Marine Biological Laboratory

THE UNIVERSITY OF CHICAGO

LASER SAFETY MANUAL

JULY 2017

APPROVAL:

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1 INTRODUCTION

[redacted]

integral part of the academic and research environment. Lasers are extraordinary research tools that enable scientists to perform novel experiments and explore innovative applications that may lead to pioneering scientific discovery.

[redacted]

2 LASER SAFETY PROGRAM ORGANIZATION

[redacted]

[redacted]

Committee (RSC), LSO, Principal Investigators or Course Directors (Authorized Laser Users) and Laser Operators (Users). The RSC is responsible for ensuring compliance

[redacted]

with all applicable federal, state and local laws and regulations involving both ionizing

[redacted]

3.2 Laser Safety Officer

The specific duties and responsibilities of the LSO include:

[redacted]

- Develop and submit to the LSO for approval the current Standard Operating Procedures (SOPs) for each Class 3B and Class 4 laser or laser system using the **LASER SOP (APPENDIX D)** as a guide.
- Identify laser hazards present in the work area, implement appropriate hazard controls (e.g., ANSI-approved signs and labels), and correct any identified unsafe conditions (**APPENDIX E** and **APPENDIX F**).
- [redacted]

LSO prior to operating a Class 3B or Class 4 laser or laser system.

- Provide required protective measures for laser radiation control (e.g., laser protective eyewear, barriers, curtains, etc.).
-
-
- Notify the LSO in the event of an exposure incident.
-
-

3.4 Laser Users

[redacted]

Contact the LSO to discuss laser decommissioning plans.

- Remove all means of activating the laser or laser system (electrically deactivated), or destroy the laser hardware (rendered inoperable).
- Review the manufacturer's laser manual for "**CAUTION!**" statements that list hazardous materials.
- Remove and properly dispose of all hazardous materials (e.g., mercury switches, beryllia, gallium arsenide, beryllium oxide) or other chemicals that are contained in the laser system.
- Properly dispose of any chemical, biological, or radioactive wastes generated from the laser activities.

4.5 Laser Hazard Evaluation

[redacted]

exposure likelihood etc.).

5 LASER USER TRAINING AND REGISTRATION

The PI/Laboratory Supervisor is responsible for ensuring that faculty, staff, and students receive appropriate training on the laser hazards in their work area and that a record of the training is kept. Laser users must be re-trained whenever a new hazard is

[redacted]

- Laser Controlled Area (LCA), Nominal Hazard Zones (NHZ), warning signs, and

- Beam and Non-Beam Hazards.
- Turning ON/OFF the laser device.
- Emergency stop or deactivation procedure.
- Alignment protocols.
- Accident reporting procedures

requirements of the FLPPS. Removal of protective housing or system modification can increase a laser's classification. Contact the LSO for review prior to servicing or system modification.

Lasers and laser systems that are fabricated in-house and are used by the individual(s) who designed and constructed the device are not subject to the requirements of the FLPPS.

They must be classified according to the recommendations of the ANSI Z136.1-2014 Standard to ensure appropriate control measures are implemented.

6.1 Class 1 Laser System

Considered incapable of producing exposure conditions during normal operation

unless the beam is viewed with an optical instrument such as a telescope.

UV-A accelerates this process and may lead to presbyopia (the loss of the

8.1 Electrical Hazards

Electrical hazards pose the most significant risk and are the major cause of injury among non-beam hazards. Most lasers have high electrical voltages inside. An electrical shock hazard can occur from contact with exposed electrical power, device control, and power supply conductors operating at potentials of 50 V or

[redacted]

proper Lockout/Tagout procedures.

[redacted]

[redacted]

hazardous UV and blue light emissions.

8.4 Explosion Hazards

Lasers and subsidiary equipment may present explosion hazards. High-pressure

[redacted]

tone of voice at a distance of about three feet, noise levels are probably exceeding safe levels and you should be using hearing protection

[redacted]

