

LASER SAFETY PROGRAM
FOR
CANISIUS COLLEGE
(Department of Chemistry and Biochemistry)

Effective: October 1, 2007

Revised: June 3, 2010

1. BACKGROUND

Procedures and guidelines for working with lasers can be found in:

ANSI Z 136.1 – 2007 (Use of Lasers)

ANSI Z 136.5 – 2000 (Use of Lasers in
Educational Institutions)

OSHA Dir/Std 01-05-001

OSHA Title 29 CFR 1910.147 (LOCKOUT/TAGOUT)

Lasers are grouped into classes 1 through 4, with 4 representing the greatest potential hazard. All three Department lasers are class 4. Refer to App. B. This classification scheme is based on the ability of the primary or reflected primary beam to cause biological damage to the eyes or skin during intended use. The major concern is irreversible damage, mostly thermal in nature. The critical factors are exposure times and wavelength of the beam. Lasers necessitate the use of controls that prevent exposure of the eyes and skin or other unwanted targets to specular or diffuse reflections of the beam. Other concerns include exposure to toxic and carcinogenic chemicals (dyes), UV radiation, electrical hazards and flammability. This program outlines procedures and controls to be followed in the Chemistry and Biochemistry Dept. for the use of all lasers.

2. PURPOSE

The ultimate purpose of the program is to provide the safest possible work environment for both involved (users) and non-involved personnel by providing reasonable and adequate guidance for the safe use of lasers and laser systems. The program focuses on three primary topics to achieve this goal:

- A. Determination of the Nominal Hazardous Zone (NHZ)
- B. Control Measures
- C. Training

3. LASER SAFETY OFFICER (LSO)

The chairman of the department will designate a qualified individual to serve as LSO. The LSO's responsibilities include, but are not limited to:

- A. Defining the Nominal Hazardous Zone (NHZ), based on a total hazard evaluation. Refer to App. A.
- B. Establishing control measures based on the extent of the NHZ:
 - 1. Engineering controls
 - 2. Personal Protective Equipment (PPE)
 - 3. Administration and procedural controls
 - 4. Special controls
- C. Controlling access to and establishing supervision for the operation of all lasers
- D. Establishing procedures for the alignment process, a critical time for eye injuries.
- E. Establishing written Standard Operating Procedures (SOPs). See App. D
- F. Establishing and maintaining records of training for faculty and student users.

4. CONTROL MEASURES

- A. Engineering Controls:
 - 1. Barriers
 - 2. Curtains
 - 3. Key Control (instruments and doors)
 - 4. Emergency shut off switches
 - 5. Signage
- B. Personal Protective Equipment (PPE)
 - 1. Eye wear. See App. C.
 - a. Use is recommended whenever lasers are in operation.
 - b. Selection is based on optical density (OD) and wavelength coverage.
 - c. Each pair of safety glasses will be labeled with its OD and wavelength coverage.
 - d. All eyewear will be inspected at least semi-annually.
 - 2. Thermal, if appropriate
 - a. Clothing
 - b. Shields
 - c. Other
- C. Administrative Procedures
 - 1. Restricted authorization in use.
 - 2. Use restricted to specific days and times.
 - 3. Levels of supervision required.

5. TRAINING

As a minimum, formal training will be conducted before a new operator is allowed to use the equipment and annually thereafter. Training is ongoing and should be conducted, on an informal basis, as needed. Additional training must

be conducted whenever utilization of the laser is other than routine. The contents of this program will be covered, plus general safety and operational considerations. Training will be tailored to accommodate the following:

- A. LSO
- B. Faculty
- C. Students doing research
- D. Students conducting structured course experiments
- E. Non users/observers, if applicable

6. INCIDENT INVESTIGATIONS AND MEDICAL EXAMINATIONS

All accidents will be reported to the LSO, who will conduct an incident investigation. The findings shall include plans for the prevention of reoccurrences. Medical examinations shall be performed as soon as practical (but within 48 hours) when a suspected or actual laser-induced injury occurs.

7. REPORTS AND RECORDS

A roster of initial and annual training attendees will be maintained (para 5, this program). Written documentation of the semi-annual eyewear inspections will also be kept (para 4,B,1,d; this program).

- App A The Nominal Hazard Zone (NHZ)
- B Class 4 Lasers
- C Protective Eyewear
- D Standard Operation Procedures (SOP) for Class 4 Lasers

Appendix A

THE NOMINAL HAZARDOUS ZONE (NHZ)

The maximum permissible exposure (MPE) is the level of laser radiation to which a person may be exposed without experiencing hazardous effects or adverse biological changes in the eyes or skin. It is determined by the criteria in Section 8 of ANSI Z 136.1 – 2000.

The NHZ is the space within which the level of the direct, reflected, or scattered radiation during normal operations exceeds the applicable MPE. The dimensions of the NHZ will determine where eye protection is required. Its magnitude is based on the laser's:

1. Power or energy output
2. Beam diameter
3. Beam divergence
4. Pulse
5. Wavelength
6. Beam path, including reflections
7. Beam profile
8. Maximum anticipated exposure

The LSO may declare the laser use area, which is the entire dedicated laser use room, as the NHZ in lieu of calculating all possible NHZ distances. In the absence of a well defined NHZ, protective eyewear is recommended in the room whenever the laser is in operation.

