PURDUE
UNIVERSITY

LASER SAFETY GUIDELINES

July 26, 2006

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PREFACE

The purpose of this manual is to provide individuals using lasers information on laser hazards, laser-related policies and procedures, recommendations for the safe use of lasers, and laser safety training. It has been designed to provide the basis for safe laser use in the research and teaching environment without placing excessive burdens of cost or use restrictions on those responsible for laser operations. Much of the information contained herein is based on the American National Standard for Safe Use of Lasers, ANSI Z136.1-2000. The ANSI standard is the accepted standard for laser safety in the United States.

Many lasers are capable of causing eye injury to anyone who looks directly into the laser output beam, or even at a specular reflection of the beam. In addition, diffuse reflection of a high-power laser beam can produce permanent eye damage. High-power laser beams can also burn exposed skin, ignite flammable materials, and cause the release of hazardous fumes, gases, and debris. Other hazards associated with the equipment and optical apparatus required to produce the lasing action and control the beam can include high-voltage, high pressure, compressed gases, cryogenics, noise, ionizing and non-ionizing radiation, and toxic materials.

Despite the potential hazards, laser equipment can be operated safely if the proper procedures and necessary precautions are followed. To this end, the Purdue University Laser Safety Committee has developed this manual. If you need additional information or assistance, contact any member of the Committee or the Laser Safety Officer at the Department of Radiological and Environmental Management (REM), phone 49-46371.

INTRODUCTION TO LASER SAFETY AT PURDUE UNIVERSITY

Is my laser dangerous?

- Locate the class label on the laser (Figure 1). All lasers sold in the US have one. This will tell you if it is class 1, 2, 3a, 3b, or 4.
- Dangers of a class 1, 2, or 3a laser are much less significant than those of a class 3b or 4 laser. Even for these low power class lasers, however, direct exposure of the eye to the output beam can be dangerous. In addition, many of these lasers, regardless of class, have high-voltage power supplies that can be hazardous.
- If you have a class 3b or 4 laser, yes, it is dangerous, and you need to be especially careful.
- Refer to APPENDIX A for information on laser classification.

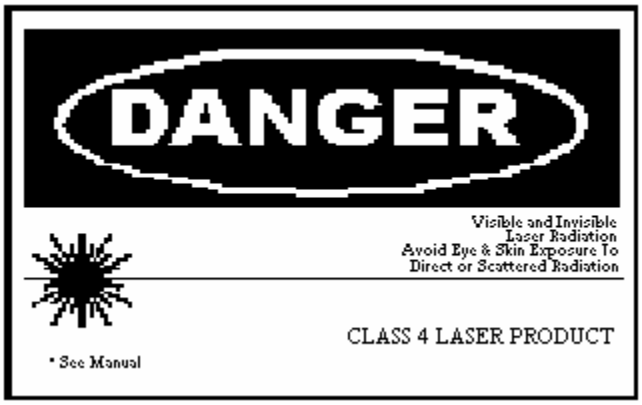

Figure 1. Laser Identification label

I have a class 3b or 4 laser. What makes it dangerous to me?

- Of foremost concern is the danger the laser poses to your eyesight. Irreparable damage to parts of your eye, and permanent partial or full loss of vision are possible. Lack of knowledge and training in laser safety is easily remedied and immensely valuable to helping you work safely.
- High-power lasers usually have large power supplies designed to deliver large currents, often at high voltages. Accidents during troubleshooting can be fatal. Untrained personnel should stay out of the high voltage power supplies.
- There have been incidents where high-power lasers have ignited laboratory equipment, leading to fire and smoke damage to the laboratory.
- There may be a risk of skin damage from direct exposure to the beam.
- Excimer lasers make use of reactive gases requiring special safety precautions and procedures to prevent exposure.
- How each of the above risks affects you depends on the type of laser, the wavelength, pulse energy (or power for a continuous wave laser), pulse duration (or exposure duration for a continuous wave laser), and the type of application.

I'm new to lasers. How do I figure out what to be concerned about in my lab?

- Ask your faculty advisor about it.
- Ask your faculty advisor about the laser safety training through the Department of Radiological and Environmental Management (REM) located in the Civil Engineering Building (phone 49-46371).
- See the REM website.
- Read on to learn a little more, and where to obtain more details.

What is the danger to me?

- Depending on the wavelength of the laser light, your cornea, lens, or retina may absorb the light. When there's too much absorption, the cells are burned, leading to damage.

- Effects on the skin are both photochemical and thermal depending on the wavelength of the laser light. Symptoms range from mild reddening (erythema) to blistering and charring. Also, there are possible carcinogenic effects.
- Non-beam hazards include fumes, compressed gases, cryogenic materials, noise, electrical hazards, fire, explosion, and collateral radiation.

