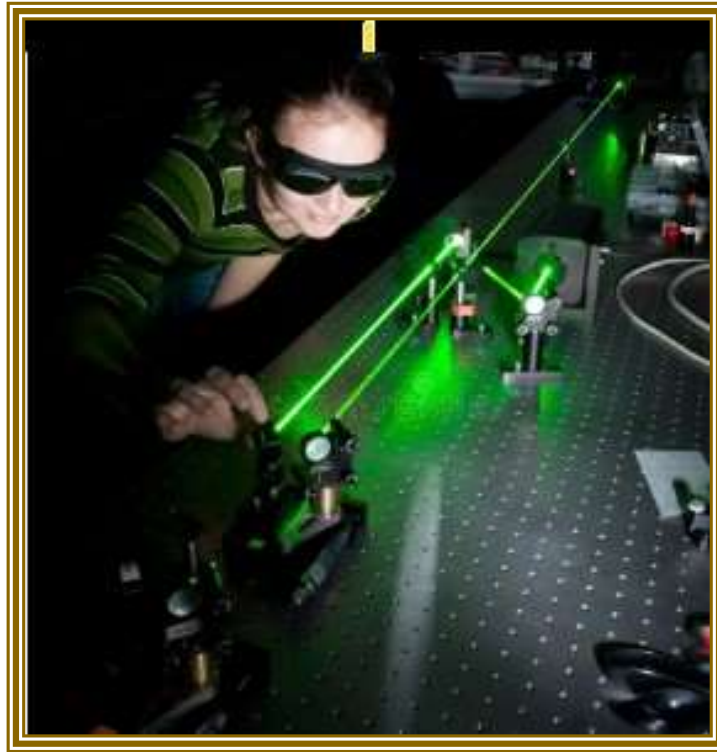




# ***UA LITTLE ROCK***



**UA LITTLE  
ROCK**

**Laser Safety Manual**

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## **Background**

LASER is an acronym for "Light Amplification by Stimulated Emission of Radiation." The energy generated by the laser is in or near the optical portion of the electromagnetic spectrum. Energy is amplified to extremely high intensity by an atomic process called stimulated emission. Energy moves from one location to another by conduction, convection, and radiation.

The color of laser light is normally expressed in terms of the laser's wavelength. The most common unit used in expressing a laser wavelength is a nanometer (nm). There are one billion nanometers in one-meter ( $1\text{nm} = 1 \times 10^{-9} \text{m}$ ). Laser light is nonionizing and includes ultra-violet (100- 400nm), visible (400-700nm), and infrared (700nm-1mm).

## **Scope**

The requirements and recommended details of this Laser Safety Manual (LSM) are applicable to all lasers used in research and instructional laboratories, as well as, in construction and maintenance operations

## **Requirements**

The University of Arkansas at Little Rock (UALR) requires that all lasers and laser systems be operated in a manner conducive to the American National Standards Institute, (ANSI) Z136.5-2000, *Standard for the Safe Use of Lasers in Educational Institutions*, and ANSI Z136.1-2007, *Safe Use of Lasers*. If a topic is not covered in this Manual, requirements expressly written in ANSI Z136.1-2007, will be applied.

To assist laser users in complying with these requirements, UALR has the LSM, written and enforced to ensure that laser radiation in excess of the maximum permissible exposure (MPE) limit does not reach the human eye or skin. Additionally, the LSM provides requirements designed to ensure that adequate protection against collateral hazards are provided. These collateral hazards may include, but not be limited to the risk of electrical shock, fire hazard from a beam or from the use of dyes and solvents, and chemical exposures from use of chemicals and vaporization of targets.

In order to implement the requirements in this LSM properly while giving the greatest possible latitude to the researcher, all laser operations at the University of Arkansas at Little Rock should be reviewed and approved by Environmental Health & Safety (EH&S) and/or the members of the Laser Safety Committee.

## **Hazards**

Most lasers are capable of causing eye injury to anyone who looks directly into the beam or specular reflections. In addition, diffuse reflection of a high-power laser beam can produce permanent eye damage. High-power laser beams can burn exposed skin, ignite flammable materials, and activate toxic chemicals that release hazardous fumes, gases, and debris. The equipment and optical apparatus required to produce lasing action and control, and direct the laser beam, also introduce additional hazards associated with high voltage, noise, optic radiation, and toxic gases.

## **Laser Classification**

All lasers are divided into classes depending on the power of energy of the beam and the wavelength of the emitting radiation. Laser classification is based on the laser's potential for causing immediate injury to the eye or skin and/or potential causing fires from direct exposure to the beam or from reflection from diffused reflective surfaces.

