Laser Safety Manual

1998 Edition

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1.0 Introduction

The purpose of this manual is to ensure the safe use of lasers at UAB by identifying hazards, for providing medical surveillance and for providing laser safety training for individuals using lasers. To achieve this goal, the University has adopted the American National Standard for the Safe Use of Lasers, ANSI

Z136.1-1993. ANSI Z136.1-1993 is recognized as a minimum standard for laser safety. A copy of the UAB Laser Safety Manual must be available in each department using Class 3b or Class 4 lasers. A copy of ANSI 2136.1-1993 or later applicable edition must be available in the Radiation Safety Division office.

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 beams can burn exposed skin, ignite flammable materials, and activate toxic chemicals that release hazardous fumes, gases, debris, and radiation. The equipment and optical apparatus required to produce the lasing action and control and direct the laser beam also introduce additional hazards associated with high voltage, high pressure, cryogenics, noise, radiation, and toxic gases.

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2.0 Scope

The requirements and recommended details of this program are applicable to all lasers used in research and instructional laboratories at the University of Alabama at Birmingham.

3.0 Administration

Responsibility for the administration of the safety standards contained herein rests with the President of the University. The Radiation Safety Officer (RSO) is responsible for the implementation of the appropriate safety standards. The RSO shall be an individual with the authority and responsibility to monitor and enforce the control of laser hazards, and to effect the knowledgeable evaluation and control of laser hazards. The laser program will be the responsibility of Radiation Safety Officer with oversight by the Subcommittee for Laboratory Use. The Subcommittee for Laboratory Use will review and approve all principal investigators, laser registry forms, laser acquisition forms, will operate a comprehensive laser safety program, and make policy recommendations to the University administration.

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4.0 Responsibilities

4.1 Principal Investigators are responsible for:

1. The immediate supervision of lasers in the laboratory.
2. Providing, implementing, and enforcing the safety recommendations and requirements prescribed in this program.

3. Classifying and labeling all of their lasers.
4. Completing a Laser Registry Form, (Table 2) and sending it to the Radiation Safety Officer.
5. Training all employees who work with and around Class 2a, 2, 3a, 3b, and 4 lasers in the safe use of lasers. This training has to be documented.
6. Registering for the Medical Surveillance program for users of Class 3b and Class 4 lasers.
7. Notifying the RSO immediately in the event of an exposure to a Class 3b or Class 4 laser.

4.2 Laser Operators are responsible for:

1. Following laboratory administrative, alignment and standard operating procedures while operating lasers and reading safety instructions in laser equipment operators manuals.
2. Keeping the Principal Investigator fully informed of any departure from established safety procedures. This includes notification of an exposure incident.
3. Reading the University's Laser Safety Training Manual, and becoming familiar with its contents.
4. Registering for the Medical Surveillance program for users of Class 3b and Class 4 lasers.

4.3 The Radiation Safety Officer or his representative will:

1. Conduct annual lab inspections to ensure that safety requirements are followed.
2. Provide assistance in evaluating and controlling hazards.
3. Update the UAB Laser Safety Manual when necessary.
4. Maintain all records of lasers and laser operators.
5. Ensure the provision of laser safety training for personnel who are assigned to an area where lasers are operated.
6. Participate in accident investigations involving lasers.
7. Coordinate the Medical Surveillance program.
8. Make a drawing of the room where the laser is being used.

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5.0 Personnel Training and Qualification

5.1 All staff and students operating lasers are required to read the Laser Safety Training Manual.

5.2 Only a qualified and authorized person is permitted to operate a laser. The Principal Investigator determines the employee's operational qualification from departmental or technical training or other acceptable learning experience.

5.3 Before operating a Class 3 or Class 4 laser, or a Class 1 laser system that encloses a Class 3 or Class 4 laser a person must:

1. Review the Laser Safety Manual.
2. Receive from the lab supervisor or Principle Investigator a thorough review of the laser equipment to be used and the administrative, alignment and standard operating procedures (SOP's).
3. Review the operating and safety instructions furnished by the manufacturer.

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6.0 Medical Surveillance

6.1 Individuals operating Class 1, 2, and 3a lasers are exempt from eye exams.

6.2 Laser operators or individuals who will work in areas where there may be exposure to laser radiation from a Class 3b or Class 4 laser are required to have a baseline eye examination within two years prior to using the laser.

6.3 An eye exam is required in the event of exposure or suspected exposure incident. Contact the Occupational Health and Safety Department.