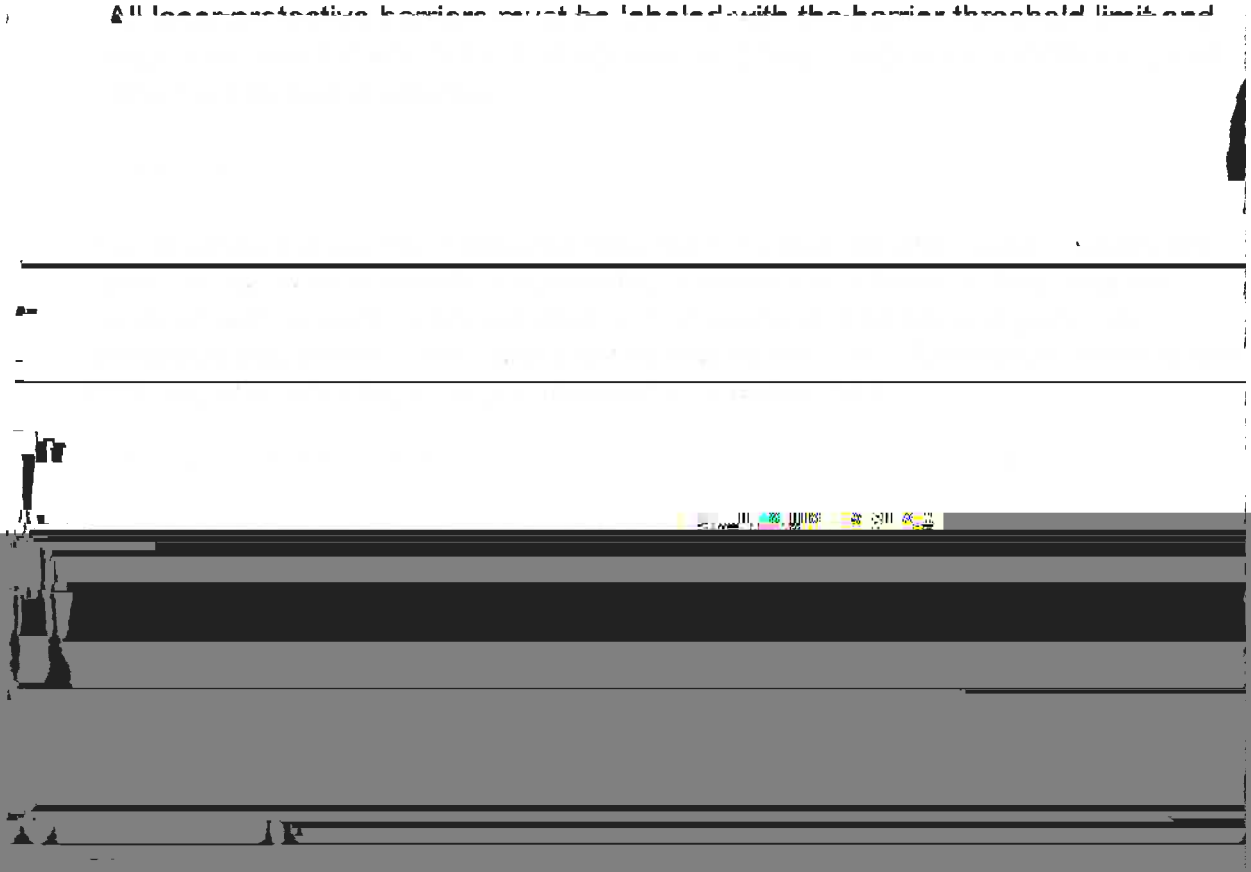
neither feasible nor appropriate.

Principal Investigators using lasers shall provide and maintain the appropriate control

[redacted]

3. Labeling of Laser Protective Barriers

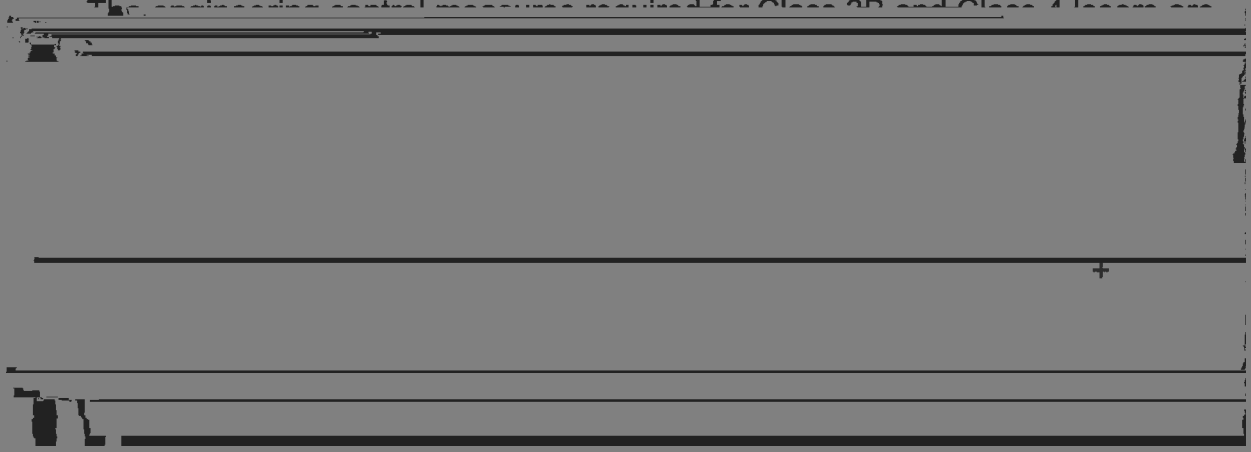
All laser protective barriers must be labeled with the barrier threshold limit and



exposure time for which the limit applies, and beam exposure conditions under which protection is afforded.

