



## Delaware State University

**University Area Responsible:** Risk and Safety Management

**Policy Number and Name:** 7-20: Laser Safety Plan

**Approval Date:** 7/28/11

**Revisions:** 8/12/13

**Reviewed:** 7/26/2013

**Related Policies and Procedures:** \_\_\_\_\_

### 1. Purpose

The Laser Safety Plan (LSP) is a means for documenting the assessment of the hazards associated with the laser system and its use.

### 2. Scope

The use of lasers has become widespread in research and industry and continues to increase with changes and development in technology and the fields of science.

- 3. Definitions / Laser Classification** -All lasers and laser systems in the U.S. are categorized into one of several hazard classes. Labels affixed to the laser or laser systems identify the hazard class according to the ANZI Z136.1 Laser Standard. The manufacturer provides the classification for most lasers; for custom-built and modified lasers, the LSO will assist you in classifying your laser. The following laser classes apply to the use of lasers

and laser systems. It is important to understand the different classes in order to work safely with laser light.

**3.1 Class 1** - Do not emit harmful levels of radiation during normal operation.

**3.1.1** Typically visible radiation, Continuous Wave (CW) with power levels  $< 0.4 \mu\text{W}$ .

**3.1.2** The maximum exposure duration limit for viewing is assumed to be no more than 30,000 seconds; in the IR region  $> 0.7 \mu\text{m}$  the duration limit is 100 seconds.

**3.1.3** A Class 1 laser system can include higher class lasers completely enclosed and interlocked to prevent beam access, allowing a Class 1 laser system designation; any time the higher class laser is accessible (e.g. during alignment or servicing), the higher laser class controls must be observed.

**3.1.4** A Class 1 laser or laser system can be used without restriction in the manner intended by the manufacturer and without special operator training, qualification or surveillance.

**3.1.5** Previously classified 2A lasers by the Federal Laser Product Performance Standard may be treated at Class 1 lasers or laser systems.

**3.2 Class 1M** - Do not emit harmful levels of radiation during normal operation *unless viewed with optics*.

**3.2.1** Two conditions exist that present a hazard when viewed through optics:

**3.2.2** If a beam is diverging, and a lens is placed within 100 mm of the aperture to focus the beam into the eye;

**3.2.3** If a beam has a large diameter, and a lens is used to increase the amount of laser light entering the eye.

**3.2.4** LEDs and fiber optic communication systems typically fall into this classification.

**3.2.5** A Class 1M laser or laser system can be used without restriction in the manner intended by the manufacturer and without special operator training, qualification or surveillance.

**3.3 Class 2** - Emits accessible laser light in the visible wavelength region, (0.4 to 0.7  $\mu\text{m}$ ) and is capable of creating eye damage through chronic exposure.

**3.3.1** Radiant power level emitted is above class 1 ( $0.4 \mu\text{W}$ ) but less than 1 mW.

**3.3.2** The blink reflex (aversion response to bright light) provides adequate protection.

**3.3.3** A Class 2 laser can be used without restriction in the manner intended by the manufacturer and without special operator training or qualification.

**3.4 Class 2M** - Is restricted to laser light in the visible wavelength region, (0.4 to 0.7  $\mu\text{m}$ ), and the blink reflex (aversion response to bright light) provides adequate protection for unaided viewing (no optics).

**3.4.1** A class 2M laser can be dangerous when viewed through optics.

**3.4.2** A class 2M laser power can exceed a class 2 (1mW) level, however the beam is either highly divergent or the beam diameter is large so that only a small proportion of the light enters the eye.

**3.4.3** A Class 2M laser can be used without restriction *in the manner intended by the manufacturer* and without special operator training or qualification.

**3.5 Class 3 Lasers (3R and 3B)** - Class 3 lasers are hazardous under direct (intrabeam) or specularly (mirror-like) reflection viewing but are not normally considered to be a diffuse viewing hazard or fire hazard.

**3.5.1** The Class 3 category is broken down into 2 distinct classifications: 3R and 3B.

### **3.6 Class 3R**

**3.6.1** Invisible ( $< 0.4 \mu\text{m}$  and  $> 0.7 \mu\text{m}$ ), and visible (0.4-0.7  $\mu\text{m}$ ) radiation emission;

**3.6.2** This laser classification presents a hazard if the eye is focused and stable. A class 3R laser is not a diffuse viewing hazard or a fire hazard.

