Laser Safety Program

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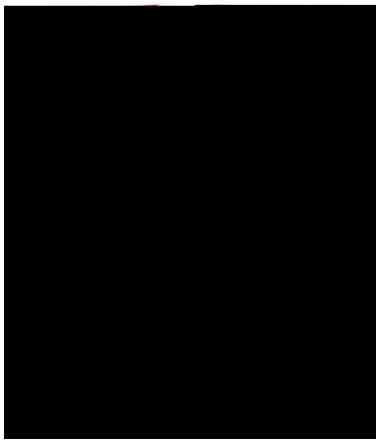

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Introduction

The Southern Methodist University Laser Safety Program Manual sets forth controls and safety guidance for research and educational activities involving lasers. Additional guidance documents are available from the American National Standards Institute (ANSI) Safe Use of Lasers (Z-136.1) and the Texas Administrative Code (TAC 289.301). For the

Each laser that is rendered permanently inoperative by disassembly or destruction, or which is removed from the University's control by gift, surplus designation, or transfer to a non-University entity shall:

- Provide information regarding the condition or destination to the University LSO not later than 10 days from its inoperative state or removal.
- The registrant shall provide disposition information to the University LSO prior to leaving the University.

3.3 Manufacture/Construction

Each laser which is manufactured from components for formal transfer to an entity outside the University shall meet US Food and Drug Administration requirements per 21 CFR Part 1040, Federal Laser Product Performance Standard.

4.0 Laboratory Personnel

4.1 Permittee

The Permittee is the person whose name appears on the Permit for the laser. Typically, this is the Principal Investigator or Teaching Laboratory Supervisor and, must be permanent faculty or staff (not a postdoctoral fellow or a graduate student). The Permittee is responsible for:

1. Laser Safety in the laboratory
2. Ensuring the availability of correct protective eyewear. (See section 6.5)
3. Providing a Laser Safety Standard Operating Procedure (SOP). (See Section 6.1)
4. Providing, implementing, and enforcing the Laser Safety Program specific to the laboratory's laser
5. Ensuring proper training in laser operation and safety
6. Classifying and labeling all lasers in the laboratory
7. Completing laser Permitting with the University LSO
8. Notifying the University LSO immediately if an exposure incident occurs
9. Notifying the University LSO if a laser is decommissioned, sold, or transferred.

The Permittee may designate any of these responsibilities to a Laboratory Laser Safety Officer.

4.2 Laboratory Laser Safety Officer (LLSO)

Each Permittee may designate a Laboratory Laser Safety Officer (LLSO) and identify the Laboratory LSO to the University (ULSO). This person may be the Permittee or a delegate, but shall be a budgeted employee (staff or faculty, not a graduate student or post-doctoral worker) of the University. (Normally the Permittee retains the function and title of the Laboratory LSO.) The Laboratory LSO shall maintain the Laser Safety Program for the individual lasers in the laboratory, and may call on the University LSO

for assistance as needed. The Laboratory LSO, acting under the Permittee's authority, has the responsibility to institute corrective actions including shutdown of laser operations when necessary due to unsafe conditions.

4.3 Laser Operator or User

The laser operator or user is a person who sets up, aligns, operates or, uses the laser for experimental or research purposes, or has other assigned laser duties. The laser operator training records should be documented. An example of appropriate documentation can be found in Appendix 4. The laser operator/user is responsible for:

1. Following laboratory administrative, alignment, safety, and standard operating procedures while operating the laser.
2. Keeping the Laboratory LSO fully informed of any departure from established safety procedures.

5.0 Maximum Permissible Exposure (MPE) and Nominal Hazard Zone (NHZ)

An MPE is the level of laser exposure to which the eye or (less limiting) the skin, may be exposed without adverse affects.

interlock instructions, and a checklist for operation. The SOP shall include clear warnings to avoid possible exposure to laser and collateral radiation in excess of the MPE. The SOP shall be available for inspection by the University LSO at any time

6.2 Safety Interlocks and Warning Systems

A safety interlock is a device that automatically prevents human access above MPE limits.

Safety interlocks shall be provided for any portion of the protective housing that by design can be removed or displaced without the use of tools during normal operation or maintenance, and thereby allows access to radiation above MPE limits.

Adjustment during operation, service, testing, or maintenance of a laser containing interlocks shall not cause the interlocks to become inoperative except where a laser controlled area, as specified in subparagraph §289.301(r)(3)(E) of the referenced regulation, is established.