6.4 An examination is not required when an individual laser user terminates his or her work in a laser laboratory unless the employee has had a known laser injury to the eye.

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7.0 Exposure Incidents

7.1 If an exposure incident occurs, OH & S must be notified by the Principal Investigator or the person operating the laser.

7.2 If the incident causes an injury or could potentially have caused an injury, the person or persons who have received an exposure should inform their supervisor and have an eye exam performed. Contact OH & S for a doctor's appointment.

7.3 OH & S will conduct an investigation, and an incident report will be written.

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8.0 Laser Hazard Analysis

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

8.1 Types of hazards include:

1. Eye: Acute exposure of the eye to lasers of certain wavelengths and power can cause corneal or retinal burns (or both). Chronic exposure to excessive levels may cause corneal or lenticular opacities (cataracts) or retinal injury.
2. Skin: Acute exposure to high levels of optical radiation may cause skin burns; while carcinogenesis may occur for ultraviolet and near ultraviolet wavelengths.
3. Chemical: Some lasers require hazardous or toxic substances to operate (i.e., chemical dye, Excimer lasers).
4. Electric shock: Most lasers produce high voltages that can be lethal.
5. Fire hazards: The solvents used in dye lasers are flammable. High voltage pulse or flash lamps may cause ignition. Flammable materials may be ignited by direct beams or specula reflections from high power continuous wave (CW) infrared lasers.

8.2 Lasers and laser systems are grouped according to their capacity to produce injury, and specific controls are then described for each group. Lasers manufactured after August 1, 1976, are classified and labeled by the manufacturer. Information on the label must include class, the maximum output power, the pulsed duration (if pulsed), and the laser medium or emitted wavelengths.

8.3 Maximum Permissible Exposure (MPE): 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 criteria for MPE for the eye and skin are detailed in Section 8 of ANSI Z136.1-1993.

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9.0 Laser Classification

9.1 Lasers are generally classified and controlled according to the following criteria:

1. Class 1: Low-power lasers and laser systems that cannot emit laser radiation levels greater than the Maximum Permissible Exposure (MPE). Class 1 lasers and laser systems are incapable of causing eye damage and are therefore exempt from any control measures.
2. Class 2: Visible, low power lasers or laser systems that are incapable of causing eye damage unless they are viewed directly for an extended period (greater than 1000 seconds). See Table 4 for laser pointers.
3. Class 3: Medium-power lasers and laser systems capable of causing eye damage with short-duration (<0.25 s) exposures to the direct or specularly reflected beam. Includes Class 3a and 3b lasers.

4. Class 3a: Lasers or laser systems that normally would not produce a hazard if viewed for only momentary periods with the unaided eye. They may present a hazard if viewed using collecting optics. See Table 4 for laser pointers.
5. Class 3b: Laser or laser systems that can produce a hazard if viewed directly. This includes intrabeam viewing or specular reflections.
6. Class 4: High power lasers and laser systems capable of causing severe eye damage with short-duration (<0.25 s) exposures to the direct, specularly reflected, or diffusely reflected beam. Class 4 lasers and laser systems are also capable of causing severe skin damage and igniting flammable and combustible materials.

9.2 It is the responsibility of the Principal Investigator who operates or supervises the operation of a "homemade" laser to classify and label the laser he/she controls. Refer to either ANSI Z136.1-1993 or contact the OH&S.

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10.0 General Laser Safety Recommendations and Requirements

10.1 Eye Protection: Principal Investigators or staff who operate or supervise the operation of a laser are responsible for determining the need for laser eye protection for a particular laser. If required, eye protection will be provided by the supervisor for staff and visitors to the area. The booklet "Guide for Selection of Laser Eye Protection: produced by the Laser Institute of America may provide assistance in eyewear selection. Check with your Principal Investigator or OH&S for a copy.

10.2 The minimum laser radiant energy or laser power level required for the application should always be used.

10.3 Beam Control: To minimize direct eye exposure, observe these precautions:

1. Do not intentionally look directly into the laser beam or at a specular reflection, regardless of its power.
2. Terminate the beam path at the end of its useful path.
3. Locate the beam path at a point other than eye level when standing or when sitting at a desk.
4. Orient the laser so that the beam is not directed toward entry doors or aisles.
5. Minimize specular reflections.
6. Securely mount the laser system on a stable platform to maintain the beam in a fixed position during operation and limit beam traverse during adjustments.