How do I know how much is too much?

- Refer to the American National Standard for Safe Use of Lasers, ANSI Z136.1, for hazard analysis of several different laser types. This ANSI standard is available for checkout from REM.
- Refer to APPENDIX B for information on common types of lasers and check the laser identification label. If the data you are looking for is not there, contact REM.

How can I avoid accidental exposure?

- Follow the safety procedures for your laboratory. REM can help you formulate such procedures if they do not exist or are outdated.
- Use correct approved laser safety goggles when appropriate. The lenses in goggles are for a specific wavelength range, and do not protect you outside of this range. Even with goggles, consider direct exposure to a laser beam to be dangerous.
- One simple rule of thumb is to keep the beam horizontal and at waist level so when you are standing in the laboratory your eyes are well above the beam plane.
- Question practices which appear unsafe to you. Are they necessary or outdated? Can the same function be performed in a manner which is less dangerous? Can the unsafe practices be replaced by some other diagnosis or measurement? Are work practices designed for expediency at the expense of safety?

Where can I get more laser safety information at Purdue?

- Laser safety information is available in this booklet, at the REM website and through REM.

Where can I find out about procedures at Purdue?

- Procedures for the safe operation of a laser can be found in the next two chapters of this booklet. In Chapter 2 we discuss safety features that should be designed into the laser and the laboratory, as well as information on procedural and administrative policies.
- Procedures at Purdue are based on many of the guidelines developed by professional organizations such as the American National Standards Institute (ANSI). Several sections of the American National Standard for Safe Use of Lasers, ANSI Z136.1, are referenced in the following sections and are denoted by parenthesis. The ANSI Standard and other laser safety references are available from REM for checkout.

CHAPTER 2

CONTROL MEASURES

I. Introduction

Control measures for Class 3b and 4 lasers are designed to reduce the possibility of eye and skin exposure to hazardous levels of radiation and to other hazards associated with the laser systems. The major causes of laser accidents in the laboratory are:

A. Eye exposure during alignment

B. Misaligned optics and upwardly directed beams

C. Available eye protection not used (two recent injuries at Purdue)

D. Equipment malfunction (one incident at Purdue)

E. Improper methods of handling high-voltage circuits

F. Intentional exposure of unprotected personnel

G. Operators unfamiliar with laser equipment

H. Lack of protection from ancillary hazards

I. Improper restoration of equipment following service

J. Eyewear worn not appropriate for laser in use

K. Failure to follow Standard Operating Procedures (SOPs)

Control measures are classified as engineering control measures (ANSI Z136.1, Section 4.3) and administrative and procedural control measures (ANSI Z136.1, Sections 4.4 and 4.5). Engineering controls are those that are incorporated into the laser system and the laser laboratory. Administrative and procedural controls are methods or instructions which specify rules and/or work practices to supplement engineering controls and may require use of personal protective equipment. An example of an engineering control measure would be a laser beam stop, and an example of an administrative and procedural control measure would be the SOPs. When feasible, engineering controls are always the preferred method to provide for safety in a laser laboratory.

Laser controls are designed to ensure skin and eye exposures do not exceed the applicable Maximum Permissible Exposure (MPE) limit. The MPE defines the maximum safe exposure without hazardous effect or adverse biological changes in the eye or skin. The MPE depends upon the wavelength and exposure duration.

An important consideration when implementing control measures is to distinguish among operation, maintenance, and service. Control measures are based on normal operation of the laser system. When either maintenance or service is performed, it is often necessary to implement additional control measures.

II. Engineering Controls

Engineering controls for Class 3b and 4 lasers are listed below. All Class 3b and 4 lasers at Purdue University are covered by this policy, and should have the listed design features unless otherwise approved by the Laser Safety Officer (LSO). If the system is purchased in the United States, the system has as part of the design features the controls stated below. This is often indicated on the laser by a “statement of certification”.

A. A protective housing shall be provided for each laser system. The protective housing shall be interlocked such that removal of the protective housing will prevent exposure to laser radiation. Interlocks shall not be defeated or overridden during normal operation of the laser (ANSI 4.3.1).

B. Service access panels that allow access to the beam during operation shall either be interlocked or require a tool for removal and have an appropriate warning label (ANSI 4.3.3).

C. A Class 3b laser should have a key controlled master switch. A Class 4 laser shall have a key controlled master switch. The authority for access to the key shall be vested in the Laser Principal Investigator (LPI) (ANSI 4.3.4).

D. All viewing portals, display screens, and collecting optics shall be designed to prevent exposure to the laser beam above the applicable MPE for all conditions of operation and maintenance (ANSI 4.3.5).

E. A laser controlled area shall be designated for all unenclosed beam paths. The laser control area is defined as the area where laser radiation is in excess of the MPE. The appropriate control measures must be implemented in the laser controlled area (ANSI 4.3.6).

