

NIH LASER SAFETY PROGRAM

I. INTRODUCTION

A. Background

This document presents the NIH procedures for the safe operation of lasers. It was developed by the Laser Safety Advisory Committee (LSAC), Division of Occupational Health & Safety (DOHS). It identifies the responsible individual and outlines his/her obligations to comply with the Occupational Safety and Health Administration (OSHA) guidelines for each laser or laser system. The safety procedures take into consideration the wide variety of laser applications in the research environment. They are designed to meet the minimum requirements of the OSHA guidelines as well as to allow some flexibility necessary in the research setting.

B. Laser Safety Standards

Laser Safety & Hazard Assessment guidelines are addressed under OSHA Directive number STD 01 05 001. These guidelines are based on safety recommendations issued by the American National Standards Institute (ANSI) currently issued as the American National Standard for Safe Use of Lasers (ANSI Z-136.1-2000) The guidelines relate specifically to the potential hazards of the laser or laser system, based on both the operating characteristics and the optical emission energy associated with the application.

A classification scheme is used to describe the capability of a laser or laser system to injure personnel. The higher the classification number (range 1-4), the greater the potential hazard. Lasers and laser systems are certified for a specific classification by the manufacturer in accordance with the Federal Laser Product Performance Standard.

C. Laser Health Hazards

The conditions under which the laser is used, the level of safety training of laser users, and other environmental and personnel factors are important considerations in determining the true "operational classification" and the full extent of safety control measures necessary. Assessment of safety conditions requires informed judgments. The responsibility for such judgments is ultimately assumed by the Laboratory Chief, Senior Investigator or his/her designee responsible for the laser and/or laser system.

According to ANSI Z136.1-2000, review of reported incidents has demonstrated that accidental eye and skin exposures to laser radiations and accidents related to the ancillary hazards, i.e., non-beam hazards (e.g., electrical, respiratory, explosion, etc.) of a laser or laser system, are most often associated with personnel involved with the use of these systems under conditions which include: (1) Unanticipated eye exposure during alignment, (2) Misaligned optics and upwardly directed beams, (3) Available eye protection not used, (4) Equipment malfunction, (5) Improper handling of high voltage, (6) Operators unfamiliar with laser equipment, (7) Lack of protection for ancillary hazards, (8) Failure to follow standard operating procedures.

II. PURPOSE

The Laser Safety Program (LSP) was established to promote safety in the use of lasers and laser systems for laser users at the NIH, in particular, Class 3b and 4 lasers. The LSP is administered by the DOHS through the Chairman, LSAC.

The NIH safety guidelines are based on recommendations from OSHA Laser Safety & Hazard Assessment (STD 01-05-001) and ANSI Z136.1-2000 guidelines. These guidelines are outlined in Tables A and B (appendix A and B). Pertinent sections of the ANSI Z136.1-2000 are included in appendix C, D and E.

The control measures outlined herein shall not be considered to restrict or limit in any way the use of laser radiation of any type which may be intentionally administered to an individual for diagnostic, therapeutic, or medical research purposes by or under the direction of qualified professionals engaged in health care. However, those administering and assisting in the administering of the laser radiation, as well as the patient, where applicable, shall be protected by the control measures as outlined herein and, as applicable, by the requirements as specified in the American National Standard for Laser Safety in Health Care Facilities, ANSI Z 136.3.

III. LASER SAFETY ADVISORY COMMITTEE

A. Function

This Committee establishes laser safety guidelines for the NIH, which are based on OSHA accepted standards for laser users, as well as provides support to laser users in complying with safety guidelines.

The Chairperson, LSAC, administers the LSP. Committee members are selected by the Chairperson with the approval of its members and are composed of laser users and others interested in promoting the safe use of lasers at the NIH.

B. Chairperson, LSAC

The Chairperson, LSAC, is appointed by the Director, DOHS. The Chairperson is responsible for managing the LSP at the NIH.

The Chairperson will:

1. Convene a meeting of the LSAC when necessary to address and resolve specific problems or issues that may arise concerning laser safety at the NIH.
2. Develop a form for conducting on-site safety surveys of class 3b and 4 lasers.
3. Conduct annual safety surveys of class 3b and 4 lasers on the NIH campus to ensure compliance with laser safety guidelines, inform the laser user(s) of any safety issues that should be addressed and provide recommendations to ameliorate the situation.
4. Inform the appropriate Occupational Safety and Health Specialists, Safety Operations Support Branch (SOSB), DOHS, assigned to the institute, and request their assistance to help implement necessary safety recommendations. For example, they may provide technical input to laser users in choosing and purchasing proper safety equipment.
5. Conduct investigations of accidents involving lasers.

