



Laser & Ultraviolet Light Sources Safety

1. Purpose and Scope

- 1.1. This procedure describes methods for the safe use of lasers and ultraviolet light sources. It applies to the use of lasers and ultraviolet light at the University of Notre Dame.

2. Responsibilities

- 2.1. Deans, Provost, Department Heads, Center/Institute Directors, or Designee

- 2.1.1. Enable enforcement of these requirements and take prompt, effective corrective action when necessary.
- 2.1.2. Identify resources needed to address risk mitigation efforts that exceed the ability of the laboratory.
- 2.1.3. Ensure notification is made to the Food and Drug Administration (FDA) for any Laser Light Shows and displays. Refer to Section 7.

- 2.2. Principal Investigators shall develop a process to ensure that:

- 2.2.1. All personnel reporting to the PI receive communication that this procedure shall be adhered to within the PI's area(s) of responsibility or all personnel reporting to the PI are trained on the requirements of this standard.
- 2.2.2. Periodic inspections are conducted of the PI's area(s) of responsibility verifying that the requirements of this standard are met.
- 2.2.3. If deficiencies are noted during the periodic inspections immediate corrective actions are implemented (correction of the deficiency and retraining, adherence to the University's discipline process, etc.).
- 2.2.4. Notification is made to RM&S every time a Class IIIB or Class IV laser or UV light source is purchased, transferred, or disposed. The notification shall be transmitted electronically to the Laser Safety Officer (LSO). The information shall include building/room location, PI, manufacturer, model, serial number, wavelength, and if the laser is used in continuous wave (CW) or pulsed mode. For CW lasers, include power output and for pulsed lasers include power output, pulse length and pulse frequency.
- 2.2.5. Standard operating procedures (SOPs) for Class IIIB and Class IV lasers are developed, communicated to affected personnel, and are



adequate. Alignment procedures are also required if University of Notre Dame faculty, staff or students align the laser(s).

2.3. Risk Management and Safety (RM&S)

- 2.3.1. Develop and provide training to all individuals working with Class IIIB and Class IV lasers and UV light sources or who are working in an area subject to hazards from such units.
- 2.3.2. Provide technical advice on Laser and UV Safety.
- 2.3.3. Conduct a Laser Hazard Evaluation of all Class IIIB and Class IV lasers prior to start of use. The University of Notre Dame uses LAZAN software developed by Rockwell Laser Industries to complete the evaluation calculations.
- 2.3.4. Conduct inspections of Class IIIB and Class IV laser units and UV light sources and provide notices of deficiencies, if found, to the PI or owner of the device.
- 2.3.5. Maintain an inventory of all Class IIIB and Class IV lasers on the Notre Dame campus. This information shall include location of the unit, PI, manufacturer, model and serial number, and classification. Records shall be kept in the RM&S office. The inventories shall be updated as new laser units are acquired or as current units are either relocated or moved off-campus.

2.4. Laser Operator

- 2.4.1. Complete Laser Safety Training provided by RM&S prior to any Class IIIB and Class IV laser work. Refresher training is required on a periodic basis.
- 2.4.2. Wear appropriate personal protective equipment (PPE) at all times work is conducted with a Class IIIB or IV laser or in the Nominal Hazard Zone (NHZ).
- 2.4.3. Follow all SOPs developed for the laser being operated.

3. Definitions

- 3.1. Nominal Hazard Zone – The area in which the level of the direct, reflected, or scattered radiation may cause adverse biological changes in the eye or skin. The NHZ will usually be the defined by the physical boundaries of the lab.
- 3.2. Optical Density (OD) – The logarithm to the base ten of the reciprocal of the transmittance at a particular wavelength. OD measures the effectiveness of laser eyewear protection (LEP). Please note that with repetitive pulsed lasers in the femtosecond or shorter pulse duration, the filter on the LEP might not function at the manufacturer's stated



OD. These lasers shall be contained to the optical table unless approved by the Laser Safety Officer.