Appendix B

CLASS 4 LASERS

Class 4 lasers (cw: 500 – mW/cm²) emit radiation, either directly or by diffuse reflection, that is hazardous to view under any conditions. These lasers have a high hazard category. They also are a fire hazard. **SIGNIFICANT CONTROLS ARE REQUIRED OF CLASS 4 LASERS!**

Controls include:

1. Direct supervision by an individual knowledgeable in laser safety.
2. Termination of all potentially hazardous beams in a beam stop.
3. The use of diffusely reflecting materials near the beam, when appropriate.
4. Availability of approved protective eyewear for everyone within the laser controlled area.
5. Location of the laser so that its beam path is above or below eye level in any standing or seated position.
6. The restricting or covering of all windows, doorways, open portals, etc., to reduce transmitted beams below appropriate ocular MPE levels.
7. Safe storage or disabling of lasers when not in use.
8. Entryway control, for both involved and non-involved personnel.
 - A. All persons entering laser controlled areas shall be adequately trained.
 - B. All persons shall follow all applicable administrative and procedural controls. Protective eyewear is a must. See App. C.
 - C. A rapid means of egress from the area will be maintained at all times.
 - D. Each instrument will have a switch clearly marked on/off that allows rapid deactivation of the laser.
 - E. Authorization to enter laser control areas is at the discretion of the LSO.

Appendix C

PROTECTIVE EYEWEAR

The goal of using laser eyewear is that if radiation strikes the lens portion of the eyewear, the lens will completely block or reduce any transmitted radiation to below the maximum permissible exposure (MPE) level. The LSO will consider wavelength coverage and optical density (OD) in selecting the required eyewear.

The basic requirements for protective eyewear include:

1. It shall be worn whenever operational conditions may result in potential eye hazard.
2. It will be specified by the LSO.
3. It will be clearly labeled with the OD value and wavelength for which protection is afforded. All lasers will be similarly labeled to insure the proper eyewear is designated for each.
4. It should be comfortable, have adequate visibility and prevent hazardous peripheral radiation.

Semi-annual inspection shall be conducted and documented to ensure maintenance of satisfactory filtration ability. The inspector will also check for pits, cracks, crazing, etc, of the lens and for mechanical integrity of the frames.

Appendix D

STANDARD OPERATING PROCEDURE (SOP) FOR CLASS 4 LASERS

1. Normal operations:
 - A. Obtain the laser key from your instructor.
 - B. See that all unauthorized people leave the room.
 - C. Secure the laboratory door. Be ready to turn the laser off if any unauthorized person or a person without laser safety eyewear enters the laboratory.
 - D. Have emergency telephone numbers readily available.
 - E. Ensure all people remove wristwatches or other reflective jewelry from their bodies.
 - F. Set up the optical components necessary for the experiment.
 - G. Check that all beam stops are in place and that there are no unnecessary reflective surfaces in the optical path. One block should be placed behind the first optical component. A second beam stop should be placed behind the second optical component, etc.
 - H. Turn on the cooling water to the laser (if appropriate).
 - I. Set the laser power control to the lowest power possible.
 - J. Ensure that appropriate laser safety eyewear is worn by everyone in the laboratory.
 - K. Insert the key into the laser switch and unlock the laser.
 - L. Announce loudly, with a short countdown, that you are turning the laser on.
 - M. Turn the laser on.
 - N. Align the optical components starting with the component nearest the laser. When it is aligned, move the first beam block behind the third optical component. Repeat this procedure until the entire optical system is aligned. It is important that the laser beam be limited to one new component at a time until the system is aligned. This will minimize uncontrolled reflection during the alignment procedure.

DO NOT REMOVE YOUR SAFETY EYEWEAR DURING THE ALIGNMENT PHASE. IF YOU CANNOT SEE A FAINT IMAGE OF THE BEAM YOU HAVE THE WRONG DENSITY EYEWEAR.

TURN OFF THE LASER AND OBTAIN EYEWEAR WITH THE CORRECT OPTICAL DENSITY.

- O. Increase beam power if necessary and complete the assigned task. Always use the lowest beam power necessary for the procedure.
- P. Turn off the laser.
- Q. Remove your laser safety eyewear and place it in its proper storage area.
- R. Allow the laser to cool down and then turn off the cooling water.
- S. Remove the key from the laser switch.
- T. Return the key to your instructor.

2. In an emergency:

- A. If possible, shut the laser off and remove the laser key. If not possible, alert everyone to get out of the laboratory and leave the laboratory yourself.
- B. If there is a fire, get everyone out of the laboratory immediately. At the time shout "FIRE" loudly and frequently. Report the fire. Do not try to "fight" the fire from inside the laboratory – do it from the doorway so that you have an escape route.
- C. Contact your instructor or other responsible person immediately and describe the emergency.
- D. If necessary, call Public Safety. The emergency telephone number is 711.

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I have read the safety regulations governing laser safety at Canisius College and agree to follow them.

Name(print) _____

Signature _____

Date _____