6. Maintain a database and laser safety reference sources, including:
 - a. An inventory of Class 3b and 4 lasers at the NIH.
 - b. The results of on-site laser safety surveys.
 - c. A record of laser related accidents and investigation results.
 - d. Current references of laser safety regulations.
 - e. Laser safety training materials, including training videotape at the Clinical Center Library, Building 10.
7. Provide an annual report on the status of the Laser Safety Program to the Director, DOHS.
8. Attend laser safety training courses and conferences.

C. Members, LSAC

The committee members provide advice to the Chairperson. Members help address and resolve specific issues pertaining to laser safety, provide technical assistance, as well as attend LSAC meetings, and participate in laser surveys.

IV. NIH LASER SAFETY GUIDELINES

The NIH laser safety guidelines are generally based on recommendations established by ANSI in their ANSI Z-136.1-2000 standard. It is recognized that ANSI Z-136.1-2000 establishes safety guidelines for the industrial setting and that some guidelines may not be applicable for biomedical research facilities such as the NIH.

A. Laser User's Safety Responsibilities

1. The Laboratory Chief and Senior Investigator

The Laboratory Chief, Senior Investigator, or his/her designee responsible for each laser and/or laser system, has the obligation to ensure compliance with NIH laser safety guidelines and to seek assistance from the Chairperson, LSAC and/or his/her ICD Occupational Safety and Health Specialist, to address safety problems when necessary.

The Laboratory Chief, Senior Investigator or his/her designee responsible for the laser and/or laser system will:

- a. Be knowledgeable of ANSI Z-136.1-2000 and NIH laser safety guidelines.
- b. Generate a standard operating procedure (SOP) for each laser or laser system and direct all laser users to follow the SOPs.
- c. Ensure safety training is provided to all personnel operating the laser.
- d. Direct all laser users to adhere to NIH laser safety guidelines, and permit only qualified and trained employees to install, adjust, align, and operate laser equipment.
- e. Notify the Chairperson, LSAC, of any modifications in the operating characteristics of any laser which may change its classification.

In cases where the laser or laser system classification is changed because of the addition or deletion of engineering control measures, the laser or laser system shall be reclassified by the responsible person in charge of the laser or laser system in accordance with the procedures described in ANSI Z136.1-2000.

- f. Ensure that the laser device has a key-switch master control which will permit only authorized personnel to operate the laser.
- g. Establish control measures for lasers or laser systems with unprotected housing.

In cases where, for research purposes, the operation of a laser or laser system without a protective housing is or may become necessary, the Laboratory Chief, Senior Investigator or his/her designee responsible for the laser and/or laser system will perform a hazard analysis, and ensure that control measures for safe operation are instituted appropriate to the maximum accessible emission.

These control measures may include, but not be limited to: (1) Access restriction, (2) Eye protection, (3) area controls, including posting appropriate warning signage, (4) Barriers, shrouds, beam stops, etc., (5) Administrative and procedural controls.

- h. Report all laser related personnel accidents to the Occupational Medical Service (OMS) for medical assistance. Also, notify the Chairperson, LSAC, in writing of the accident.

2. Laser User

Each laser user is responsible for operating the laser/laser system in a safe manner. The laser users safety responsibilities include:

- a. Ensuring that he/she is qualified and adequately trained to use and operate the laser.
- b. Adhering to safety guideline as delineated in the SOP and operate the laser in a well-controlled area. For example, within a closed room with covered or filtered windows and controlled access.
- c. Ensuring that the appropriate laser safety goggles for eye protection are available to all personnel in the laser area. If the laser beam irradiance represents a serious skin or fire hazard, ensure that a suitable shield is present between the laser beam(s) and personnel.
- d. Using remote firing or remote viewing through a laser safety shield, where appropriate.
- e. Using beam shutter and laser output filters to reduce the laser beam irradiance to less hazardous levels whenever the full beam power is not required.
- f. Using dark, absorbing, diffuse, fire resistant target and backstops where appropriate.
- g. Reporting all laser accidents to the Laboratory Chief and OMS.

V. LASER SAFETY SURVEY

A. Laser Safety Survey

- 1. An on-site laser safety survey will be conducted annually by a survey team to identify any potential laser safety problems. The criteria for this survey are based on recommendations from ANSI Z136.1-2000 (Laser Safety Survey Form is attached).