7. Confine primary beams and dangerous reflections to the optical table.
8. Clearly identify beam paths and ensure that they do not cross populated areas or traffic paths.
9. When the beam path is not totally enclosed, locate the laser system so that the beam will be outside the normal eye-level range, which is between 1.2 to 2 meters from the floor. A beam path that exits from a controlled area must be enclosed where the beam irradiance exceeds the MPE.

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11.0 Additional Controls for Class 1 and Class 2 Lasers.

11.1 Warning signs: Post at each entrance to the operating area "CAUTION-LOW POWER LASER" signs.

11.2 If the laser has not been labeled by the manufacturer, attach a label on the laser with its classification and relevant warning information. Contact the Radiation Safety office for assistance.

Refer to the ANSI Z136.1-1993 and Table 1 of this manual for further guidance on control measures for various classifications of lasers.

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12.0 Additional Controls for Class 3 and 4 Lasers

12.1 All Principal Investigators are required to write standard operating procedures (SOP) for all laser operations involving Class 3 and Class 4 lasers detailing alignment, operation and maintenance procedures. The SOP should be posted or attached to the inside surface of the lab door.

12.2 SOP'S must include procedures to address when:

1. Use of eyewear, shields, and access control are necessary.
2. Two or more Class 3 or Class 4 lasers will be used in the same area by different operators without permanent, intervening barriers.
3. An interlock bypass is installed that does not conform to the conditions of the Laser Safety Manual.
4. A Class 3 or Class 4 laser will be used by non-University personnel; (e.g., contract personnel or visiting colleagues).
5. A laser installation does not include all the required controls specified in this manual (e.g., temporary operations).
6. A UAB Class 3 or Class 4 laser or laser system is operated off campus.
7. Other hazards may be involved that require an SOP (e.g., acutely toxic gases, unattended laser operation).

12.3 For assistance in completing an SOP, contact the Occupational Health and Safety Department.

12.4 A log must be maintained showing periods of use, service, maintenance and incidents.

12.5 Labels: A laser classification label must be conspicuously affixed to the laser housing.

12.6 Warning Signs: Each entrance must be posted with a danger sign in accordance with ANSI Z136.1-1993.

12.7 Warning Devices: Entrance to laboratories with a Class 3b or 4 laser shall have a lighted warning sign that is fail-safe interlocked with the laser to activate when the laser is energized. The sign must be tested monthly. A written record must be kept of each test in the log book (see section 12.4).

12.8 Safety Interlocks

1. Access doors to a controlled laser area in which a Class 3b or a Class 4 laser is being operated must be equipped with safety interlocks to prevent laser operation when the interlock circuit is broken.
2. All protective enclosures that surround laser devices and high-voltage electrical sources must also be equipped with interlocks to prevent operation of the equipment when enclosures are in place.
3. Interlocks must be tested monthly to ensure that they are operational. A written record must be kept of each test in the log book (see section 12.4).
4. Interlocks must be designed so that after they are actuated, the capacitor banks, shutters, or power supplies cannot be re-energized except by manually resetting the system.

12.9 The responsible individual in a laser area controlled by a warning light is permitted to momentarily override (bypass) door interlocks to allow access of authorized persons if all of the following conditions are met:

1. There is no laser radiation hazard at the point of entry.
2. The necessary protective devices are worn by the personnel entering the area.
3. An interlock bypass circuit is designed into the interlock control system. This bypass circuit must only be operated from inside the interlocked area. It must delay no more than 15 seconds before shutting down the system.

12.10 If interlocks are not feasible, the Principal Investigator may consider the use of alarms, voice warnings, danger lights, door locks, key cards, or extensive security. The Radiation Safety Officer must be consulted. The Radiation Safety

Officer and the Laser Safety Committee must be consulted in choosing alternatives to interlocks.

12.11 Laser laboratories and controlled areas must be designed so that personnel can enter and leave under emergency conditions.

12.12 Lasers must have a master switch with a key or coded access that prevents use once the key has been removed or a code has been entered. The key must not be left in the control panel when the laser is not in use.

12.13 Laser Activation Warning Systems: An alarm, a warning light, or a verbal "countdown" command must be used during activation and start up.

12.14 Lasers must have a permanently attached beam stop or attenuator and emission delays.

12.15 Laser controlled areas shall be established which have limited access, covered windows and doors, and only diffuse reflective material. The facility must be a fully enclosed room or laboratory with floor-to-ceiling walls. Access to the area during laser operation requires the permission of the responsible operator.