F. A Class 3b laser should be provided with a remote interlock connector. A Class 4 laser shall have a remote interlock connector. The remote interlock connector will decrease the laser beam power to safe levels when activated (ANSI 4.3.7).

G. A Class 3b laser should have a permanent beam stop in place. A Class 4 laser shall have a permanent beam stop in place (ANSI 4.3.8).

H. An alarm (for example, an audible sound such as a bell or chime), a warning light (visible through protective eyewear), or a verbal "countdown" command should be used at start-up of a Class 3b laser, and shall be used with Class 4 lasers. For Class 4 laser systems, the warning should allow sufficient time to take appropriate actions to avoid exposure to the laser beam (ANSI 4.3.9).

I. Whenever possible, Class 4 lasers should be operated and fired from a remote location (ANSI 4.3.13).

III. Administrative and Procedural Controls

A. Approval is required for each laser facility. The application should be filed for approval before work begins. Refer to APPENDIX C for information.

B. Standard operating procedures, with safety controls, shall be readily available for operation of the laser system (ANSI 4.4.1). Refer to APPENDIX D for a guide to assist in the development of SOPs.

C. Each laser operator shall have the education and training level commensurate with degree of hazard and responsibility (ANSI 4.4.3). Refer to Section IV of Chapter 3.

D. All personnel using the laser system shall be listed on the project application submitted by the LPI (ANSI 4.4.4). Refer to APPENDIX C2 for the Laser User Application.

E. Alignment procedures shall be developed to ensure that eye exposure to the primary beam or to a diffuse or specular reflection does not exceed the MPE (ANSI 4.4.5).

F. The laser facility shall be designed in such a way to limit spectator access to the laser controlled area (ANSI 4.4.6).

G. Service personnel must comply with appropriate control procedures for the laser system and have education and training commensurate with the laser system (ANSI 4.4.7).

H. Proper eye protection devices, specifically designed for the laser radiation, shall be worn when engineering or other administrative and procedural controls are inadequate to eliminate exposures above the MPE (ANSI 4.6.2).

IV. Class 3b and 4 Laser Controlled Area

A. The area designated as the controlled area for Class 3b laser facilities shall have the following adequate control measures (ANSI 4.3.10.1).

1. Operation only by qualified and authorized personnel. Refer to Section I of Chapter 3.

2. Appropriate warning signs at all entryways and within the area. Refer to Section VI of Chapter 3.

3. Supervision by an authorized LPI. Refer to Section II of Chapter 3.

4. Limited spectator access. Visitors must be approved by the LPI.

5. Appropriate beam stops for terminating potentially dangerous beams.

6. Only diffuse-reflective surfaces on non-optical structures in or near the beam path.

7. Appropriate eye protection for all personnel within the area.

8. Laser beam positioned well above or below eye level.

9. All windows, doorways, and open portals covered to prevent the laser radiation above the applicable MPE outside the laser facility.

10. Secured storage of laser equipment.

B. In addition to the above control measures for Class 3b laser facilities, the controlled area for Class 4 laser facilities (Figure 2) **shall** have the following control measures (ANSI 4.3.10.2).

1. All entryway controls designed to allow rapid egress.

2. A "Panic Button" shall be clearly marked and readily accessible to the laser personnel. When activated the "Panic Button" will reduce the output power of the laser to levels below the MPE. The following are acceptable examples of "Panic Buttons".

a. Key switches to deactivate the laser.

b. Master switch on power source to turn off power.

c. Red mushroom-type button on control panel or other readily accessible location within the area.

3. Limited Access Entryway. The LPI shall implement one of the following mechanisms to protect personnel. The LSO will be available for consultative services.

a. Non-Defeatable (non-override) Entryway Safety Controls

Non-defeatable entryway controls will reduce the output power of the laser to levels below the MPE when the door is opened unexpectedly.

b. Defeatable Entryway Safety Controls

Defeatable entryway controls, with an override for safety latches and/or interlocks, may be used if it is clearly evident that there is no laser radiation hazard at the point of entry. Only adequately trained and authorized personnel may operate the overrides to enter the facility.

c. Procedural Entryway Safety Controls

i. All authorized personnel shall be trained, and proper personal protective equipment (PPE) shall be available upon entry.

ii. A secondary barrier (laser curtain) shall be used to block the laser radiation at the entryway.

iii. At the entryway there should be a visible or audible indication that the laser is in operation.