Class 1: Class 1 lasers are considered to be incapable of causing immediate injuries and are therefore exempt from the most control measures or surveillance. Examples are laser printer, CD player.

Class 2: Class 2 lasers emit radiation in the visible portion of the spectrum, and protection normally occurs by human aversion response (blinking reflex) to bright radiant light. This reflex provides adequate protection. However, Class 2 lasers emit light in the visible range and are capable of causing an eye damage through chronic exposure. Examples are laser pointers and surveying lasers.

Class 3a: Class 3a lasers would not normally cause injuries, if viewed only momentarily with the unprotected eye. They will present a hazard if viewed using collecting optics (e.g. telescopes, microscopes, binoculars, etc.). Examples are HeNe laser above 1 milliwatt, but not exceeding 5 milliwatts radiant power, or some pocket laser pointers. Note: Laser pointers normally classified as Class 3a lasers are specifically exempted from this LSM.

Class 3b: Class 3b laser light will cause injury from direct viewing of the beam and specular reflections. Example is a visible HeNe laser above 5 milliwatts, but not exceeding 500 milliwatts radiant power.

Class 4: Class 4 lasers include all lasers with power levels greater than 500mW radiant power. They pose eye hazards, skin hazards, and fire hazards. Viewing of the beam and of specular reflections or exposure to diffuse reflections can cause eye and skin injuries.

## **Responsibilities**

*Principal Investigators (PIs)* are responsible for:

- A. The immediate supervision of lasers in the laboratory.
- B. Providing, implementing, and enforcing the safety recommendations and requirements prescribed in this LSM.
- C. Classifying and labeling each of their lasers.
- D. Completing a Laser Registration Form for each class 3b or 4 laser, or laser producing equipment.
- E. Ensuring that students/staff who work with the lasers receive regular documented training in the safe use of the lasers.
- F. Notifying EH&S immediately in the event of an exposure to a Class 3b or Class 4 laser.
- G. Revoking an operator's privilege in the case of breached safety protocol procedures. The revocation and exclusion from a lab may be immediate. A report of the incident will be written, submitted to the Laser Safety Committee, and documented with EH&S.

*Laser Operators* are responsible for:

- A. Knowing and following the individual laboratory and University standard operating procedures and safety instructions of the laser they are using (see the operating manual of the laser). This is critical, as operators assume full responsibility when operating the laser, from power ON until power OFF.
- B. Maintaining up-to-date training and knowledge of the appropriate laser.
- C. Keeping the PI fully informed in writing of any departure from established safety procedures. This includes notification of an exposure incident.
- D. Wearing the appropriate PPE, including laser safety goggles when operating the laser. In the case of an exposed beam laser, the operator should always wear long sleeves, long pants with closed shoes, jewelry should be removed, and their hands should be protected with gloves.

- E. Performing a visual inspection of the electric plug of the laser before each use, to detect any possible disconnected wire(s) (could lead to electric fires).
- F. Checking the cooling system of the laser (if any) to detect any possible leaks before each use, and for checking the laser power before each use.
- G. Maintaining an up-to-date laser logbook (e.g., should document date, power, and any other relevant information, per Lab SOG).

*EH&S or representative of, will:*

- A. Conduct lab inspections to ensure that safety requirements are followed.
- B. Help in evaluating and controlling hazards.
- C. Update the LSM when necessary.
- D. Maintain a record of lasers and laser operators.
- E. Ensure the provision of laser safety training for personnel who are assigned to an area where lasers are operated.
- F. Participate in accident investigations involving lasers.

### **Personnel Training and Qualification**

Only qualified and authorized persons are permitted to operate lasers on the UA Little Rock campus.

Before operating a Class 3b or Class 4 laser (or Class 1 laser system that encloses a Class 3b or Class 4 laser), current students, new students, employees, and/or guests of UA Little Rock must complete the following:

- A. Review the LSM.
- B. Obtain appropriate laser safety training. The PI determines the operational qualification from departmental or technical training, or other acceptable learning experience. New students, employees and guests must operate under the direct supervision of the PI until proper training is completed.
- C. Receive a thorough review of the laser equipment from the lab supervisor or PI.
- D. Review the operating and safety instructions furnished by the manufacturer.
- E. Sign and date the acknowledgement form provided by their PI. Initially and annually thereafter.
- F. Know the safety requirements that apply to their specific laser or laser system, and follow any and all applicable lab-specific policies (e.g., PPE, etc.).

Note: The PI should notify EH&S of any new students, employees, or guest laser users as soon as possible.