9.3 Engineering Controls

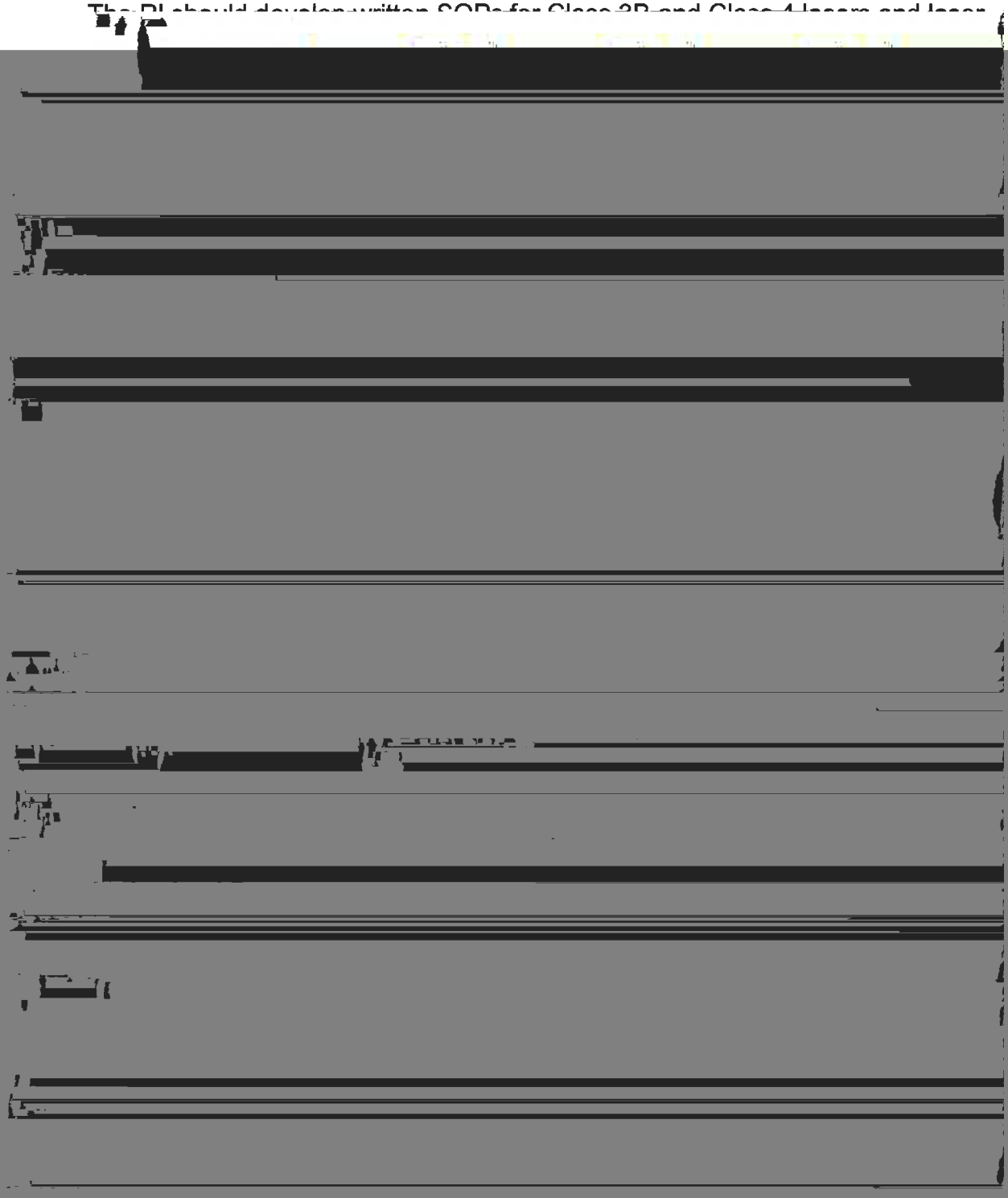
The engineering control measures required for Class 3B and Class 4 lasers are