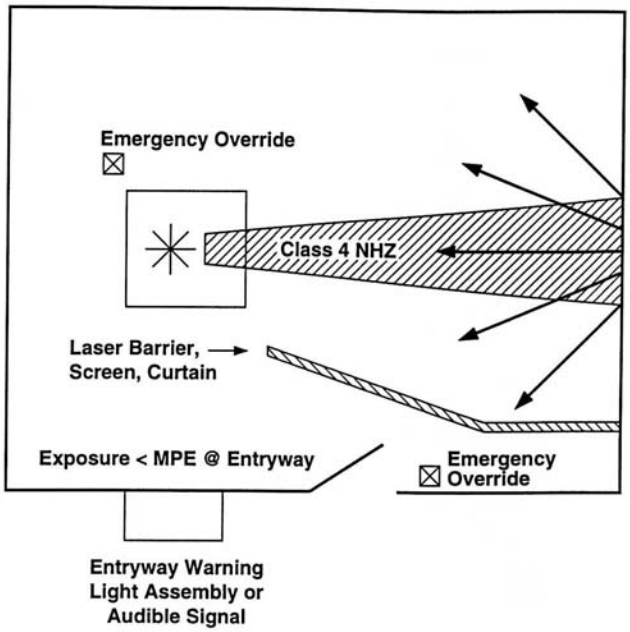

Figure 2. Class 4 Laser Controlled Area

V. Equipment Labels

All lasers (except Class 1) shall have appropriate warning labels with the laser sunburst logo and the appropriate cautionary statement (Figure 1). The labels shall be affixed to both the control panel and the laser housing.

Ancillary hazards shall also be appropriately labeled, but the sunburst logo is not required.

VI. Area Posting Signs

Areas which contain Class 2 or 3a laser systems should be posted with appropriate area postings as described in Figure 3. Areas which contain Class 3b or 4 laser systems shall be posted with appropriate area postings as described in Figure 4. Also, the laser controlled area should be indicated with the appropriate warning sign.

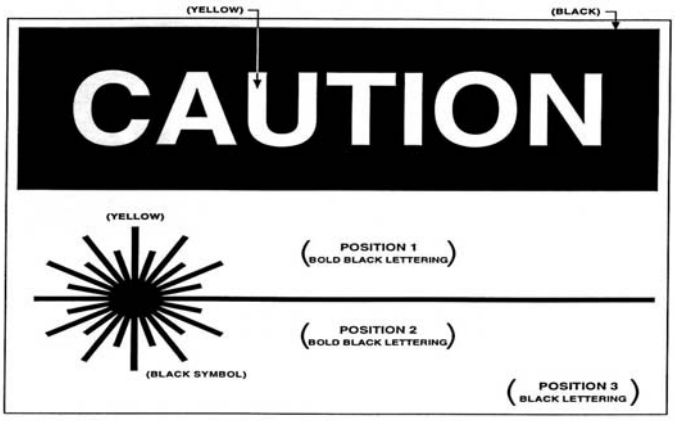

Figure 3. Area Posting for Class 2 and 3a Lasers

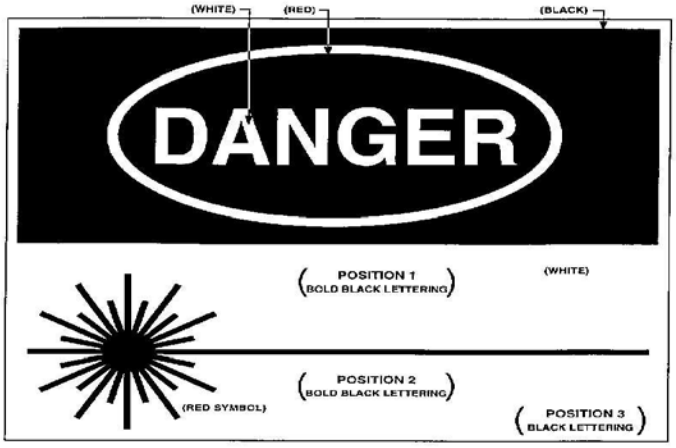

Figure 4. Area Posting for Class 3b and 4 Lasers

CHAPTER 3

LASER SAFETY PROGRAM

This chapter was developed to inform supervisors and operators of their roles and responsibilities to help provide a safe laser environment at Purdue University.

I. RESPONSIBILITY OF EMPLOYEES AND STUDENTS WORKING WITH OR NEAR LASERS

A. Authorization

An employee or student shall not operate a class 3b or 4 laser system unless authorized to do so by the LPI for that laser. The LPI may give system specific laser safety training, including this document, and grant temporary permission to use the laser, provided that official authorization is completed within 2 months after use of the laser begins. Individuals are officially authorized to use laser systems upon completing training, demonstrating competency, and submitting an application (APPENDIX C).

B. Compliance

All employees and students shall comply with the safety rules and regulations prescribed by the LPI, LSO, and Laser Safety Committee (LSC). Employees and students shall know the operating procedures applicable to their work.

