UTSA

Laboratory Safety

LASER SAFETY PLAN

Laboratory Safety Division

UTSA
Office of the Vice President for
Research, Economic Development,
and Knowledge Enterprise

2024

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REVIEW PAGE

This version of the manual has been reviewed for regulatory compliance and best management practices by the listed individuals and committees and is hereby adopted for use and compliance by all employees at the University of Texas at San Antonio owned or operated facilities.

NAME	TITLE	DATE
Quy Fung	Radiation and Laser Safety Coordinator, LSO	
Anthony Vallejo	Director, Laboratory Safety and Compliance	
Alexis Godet	Chair, Radiation and Laser Safety Committee	

COMMITTEE

COMMITTEE	REVIEW DATE	APPROVAL DATE
Radiation and Laser Safety Committee		

Review:
Replaces: July 13, 2021
Review Frequency: Annual

Changes to the plan are highlighted in “gray” and summarized below.

SECTION	SUMMARY OF CHANGE
Emergency Contacts	Laser Safety Officer contact number updated.
IV B	Requirement for consultants to be registered with the state.
V	Laser class overview added, Texas DSHS web address added.
Appendix A	Appendix A added
Appendix E	Appendix E added

EMERGENCY CONTACTS

ROUTINE OFFICE HOURS (8 am – 5 pm)	
Radiation and Laser Safety Coordinator	210-458-6697
AFTER-HOURS (including weekends)	
UTSA Police	210-458-4911 (cell or outside phone) x4911 (from a campus phone)
LIFE-THREATENING EMERGENCIES (any time)	
UTSA Police	210-458-4911 (cell or outside phone) x4911 (from a campus phone)

OVERVIEW

This plan provides the requirements for protection against all classes of laser radiation and intense-pulsed light (IPL) device hazards based on regulations established by the state and the federal governments. This plan includes the responsibilities of those in the various roles involved with lasers. It provides individuals using lasers with information on laser hazards, laser-related policies and procedures, recommendations for the safe use of lasers, and information on laser safety training. It has been designed to provide the basis for safe laser use in the research and teaching environment.

SCOPE

This plan applies to all persons at UTSA who receive, possess, acquire, transfer, or use lasers that emit or may emit laser radiation. The plan applies to all facilities owned, operated, or leased by UTSA where lasers are used or stored, to all personnel, whether from inside or outside UTSA, who work on these premises, and all laser equipment owned or leased by UTSA or used within the premises of UTSA.

This plan applies to lasers that operate at wavelengths between 180 nanometers (nm) and 1 millimeter (mm).

This plan also applies to intense pulsed light (IPL) devices. These devices are Class 2 or Class 3 surgical devices certified as complying with the design, labeling, and manufacturing standards of the United States Food and Drug Administration (FDA). They differ from lasers in that they operate over specific parts of or the entire spectrum from 500 to 1200 nm.

All persons at UTSA authorized to use Class 3b and Class 4 lasers are subject to the following sections of the Texas Administrative Code (TAC): §289.203, .204, .205, .231, and .301. The American National Standard for the Safe Use of Lasers, ANSI Z136.1 and Safe Use of Lasers in Research, Development, or Testing ANSI Z136.8 contain safe practice details. ANSI Z136.1 is referenced in the TAC laser sections.

PROHIBITIONS

UTSA may prohibit the use of lasers and IPL devices that pose a significant threat or endanger occupational or public health and safety, in accordance with state regulations. All lasers at UTSA MUST have a hazard classification. Any laser purchased from online retailers must comply with the American National Standard (ANSI), Federal Laser Product Performance Standard (FLPPS), or the Center for Devices and Radiological Health (CDRH) which is part of the Food and Drug Administration (FDA).

Individuals shall not be intentionally exposed to laser and IPL radiation without first obtaining all appropriate permissions from the Radiation and Laser Safety Committee (R&LSC), the Institutional Review Board (IRB) and the Texas Department of State Health Services (TXDSHS). Contact the Laser Safety Officer (LSO) well in advance of planned work to ensure all university, state and federal requirements are met prior to beginning such a project.

PERIODIC REVIEW

The contents of this plan will be reviewed annually by the Laboratory Safety Division and any pertinent committees. Updates will be made to this Plan whenever relevant sections of the TAC or ANSI on the use of lasers are changed and whenever internal policy decisions mandate a review.

RESPONSIBILITIES

This section was developed to inform supervisors and operators of their roles and responsibilities to assist in providing a safe laser environment at UTSA.

RESPONSIBILITY AND AUTHORITY OF THE LASER SAFETY OFFICER

1. The LSO will work with the individual Principal Investigator (PI) to ensure safety standards are adequately met at the given laser laboratory. The LSO has the authority to monitor and enforce the control of laser hazards.

2. The LSO will provide consultative services on laser hazard evaluation and controls, and on personnel training programs.

3. Laser Safety Personnel will provide training to each employee and student planning to operate a Class 3b or 4 laser or laser system or work in an area where such a laser is in operation. A comprehensive laser safety training program is available from the Laboratory Safety Division. Additional laser-specific training programs are encouraged. The R&LSC should be informed of the content of these alternative programs. The Laboratory Safety Division training course must be completed before any individual begins work with a laser or in an area where a laser is used. The Laser Safety course is available online at the BioRAFT portal.

