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 for any Laser Light Shows and displays. Refer to Section 8.

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. See Appendix A, University of Notre Dame Laser Registration Application.
- 2.2.5. Operating procedures for Class IIIB and Class IV lasers are developed, communicated to affected personnel, and are adequate.

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. Refer to Appendix B, Laser Safety Hazard Evaluation.

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.

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 Hazard Zone of a laser.

2.4.3. Undergo a baseline eye exam prior to use of any Class IIIB or Class IV laser.

3. Definitions

3.1. 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.

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 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 Hazard Zone.
6.1.5. Appropriate signage is required at the entrance to the Hazard Zone. Refer to Appendix D 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 shall 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 E and the RM&S website.

6.4. All users of Class IIIB and Class IV lasers, and all users of UV light sources and all personnel entering the Hazard Zone where such units are in use shall complete laser/UV safety training provided by RM&S prior to beginning work with the units or entering an area where the units are in use. See Section 9 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. See Appendix C 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 Hazard Zone prior to laser activation.

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.

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. Medical Surveillance Program – Eye Exam Process

7.1. All personnel working with Class IIIB and Class IV lasers shall receive a baseline eye exam. This includes undergraduate students.

7.2. Eye exams shall be scheduled at:

Grossnickle Eye Center
4330 Edison Lakes Parkway
Mishawaka, IN, 46545.
Telephone: (574) 27I-0120

7.3. Personnel shall print and complete the top half of Baseline Eye Exam Service Form from RM&S website http://riskmanagement.nd.edu/safety-policies-consumer-warnings-and-reports/laboratory-policies-and-manuals/
The form is provided in Appendix F of this procedure and can be copied and completed and taken by the user to the appointment.

7.4. A Grossnickle representative is required to sign the bottom portion of the Form (Appendix F) to verify completion of the eye exam. Laser Operators shall retain the bottom portion of the form for verification to an auditor during laboratory inspections/assessments.

7.5. . There are no “Pass/Fail” criteria for the laser eye exam. If an evaluating physician makes the recommendation that a prospective

user is not suitable for working with lasers this information shall be shared with the PI and RM&S.

7.6. In the event of a laser exposure the post-exposure exams shall document the presence or absence of any changes from the baseline exam. The exam shall be performed at Grossnickle Eye Center.

7.7 Refer to ANSI Z136.8.6.IV for exam protocol. Contact RM&S to view the ANSI document.

8. 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

9. Training

9.1. All personnel using Class IIIB and Class IV lasers and UV light sources shall attend in-person laser safety training or complete on-line General Lab Safety Training prior to use of the laser.

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

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

10. 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.

11. References

11.1. ANSI 126.8.6.IV – American National Standard for Safe Use of Lasers
11.2 Princeton University Environmental Health and Safety Guide
II.III Tufts University Environmental Health and Safety Laser Guide

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

Appendix A

University of Notre Dame Laser Registration Application
UNIVERSITY OF NOTRE DAME LASER REGISTRATION APPLICATION

P.I. _____
Department/Unit _____
Building and Room Number _____
Manufacturer of Unit _____
Model Number _____ **Serial Number _____**
Class _____

COMPLETE APPLICABLE LINES

Purchase Date _____
Transfer Date _____ **To Whom _____**
Location _____
Disposal Date _____

UNIVERSITY OF NOTRE DAME

Appendix B
Laser Safety Hazard Evaluation Form

Laser Safety Hazard Evaluation Form			
Evaluation Date			
Name of person conducting the review			
General Information			
I	Requesting Department/Unit		
II	Location of Equipment – Building and Room Number		
III	Application Description		
IV	PI Name		
5	PI Phone		
6	Other Contact Name		
7	Other Contact Phone		
8	Number of personnel authorized to use or maintain the equipment?		
Laser Information			
I	Manufacturer Name		
II	Laser Model #		
III	Laser Serial Number		
IV	Is laser imbedded	Yes ☐	No ☐
5	Laser Classification e.g., IIIB		
6	Primary Beam e.g., CO_{II}, Neodymium YAG, HeNe)		
7	Electromagnetic Spectrum e.g., Infrared		
8	Operational Wavelength in um		
Primary Laser Specifications			
I	Maximum Power / Energy in W/J		
II	Beam Divergence in mrad		
III	Beam Size at Laser Aperture in mm		
IV	Beam Size at Lens in mm		

5	Lens Focal Length in mm (Longest)	
6	Fiber Optic in mm	

	Personal Protective Equipment	
I	Eye Protection Optical Density	

Engineering Controls				
	Question	**Yes**	**No**	**N/A**
I	Does the protective housing meet Class I Levels?			
II	Is the laser enclosure interlocked?			
III	Are there appropriate warning labels on the laser and apertures?			
IV	Is the master switch key access controlled (required for Class IV Lasers)?			
5	Are there appropriate filters, attenuators in place for viewing portals and collecting optics?			
6	Is there a beam stop or attenuator in place (Class IIIB and IV)?			
7	Is there a laser activation warning system (Class IIIB and IV)? The warning shall be a light or audible tone.			
8	Is there an emission delay (Class IV)?			
9	If a laser controlled area is required under normal operation or maintenance, has it been established?			
10	Are windows and other openings covered by non-reflective material?			
Administrative Controls				
	Question	**Yes**	**No**	**N/A**
I	Is maintenance (example: alignment) conducted at reduced or no power?			
II	Is the SOP written and available? SOP shall include micro switch and alignment methods (Class IIIB and IV).			
III	Have affected personnel received laser safety training?			
IV	Is access to the laser area limited to authorized personnel during normal and maintenance operations?			
5	Are the appropriate signs posted at the entrance to the hazard area?			
6	Are personnel included in the medical surveillance program (Class IIIB and IV only)?			

Other Considerations				
	Question	**Yes**	**No**	**N/A**
I	Is industrial hygiene monitoring for gases or vapors or high noise required?			
(Go to next page.) **Comments / Recommendations**				
All questions except #1 in Other Considerations that are answered "No," must have a recommendation or recommendations added.				

Appendix C

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.

Name	Signature	Date

Appendix D
Laser Signage

Class IIIB

Class IV Laser Signs
Required for Class IV Open Beam

Appendix E
UV Signage

Notice: You must have this form with you to be seen for you appointment

GROSSNICKLE EYE CENTER

4330 Edison Lakes Parkway

Mishawaka, IN 46545

573-271-0120

BASELINE EXAM FOR LASER USE

APPOINTMENT AUTHORIZATION

FOAPAL (Required): _____ _____ _____ _____

Fund Organization Account Program

Employee Name: _____

Department: _____

TREATMENT AUTHORIZED BY:

PI/Supervisor Name: _____

Department: _____

Signature: _____Date: _____

EYE EXAM COMPLETED BY GROSSNICKLE EYE CENTER ON (DATE) _____

Signature of Grossnickle Representative: _____

AFTER EXAM IS COMPLETED, AND FORM IS SIGNED, FAX OR EMAIL TO NOTRE DAME OFFICE OF RISK MANAGEMENT AND SAFETY.

Fax: 574-631-8794 Email: welding.1@nd.edu