C. Accident Reporting

All injuries and accidents involving lasers and laser systems shall be reported to the LPI and the LSO. However, the treatment of injured personnel and the preservation of property shall be the first priority.

II. RESPONSIBILITY OF THE LASER PRINCIPLE INVESTIGATOR

A. Prerequisite

The LPI shall know the educational and training requirements, the potential laser hazards and associated control measures, and all OPERATING procedures pertaining to laser safety for lasers and laser systems under the LPI's control. Generally the LPI is a faculty member in charge of one's laser facility.

B. Training

The LPI shall ensure that all laser users under his/her control are trained.

C. Authorized Users of Laser Systems

The LPI shall determine which students and employees are authorized (APPENDIX C) to operate a laser system under his/her control. The LPI may grant temporary permission to use the laser, if system specific laser safety training and this document are provided before use. Official authorization must be completed within 2 months after use of the laser begins. Individuals are officially authorized to use laser systems upon completing training, demonstrating competency, and submitting an application (APPENDIX C).

D. Accidents and Injuries

The LPI shall notify the LSO of known or suspected laser-related accidents and injuries. The LPI shall ensure that their departmental business office is promptly notified. If necessary, the LPI will assist in obtaining appropriate medical attention for any employee or student involved in the laser accident. The LPI shall cooperate with the LSO and/or LSC during the course of their investigation and implement recommendations to prevent a recurrence. A written incident report shall be prepared by the LPI within 1 month.

E. Approval of Laser System Operation

The LPI shall not permit operation of a new, modified or manufactured class 3b or 4 laser under his/her authority without prior approval of the LSO or the LSC.

F. Approval of Planned Installations

The LPI shall assure that plans for laser installations or modifications of installations are submitted to the LSC for approval. The LSO will act as a consultant, in conjunction with Facilities Planning, for the installation of new laser facilities.

G. Operating Procedures

For Class 3b and 4 laser systems, the LPI shall ensure standard operating procedures (SOPs) are developed and provided in order to prevent the operation of a laser if exposure to employees, students, visitors, or the general public could exceed the MPE. SOPs shall also be necessary for alignment, maintenance and/or service, and emergency response.

III. RESPONSIBILITY AND AUTHORITY OF LASER SAFETY COMMITTEE

A. Policies and Practices

The committee shall establish and maintain policies, procedures, and guidance for the control of laser hazards. Refer to APPENDIX E, Purdue University President's Executive Memorandum No. D-2.

B. Approval of Class 3b and 4 Laser Facility

Approval of a laser or laser system for operation will be given only if the LSC is satisfied that the laser hazard control measures are adequate. These include standard operating procedures (SOPs), engineering controls for the laser, engineering controls for the laboratory or area, and administrative and procedural controls for the laser facility. Standard operating procedures for alignment, maintenance and/or service, and emergency response shall be provided as necessary.

Temporary approval for operation can be given by the LSO, who will then seek final approval at the next LSC meeting.

C. Standards

The committee will review all applicable new or revised laser safety standards.

D. Membership of Laser Safety Committee

The Purdue University Laser Safety Committee shall consist of faculty and staff who by their knowledge and experience are qualified to make judgements and recommend policy in the area of laser safety. Committee members shall be appointed by the President upon recommendation of the Vice President of Research and the Vice President for Physical Facilities in consultation with the various deans, directors, and department heads.

E. Authority

The LSC and the LSO have the authority to suspend, restrict, and terminate the operation of a laser project if it is deemed that the laser hazard controls are inadequate.

IV. RESPONSIBILITY AND AUTHORITY OF LASER SAFETY OFFICER

A. General

The LSO will work with the individual LPI to ensure the safety standards of each laser laboratory are adequate. The LSO shall be designated by the LSC and has the authority to monitor and enforce the control of laser hazards.

B. Consultative Services

The LSO will provide consultative services on laser hazard evaluation and controls, and personnel training programs.

C. Training Programs

Training shall be provided to each employee and student routinely operating a Class 3b or 4 laser or laser system. The level of training will be commensurate with the degree of potential laser hazards. A comprehensive laser safety training program is available from REM. Other training programs are encouraged. The LSC should be informed of the content of these alternative programs. Training should be completed at the time work begins, but no later than 2 months subsequent to initiation of work.

D. Records

The LSO will ensure that the appropriate records are maintained indicating that appropriate training has been provided and all users of laser systems are listed on the appropriate projects.

The LSO shall periodically contact the LPIs to ensure the laser application is current.

E. Surveys and Inspections

The LSO will survey all areas where Class 3b and 4 laser equipment is used. Surveys shall be performed on a regular basis, when modifications to the laser and/or laser system have occurred, before the initial operation of a new laser, or as deemed necessary.

The LSO will accompany regulatory agencies inspecting the laser facility. The LSO will ensure that corrective action is taken where required.