- 3.2. Class I Lasers – These cannot emit accessible levels of radiation that are capable of causing eye injury under any normal operations. A more hazardous laser may be embedded in a Class I product that is not accessible during normal operation conditions but may be during service and maintenance. Class IM and Class IIM are Class I.
- 3.3. Class II Lasers – These are visible lasers with an accessible output \leq 1 mW. Class II lasers are incapable of causing eye injury unless intentionally viewed directly for an extended period of time. Class II units are potentially hazardous if viewed with collecting optics.
- 3.4. Class IIIR (formerly IIIA) Lasers – These have an accessible output between 1-5 mW and do not pose a serious eye hazard unless viewed through optical instruments. Collecting optics shall not be used to directly view the beam.
- 3.5. Class III B Lasers – These have an accessible output between 5-500 mW for continuous wave lasers and <0.125 J within 0.25 second for a pulsed laser. Class IIIB lasers pose a serious eye hazard from viewing the direct beam or specular reflections.
- 3.6. Class IV Lasers – These have an accessible output >500 mW for a continuous wave laser and > 0.125 J within 0.25 second for a pulsed laser. Class IV lasers pose a serious eye hazard from viewing the direct beam, specular reflections, and diffuse reflections. Class IV lasers pose skin and fire hazards.
- 3.7. Ultraviolet Light – Non-ionizing radiation which falls within the 180-400 nanometer region of the electromagnetic spectrum.

4. Hazard Description

Both lasers and UV light have the potential to cause serious eye injury even to the point of permanent blindness. Prolonged exposure to UV light can cause premature aging of the skin and skin cancer. Lasers can also pose a skin or fire hazard as well as an electrical hazard. Some lasing medium can be carcinogenic or mutagenic. Finally, some processes with lasers can create non beam hazards such as laser generated air contaminants (LGACs). Lasers and laser systems are classified based on their capability of injuring personnel.

5. Laser and UV Incidents / Exposures

- 5.1. Personnel shall seek immediate medical attention for acute exposures to harmful laser or UV energies. Medical attention shall be sought at the ND Wellness Center or contact NDFD to be transported to an appropriate medical facility.
- 5.2. Personnel shall report all exposure incidents to their supervisor or PI involving exposure to laser or UV hazardous energies. These events shall be considered incidents requiring an investigation to prevent recurrence. The First Report of Injury, Illness form must also be completed. This form is available at <http://riskmanagement.nd.edu/forms/>
- 5.3. Faculty, staff, and graduate students with eye or skin conditions believed to be caused by laser or other ionizing or non-ionizing radiation exposure shall seek medical treatment at the ND Wellness Center. Undergraduate students with these conditions shall seek medical treatment at St. Liam Hall.

6. Operating Controls

- 6.1. Class IIIB lasers
 - 6.1.1. Never look directly into the beam.
 - 6.1.2. Eyewear of appropriate optical density shall be worn. To determine the proper optical density the laser operator shall refer to the unit's operator's manual or consult with RMS.
 - 6.1.3. Reflective items such as rings, watches, necklaces or medallions, or other jewelry shall not be worn when working with or near an open beam.
 - 6.1.4. The beam shall never be at eye level, either seated or standing, for anyone in the NHZ.
 - 6.1.5. Appropriate signage is required at the entrance to the NHZ. Refer to Appendix B and the RM&S website.
 - 6.1.6. If an active unit must be unattended, i.e. no trained user on-site, access shall be available only to trained laser operators.
- 6.2. Class IV lasers
 - 6.2.1. In addition to items 6.1.1 through 6.1.6. a lighted warning sign near the entrance to the Hazard Zone should be activated at all times that an open beam Class IV laser is in use.

6.3. Ultraviolet light

- 6.3.1. The UV light source shall be properly shielded as recommended by the manufacturer or in consultation with RMS.
- 6.3.2. Personal protection shall be worn. This can include welder's masks, goggles, face shields or other protection as recommended by the manufacturer or RMS. Exposed skin shall also be covered to the greatest extent practical.
- 6.3.3. Appropriate signage is required at the entrance to the Hazard Zone. Refer to Appendix C and the RM&S website.

6.4. All users of Class IIIB and Class IV lasers, and all personnel entering the NHZ where such units are in use shall complete laser training provided by RM&S prior to beginning work with the units or entering an area where the units are in use. See Section 8 Training.

6.5. Written standard operating procedures (SOP) for each Class IIIB and Class IV laser and each UV light source shall be developed and stored in the area of that unit. The SOP shall be available to anyone entering that area. Written alignment procedures are also required when University of Notre Dame personnel perform alignment. See Appendix A for a template for an SOP.

6.5.1. The SOP shall include:

- Contact information for the PI, Laser Safety Officer (if different from the PI) protocols for target preparation, start-up, emergency shutdown, and other procedures relative to the operation of the unit.
- List all possible hazards relative the operation of the unit and all control measures to be taken to mitigate those hazards
- State the required optical density of the eye wear required for the laser.
- State the procedure for clearing unauthorized personnel from the NHZ prior to laser activation.
- For alignment procedures, state the output power to be used during alignment. Alignments should be performed at the lowest power possible.