**3.6.3** Class 3R lasers are restricted to 1-5 mW in power and can be considered safe for momentary viewing except in the case of optics.

### **3.7 Class 3B**

**3.7.1** Invisible emission: Restricted to 125mJ per pulse and 5-500 mW CW in  $< 0.25$  seconds.

**3.7.2** Visible emission: Restricted to 30mJ per pulse and 5-500 mW CW in  $< 0.25$  seconds.

**3.7.3** This laser classification will cause injury upon direct viewing of the beam and specular reflections, but is not normally a fire hazard, or diffuse viewing hazard unless done under conditions of intentional staring within the diffuse hazard distance.

**3.7.4** Specific controls must be in place to operate a class 3B laser. All personnel operating such a laser or laser system must complete training before use.

**3.7.5** Eyewear is required for all Class 3B unenclosed laser use.

**3.8 Class 4** - These laser or laser systems contain high powered lasers  $> 500$  mW or 125mJ per pulse in  $< 0.25$  seconds. **This laser or laser system is a hazard to the eye and skin under any viewing conditions if viewing directly, specularly or within the diffuse reflection safety distance.**

**3.8.1** **This laser class can also produce laser generated air contaminants (LGAC) and potentially hazardous laser plasma radiation.** Specific controls must be in place to operate a class 4 laser. All personnel operating such a laser or laser system must complete training before use.

**3.8.2** Eyewear is required for all Class 4 unenclosed laser use.

**4. Policy** - The LSP consists of a description of the laser system, a Standard Operation (SOP) that is a description of the operations involving the laser use, a description of the laser radiation hazard zone(s) and other hazards (such as electrical or toxic substances) associated with the laser system, and the physical and procedural control measures that have been implemented to limit the hazards.

## **5. Procedure**

**5.1** LSP is submitted to the Laser Safety Officer (LSO) for approval prior to beginning operation of the system. The person responsible for the laser system is responsible for completing a hazards analysis and applying the standards in ANSI Z136.1-2000.

**5.2** The Laser Safety Plan should be kept current and resubmitted for approval where significant modifications are made by Department head, LSO and Office of Occupational Safety Health annually.

**5.3** Lasers and laser systems shall have appropriate warning signs based on the hazard analysis and subsequent classification as Class 1, 1M, 2, 2M, 3R, 3B or 4. Appropriate “signal” words such as “Caution”, “Danger”, “Do Not Stare into Beam” and others shall be utilized to warn both trained and untrained personnel that may enter into areas where lasers or laser systems are in use.

### **5.4 Laser Warning signage**

**5.4.1** Referring to the Laser Classification/Definitions the standard laser warning sign shall be used for all laser facilities; “**CAUTION**” shall be used for Class 1, 1M, 2, 2M and 3A (below the applicable MPE); “**DANGER**” shall be used for Class 3R (output radiation > MPE), 3B and 4.

**5.4.2** **Position 1** above the tail of the laser starburst shall have the following:

**5.4.2.1** For Class 2: “*Laser Radiation - Do Not Stare into Beam.*”

**5.4.2.2** For Class 2M and 3R: where the MPE is not exceeded for a 0.25 second exposure to visible wavelength region (0.4-0.7 $\mu$ m: “*Laser Radiation - Do Not Stare into Beam or View Directly with Optical Instruments.*”

**5.4.2.3** For all other class 3R: “*Laser Radiation – Avoid Direct Eye Exposure to Beam.*”

**5.4.2.4** For Class 3B: “*Laser Radiation – Avoid Direct Eye & Skin Exposure to Beam.*”

**5.4.2.5** For Class 4: “*Laser Radiation – Avoid Eye or Skin Exposure to Direct or Scattered Radiation.*”

**5.4.3 Position 2** below the tail of the laser starburst shall have the following:

5.4.3.1.1 For all Classes: type of laser, wavelength, pulse duration (if applicable) and maximum output.

**5.4.4 Position 3** all signs shall have the Class of the laser or laser system.

**5.4.5** Laser signs are available commercially or through the campus sign shop. Contact the LSO to determine the appropriate sign for your laser area.