F. Accidents and Injuries

Upon notification of a known or suspected laser-related accident or injury, the LSO shall investigate the accident or injury and take appropriate action. The LSO shall perform a hazard evaluation of the laser facility to determine the cause of the accident, interview individuals involved in the accident, and make certain that necessary controls have been implemented before operation resumes.

V. RESPONSIBILITY OF PURCHASING DEPARTMENT

The Purdue University Purchasing Department will inform the LSO of all orders for lasers and laser systems. Notification should be in the form of a copy of the Purchasing Requisition, Form 12. The LSO will contact the LPI to determine if the appropriate laser safety controls are in place, and to help remedy any problems or deficiencies.

APPENDICES

APPENDIX A

LASER CLASSIFICATION

Class	Power Output	Description
1	<0.4 μW	Considered safe for continuously viewing or are designed in such a way that prevents human access to laser.
2	0.4 μW-1 mW	Visible light lasers will not cause eye injury if viewed momentarily. They can possibly present an eye hazard if viewed directly for a long period of time.
3a	1 mW-5 mW	Can not damage the eye within 0.25 second of the aversion response or blink reflex. Injury is possible if the beam is viewed with collecting optics or by staring at the direct beam.
3b	5 mW-500 mW	Present an eye and skin hazard from viewing the direct beam or a specularly reflected beam. No production of a hazardous diffuse reflection except when viewed with collecting optics. No fire hazard is presented.
4	>500 mW	These are the most hazardous lasers and may cause an eye and skin injury from the direct viewing, specular reflection, and diffuse reflection. These lasers can produce fire and generate hazardous airborne contaminants.

APPENDIX B

COMMON LASER TYPES AND WAVELENGTHS

TABLE B1: Ultraviolet (0.180 μm – 0.400 μm)

Laser Type	Wavelength (μm)
Argon Fluoride	0.193
Krypton Fluoride	0.248
Neodymium:YAG (4th harmonic)	0.266
Argon	0.275, 0.351, 0.363
Xenon Chloride	0.308
Helium Cadmium	0.325
Nitrogen	0.337
Xenon Fluoride	0.351
Neodymium:YAG (3rd harmonic)	0.355

TABLE B2: Visible (0.400 μm – 0.700 μm)

Laser Type	Wavelength (μm)
Helium Cadmium	0.442
Rhodamine 6G	0.450, 0.650
Argon	0.457, 0.476, 0.488, 0.514
Copper vapor	0.510, 0.578
Krypton	0.530
Neodymium:YAG (2nd harmonic)	0.532
Helium Neon	0.543, 0.632
Indium Gallium Aluminum Phosphide	0.670
Ruby	0.694

TABLE B3: Near-infrared (0.700 μm – 1.400 μm)

Laser Type	Wavelength (μm)
Ti-Sapphire	0.700 – 1.000
Alexandrite	0.720 – 0.800
Gallium Aluminum Arsenide	0.780, 0.850
Gallium Arsenide	0.905
Neodymium:YAG	1.064
Helium Neon	1.180, 1.152
Indium Gallium Arsenic Phosphide	1.310

APPENDIX B

TABLE B4: Mid-infrared (1.400 μm – 3.000 μm)

Laser Type	Wavelength (μm)
Erbium:Glass	1.540
Homium	2.100
Hydrogen Fluoride	2.600 – 3.000
Erbium	2.940

TABLE B5: Far-infrared (3.000 μm – 1 mm)

Laser Type	Wavelength (μm)
Helium Neon	3.390
Carbon Monoxide	5.000 – 5.500
Carbon Dioxide	10.6

FACILITY AND PERSONNEL APPLICATIONS FOR CLASS 3B AND 4 LASERS

APPENDIX C1 - Form LU-1 Application for Use of Laser Facility
(http://www.purdue.edu/rem/home/forms/LU-1.doc)

APPENDIX C2 - Form LU-2 Laser User Application
(http://www.purdue.edu/rem/home/forms/LU-2.doc)

APPENDIX C3 - Form LS-1 Laser System Registry
(http://www.purdue.edu/rem/home/forms/LS-1.doc)

REM - FORM LU-1
Revision 2/01

Termination: _____

PURDUE UNIVERSITY
Application for Use of Laser Facility

IMPORTANT: All classes 3b and 4 lasers used at Purdue University are required to have an approval from the Laser Safety Committee through Radiological & Environmental Management Department (REM). Safe laser use and procedural compliance are the responsibilities of the Project Director.