### **Exposure Incidents**

If an exposure incident occurs, the PI, or the laser operator must notify EH&S of that exposure. EH&S will investigate incidents, and create an incident report for each exposure or suspected exposure incident.

### **Laser Hazard Analysis**

Before appropriate controls can be selected and implemented, laser radiation hazards must be identified and evaluated.

Types of laser-related hazards may include, but not be limited to:

- A. Eye: acute exposure of the eye to lasers of certain wavelengths and power can cause corneal and/or retinal burns. Chronic exposure to excessive levels may cause corneal or lenticular opacities (cataracts) or retinal injury.
- B. Skin: acute exposure to high levels of optical radiation may cause skin burns, while carcinogenesis may occur from ultraviolet and near ultraviolet wavelengths.
- C. Chemical: some lasers may require hazardous or toxic substances to operate (e.g., chemical dye, excimer lasers, etc.).
- D. Electric shock: Most lasers produce high voltages that if improperly used, could produce lethal shock.
- E. Fire hazards: Solvents used in some dye lasers may be flammable, which when combined with high voltage pulse or flash lamps, may cause ignition. Direct beams from high power lasers may ignite flammable materials.

Note: Maximum Permissible Exposure (MPE) is the level of laser radiation to which a person may be exposed without hazardous effect or adverse biological changes in the eye or skin. The MPE criteria for the eye and skin are detailed in Section 8 of ANSI Z136.1-2007.

### **Administrative Controls**

- A. Lab Safety Plan: All principal Investigators utilizing Class 3 and 4 lasers should have a current Lab Safety Plan, detailing laser alignment, operation, and maintenance procedures. The Lab Safety Plan should be available in an easily accessible location for appropriate lab personnel. For additional assistance in completing a Lab Safety Plan, contact EH&S.
- B. Warning Signs: Entrances to a laser-utilized lab must be posted with the appropriate DANGER sign, in accordance with ANSI Z136.1-2007.
- C. Access: Laser controlled areas shall be established which have limited access, covered windows and doors, and only diffuse reflective material.

**Laser Registration Form**  
University of Arkansas at Little Rock

Please return the completed form to EHS, at Room #216, Facilities Management building

Principal Investigator's Name: \_\_\_\_\_

Department: \_\_\_\_\_

Campus Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Laser Lab Location: Building: \_\_\_\_\_ Room: \_\_\_\_\_

**Laser system Information:**

Manufacturer: \_\_\_\_\_ Model# \_\_\_\_\_

Serial # \_\_\_\_\_ Wavelength \_\_\_\_\_

Power \_\_\_\_\_ Laser Class: (1, 2, 3a, 3b, 4) \_\_\_\_\_

**Continuous or Pulsed**

**Fully Enclosed or Visible Beam**

(Circle the appropriate answer)

(Circle the appropriate answer)

**Attach latest laser system description. This includes the laser type, intended application, location, wavelength, output beam diameter, and beam divergence. For continuous wave (CW) lasers include the average power; for pulsed lasers include the energy per pulse, pulse duration, and repetition rate. Update as required.**

**Description of Laser Use / Research:**

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PI Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**Laser Manual Acknowledgment Form**  
University of Arkansas at Little Rock

Please send a copy of the completed form to EHS, at Room #216, Facilities Management

*This form shall be signed annually by anyone using Class 3 and 4 lasers listed on the UALR campus.*

**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

Principal Investigator's Name: \_\_\_\_\_

Department: \_\_\_\_\_

T Number: \_\_\_\_\_ Email: \_\_\_\_\_

Laser Lab Location: Building: \_\_\_\_\_ Room: \_\_\_\_\_

**Laser system Information:**

Manufacturer: \_\_\_\_\_ Model# \_\_\_\_\_

Power \_\_\_\_\_ Laser Class: (1, 2, 3a, 3b, 4) \_\_\_\_\_

**Continuous or Pulsed**

(Circle the appropriate answer)

**Fully Enclosed or Visible Beam**

(Circle the appropriate answer)

I attest to the following:

1. I have read UALR's current Laser Safety Manual and understand its contents.
2. I have received the appropriate laser safety training.  
(The PI determines the operational qualification from departmental or technical training, or other acceptable learning experience. New students, employees and guests must operate under the direct supervision of the PI until proper training is completed.)
3. I have received a thorough review of the laser equipment from the lab supervisor or PI.
4. I have reviewed the operating and safety instructions furnished by the manufacturer.
5. I am aware of my responsibilities of being a laser operator, potential laser hazards, actions to mitigate those hazards, and agree to follow the safety requirements that apply to my specific laser or laser system, and the contents of any applicable lad-related policies (e.g., PPE, etc.).

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date