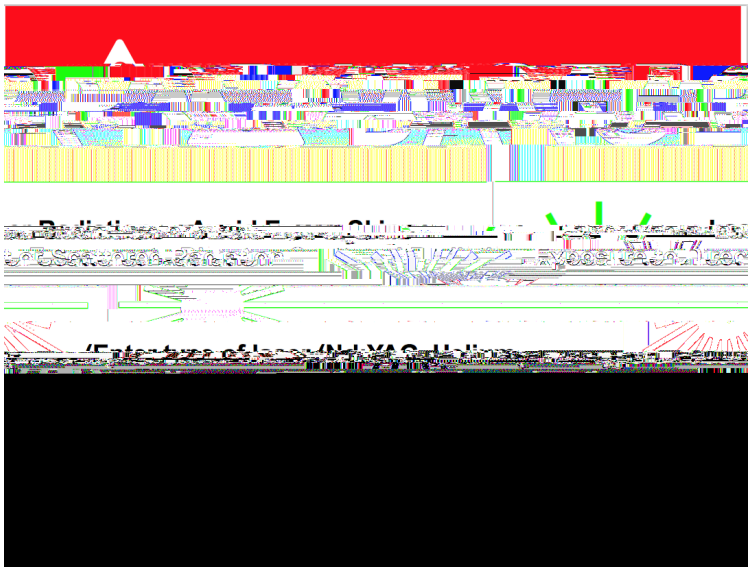
For pulsed lasers, interlocks shall be designed to prevent firing of the laser; for example, by dumping the stored energy into a dummy load and for CW lasers, the interlocks shall turn off the power supply or interrupt the beam (i.e., by means of shutters).

Each class IIIb or IV laser system shall provide visual or audible indication during the emission of accessible laser radiation. The indication shall occur prior to emission of

a. For indoor controlled areas, during tests requiring continuous operation, the individual in charge of the controlled area may momentarily override

Sign information shall conform to the following specifications:

1. Above the sunburst, precautionary instructions or protective action details are inserted such as:
    a. Laser Protective Eyewear Required
    b. Invisible Laser Radiation
    c. Knock Before Entering
    d. DO NOT ENTER when light is illuminated
    e. Restricted Area
2. Below the sunburst, the type of laser (i.e. Nd:YAG, Helium-Neon, etc.), the emitted wavelength, pulse duration (if applicable), and maximum output SHALL be written
3. The bottom right hand corner SHALL include the class of laser or laser system.



6.5 Training

where a class IIIb or IV beam is not enclosed. This normally includes alignments.

Optical cables used for transmission of laser radiation shall be considered part of the laser protective housing. Disconnection of a fiber optic connector which results in access to radiation in excess of the MPE, shall take place in a controlled area. All connectors shall bear appropriate labels. Optical cables shall be encased in an opaque sleeve to prevent leakage of laser radiation in case of breakage. Note: If the fiber is designed to emit light through the walls of the fiber the Laboratory LSO must inform the University LSO and include justification for lack of opaque cover in the SOP.

6.10 Skin protection

When there is potential for skin exposure to levels exceeding the skin MPE for the laser, persons in the controlled area shall wear appropriate clothing, gloves, and/or shields.

6.11 Magnification of Laser Beam

If at any time a laser beam is optically magnified or concentrated, special precautions shall be taken by the Permittee to prevent specular or diffuse reflection or other exposure greater than the MPE for the laser. The special precautions shall be documented in the SOP for the laser.

7.0 Records

Records of Surveys, Training, NHZ and MPE calculations, and other laboratory-specific information shall be maintained in the laboratory, and shall be available for inspection/review by the University LSO at any time.

8.0 Non-Radiation Hazards

Each Laboratory LSO shall evaluate or have an evaluation made of non-radiation hazards. This evaluation shall include electrocution, chemical, cutting edge, compressed gases, noise, confined space, fire, explosion, ventilation, and physical safety hazards. The evaluation shall be made part of the SOPs and be available for review.

9.0 Incident Reporting

Each Permittee shall immediately seek appropriate medical attention for the injured individual and notify the Office of Risk Management at 214-