Date: _____ Authorization Number: _____

☐ New Facility ☐ Amendment

1. Project Director: _____ 2. Department: _____
3. Position: _____ 4. Phone: _____
5. Office Location: _____ 6. Email: _____
7. Authorized Users (attach FORM LU-2 for each user):

	Name	Department	Position
a)			
b)			
c)			
d)			
e)			
f)			

8. Laser Systems to be Used (attach FORM LS-1 for each laser system):

	Laser Type	Class	Operating Wavelength (nm)	Max. Power (W)/ Pulse Energy (J)	Pumping Laser
a)					
b)					
c)					
d)					
e)					
f)					

9. Locations of Use (sketch the relative location of the laser system(s) in the designated room on back):

	Building	Room	Type of Use (experimental, industrial, teaching, etc.)	Laser System(s)
a)				
b)				
c)				
d)				

REM - FORM LU-1
Revision 2/01

Termination: _____

10. Provide a brief outline in terms of the application of the laser system(s) for the project.

11. Attach standard operating procedures (SOPs) for the alignment and operation of each laser system.

12. Is there any chance that gas or aerosols will be formed? If so, what method(s) will be used to prevent inhalation of the released gas or aerosols?

13. Indicate what methods will be used to define a laser control area. This area is designated where the laser has the potential to cause injury (the entire room, inside laser curtain, behind protective barrier, etc.).

14. Specify precautions and procedures to be used by personnel to:

Prevent eye and/or skin injuries (attach emergency SOPs)?

Prevent unauthorized use or removal of the laser system?

Prevent beam exposure in work areas and in adjacent area?

15. Laser Safety Eyewear

	Manufacturer	Wavelength Protected	Optical Density	ANSI Approved
a)				
b)				
c)				

I certify that the provided information contained in this form is true and correct to the best of my knowledge and belief. The required forms (LU-2 and LS-1) and SOPs are attached.

Laser Project Director Signature: _____ Date: _____

Approval Recommended (LSO): _____ Date: _____

Approved (Chair of LSC): _____ Date: _____

REM - FORM LU-2
Revision 7/06

Termination _____

PURDUE UNIVERSITY
Laser Use Application

IMPORTANT: The applicant must attend the laser safety training and submit this application to be authorized for laser use. Previously authorized applicant at Purdue University should indicate his/her previous project director's name.

Previous Project Director: _____

1. _____
Last Name First Name Middle Initial Maiden Name

2. Position: _____ 3. Department: _____

4. Building & Room: _____ 5. Phone: _____

6. Purdue ID Number: _____ 7. Estimated Starting Date: _____
(Month/Day/Year)

8. Characterize the laser system(s) you are planning to use.

	Laser Type	Class	Operating Wavelength (nm)	Max. Power (W)/Pulse Energy (J)
a)				
b)				
c)				

9. Statement of Previous Course(s), Training or Experience with Laser(s):

Formal Course(s):

Training On-The-Job:

Experience:

10. Have you had any exposures to laser in amounts known (or suspected) to be above the ANSI Z136.1-2000 maximum permissible exposure?

☐ Yes ☐ No ☐ Unknown

TO BE COMPLETED BY PROJECT DIRECTOR

Project Director Name: _____ Authorization Number: _____

Project Director Signature: _____ Date: _____

I have received, read, and understand the Purdue University Laser Safety Guidelines and am willing to abide by the university, state, and federal regulations governing the use of lasers. I have attended the Laser Safety Training and was afforded the opportunity to ask questions addressing any concerns I have relating to the safe use of laser.

I certify that the statements contained in this application are correct and complete to the best of my knowledge and belief.

Applicant Signature: _____ Date: _____

REM - FORM LS-1
Revision 2/01

PURDUE UNIVERSITY
Laser Safety Registry

1. Project Director: _____ 2. Department: _____

3. Phone: _____ 4. Email: _____

5. Laser Location (Building & Room): _____

6. Specifications of Laser System:

Manufacturer: _____ Model: _____

Laser Type: _____ Class: _____ System Date: _____

Serial #: _____ PU#: _____ Manufacturer Operation Manual: ☐ Yes ☐ No

Beam Diameter (cm): _____ Beam Divergence (mradian): _____

Beam diameter and divergence were measured at ☐ 1/e ☐ $1/e^2$ ☐ 90% ☐ 50% point.