6.5.2. All personnel who work in the area shall acknowledge through signature that they have been made aware of the SOP and the



need to wear the appropriate eye protection when the unit is operating in an open beam mode. Alignments shall only be performed by experienced operators and shall acknowledge through signature that they have been made aware of the alignment SOP.

6.6. The Notre Dame Laser/UV Safety Manual shall be in the area of the units and available to anyone entering that area. This manual can be obtained from RM&S and is available on the RMS Web Page.

6.7. Class IIIB and Class IV laser shall be operated under the direct supervision or control of an experienced, trained operator who shall maintain surveillance of the entire laser control area. If it is not practical for the operator to remain in the area while the unit is activated, access to the area shall be allowed only to other personnel who have completed Laser Safety Training.

7. Laser Light Shows

Per federal regulations, the Food and Drug Administration shall be notified of all laser light shows or displays of Class IIIB or Class 4 lasers at least one (1) month prior to the show or display. The notification form is available on the FDA website

<https://www.fda.gov/downloads/AboutFDA/ReportsManualsForms/Forms/UCM080788.pdf>

8. Training

8.1. All personnel using Class IIIB and Class IV lasers shall complete the online laser safety training through eNDeavor.

8.2. All personnel using Class IIIB and Class IV lasers shall be trained on the SOPs related to the laser(s) in use.

8.3. Training documentation shall be maintained shall be maintained for verification during a lab safety audit.

8.4. Training information is available on the RMS web site.

9. Record Retention



Copies of inspection reports and laser unit inventories shall be maintained in the RM&S office for a period of not less than three years from the date of the inventory or inspection.

10. References

- 10.1 ANSI 136.1 American National Standard for Safe Use of Lasers
- 10.2 ANSI 136.8 American National Standard for Safe Use of Lasers in Research, Development, or Testing

History - Laser UV	Effective Date
Updated Laser Safety Procedures to include an additional engineering control.	April 21, 2015
Reviewed Laser Safety Procedures, no changes made.	April 28, 2017
Updated Manual to take out eye exam requirements and align program with 2022 ANSI 136 standards	January 10, 2024

Appendix A

Example Standard Operating Procedure for Class IIIB and IV Lasers

Principal Investigator:	Date:
Department:	Location:

1. LASER SAFETY CONTACTS

Principal Investigator: Phone:

Laser Safety Officer: Phone:

Service Contractor: Phone:

Emergencies: Phone:

2. LASER DESCRIPTION

Type: Wavelength:
Classification:

Manufacturer: Model: Serial#:

Continuous Wave Laser

Maximum Power:

Pulsed Laser:

Maximum Energy: Pulse Duration:

Pulse Repetition Frequency:

Description of Application:

3. OPERATING PROCEDURES:

a. Laboratory preparation and start-up procedures.

b. Target area preparation.

c. Normal operating procedures.

- d. Shut down procedures.
- e. Special operating procedures, including alignment, interlock bypass, maintenance and service.
- f. Emergency procedures.

IV. CONTROL MEASURES

Y/N/NA	CONTROL	COMMENTS
	Entryway interlocks or controls are present.	
	Protective housing interlocks are present.	
	Enclosure interlocks are present.	
	Emergency stop/panic button is present.	
	Master switch is present.	
	Laser and associated equipment is secured to base.	
	Beam stops or attenuators are present.	
	Protective barriers are present.	
	Warning signs are posted.	
	Personal protective equipment is secured to base.	
	Nominal Hazard Zone is defined.	
	Manufacturer's operating manual is available.	

ADDITIONAL COMMENTS:

5. HAZARDS AND CONTROLS

Y/N/NA	HAZARD	CONTROL MEASURES
	Unenclosed beam.	
	Potential exposure to direct beam or reflections.	
	Laser positioned at eye level.	

	Reflective materials in beam path.	
	Exposure to ultraviolet or blue light.	
	Hazardous materials are used. (Dyes, solvents, etc.)	
	Hazardous waste is generated.	
	Laser generated air contaminants are generated.	
	Exposure to high voltage.	
	Compressed gases are used.	
	Fire hazards are present.	
	Plasma radiation is generated.	

ADDITIONAL COMMENTS:

6. PERSONAL PROTECTIVE EQUIPMENT (PPE)

Laser Eyewear

FOR THIS LASER			WEAR THIS EYEWEAR	
Laser	Wavelength(s) (nm)	Wavelength(s) Attenuated(nm)	Optical Density	Manufacturer

Other PPE Required

7. Operator Review

I have read this procedure and understand its contents.

<u>Name</u>	<u>Signature</u>	<u>Date</u>

Appendix B Laser Signage

Class IIIB



Class IV Laser Signs
Required for Class IV Open Beam



Appendix C
UV Signage

