



Northern Illinois University Laser Safety Program

Introduction

The purpose of this program is to insure the safe use of lasers in Northern Illinois University (NIU) research by identifying hazards, providing recommendations for proper use, and for laser safety training for individuals using lasers. Lasers used at NIU are capable of causing eye injury to anyone who looks directly into the beam or its reflections from a specular (mirror-like) surface. High-power laser beams can burn exposed skin, ignite flammable materials, and heat materials that release hazardous fumes and gases. Many lasers are generated use high voltages that can be lethal. All laser users must understand hazards and ways to minimize them.

Scope

This Laser Safety Program applies to individuals who operate or work in proximity to Class 2, Class 3 or Class 4 lasers at NIU.

Laser Safety at NIU

The Environmental Health & Safety office, administers the NIU Laser Safety Program. The NIU Radiation Safety Officer (RSO) has been designated as the Laser Safety Officer (LSO) for NIU.

It is recommend that all lasers be set up and operated to meet the laser safety guidelines established by the American National Standards Institute (ANSI) standard ANSI Z136.1-2007, *American National Standard for the Safe Use of Lasers* and ANSI Z136.5 – 2000, *American National Standard for Safe Use of Lasers in Educational Institutions*.

Definitions

LASER	Light Amplification by Stimulated Emission of Radiation. A laser produces an intense, coherent, directional beam of light by stimulating electronic or molecular transitions to lower energy levels.
Class I laser	Poses no threat of biological damage.
Class II laser	Output can cause biological damage if the beam is stared into for long periods of time.
Class IIIa laser	Output cannot cause biological damage to the eyes under normal use. Injury is possible if the beam is collected by an optical instrument and directed into the eye.
Class IIIb laser	Can cause biological damage to the eyes if viewed briefly.
Class IV laser	Direct exposure to primary beam, specular reflections and diffuse reflections can cause biological damage to the eyes or skin.

Hazard Classification

Commercial lasers are classified and certified by the manufacturer. When a commercial laser is modified or when a new laser is constructed in the laboratory, it is the responsibility of the principal investigator to classify and label the laser per the ANSI Standard. The NIU Laser Safety Officer (LSO) can assist in determining the appropriate classification.

Training

Individuals who work with or in close proximity to Class 3b, or Class 4 lasers must complete laser safety training provided by NIU LSO. This training includes:

- Fundamentals of laser operation.
- Laser hazards
- Classification of lasers and laser systems.
- Control measures and personal protective equipment.

Individuals who work with or in close proximity to Class 3b or Class 4 lasers must receive additional training from principal investigator and NIU LSO, including:

- Operating and emergency procedures for laser(s) in use.
- Relations of specular and diffuse reflections.
- Maximum personal exposure levels for eye and skin.
- Laser hazard evaluations and range equations.

Roles and Responsibilities

Principal investigators (PI)

The principal investigator has the ultimate responsibility for the safe operation of each laser device being used in research work.

- Maintain procedure(s) for the safe use of all lasers.
- Provide any necessary safety equipment to ensure safe use of laser.
- Register all class 3b and class 4 lasers purchased or acquired with the NIU LSO.
- Be knowledgeable of the potential laser hazards and associated control measures for all lasers under their control.
- Immediately report known or suspected accidents to NIU supervisor and LSO.
- Ensure that lasers under their control are not operated or modified without prior approval.
- Ensure that all safety related administrative and engineering controls are in place.
- Maintain inventory control and a permanent record of the status of all Class 3b, and Class 4 lasers.
- Ensure that individuals working with lasers have completed the required laser safety training and provide laser operators with training in the administrative, alignment, standard operating procedures and emergency instructions.

LSO

- Provide assistance in evaluating and controlling hazards.
- Maintain records of lasers and laser operators and register class 3b and 4 lasers with the Illinois Emergency Management Agency, Department of Nuclear Safety.
- Participate in accident investigations involving lasers.
- Provide laser safety training.
- Perform semi-annual inspections of class 3b and 4 lasers and laser labs in use at NIU.
- Suspend any laser operation that constitutes a hazard to laser operator, NIU student or member of the general public.

