

Rice University  
Laser Safety Manual



Environmental Health and Safety  
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January 2014

## Introduction

The objective of the Rice University Laser Safety program is to assist all levels of management in fulfilling the Rice commitment to furnish a place of employment and learning that is as free as possible from recognized laser hazards that cause or are likely to cause harm to Rice personnel or the surrounding community. It is vital that faculty, staff and students have enough information available to aid them in the safe conduct of their daily work activities relating to lasers and laser-producing devices.

The Texas Department of State Health Services Radiation Control issues a registration to Rice authorizing the use of lasers and laser-producing devices. An essential component of that registration is this Laser Safety Manual. A significant factor in being allowed the flexibility of a laser registration by the Texas Department of State Health Services is that Rice implicitly accepts the responsibility to regulate and control the broad use of lasers and laser-producing machines within its jurisdiction. This responsibility is not to be taken lightly.

The purpose of the Rice University Laser Safety Manual is to assist both personnel and management in complying with the objectives of the Texas Department of State Health Services, Radiation Control regulations (25 TAC §289.301) and Rice University Health and Safety Policies. The Radiation Safety Program addresses many of the items in this manual in the Laser Safety training sessions provided. It is intended that the each Principal Investigator will supplement this information with instruction, training and guidance regarding specific practices and procedures unique to the work being done in their laboratory area with the goal to eliminate the potential for exposure to laser radiation.

This manual is not intended to be an exhaustive or fully comprehensive reference, rather a guide for registered users and other technically qualified individuals. Further advice concerning hazards associated with specific substances, devices and the development of new or unfamiliar activities should be obtained through consultation with the Laser Safety Officer or the Radiation Safety Program.

All users of lasers and laser-producing devices must be familiar with the requirements set forth in this manual and applicable regulations of the Texas Department of State Health Services Radiation Control, and must conduct their operations in accordance with them.

This manual is intended to provide the basic information, State guidelines, and general procedures to aid those individuals working in the laser laboratory environment.

## References

Texas Regulation for Control of Laser Radiation Hazards (25 TAC 289.301)

<http://www.dshs.state.tx.us/radiation/laser.shtm>

ANSI Safe Use of Lasers in Educational Institutions (ANSI Z136.5 2009)

<http://www.lia.org/>

FDA Performance Standards for Light-Emitting Products (21 CFR 1040.10)

<http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcr/CFRSearch.cfm?CFRPart=1040>

## Scope

This program is applicable to all laboratories, research, service and support activities at Rice University that uses Class 3B and 4 lasers.

## Responsibilities

Laser Safety Officer (LSO) – The LSO is responsible for administering this Laser Safety Program with duties including but not limited to the following:

- Ensure State registration for all Class 3B and 4 laser equipment is up current and accurate
- Ensure standard operating procedure and training is current for all users
- Maintain inventory control of all lasers under the LSO jurisdiction

Environmental Health and Safety – EHS is responsible for audits in compliance of the Laser Safety Program including but not limited to the following:

- Review of current registration for compliance
- Identify work area hazards and approve proper personal protective equipment.
- Evaluate facility for proper interlock controls, laser signs and labels, and equipment operation.
- Evaluate and update the programs as needed
- Provides General Laser Safety training

Principle Investigator – PIs are authorized to use laser sources with following requirements

- Provide laser specific training for all students and staff required to use lasers sources 3B and 4 for their research
- Notify the LSO of any new, laser sources
- Notify the LSO if any laser sources are transferred, received or removed from use
- Ensures good laboratory practices with emphasis on safety

## Laser Classifications

Lasers are assigned one of four classes depending on the potential for causing biological damage.

**Class 1** – lasers are considered to be safe for intended purposes and exempt from any safety controls.

**Class 2** – lasers produce low power visible laser radiation with a radiant power below 1mW. Limited safety controls are required. Must have caution labels affixed to the laser.

**Class 3A** – laser produce intermediate levels of visible and invisible laser radiation with an output power between 1 to 5mW. The normal eye response to bright lights will protect user from eye injury. However, no collecting optics can be used to directly view the beam. Requires Labeling and Controls.