## **6. Responsibilities**

**6.1 The Principal Laser User’s (PLU) responsibilities include:**

- 6.1.1** Planning and implementation of all safety measures required for safe laser use in the laboratory;
- 6.1.2** Completion in a timely manner of a Laser Registration Form for each Class 3B or 4 lasers.
- 6.1.3** A written Standard Operating Procedure (SOP) in a location readily available to laser operators for all Class 3B and 4 lasers and ensures compliance with the SOP.
- 6.1.4** Supervision in the safe use of lasers in the laboratory;
- 6.1.5** Ensuring all lasers under the PLU’s control are properly classified and labeled.
- 6.1.6** Establish and maintain a list of personnel approved to operate Class 3B or 4 lasers; keeping the Laser Safety Officer up to date on personnel authorized to use the laser(s);
- 6.1.7** Assuring completion of the University Laser Safety Training course by all personnel in the lab; assuring attendance at refresher training once per year following the completion of the University Course for all personnel using lasers in the lab.
- 6.1.8** Immediately notifying the LSO in the event of a suspected overexposure to laser light.
- 6.1.9** Following the disposal directions for unwanted lasers in the Laser Safety Manual.

**6.2 Laser User’s (LU) responsibilities include:**

- 6.2.1** Only a PLU or an LU may operate a Class 3B or 4 laser. Each LU must initially work under the supervision of a PLU. LU responsibilities include:
- 6.2.2** Completing the University Laser Safety Training class before operating a Class 3R, 3B or Class 4 laser; attending refresher

training once per year following the completion of the University Course.

- 6.2.3** Using lasers safely.
- 6.2.4** Complying with established policies, SOPs and other procedural requirements.
- 6.2.5** Promptly reporting to the PLU any malfunctions, problems, accidents, or injuries, which may have an impact on safety.
- 6.2.6** Not disabling, removing, or modifying any safety control systems without prior written approval from the PLU.

**6.3 Laser Safety Officer (LSO) responsibilities include:**

- 6.3.1** Administering the day-to-day operation of the Laser Safety Program.
- 6.3.2** Maintaining an up to date inventory of Class 3R, 3B and 4 lasers.
- 6.3.3** Performing laser hazard analyses and audits; ensuring, by follow up and additional audits as necessary, that all laser safety deficiencies are addressed and resolved.
- 6.3.4** Restricting or terminating the use of lasers that present an imminent danger or excessive hazard.
- 6.3.5** Ensuring the availability of proper laser safety training.
- 6.3.6** Making recommendations for selection of proper personnel protective equipment.
- 6.3.7** Investigating laser accidents and near misses.
- 6.3.8** Updating the DSU Policy on Occupational Exposure to Laser Light and manual on an annual basis.
- 6.3.9** Reviewing, approving, and maintaining a copy on file of all laser SOPs.
- 6.3.10** Maintaining laser safety training records;
- 6.3.11** Providing periodic reports on the status of laser safety to the Radiation Safety Officer (RSO) and Executive Management, and promptly informing the RSO of any imminently hazardous laser issues.

- 7. References** - The ANSI Z136 series of laser safety standards are referenced by the Occupational Safety and Health Administration (OSHA).

**Laser Safety Plan Form / Appendix**

Please provide the names, signature and contact information (address, phone, and e-mail of the faculty member, department head and University official, Dean, Assoc. Dean

Responsible for the operation of the laser system.

Faculty Member \_\_\_\_\_ /Signature

Dept. Head \_\_\_\_\_ / Signature

College Official \_\_\_\_\_ /Signature

1. Provide a summary of technical specifications for the laser or laser system and a brief description of the work performed with laser (include copy of the vendor's specification and classification.

a. Wave length(s) \_\_\_\_\_ )

b. Continuous Wave (y)/ (n)

c. Pulsed /Pulse Duration

Maximum Power or Energy

Describe where laser system will be used (research laboratory, teaching labs, office)

Attach a standard operating procedure (SOP) for the general operation that includes identification of beam hazards and other hazards related to laser operation. List maintenance and service procedures if not by a manufacturer's representatives. Prevent exposure levels above MPE (ANSI Z-136.1).

Describe any laser safety training received or qualifications including students and observers.

Will operation of this laser or laser system involve using lasers for healthcare, medical or surgical applications to animals or human patients (Yes) / (No)?

Will operation of this laser or laser system involve the presence or any exposure to the general public?

Signatures:

Faculty Member

Dept. Head

Safety/Risk Manager

*To be completed by Laser Safety Officer/Research*