12.16 Class 3b and 4 infrared laser beams with a wavelength greater than or equal to 710 nm must be terminated with fire resistant material.

12.17 Securely fasten all mirrors, prisms, beam stops, etc. in the beam path. Ensure that the laser is also securely fastened.

12.18 Circuit breakers must be identified for each laser.

12.19 Beam Enclosure: The entire beam path of Class 3 and Class 4 lasers, including the target area, should be surrounded by an enclosure equipped with interlocks that prevent operation of the laser system unless the enclosure is properly secured. When total enclosure of the laser beam path is not practical, both the non-enclosed laser beam and any strong reflections must be terminated at the end of their useful path using such devices as backstops, shields or beam traps.

12.20 Reflection Control

1. Materials that diffusely reflect laser radiation must be used in place of specularly reflective surfaces wherever possible.
2. To minimize personnel exposure, specularly reflecting surfaces that are needed for beam-path control should be enclosed or shielded.

12.21 Invisible Beams

Ultraviolet (UV) and infrared (IR) lasers that emit invisible beams require several additional controls:

1. Visual or audible beam-warning devices must be installed in areas where personnel may be exposed to radiation in excess of the MPE. These warning devices must be clearly identified and visible from all areas of potential exposure.
2. Shielding must be installed that will attenuate UV radiation to levels below the MPE for the wavelength being used.
3. Hazardous concentrations of by-products formed by the reaction of intense UV radiation with materials in the area must be controlled.
4. IR beam enclosures and backstops must be fabricated of IR-absorbent material and must also be fire-resistant

12.22 Beam Mapping

Controlled laser areas must be surveyed with appropriate measuring devices to locate and identify direct and reflected beams that exceed the MPE; shielding may be required to limit unwanted radiation.

12.23 Direct Viewing

1. Personnel must never look directly into any laser beam unless such action is specifically approved by OH&S.
2. The primary beam and specular reflections of Class 3 or Class 4 lasers are particularly hazardous. In those cases where it is necessary to directly view a beam from a Class 3 or Class 4 laser, special provisions, such as filters, are mandatory.
3. An SOP must be prepared for operations where the beam of a Class 3 or Class 4 laser must be viewed directly or where it is necessary to work with optical viewers in close proximity to the laser beam.
4. Alternatives to direct viewing must be considered: for example, video cameras

12.24 Alignment

1. High power laser optical systems must never be aligned by direct beam viewing if the radiant exposure or irradiance exceeds the MPE.
2. Use low-power lasers, diffuse reflectors, image-retaining screens, exposed Polaroid film, and other devices that will minimize eye exposure.

12.25 Optical Viewing Aids

Using optical systems such as cameras, telescopes, microscopes, etc., to view laser beams may increase the eye hazard. Therefore, all collecting optics must incorporate suitable means (such as interlocks, filters, or attenuators) to prevent eye exposures above the MPE.

12.26 Protective Equipment

1. Laser protective eye wear shall be worn whenever MPE levels may be exceeded. However, it is good practice to always wear eye protection when lasers are in use.
2. In general, eye wear provides protection over a narrow range of the laser spectrum. Eye wear designed for protection at one wavelength may afford little or no protection at another wavelength.
3. Consult eye wear manufacturers and OH&S for proper selection of protective eye wear (see section 10.1).
4. Laser protective eye wear must be approved by the American National Standards Institute (ANSI) and clearly labeled with optical densities and wavelengths for which protection is afforded. Eye wear must be inspected periodically by the user for pitting and cracking of the attenuating material, and for mechanical integrity and light leaks in the frame.
5. Protection for the skin may be afforded through the use of clothing to cover normally exposed skin areas.
6. Protective equipment is no substitute for common sense and the use of good safety practice.

12.27 Unattended Equipment

1. When lasers are to be left unattended, de-energize the power supplies or capacitor banks and remove the keys from power switches or master interlocks to prevent unauthorized activation of the equipment.
2. The operation of unattended lasers is only allowed when a specific SOP has been written and approved by the Principal Investigator and the Subcommittee for Laboratory Use.

12.28 Temporary Installations

1. Occasionally, it may be necessary to remove protective enclosures or override equipment interlocks or other safety devices for service adjustments, maintenance, special training exercises, etc.
2. In these instances, a temporary controlled laser area must be set up. Specific methods for handling situations of this type must be described in the SOP.
3. Because the area will not have all the standard safety features, the SOP must describe provisions for protecting personnel who could potentially be exposed.