9.4 Administrative and Procedural Controls

1. Standard Operating Procedures

The PI should develop written SOPs for Class 3B and Class 4 lasers and laser



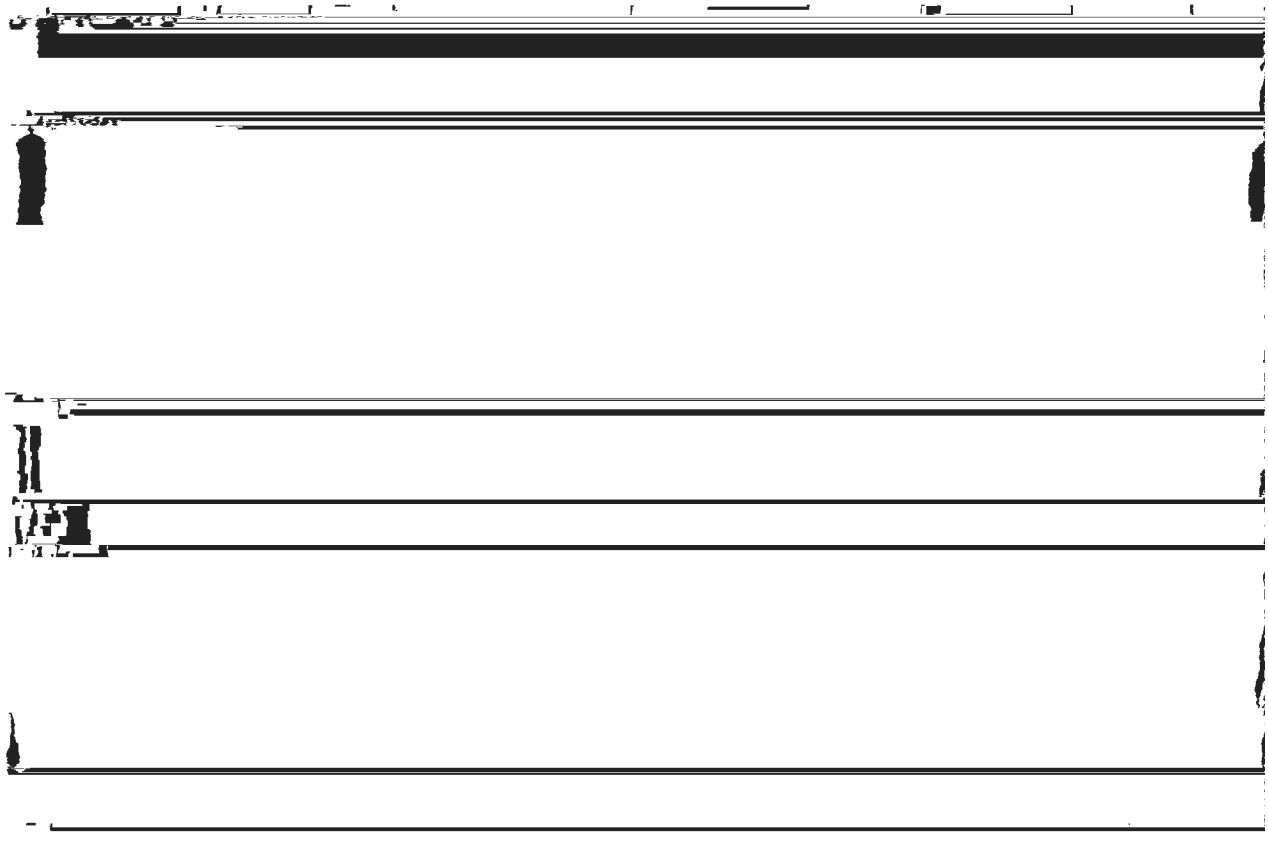
The PI/Laboratory Supervisor must identify authorized personnel who are

cause instant eyewear failure. Users must take all possible precautions to avoid

and prevent direct beam exposures.

9.7 Skin Protection

The potential for skin injury from the use of high power lasers can present a



[redacted]

Must have all windows, doorways, open portals, etc. either covered or restricted

[redacted]

Must have appropriate personal protective equipment readily available (i.e., eye

safety.

[redacted]

Personnel trained on entryway procedures and adequate personal protective

11 SPECIAL CONSIDERATIONS

11.1 Service of Embedded Class 3B or Class 4 Lasers

safety@mbl.edu

Access to Class 3B or Class 4 lasers or laser systems enclosed within a protective housing or protected area enclosure is limited to properly trained individuals and

by specific engineering and administrative controls. Contact the LSO for more information (x7645 or).

11.2 Laser Alignment Guidelines

- Exclude unnecessary personnel from the laser area during alignment.
- Use low-power visible lasers for path simulation of higher power visible or invisible lasers whenever possible.
- Wear laser protective eyewear during alignment. Use special alignment eyewear when circumstances (e.g. wavelength, power, etc.) permit their use.
- When aligning invisible (e.g. UV, IR) beams, use beam display devices such as image converter viewers or phosphor cards to locate beams.

12 MEDICAL EVALUATIONS

Baseline and termination eye examinations are optional for Class 3B and Class 4 laser use, based on ANSI Z136.1-2014 recommendations. Eye examinations are required for

[redacted]

safety@mbl.edu

[redacted]

- In case of exposure or suspected exposure to laser radiation, seek immediate medical attention.
- In the event of fire or life-threatening injuries, call 911 or MBL Campus Security (7-911).
- Inform the PI/Laboratory Supervisor promptly following the incident; and

[redacted]

safety@mbl.edu

[redacted]

15 APPENDICES

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APPENDIX A

LASER REGISTRATION FORM

PRINCIPAL INVESTIGATOR/DEPARTMENT INFORMATION

[redacted]

Department/Center/Division: Phone:

LASER SYSTEM LOCATION Building: Room #:

LASER REGISTRATION INFORMATION

Type of Registration:

NEW laser or laser system acquisition or installation.

ALTERATION of an existing laser or laser system.

[redacted]

LASER SAFETY OFFICER (LSO) USE ONLY

MRCP Laser Reference **Date of Registration** **Date of Disposal**

NAME OF LSO:

SIGNATURE: **DATE:**

APPENDIX B

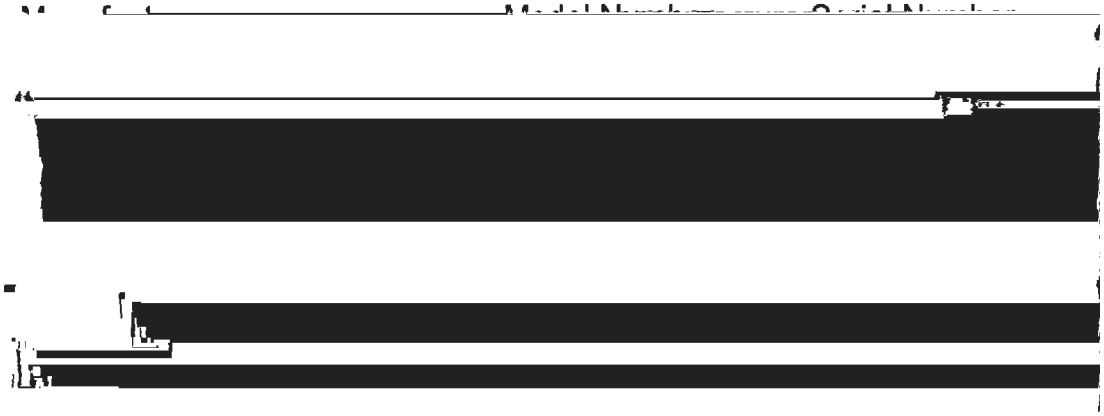
LASER TRANSFER FORM

PLEASE COMPLETE AND SEND THIS SOP to the Laser Safety Officer (LSO) at safety@mbl.edu.

SECTION 1: CURRENT OWNER INFORMATION

Principal Investi ator: Email:
Department: Phone:
Buildin where laser is currentl located: Room #:
Intended Date of Transfer:

SECTION 2: LASER IDENTIFICATION INFORMATION



If laser is moving to another Department or leaving MBL completely, please explain:

Principal Investi ator:
Signature: **Date:**

LASER SAFETY OFFICER LSO USE ONLY

New MBL Laser ID Number Date Reviewed Date of Transfer

Comments:

Date:

EQUIPMENT-SPECIFIC LASER TRAINING FORM

Principal Investi ator:
Department / Center / Division:
Laboratory Supervisor:
Laser User / Trainee:
Date of Trainin :

SECTION 2: REQUIRED TRAINING

TOPICS	INITIALS
Laser Area, Nominal Hazard Zones, Signs and Warning Labels	
✓ Laser safety equipment and Personal Protective Equipment PPE	
✓ Beam and Non-Beam Hazards	
✓ Turnin ON the laser or laser s stem	
✓ Turnin OFF the laser or laser s stem	

APPENDIX D

LASER STANDARD OPERATING PROCEDURES (SOP)

safet mbl.edu

PLEASE COMPLETE AND SEND THIS SOP to the Laser Safety Officer (LSO) at . The LSO will review the SOP and send the approved copy to the Principal Investigator / Laboratory Supervisor or designee.

1. LASER LOCATION

2. LASER SAFETY CONTACTS

Principal Investigator/Course Director:	Ph..
Laboratory Supervisor/Course Assistant:	Ph.
Laser Safet Officer LSO : **Simon Muchohi**	508 -289-7645
MBL Cam us Securit :	x7911
Fire/Medical Emergency	Dial 911

[redacted]

Manufacturer Model Serial Number

[redacted]

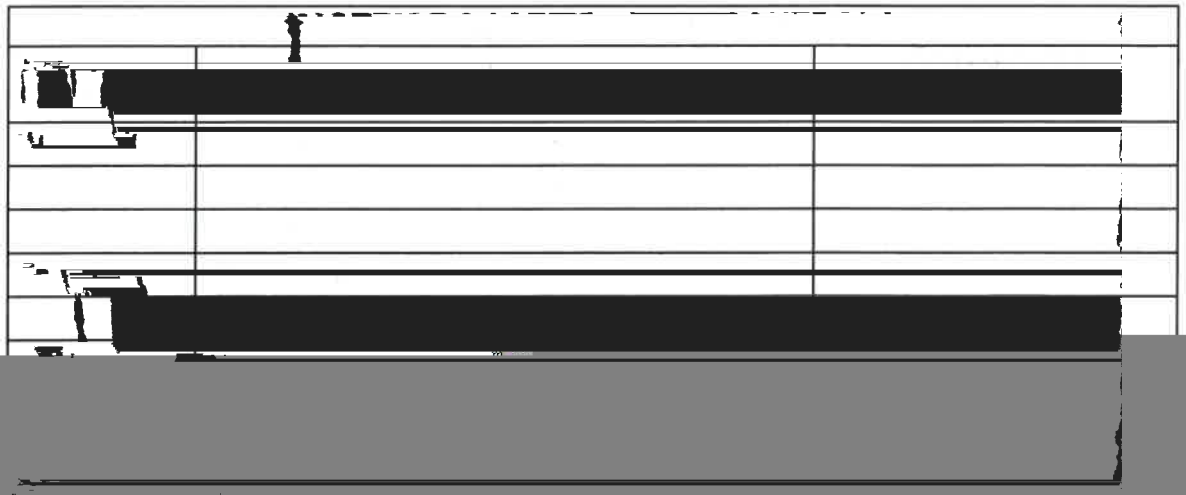
OTHER:

Laser Classification: Class 1 with a Class 4 inside Class 3B Class 4

Wavelen th nm :

y):