Appendix 1 – Beam Control Precautions

- Do not look directly into the beam or at a specular reflection, regardless of its power.
- Terminate the beam at the end of its useful path.
- Locate the beam path at a point other than eye level when standing or sitting at a desk.
- Orient the laser so that the beam is not directed toward entry points to the controlled area or toward aisles.
- Minimize the possibility of specular and diffuse reflections.
- Securely mount the laser on a stable platform.
- Limit beam traverse during adjustments.
- Clearly identify beam paths. Ensure the path does not cross into areas, study areas, desk areas, or traffic paths.
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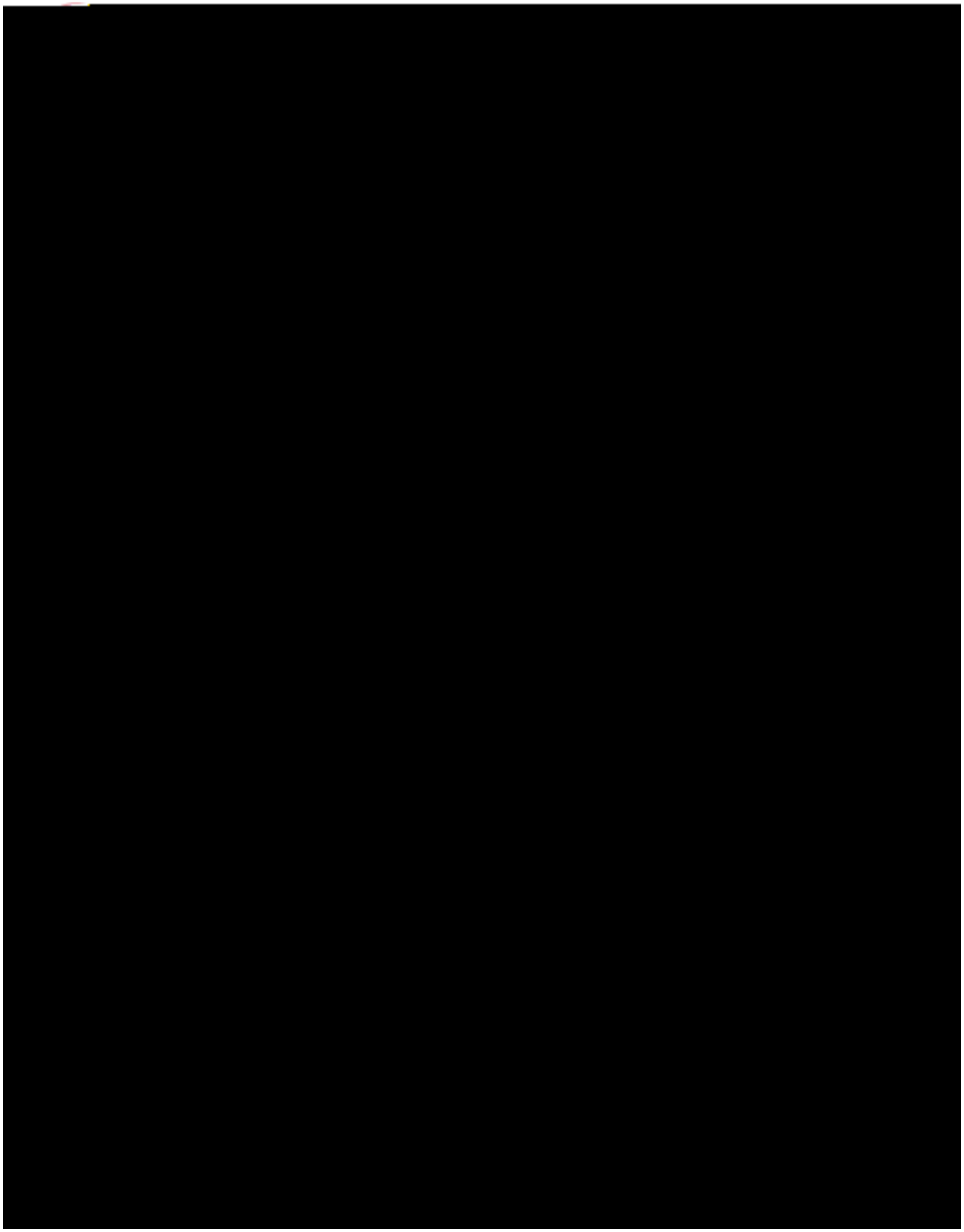
Appendix 2 – Laser Registration Form



Appendix 3 – Laser Survey

Laboratory Laser Survey

A. Labels and Signs		**N NA**
!	Is the correct warning label affixed to the laser?	
"	Are signs posted clearly near the laser?	
#	Are all accesses to the room properly posted?	
$	Is a label, sign, or warning posted near the aperture?	
%	Is a label or warning posted near an interlock?	
B E C		
!	Does each laser have a key switch or entry password?	
"	Is appropriate safety eyewear provided and present?	
#	Do safety covers have interlocks?	
$	Are latches or interlocks provided to restrict access to the controlled area?	
%	Are all warning devices functioning within design specifications?	
&	Are any items in or near beam paths which could cause specular reflections?	
'	Is a physical barrier present at the controlled area entry?	
C C		
!	Is each laser registered properly?	
"	Is access to the NHZ restricted?	
#	Does each person have required training?	
$	Is the SOP for the laser present at the control?	
%	Are curtains up and used (If required)?	
&	Is documentation available?	
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Appendix 4 – Laser Operator Registration

Laser Operator Registration

Name:
Lab Room number:
Department/Program:

List the permit number or numbers of the Laser the operator will be authorized to operate.