4. When the entire beam path is not fully enclosed, restrict access into the area to persons wearing proper protective equipment. Make sure that all optical paths from the restricted-access area are adequately covered to prevent escape of laser radiation greater than the MPE for the eye.

12.29 Refer to the ANSI Z136.1-1993 and Table 1 of this manual for further guidance on control measures for various classifications of lasers.

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13.0 Converting to a Class 1 Enclosed Laser

Any laser or laser system can be converted to a Class 1 enclosed laser by including all of the following controls in the laser system design. These controls will effectively enclose the laser, thus preventing personnel contact with emitted radiation while permitting unrestricted access into the area.

13.1 Protective Housing

1. House the laser system within a protective enclosure to prevent escape of laser radiation above the MPE.
2. The protective housing must prevent personnel access to the laser system during normal operations.
3. Personnel entering the enclosure to perform maintenance or adjustment tasks must be made aware of the higher risk laser class.

13.2 Safety Interlocks

1. Install safety interlocks wherever the protective enclosure can be opened, removed or displaced.
2. When activated, these interlocks must prevent a beam with a radiant energy above the MPE from leaving the laser or laser system.
3. Service adjustments or maintenance work performed on the laser system must not render the interlocks inoperative or cause exposure levels outside the enclosure to exceed the MPE, unless work is performed in a laser area with limited access and appropriate safeguards, supervision, and control.

13.3 Fail-Safe Design: The protective enclosure and the laser system must be designed and fabricated so that if a failure occurs, the system will continue to meet the requirements for an enclosed laser operation.

13.4 Modifications to commercial laser systems must be evaluated. Contact the OH&S for an evaluation. If the modifications decrease the safety controls, an SOP will be required.

13.5 Attenuated Viewing Windows: Use viewing windows containing a suitable filter material that will attenuate the transmitted laser radiation to levels below the MPE under all conditions of operation.

13.6 Warning Signs and Labels

1. Label the enclosure with "**CAUTION-ENCLOSED LASER**" signs.
2. Attach a label directly to the laser which gives the laser classification in the absence of the enclosure. Make sure that the label can immediately be seen when the enclosure is opened.

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14.0 Controlling Associated Hazards

Many chemical and physical hazards other than laser radiation can be found in the laser area that must also be adequately controlled.

14.1 Electrical Equipment And Systems

1. Always be aware of the high risk of injury and fire in laser operations because of the presence of electrical power sources.
2. The installation, operation, and maintenance of electrical equipment and systems must conform to the standards stated in the National Electric Code (NFPA 70). Contact Facilities Division for assistance.

14.2 Lighting

1. Adequate lighting is necessary in controlled areas.
2. If lights are extinguished during laser operation, provide control switches in convenient locations or install a radio controlled switch.
3. Luminescent strips should be used to identify table and equipment corners, switch locations, aisles, etc.
4. When ambient light is not sufficient for safe egress from a laser area during an electrical power failure, install emergency lighting.

14.3 Ionizing and Non-ionizing Radiation

1. A laser operation may involve ionizing radiation that originates from the presence of radioactive materials or the use of electrical power in excess of 15kV.
    - If radioactive material is present in the laser system, "CAUTION-RADIOACTIVE MATERIAL" sign must be prominently displayed. If X-rays are generated a "CAUTION-X-RAYS" sign must be prominently displayed.

2. Microwave and radio frequency (RF) fields may be generated by laser systems or support equipment.
3. Contact the Radiation Safety Office (RSO) at 934-4751 to obtain an evaluation of these hazards before starting an operation.

14.4 Hazardous Materials

1. Bring into the laser area only those hazardous materials that are needed for the operation.
2. All hazardous materials must be properly used, stored and controlled. Consult Material Safety Data Sheets, and OH&S for information.
3. Do not allow laser beams and strong reflections to impinge on combustible materials, explosives, highly flammable liquids or gases or substances that decompose into highly toxic products under elevated temperatures, without providing adequate controls.
4. Conduct or sponsor tests that establish the effects of beam interactions with hazardous materials. Test results can be used to determine safe parameters for laser operation.