2. Safety topics addressed in the surveys of class 3b and 4 lasers or laser systems include engineering (appendix A) as well as administrative and procedural (appendix B) control measures. Tables A and B contain references (in parentheses) for control measures described in ANSI Z136.1-2000 (see appendices C, D and E).

B. Laser Safety Survey Team

1. The survey team may be composed of the Chairperson, LSAC, Occupational Safety and Health Specialists, laser users, and other member(s) of the LSAC.
2. The survey team will consult with the Laboratory Chief, Senior Investigator or his/her designee responsible for the laser and/or laser system and identify any potential safety problems, including any ancillary hazards associated with laser use, such as electrical problems and exposure to UV light, dye, smoke plumes, carcinogens, etc as well as make recommendations on how to address such hazards.

C Disposition of Survey Results

1. Results of the laser safety survey, along with any safety recommendations, will be forwarded to the person responsible for the laser or laser system. This person is responsible for addressing and implementing steps to appropriately rectifying any identified safety problems.
2. The Chairperson, LSAC, will inform the Occupational Safety and Health Specialist, SOSB, DOHS who has responsibility for the ICD where the laser or laser system is located. If necessary, the Chairperson will request the Specialist to assist the Laboratory Chief, Senior Investigator or his/her designee responsible for the laser and/or laser system to address and rectify the identified safety problem. The Specialist will inform the Chairperson, LSAC, of actions taken.

- D. The Laboratory Chief, Senior Investigator or his/her designee responsible for the laser and/or laser system will inform the Chairperson, LSAC of the efforts to implement safety recommendations. The results of laser safety surveys will be maintained in a computer database at DOHS by the Chairperson, LSAC.

TABLE A RECOMMENDED ENGINEERING CONTROLS

Note: The sections referenced in the ANSI Z136.1-2000 are enclosed in parentheses. An "X" indicates a mandatory requirement whereas an "o" is recommended only.

CONTROL MEASURES	LASER CLASSIFICATION	
	3b	4
Protective Housing (4.3.1)	X	X
Interlocks On Protective Housing (4.3.2)	X	X
Service Access Panel (4.3.3)	X	X
Key Control (4.3.4)	o	X
Viewing Portals (4.3.5.1)	MPE	MPE
Collecting Optics (4.3.5.2)	MPE	MPE
Totally Open Beam Path (4.3.6.1)	X / NHZ	X / NHZ
Limited Open Beam Path (4.3.6.2)	X / NHZ	X / NHZ
Enclosed Beam Path (4.3.6.3)	(None required if 4.3.1 and 4.3.2 fulfilled)	
Remote Interlock Connector (4.3.7)	o	X
Beam Stop or Attenuator (4.3.8)	o	X
Activation Warning System (4.3.9)	o	X
Indoor Laser Controlled Area (4.3.10)	X / NHZ	X / NHZ
Class 3b or Class 4 Controlled Area (4.3.10.1) or (4.3.10.2)	X	X
Labels (4.3.14 and 4.7)	X	X

LEGEND X = Shall
o = Should
MPE = Shall if Maximum Permissible Exposure (MPE) is exceeded
NHZ = Nominal Hazard Zone Analysis required

* ANSI Z136.1-2000 References:For Section 4.3, See Appendix C

TABLE B ADMINISTRATIVE & PROCEDURE CONTROLS

Note: The sections referenced in the ANSI Z136.1-2000 are enclosed in parentheses. An "X" indicates a mandatory requirement whereas an "o" is recommended only.

CONTROL MEASURES	CLASSIFICATION	
	3b	4
Standard Operating Procedures (4.4.1)	o	X
Education and Training (4.4.3)	X	X
Authorized Personnel (4.4.4)	X	X
Alignment Procedures (4.4.5)	X	X
Spectator (4.4.6)	o	X
Service Personnel (4.4.78)	X	X
Laser Optical Fiber Systems (4.5.2)	X	X
Eye Protection (4.6.2)	X	X
Protective Windows (4.6.3)	X	X
Skin Protection (4.6.6)	X	X
Warning Signs and Labels (4.7)	MPE	MPE
	X	X
	NHZ	NHZ

LEGEND X = Shall
 o = Should
 MPE = Shall if MPE is exceeded
 NHZ = Nominal Hazard Zone Analysis required

* ANSI Z136.1-2000 References: For Section 4.4, See Appendix D
 * ANSI Z136.1-2000 References: For Section 4.4, See Appendix E