Laser operators

- Attend/complete required NIU laser safety training.
- Be familiar with specific safety hazards of lasers in lab area.
- Follow operating and emergency procedures established by your principal investigator.
- Use Class 3b or Class 4 lasers only if specifically authorized and hazards are understood.
- Report known or suspected accidents to the principal investigator and NIU LSO. For serious injury from a laser - medical attention should always be 1st priority and then report.
- Inform lab visitors about and protect any spectators from all potential laser hazards.

General Requirements

- Lasers should be operated in well-lighted areas whenever possible to reduce pupil size and minimize possible eye damage.
- Jewelry must not be worn in a laser controlled area as laser beams may reflect off the jewelry and cause damage to the eyes or skin.
- Materials capable of specular reflection should be avoided or removed from the laser operating area.
- The laser beam must never be intentionally stared into or directed into the eyes.
- If the laser operator suspects that a safety hazard may exist, the operator should **STOP WORK** and request the Laser Safety Officer to conduct an immediate laser safety inspection.
- Each laser and laser facility must be designed to ensure that maximum protection is afforded to the operator.
- Only Class I, Class II, and Class IIIa lasers may be used for demonstration purposes unless approved by NIU LSO.

Control Measures for NIU Lasers:

Class I lasers require no controls. Embedded systems must be approved by the NIU LSO.

Class II lasers require the following controls:

- The protective housing must be provided for all lasers.
- A Class II "Caution" laser label should be posted on the laser device, and should read "Do Not Stare Into The Beam".
- The laser beam must never be intentionally stared into or directed into the eye.

Class IIIa lasers require the following controls:

- The appropriate "Caution" label must be affixed to the protective housing.
- Any protective housing must remain in place to prevent exposure to radiation from any source other than the defined aperture unless the protective housing interferes with necessary laser operation.
- Since viewing portals and collecting optics may increase the hazards, all devices must incorporate a means to maintain laser radiation emitted through them at or below safe levels.
- Equipment labels must be properly displayed on each laser and must include the class of laser, power output, and the appropriate cautionary statement.

Class IIIb and Class IV lasers require the following controls in addition to requirements needed with Class IIIa lasers:

- The appropriate "Danger" label must be affixed to the protective housing;
- Each laboratory must keep written operating, alignment, safety, and emergency procedures. Copies of these documents must be submitted to the LSO upon request. Changes to any of these procedures must be forwarded to the LSO upon request.
- If the interlocks must be bypassed during maintenance, a temporary Laser Control Area must be established.
- A master switch (either a key or coded access) must be provided that, when removed, must make the laser inoperable. Authority for access to the master switch must be with the principal investigator.
- Beam paths must be oriented so that totally unenclosed and partially enclosed beams are operated only in specific laser controlled areas established by the principal investigator in conjunction with the LSO.

A laser controlled area for Class IIIb and IV lasers must meet the following criteria:

- A Laser Control Area must be under the direct supervision of the PI or designee.
- The Laser Control Area must be posted with appropriate warning signs.
- Hazardous beams must terminate in an appropriate beam stop.
- Only diffusely reflecting materials may be near the beam path.
- Effective eye protection must be available. Contact LSO for assistance in selecting proper laser safety eye protection.
- All openings (windows, doors) from the Laser Control Area must be covered or restricted to prevent unnecessary exposure to laser radiation.
- Backstops must be constructed of diffusely reflecting material and, when practical, fire resistant material.

References

The following references are available for review – contact LSO:

- 32 Illinois Administrative Code: Chapter 2, Part 315, Standards for Protection Against Laser Radiation
- ANSI Standard Z136.1-2014, *American National Standard for the Safe Use of Lasers*
- ANSI Standard Z136.5-2009, *American National Standard for Safe Use of Lasers in Educational Institutions*
- CFR Chapter I, Subpart J, Part 1040 - *Performance Standard for Light Emitting Products* - Food and Drug Administration requirement document for light emitting products.
- Laser Institute of America – Laser Safety Guide, 11th edition
- Laser Institute of America – Guide for the selection of laser eye protection, 5th edition