14.5 Dyes and Solutions

1. Dye lasers normally use a lasing medium composed of a complex fluorescent organic dye dissolved in an organic solvent. These dyes vary greatly in toxicity, mutagenicity, and potential carcinogenicity.
2. All dyes must be treated as hazardous chemicals. Most solvents suitable for dye solutions are flammable and toxic by inhalation and/or skin absorption.
3. Obtain Material Safety Data Sheets from OH&S for all dyes and solvents.
4. Use and store all dyes and solvents in accordance with the Materials Safety Data Sheets.
5. Prepare and handle dye-solutions inside a chemical fume hood.
6. Wear a lab coat, eye protection and gloves. Call OH&S for assistance in glove selection.
7. Pressure-test all dye laser components before using dye solutions. Pay particular attention to tubing connections.
8. Install spill pans under pumps and reservoirs.
9. Be alert to contaminated parts.
10. Keep dye-mixing areas clean.

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Table 1. Control Measures for the Four Laser Classes

This summary is taken from the ANSI Z136.1-1993. Reference numbers in the parentheses refer to sections in the standard.

Legend

X	Shall
*	Should
– –	No requirements
%	Shall if enclosed Class 3b or Class 4
MPE	Shall if MPE is exceeded
NHZ	Nominal Hazard Zone analysis required
+	Applicable only to UV and IR lasers
RSO	Radiation Safety Officer

Table 1

Engineering Controls	1	2a	2	3a	3b	4
Protective Housing (4.3.1)	X	X	X	X	X	X
Without Protective Housing (4.3.1.1)	RSO Shall Establish Alternate Controls					
Interlocks on Protective Housing (4.3.2)	%	%	%	%	X	X
Service Access Panel (4.3.3)	%	%	%	%	X	X
Key Controls (4.3.4)	– –	– –	– –	– –	*	X
Viewing Portals (4.3.5.1)	– –	– –	MPE	MPE	MPE	M
Collecting Optics (4.3.5.2)	MPE	MPE	MPE	MPE	MPE	
Totally Open Beam	– –	– –	– –	– –	X	X

Path (4.3.6.1)					NHZ	NHZ
Limited Open Beam Path (4.3.6.2)	– –	– –	– –	– –	X, NHZ	X, NHZ
Enclosed Beam Path (4.3.6.3)	None is required if 4.3.1 and 4.3.2 are fulfilled					
Remote Interlock Connector (4.3.7)	– –	– –	– –	– –	*	X
Beam Stop or Attenuator (4.3.8)	– –	– –	– –	– –	*	X
Activation Warning Systems (4.3.9)	– –	– –	– –	– –	*	X
Emission Delay (4.3.9.1)	– –	– –	– –	– –	– –	
Indoor Laser Controlled Area(4.3.10)	– –	– –	– –	– –	X, NHZ	X, NHZ
Class 3b Laser Controlled Area (4.3.10.1)	– –	– –	– –	– –	X	– –

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Class 4 Laser Controlled Area (4.3.10.2)	– –	– –	– –	– –	– –	X
Laser Outdoor Controls (4.3.11)	– –	– –	– –	– –	X, NHZ	X, NHZ
Laser in Navigable Airspace (4.3.11.2)	– –	– –	– –	*	*	*
Temporary Laser Controlled Area (4.3.12)	% , MPE	%	%	%	– –	– –

Remote Firing and Monitoring (4.3.13)	– –	– –	– –	– –	– –	*
Labels (4.3.14 and 4.7)	X	X	X	X	X	X
Area Posting (4.3)	– –					
Administrative and Procedure Controls						
Standard Operating Procedures (4.4.1)	– –	– –	– –	– –	*	X
Output Emission Limitations (4.4.2)		– –	– –	RSO Determination		
Education and Training (4.4.3)	– –	– –	*	*	X	X
Authorized Personnel (4.4.4)	– –	– –	– –	– –	X	X
Alignment Procedures (4.4.5)	– –	– –	X	X	X	X
Protective Equipment (4.4.6)	– –	– –	– –	– –	– –	– –
Spectator (4.4.7)	– –	– –	– –	– –	*	X
Service Personnel (4.4.8)	% , MPE	% , MPE	% , MPE	% , MPE	X	X
Demonstration with General Public (4.5.1)	MPE, +	– –	X	X	X	X
Laser Optical Fiber Systems (4.5.2)	MPE	MPE	MPE	MPE	X	X
Laser Robotic Installation (4.5.3)	– –	– –	– –	– –	X, NHZ	X, NHZ

Eye Protection (4.6.2)	– –	– –	– –	– –	* , MPE	* , MPE
Protective Windows (4.6.3)	– –	– –	– –	– –	X, NHZ	X, NHZ
Protective Barriers and Curtains (4.6.4)	– –	– –	– –	– –	*	*
Skin Protection (4.6.5)	– –	– –	– –	– –	X, MPE	X, MPE
Other Protective Equipment (4.6.5)	Use may be required					
Warning Signs and Labels (4.7)	– –	– –	*	*	X, NHZ	X, NHZ

Service and Repairs (4.8)	RSO determination
Modification of Laser Systems (4.9)	RSO determination

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Table 2. Laser Registry for Class 3B and 4 lasers.