How many simultaneous wavelengths? _____ What are these wavelengths? _____

In-House Service: ☐ Yes ☐ No Service Contractor Contact: _____

CW

Wavelength (nm): _____

Maximum Operating Power (W): _____

Average Operating Power (W): _____

Pulsed

Wavelength (nm): _____

Minimum Pulse Duration (sec.): _____

Maximum Pulse Frequency (Hz): _____

Maximum Operating Energy (J): _____

Average Operating Energy (J): _____

7. Please check appropriate box for the following items:

☐ Yes	☐ No	Use of cryogens
☐ Yes	☐ No	Use of compressed gases
☐ Yes	☐ No	Use of high voltage supplies
☐ Yes	☐ No	High voltage > 30 kVp
☐ Yes	☐ No	Dye laser
☐ Yes	☐ No	Tunable laser
☐ Yes	☐ No	Used as a pumping laser
☐ Yes	☐ No	Exposed beam path
☐ Yes	☐ No	Use of beam focusing optics
☐ Yes	☐ No	Use of frequency doubling crystal
☐ Yes	☐ No	High noise level
☐ Yes	☐ No	Laser cutting/welding
☐ Yes	☐ No	Home-fabricated laser
☐ Yes	☐ No	Self-modified laser

GUIDELINES FOR LASER OPERATING PROCEDURES

These guidelines are intended to assist lasers users in preparing standard operating procedures (SOPs) for laser facilities. The information should be used as a guide to allow you to develop SOPs specific to your laser systems.

Anyone writing operating procedures should be familiar with laser safety and the Purdue University Laser Safety Policy. The Purdue University Laser Safety Policy and ANSI Z136.1 require **all** SOPs for laser facilities to be approved by the LSO. It is recommended that the LSO be consulted early in the development of SOPs for guidance in determination of the specific laser hazards and required control measures.

For assistance in preparation of your facilities SOPs or laser safety concerns please contact REM at 49-46371.

I. INTRODUCTION

A. Describe the laser location.

B. Describe the laser(s) by type, classification, and technical specifications (wavelength, power/energy, pulse length, repetition rate, beam diameter and divergence, etc.).

C. Briefly describe the purpose of the operation.

II. HAZARDS

Identify and analyze the specific hazards associated with this laser operation; include beam hazards as well as any non-beam hazards (electrical, hazardous chemicals, high pressure, plume emissions, etc.).

III. HAZARD CONTROLS

Describe the means used to mitigate each of the hazards listed above in the HAZARDS section. Please refer to ANSI Z136.1, the Purdue University Laser Safety Policy, or the LSO for assistance.

IV. TRAINING REQUIREMENTS

Describe the training requirements for the laser operator and incidental personnel. The laser operator shall have formal training in laser safety as well as hands on training with the specific laser system. Incidental personnel shall be made aware of the specific hazards associated with the laser operation.

V. OPERATING PROCEDURES

List the sequential events that describe the complete operation, including when to implement the hazard control measures. The procedures shall be written for the benefit of the laser operator who must read and understand them to perform the operation safely.

VI. ALIGNMENT PROCEDURES

List the steps used to perform beam alignment on a laser or laser system. Special attention should be given to control measures that can reduce the potential for exposure. Examples for control measures are shutting down the main laser and using an alignment laser, reducing the power/energy of the laser, use of beam dumps for the primary beam, etc.

Most laser accidents from the beam occur during the alignment operation.

VII. EMERGENCY PROCEDURES

Describe your planned actions in case of an accident, injury, fire, or other emergency. Include names and phone numbers of those that must be contacted in case of an emergency. The procedures shall include REM @ 49-46371 and Purdue Police @ 911 or 49-48221. Also post the emergency procedures in the laboratory.

VIII. RESPONSIBILITY AND REGISTRATION

State the name, title, and phone number (or office location) for the person(s) responsible for ensuring that the operation is carried out in accordance with the SOPs.

All laser systems must be registered with REM. Refer to APPENDIX C for information.

PURDUE UNIVERSITY OFFICE OF THE PRESIDENT
EXECUTIVE MEMORANDUM NO. D-2

Composition, Duties, and Responsibilities of the Purdue University Laser Safety Committee

August 1, 2001

An electronic version of this memorandum can be found at the Purdue University Policies web site at the following URL.

(http://www.purdue.edu/policies/pages/facilities_lands/d_2.html)

APPENDIX F

Laser Safety Committee Member List

Name	Department	Phone	Email	Termination Date
Anant K. Ramdas, Chair Professor	PHYS	49-43028	akr@purdue.edu	Revolving Appointment
John A. Coy Microfab Research Engineer	ECE	49-43480	jcoy@purdue.edu	June 30, 2007
Daniel E. Leaird Senior Research Engineer	ECE	49-43370	leaird@purdue.edu	June 30, 2007
Garth J. Simpson Assistant Professor	CHEM	49-63054	gsimpson@purdue.edu	June 30, 2007
Voicu S. Popescu Assistant Professor	CS	49-67347	vpopescu@purdue.edu	June 30, 2007
James F. Schweitzer Director, Assistant Professor	REM, HSCI	49-42350	jfschweitzer@purdue.edu	Revolving Appointment
Carol A. Shelby Senior Director	EHPS	49-47504	cshelby@purdue.edu	Revolving Appointment
Mary J. Handy Laser Safety Officer, Health Physicist	REM	49-42721	maryjo24@purdue.edu	Revolving Appointment