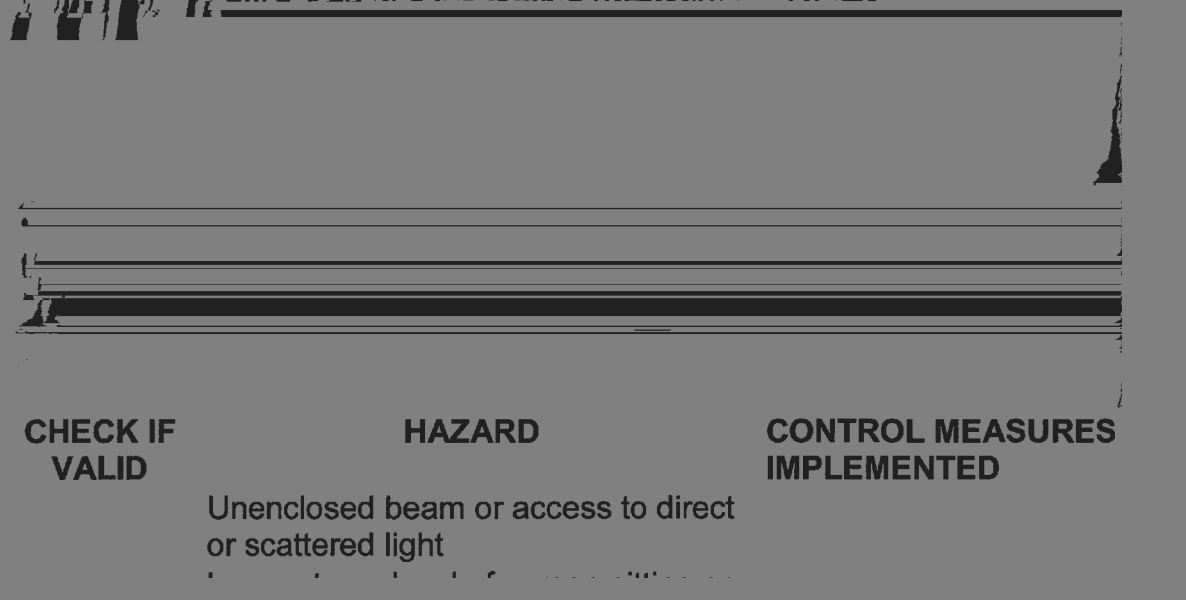
5. CONTROL MEASURES



CHECK IF VALID	CONTROL	COMMENTS
	Entryway (door) interlocks or controls	
	Laser enclosure interlocks	
	Emergency stop/panic button	
	Master switch (operated by key or code)	
	Laser secured to base	
	Beam stops/beam attenuators	
	Warning signs	
	Reference to equipment manual	
	Appropriate/sufficient eyewear available	
	Other:	

SPECIFIC HAZARDS AND CONTROLS

Check all that apply and provide control measures that will be implemented



CHECK IF VALID	HAZARD	CONTROL MEASURES IMPLEMENTED
	Unenclosed beam or access to direct or scattered light	

6. PERSONNEL PROTECTIVE EQUIPMENT

A. Eyewear

LASER EYEWEAR

For This Laser....			...Wear This Eyewear		
Serial No.	Type	Wavelength (nm)	Wavelength attenuated	Optical Density	Manufacturer / Model

B. Other protective equipment required within the Nominal Hazard Zone.

ITEM	LOCATION	USAGE	CONDITION

APPENDIX E

CONTROL MEASURES FOR DIFFERENT CLASSES OF LASERS (ANSI Z136.1–2014)

Table 10a. Control Measures for the Seven Laser Classes

Engineering Control Measures	Classification						
Protective Housing (4.4.2.1)	X	X	X	X	X	X	X
Without Protective Housing (4.4.2.1.1)	LSO shall establish Alternative Controls						
Interlocks on Removable Protective Housings (4.4.2.1.3)	∇	∇	∇	∇	∇	X	X
							X
							X

APPENDIX F

LASER WARNING SIGNS

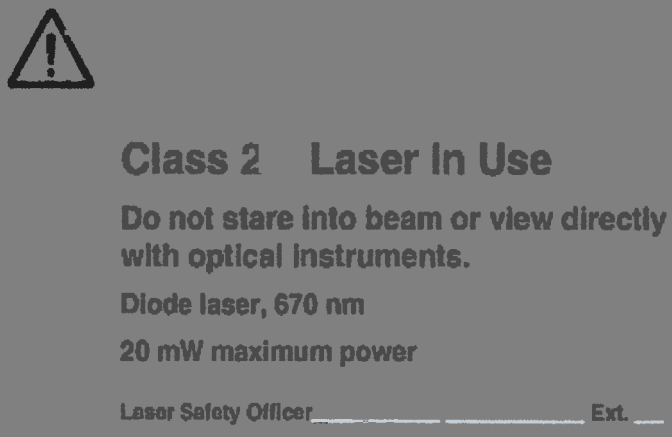


Figure 2. Sample warning sign for certain Class 3R, Class 3B, and Class 4 Laser Controlled Areas. Adapted from ANSI Z36.1-2014 (Figure 1b).