I. Principal Investigator

Department

School/College

Phone

II. Personnel who use laser system

Name	**SS#**	**Status** **(student or staff)**

III. Laser System Information

1. System location (Building/Room #)

2. Laser warning sign on door ☐ Yes ☐ No

Wording on sign

3. Do users wear safety goggles? ☐ Yes ☐ No

Type/Manufacturer

4. Are goggles available for visitors? ☐ Yes ☐ No

5. Service for laser: in-house ☐ Yes ☐ No

Contract service company's name

6. Is there a written SOP available? ☐ Yes ☐ No

7. Complete the table below:

Manufacturer:	
Model #:	
Class (3b and 4):	
Type (CW, Pulsed):	
Description (ie, He-Ne, ND:Yag)	
Wavelength(s)	
Maximum Power/Peak Power	
Pulse Duration (repetition rate)	
Emerging Beam Dimensions (mm)	
Use (holography, alignment, etc.)	

Complete one form per laser and return to the Laser SafetyOfficer, Suite 445 CHSB-19 (933 South 19th Street).

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Table 3. Laser Acquisition for (give specifications/description of laser or laser system to be acquired):

Proposed Vendor or Loaner:

Laser Classification:

For additional information and guidelines, refer to the UAB Laser Safety Manual.

Please provide the names and signatures of the applicant and department head acquiring the laser or laser system (through purchase or loan).

Applicant:

Department:

Campus
Address:

Campus Phone
Number:

1. Provide technical specifications of the laser or laser system and a brief description and a brief description of the work to be performed with the laser (include a copy of the vendor's specification and classification, if available).

A. Wavelength
Range:

B. Emission
Duration:

C. Maximum Power or
Energy:

2. Describe the facility/environment in which the laser or laser system will be used (research laboratory, veterinary medicine/surgical laboratory, office, etc.).

3. Describe the level of safety knowledge and training of the personnel working with the laser. Also, address the presence of any other personnel who may not work directly with the laser, but may be exposed to hazards in the work area.

4. Describe the safety and control measures already present in the facility.

5. Describe the safety and control measures that will be implemented along with the laser installation and how those measures will be achieved, including any protective housing, warning sign, etc.

6. Describe any special ancillary hazards such as toxic materials/fumes, electrical exposures, or compressed gasses and specific control measures that will be implemented to control said hazards.

7. Provide a standard operating procedures (SOP) for general operation, maintenance, and service procedures (required for Class 3b and Class 4). Attach a copy of manufacturer's safety instructions.

8. Will operation of this laser or laser system involve the presence of any exposure to the general public at any time (such as special tours) or any other unusual circumstances?

☐ **Yes** ☐ **No** if yes, please describe;

9. Will operation of this laser or laser system involve using laser for Veterinary Medicine/surgical applications to animal patients? ☐ **Yes** ☐ **No** if yes, please indicate what institutional reviews (IACUC, IBC, IRBUHSR, etc.) are required/obtained, and describe the procedure(s) in which the laser will be used.

10. Applicant signature:

Signature date

11. Departmental
Approval:

Signature date

12. **RECOMMENDATIONS**-Laser Safety Officer

Laser Safety Officer
Signature:

Signature date

13. Subcommittee for Laboratory Use Action

- ☐ Approved
- ☐ Approved with Provisions (see comments)
- ☐ Deferred for Revision (see comments)
- ☐ Disapproved

Chairman, Subcommittee for
Laboratory Use

Signature
date

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Table 4. Laser Pointers

Please read the following information on Laser Pointers and sign at the bottom. Send the original copy of the completed form to the Radiation Safety Department, Suite 445 CHSB 19 and retain a copy for your Department files.

The Safe Use of Common Laser Pointers

Despite their size, availability, and the fact that most pen sized laser pointers are powered by small, widely obtainable batteries, these pointing devices can cause eye damage if used improperly. The potential hazard is limited to looking directly into the laser beam with unprotected eyes. No hazard to the skin exists.