Permit No:	Laser Class:
Permit No:	Laser Class:
Permit No:	Laser Class:

☐GENERAL LASER SAFETY TRAINING
The undersigned completed the SMU General Laser Safety Training Course.
Completion Date:_____

☐SPECIFIC LASER SAFETY TRAINING
The undersigned completed training specific to each laser and laser system listed herein.
Trained By: _____
Completion Date:_____

☐SMU LASER SAFETY WEBSITE/MANUAL
The undersigned has read and is familiar with the contents of the SMU Laser Safety Website/Manual.

Appendix 6 – Glossary of Terms

Accessible Emission Limit (AEL): Maximum accessible emission level which is permissible in the appropriate class of laser

Accessible Radiation: Laser radiation that can expose human eye or skin in normal usage

Aperture: The opening through which laser radiation can pass

Average Power: T

Radiant Power: laser power emitted, expressed in watts (W)

Repetitively Pulsed Laser: Laser with multiple pulses with a pulse repetition frequency greater than or equal to 1 Hz

Specular Reflection: Mirror-like reflection

Appendix 7 – General Beam Control Precautions

- Do not look directly into the beam or at a specular reflection, regardless of its power.
- Terminate the beam at the end of its useful path.
- Locate the beam path at a point other than eye level when standing or sitting at a desk.
- Orient the laser so that the beam is not directed toward entry points to the controlled area or toward aisles.
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Appendix 8 – ANSI Safety Control Measures

(adopted from ANSI Z136.1)

Classes of Lasers (adopted from ANSI Z-136.1)

1. Class 1 lasers and laser systems cannot emit accessible levels of radiation that are capable of causing eye injury under any normal operating condition. (A more hazardous laser may be embedded in a Class 1 product that is not accessible during normal operating conditions, but may be during service and maintenance.
2. Class 2 lasers and laser systems are visible lasers with an accessible output # 1 mW. Class 2 lasers and laser systems are incapable of causing eye injury unless intentionally viewed directly for an extended period.
3. Class 3a lasers and laser systems have an accessible output between 1-5 mW and do not pose a serous eye hazard unless viewed through optical instruments.
4. Class 3b lasers and laser systems have an accessible output 5-500 mW for continuous wave lasers and < 0.125 J within 0.25 second for a pulsed laser. Class 3b lasers and laser systems pose a serious eye hazard from viewing the direct beam or specular reflections.
5. Class 4 lasers and laser systems have an accessible output > 500 mW for a continuous wave laser and > 0.125 J within 0.25 second for a pulsed laser. Class 4 lasers and laser systems pose a serious eye hazard from viewing the direct beam, specular reelections and diffuse reflections. Class 4 lasers and laser systems also pose skin and fire hazards.

Control Measures for all Laser Classes

The purpose of control measures is to prevent exposure to laser radiation above the MPE. Use engineering controls whenever possible. When engineering controls are not able to reduce exposure below the MPE, administrative controls and personal protective equipment should be used.

A. Protective Housing
    a. Place lasers in protective housings whenever practical. When protective housings are not practical, ORM shall perform a hazard analysis to ensure that control measures are implemented to ensure safe operation.
    b. Protective housings or service panels enclosing embedded Class 3b and 4 lasers shall be interlocked or fastened closed requiring special tools for removal.
    c. When it is necessary to remove protective housings or service panels, a tem

personnel within and outside the area. Requirements for the temporary laser controlled area include, but are not limited to:

i. Restricted access to the area.
ii. Control of the beam to prevent the beam and reflections from extending beyond the area.
iii. Removal of reflective materials in and near the beam path. 4. Appropriate laser eye protection if there is a possibility of exposure to laser radiation above the MPE.
iv. A warning sign posted outside the area.

B. Collecting Optics

Collecting optics used to view the laser beam or its interaction with a material shall have permanently attached attenuators, filters or shutters to prevent hazardous level of radiation from entering the eye.

C. Beam Control

a. Ensure the beam height is not at the normal eye position of a person in a standing or seated position.
b. Position the laser so that the beam is not directed toward doorways or aisles.
c. Securely mount the laser system to maintain the beam in a fixed position during operation and limit beam movements during adjustments.
d. Ensure beam path is well defined and controlled.
e. Terminate the beam at the end of its useful path.
f. Confine beams and reflections to the optical table. The addition of beam-stopping panels to the sides of the optical table is recommended.