**Class 3B** – laser may produce moderate levels of visible and/or invisible emissions with an output power range from 5 to 500mW. These lasers are capable of producing eye injury and must have safety controls to minimize the viewing of the beam directly or reflectively. Requires labeling on the door and instrument; requires a Laser Warning light over the door that is active when the laser is in use and requires physical controls to prevent viewing of direct and reflected beam.

**Class 4** – laser may produce high levels of visible and/or invisible emissions with an output power above 0.5 W. These lasers are capable of inflicting damage to the skin and eye and may pose a fire hazard. Safety controls must be used to minimize the viewing of the beam directly, reflectively, or diffused. Requires labeling on the door and instrument and physical controls to prevent eye or skin contact with the direct or reflected beam, and also with the diffusely

reflected beam.

### **Embedded systems**

Class 2, 3 or 4 lasers or laser systems contained in a protective housing and operated in a lower classification mode may be classified at a lower classification. Specific control measures may be required to maintain the lower classification. For embedded systems that are non-commercial design and construction the Department LSO shall determine the classification.

For purposes of laser safety, a direct laser beam which has been deflected from a mirror or polished surface is considered to be as intense as the direct beam. Lasers beams which hit flat or non-mirror like surfaces are considered to be diffuse and the diffusely reflected beam is not as intense or as well defined as the direct beam.

### **Confocal Microscopes**

Confocal microscope systems with embedded class 3B and 4 lasers are classified as Class 1 laser system when used as intended and are exempt from registration with the State of Texas. If the protective housing is removed for alignment, maintenance, or servicing, a temporary laser control area should be used to minimize risk to other. A temporary control area should consist of

- all necessary personal protective equipment
- signage warning others about laser dangers
- laser curtain/ barrier

### **Registration Requirements**

Class 1, 2, and 3A lasers are considered safe to use under prescribed operations and pose little to no hazard to the user unless viewed directly for a prolonged time period. Certain regulations apply only during the servicing or modification of the laser source or housing. No registration with the State of Texas is required.

Class 3B and 4 lasers must be registered with the State of Texas before purchasing or transferring between any labs or department. All necessary documentation and interlocks must be established and a LSO appointed before operation is permitted.

### **Controls Procedures**

Posting Laser Warning Sign – The following sign must be posted outside of the laser control area when using ONLY class 3B and 4 lasers:



- Position 1: For Class 3B: “LASER RADIATION – AVOID DIRECT EYE EXPOSURE”  
 For Class 4: “LASER RADIATION – AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION”
- Position 2: Type of laser or the emitted wavelength, pulse duration or maximum output
- Position 3: Class of laser

### Personal Protective Equipment

Eye protection must be worn when operating any Class 3B and 4 lasers and should be specific to the laser emission spectrum and power. Skin protection can be achieved by wearing a lab coat and gloves that adequately covers any exposed skin.

Laser goggles may be necessary. Be certain that the goggle in use is appropriate both in the attenuation factor provided by the goggle and that the goggle is for the proper wavelength. Laser goggles must be matched to the wavelength of the laser systems being used!

### Engineering Controls

These controls should be incorporated into the facility design and operation of the laser in a controlled area. Some controls include but not limited to the following:

- a. Master kill switch – All class 3B and 4 lasers should have a master kill switch to safety power down the unit in case of an emergency.
- b. Laser in use sign – Any lab using class 3B and 4 lasers must activate the “Laser in Use” sign during operation.
- c. A permanently attached beam stop or attenuator should be provided to reduce the output emission

- level.
- d. Do not align the beam with the naked eye.
  - e. A beam stop must be provided to adequately stop the beam with the absence of scattered light emission. Be certain that scattered laser radiation is not escaping through a window to the outside.

### **Training and Communication**

Environmental Health and Safety will provide general laser safety classes for all users at Rice University.

The Principle Investigator or the individual with primary supervisory responsibility must assure that all personnel working with Class 3B and 4 lasers are informed of the hazards and are trained in operating procedures specific to the equipment in that lab. Standard operating procedures with a training acknowledgement log sheet should be readily accessible next to each laser source for inspection.

All records must be maintained according to 25 TAC 289.301(ee).

<http://www.dshs.state.tx.us/radiation/laser.shtm>