Pen sized laser pointers have become common presentation aids in recent years. These battery powered laser pointers produce a narrow bright red beam, are convenient to carry and use, relatively inexpensive, and readily available through mail-order catalogs and magazines.

ANSI Classification Addresses Possible Eye Hazard

Two types of these pointer devices are widely used in visual presentations helium-neon (HeNe) and diode lasers. HeNe laser pointers are classified as Class 2 lasers as defined by the American National Standards Institute (ANSI). A "CAUTION" label for these class 2 devices is appropriate. Momentary or accidental viewing of the direct beam of Class 2 lasers, for less than 0.25 second, will not cause eye injury. However, ANSI has classified most diode lasers as Class 3a, these lasers are potentially hazardous, even for momentary direct viewing, if the entire beam enters the eye.

Class 3a lasers may be labeled "CAUTION" if they present the same risk to the naked eye as a Class 2 laser. However, if a class 3a diode laser has a very small beam diameter (less than 7 millimeter [mm]) and a power rating between 1 and 5 milliwatts [mW], it must have a "DANGER" label. Class 3a lasers pose an increased risk if viewed at close distance where the beam is less than 7 mm.

HeNe laser pointers have been available for several years. On a relatively low power level (typically less than 1.0 mW), they produce a bright red (632.8 nanometer [nm]) spot that is easily noticeable on a bright screen. The more recently developed diode lasers are much smaller in size and more rugged. The fact that diode lasers cost only about one-third as much as HeNe lasers makes them popular.

The diode lasers however, produce a light that is of a longer wavelength (670 nm) than HeNe lasers. To achieve the same effect as a HeNe laser, the diode laser power levels are increased (typically to 5 mW). ANSI has assigned the safety classification described above to these laser pointers in accordance with the level of danger to the eye.

Recommendations for Use

Because of safety considerations, laser pointers with a "CAUTION" label should be purchased as opposed to those with a "DANGER" label. In other words, Class 2 lasers are recommended.

Users should also be aware of the manufacturer's safety precautions, as looking into any laser beam has the potential to cause eye injury, and thus should be avoided. Thus, the beam from a laser pointer should never be directed toward any individual or audience. A mirror-like reflection of the laser beam can be equally hazardous.

In addition, when storing pointers, remove the power source or unscrew the case/housing enough to disable the power source.

Please sign that you understand the hazards of Laser Pointers and mail to the Radiation Safety Division, Suite 445 CHSB-19.

Signature:

Signature date

Please print your name:

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Table 5.Principal Investigator User Application

SECTION I: LICENSE

1. Name_____

Last First Middle

2.Title_____

3. Social Security Number_____

4. Date of Birth_____

5.School/College_____

6.Department_____

7. Office Location_____

8. Office Phone No._____

9. Home Phone No._____

10. Laser or laser system to be used._____

A. Wavelength Range_____

B. Emission Duration_____

C. Maximum Power or Energy_____

11. Laboratory and location where the laser will be used.

A. _____

B. _____

12. Additional names of persons using the laser under your license.

A. _____

B. _____

SECTION II: PROTOCOL

1. Past experience. List formal course work, on-the-job training, etc.

A. _____

B. _____

C. _____

D. _____

2. Attach procedures for utilizing your laser. Please include:

A. Brief description of your experimental procedures.

B. Detailed safety precautions to be taken to minimize laser exposure.

3. **AGREEMENT:**

I,_____, certify that I have read, understand and am willing to abide by the UAB regulations governing the use, procurement, handling, storage, transfer and disposal of lasers. I further agree to submit to a physical examination if called upon, and waive my right to any recourse against UAB for any damage resulting from my failure to conform with pertinent rules, regulations and memoranda.

____

Applicant's signature Date

4. **DEPARTMENTAL APPROVAL**

_____
_____
_____

Head of Department
Date

5. RECOMMENDATIONS - RADIATION SAFETY OFFICER

A. _____

B. _____

C. _____

_____
_____
_____

Radiation Safety
Officer Date

6. SUBCOMMITTEE FOR LABORATORY USE ACTION

[ ] Approved

[ ] Approved with provisions (see comments)

[ ] Deferred for revision (see comments)

[ ] Disapproved

7. COMMENTS

A. _____

B. _____

C. _____

_____
_____

Chairman, Subcommittee for
Laboratory Use date