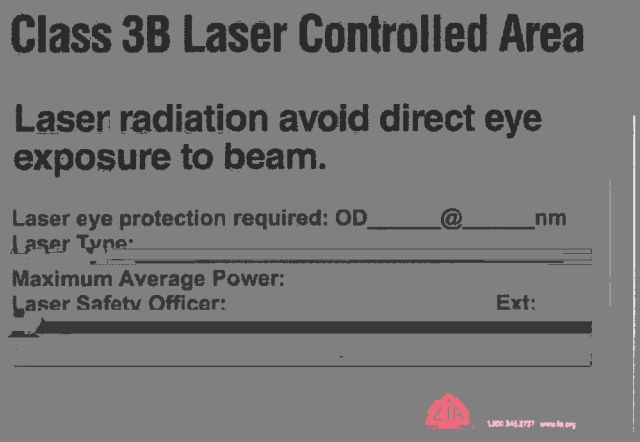


Figure 3. Sample warning sign for Class 4 Laser Controlled Area. Adapted from ANSI Z136.1-2014 (Figure 1c).

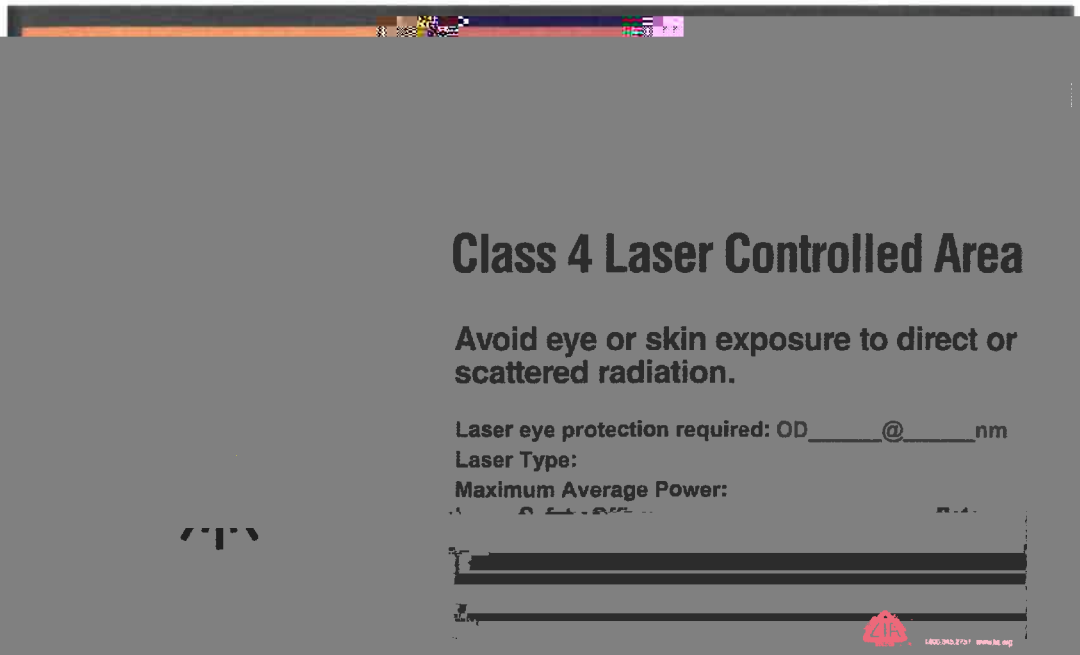
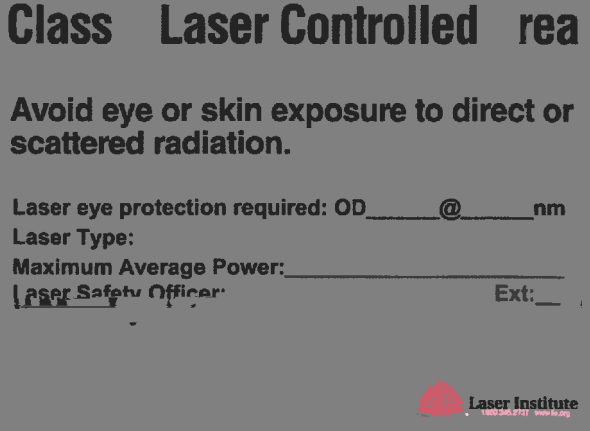
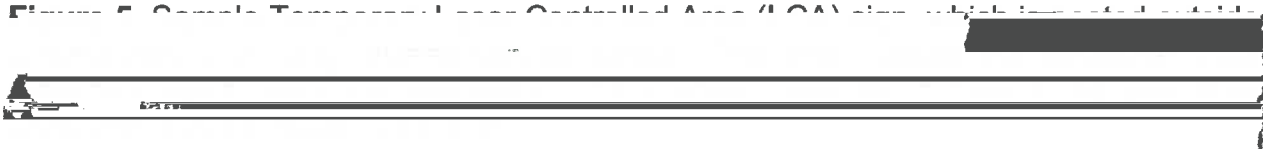


Figure 4. Sample warning sign for Class 4 Laser Controlled Area. Adapted from ANSI Z136.1-2014 (Figure 1c)





APPENDIX G

LASER SAFETY SELF-INSPECTION CHECKLIST

The Principal Investigator (PI) or Laboratory Supervisor is responsible for ensuring that laser self-inspections are conducted annually and that completed checklists, including any corrective actions taken, are maintained on file in the laser laboratory.

