



## **OPERATING & SAFETY PROCEDURES FOR BAYLOR UNIVERSITY LASERS**

### **1. Purpose**

This procedure establishes requirements for Class 3B or Class 4 lasers that will minimize dangerous laser wave exposure to students, faculty and staff. It is provided to comply with rules enforced by the Texas Department of State Health Services (TDSHS), Radiation Control.

### **2. General**

- 2.1. Only trained, authorized personnel may operate lasers. Authorization is received from the Principal Investigator for the laser lab and the Laser Safety Officer.
- 2.2. NEVER put yourself into any position where your eyes approach the axis of a laser beam (even with eye protection on).
- 2.3. Keep beam paths below or above standing or sitting eye level. Do not direct them towards other people.
- 2.4. Do not damage laser protective housings, or defeat the interlocks on these housings.
- 2.5. Eliminate all reflective material from the vicinity of the beam paths.
- 2.6. Never use viewing instruments to look directly into a laser beam or its specular reflection. If this is necessary, install an appropriate filter into the optical element assembly.
- 2.7. Keep ambient light levels as high as operations will permit.
- 2.8. Do not work alone when performing high power laser operations.
- 2.9. Visitors should not be permitted to observe a laser experiment without first receiving a laser safety briefing and being issued laser eye protection. They will be escorted by knowledgeable personnel at all times.
- 2.10. LSO approval is required for deviations from this procedure.

### **3. Laser Entryway Controls**

#### **3.1. Class 3b Laser Only Labs**

- Doors must be closed and locked during laser operations.
- Doors must be properly posted and the warning light (if available) energized during operations.
- Door windows and labs windows must be covered to prevent the escape of a laser beam, unless an interlocked laser beam path enclosure is provided.

#### **3.2. Class 4 Laser Labs**

- All Class 4 lasers laboratories must have either approved entry way controls or an installed certified laser enclosure system.
- Overriding any safety controls is considered a serious violation of safety rules. Overriding actions include, but are not limited to the following: defeating of interlocks; removal of external shutter from the laser beam path; rewiring laser interlock connectors.



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- 3.3. Personnel requiring entry to a laser lab with laser operations in progress shall knock or press the door buzzer and verbally request permission to enter. Personnel who have key card access, or who have a key, may enter after announcing their presence and asking for instructions. Enter with care, following any laser operator's instructions that are given.
4. Turn-on Procedures
  - 4.1. Follow any pertinent safety precautions listed in the laser manufacture's published owner's manual.
  - 4.2. Prior to lasing, perform a "countdown" or make an announcement to warn others that you are about to lase.
5. Shared Laser/Non-Laser Space
  - 5.1. Class 3b and 4 Laser Labs. Labs will be arranged so that non-laser personnel will not have to pass through laser areas to enter or leave the lab. This can be done through lab design, or the use of movable partitions or interlocked curtains.
6. Use of Laser Eye and Skin Protection
  - 6.1. Laser protective eyewear must be worn whenever you are within the Nominal Hazard Zone (NHZ). The NHZ is defined as that area within which the laser beam power exceeds maximum permissible exposure levels. During maintenance or alignment operations, the NHZ extends to the entire lab or to the partitioned laser use area. Once the laser beam path is well defined and contained to a specific area, the NHZ may be reduced in size to the area where the experiment is taking place. Note that Class 4 lasers can produce hazardous diffuse reflections, and that the NHZ for laser experiments must be extended to account for diffuse reflection hazards from your experiment.
  - 6.2. Eyewear must be of the correct optical density and offer protection at the wavelength(s) of the laser(s) being used.
  - 6.3. Eyewear will only protect your eyes for short time periods, depending on the laser power. Therefore do not look directly into any laser beam, even with laser eye protection on.
  - 6.4. Periodically inspect and replace damaged or defective eyewear.
  - 6.5. Exposure to direct or diffuse reflections from ultraviolet lasers (particularly excimers) can result in short and long term skin hazards. Cover your exposed skin areas when working near these lasers (use long sleeve shirts or lab coats, cloth gloves, etc. as necessary).

Exceptions:

    - Lower optical density eyewear may be used when a laser beam must be seen. This eyewear is chosen to eliminate the diffuse reflection hazard.



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- If a diffuse reflection must be observed, do this after the beam path is well defined and away from the area that the diffuse reflection will be viewed from. During viewing, your eyes may not come within the diffuse reflection hazard distance.

### **7. Laser Beam Termination**

- 7.1. Terminate laser beams at the end of their useful path with immovable, non-specular, fire retardant beam stops or targets.
- 7.2. Do not allow open beams to cross aisle ways.
- 7.3. Choose target materials that partially absorb the laser beam.
- 7.4. Unused secondary beams emerging from alternate laser apertures will be terminated.
- 7.5. Terminate all unused beams.
- 7.6. Every time that a beam hits an optical element in your beam path, a portion of the beam will be reflected. This is of particular concern with an invisible beam and when a prism or angled optical element is used. Block all reflections and prevent them from leaving the experimental area. Even a 1% reflection from a high power YAG laser beam can cause instantaneous eye damage.

### **8. Non-Beam Hazards**

#### **8.1. Electrical Safety**

- Practice Lock-Out/Tag-Out procedures where appropriate.
- Do not defeat laser housing interlocks or come into contact with energized electrical circuits.
- Do not wear jewelry or metallic objects when working near a high voltage source.
- In case of emergency, press the Emergency Power Off button in your lab to turn off the electricity to your lab.

#### **8.2. Chemical Safety**

- Follow the precautions in your Chemical Hygiene Plan or Lab Safety Plan when working with chemicals in your lab.
- Work shall be performed in hoods where required. Use appropriate personal protective equipment, including safety glasses/goggles, gloves, respirators, etc., as required.
- Follow the precautions listed on the Safety Data Sheets for your chemicals.
- Many dyes and dye solvents are either known or suspected carcinogens. In addition to the above, you must have a containment tray or system to contain any dye spill which may occur within your laser.



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- 8.3. Gas Safety
  - Store hazardous gases in vented gas cabinets. Provide laser housing ventilation for those lasers (e.g. excimers) that use hazardous gases.
- 8.4. Airborne Contaminants
  - High power lasers interacting with a target or sample may cause airborne contaminants to be released to the air. Use a hood or other ventilation system to remove these contaminants from the ambient air.
- 8.5. Noise Safety
  - Wear hearing protection when in the vicinity of a laser that generates excessive noise levels.
- 8.6. Cryogenic Safety
  - Wear protective gloves, face shields, and clothing, as required when handling cryogenic materials.
9. Service and Maintenance Procedures
  - 9.1. Wear laser skin and eye protection.
  - 9.2. Set up a temporary controlled area that restricts access to the nominal hazard zone. Post warning signs as required.
  - 9.3. When access cannot be adequately restricted, use partitions or curtains to prevent the beam from leaving the area.
  - 9.4. Work carefully. Take the time needed to service the laser properly.
  - 9.5. Remove only the minimum number of protective housings required to do the work. Replace the housings promptly when done.
  - 9.6. Use the lowest possible laser power.
  - 9.7. Use indirect viewing instruments or targets to align the beam. Do not look directly at a potentially hazardous beam or specular reflection.
  - 9.8. After servicing, reactivate all safety features.
10. Accident/Emergency Procedures (See Procedure Supplement for posting.)
  - 10.1. In case of an emergency, call Baylor Police at 254-710-2222, for assistance. Emergency response personnel will be directed to you as necessary, and Environmental Health & Safety will be notified.
  - 10.2. Shut down power to laser equipment, and the lab if necessary.
  - 10.3. Notify the Principal Investigator and the Baylor University Laser Safety Officer.



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**Emergency Procedure Supplement**

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