[redacted]

Principal Investigator: Email:
Laboratory Supervisor: Email:
Department/Center/Division/Course: Phone:
Buildin · Room #·

	YES	NO
Administrative and Procedural Controls		
Are all authorized users and training dates listed in the SOP?		
Have all commercially produced Class 3B and Class 4 lasers been registered with the LSO?		
Have all lasers fabricated or modified on MBL Campus been registered with the LSO?		
Written Standard Operating Procedures (SOP) and maintenance and		

[redacted]

	YES	NO
Is an inspection covering the items listed below performed prior to each operation?		
(a) Protective eyewear is appropriate for laser operation and is clean/ free of damage?		
b All beams traced and dum ed?		
c Mirror backs covered?		
d Beam ath enclosed where ossible?		
e O tical bench free of unnecessa reflective items?		

[redacted]

INSPECTED BY:

SIGNATURE: **DATE:**

APPENDIX H

*LIST OF LASER PROTECTIVE EYEWEAR MANUFACTURERS AND VENDORS

[redacted]

htt s://www.lia.or /

https://www.cohr.com/

Sperian Protection Americas Inc.
900 Douglas Pike
Smithfield, RI 02917
Phone: (813) 412-8666
Fax: (401) 233-7641
htt ://www.s erian rotection.com

Kentek Corp.
32 Broadway Street
[redacted]

htt ://www.kenteklaserstore.com

[redacted]
7754 Camargo Road
Cincinnati, OH 45243

[redacted]

htt s://www.rli.com/

U.S. Laser Corp.

[redacted]

www.uslasercorp.com

Fax: (603) 435-7441

htt ://noirlaser.com

Phone: (513) 272-9900
Fax: (513) 272-9901

www.lasersafe .com www.laservision-usa.com

[redacted]

APPENDIX I

GLOSSARY OF TERMS

[redacted]

interaction with matter.

[redacted]

within a particular laser hazard class.

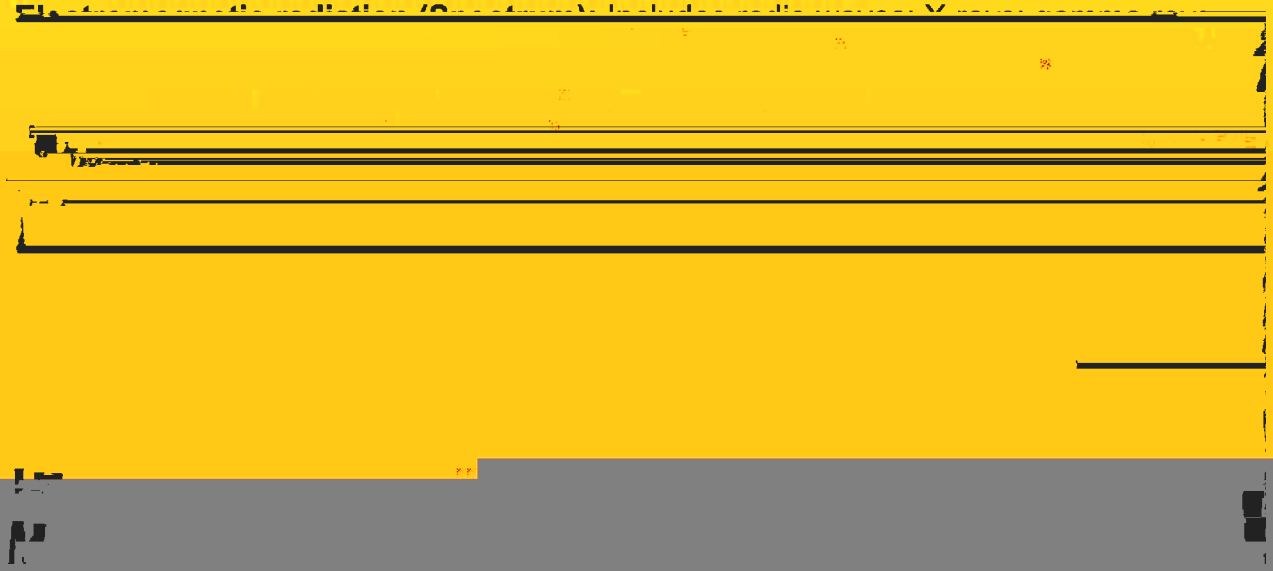
[redacted]

Divergence: The angle at which the laser beam spreads in the far field; the bending of

rays away from each other, as by a concave lens or convex mirror; measured in milliradians (mrad). Sometimes this is also referred to as beam spread.

Duty factor: The product of the pulse duration and the pulse repetition rate.

Electromagnetic radiation (Spectrum): Includes radio waves; X rays; gamma rays;



Irradiance (E): The power emitted per unit area upon a surface, expressed in watts per

[redacted]

Power: The rate at which energy is emitted, transferred, or received. Unit: watts (Joules per second).

Protective housing: An enclosure that surrounds the laser or laser system and prevents access to laser radiation above the applicable MPE. The aperture through which the useful beam is emitted is not part of the protective housing. The protective housing limits access to other associated radiant energy emissions and to electrical

and a workstation.

Specular reflection: A mirror-like reflection.

Transmittance: The ratio of total transmitted radiant energy to the incident radiant energy, or the fraction of light that passes through a medium.

Ultraviolet (UV) Radiation (light): Electromagnetic radiation with wavelengths smaller than those of visible radiation; for the purpose of laser safety, 180nm to 400nm