4. The LSO will register all class 3b and 4 lasers with TXDSHS for UTSA and maintain appropriate records and reports as required for registration.

5. The LSO will review all laser system operations at UTSA to ensure Texas State Regulations and ANSI standards are followed.

RESPONSIBILITY OF THE PRINCIPAL INVESTIGATOR

1. The PI shall know the educational and training requirements, the potential laser hazards and associated control measures, and all operating procedures pertaining to laser safety for lasers and laser systems under the PI's control. Generally, the PI is the faculty member in charge of a laser facility/laboratory.

2. Prior to ordering or acquiring a class 3b or 4 lasers, the PI shall notify the LSO and provide any requested information to assist in the registration of the laser.

3. The PI shall ensure that he/she, as well as all laser users under his/her control, are trained and have taken formal UTSA Laser Safety Training, SA465.

4. The PI shall determine which students and employees are authorized to operate a laser under his/her control. PI will complete On-The-Job Training for all personnel and keep a physical record in the lab.

5. The PI shall notify the LSO immediately of known or suspected laser-related accidents and injuries. The PI shall ensure that their departmental business office is promptly notified. If necessary, the PI will assist in obtaining appropriate medical attention for any employee or student involved in the laser accident. The PI shall cooperate with the LSO and/or R&LSC during the course of their incident review and implement recommendations to prevent a recurrence. A written incident report of any actual injury shall be prepared by the PI and submitted to the LSO as soon as possible as UTSA is required to file a report with the state within 30 days. The incident report should include the time and date of the incident, remediation steps followed, and any steps taken to prevent a repeat of the incident.

6. The PI shall not permit operation of a new, modified, or manufactured class 3b or 4 lasers under his/her authority without prior approval of the R&LSC. Additionally, location is part of the approval process and NO LASER MAY BE RELOCATED, even within the same laboratory, without prior approval of the R&LSC.

7. To prevent loss or theft of lasers, any laser relocation or loan~~s~~ requires prior approval by the LSO and R&LSC. The PI will submit the Laser Device Transfer Request Form for approval (25TAC§289.301(h)(2)(B).

8. The PI shall ensure that plans for laser installations or modifications of installations are submitted to the R&LSC for approval. Any outside consultants MUST have a Laser Demonstrator Registration according to TAC 289.301 (g) (3) in order to do any laser demonstrations on site. The LSO will act as a consultant in conjunction with Facilities Planning, for the installation of new laser facilities.

9. For Class 3b and 4 laser systems, the PI shall ensure standard operating procedures (SOPs) and On-the Job-Training (OTJ) are developed and provided in order to prevent the operation of a laser if exposure to employees, students, visitors, or the general public could exceed the maximum permissible exposure (MPE). Standard Operating Procedures (SOPs) are necessary for alignment, maintenance, service, and emergency response.

10. Prior to the disposal or transfer of any class 3b or 4 lasers, the PI must contact the LSO. This includes sending lasers to the Surplus Department. UTSA is required by regulation to maintain information on the final disposition of all registered lasers.

RESPONSIBILITY OF EMPLOYEES AND STUDENTS WORKING WITH OR NEAR LASERS

1. An employee or student shall not operate a class 3b or 4 laser system unless authorized to do so by the PI for that laser. The PI needs to provide system-specific laser safety training and may grant temporary permission to use the laser if the individual is certified as having completed UTSA Laser Safety Training by the Laboratory Safety Division and informing the R&LSC.

2. All employees and students shall comply with the safety rules and regulations prescribed by the PI, LSO, and R&LSC. Employees and students shall know the operating procedures applicable to their work. All employees need to complete the OTJ training form before doing any laser work.

3. All injuries and accidents involving lasers and laser systems must be reported to the PI and the LSO. However, the treatment of injured personnel and the preservation of property shall be the priority.

RESPONSIBILITY AND AUTHORITY OF THE RADIATION AND LASER SAFETY COMMITTEE

1. The UTSA R&LSC shall consist of faculty and staff who by their knowledge and experience are qualified to make judgments and recommend policy in the area of laser and radiation safety. Committee members shall be appointed by the Vice President of Research, Economic Development, and Knowledge Enterprise (VPREDKE) in consultation with the various deans, directors, and department heads.

2. The committee in conjunction with the LSO will help establish and maintain policies, procedures, and guidance for the control of laser hazards.

3. Approval of a laser or laser system for operation will be given only if the R&LSC is satisfied that the laser hazard control measures are adequate. These include lab-specific SOPs, OTJ training, engineering controls for the laser, engineering controls for the laboratory or area, and administrative and procedural controls for the laser facility/laboratory. SOPs for alignment, maintenance and/or service, and emergency response shall be provided as necessary.

4. The committee will review all applicable new or revised laser safety standards.

5. The R&LSC and the LSO have the authority to suspend, restrict, or terminate the operation of a laser project if it is deemed that the laser hazard controls are inadequate.

6. The LSO has the authority to shut down any laser operations in emergency situations or if personnel are not following safe working conditions (25TAC§289.301(q)(2).

RESPONSIBILITY OF THE UTSA PURCHASING DEPARTMENT

1. The UTSA Purchasing Department will inform the LSO of all requisitions for lasers and laser systems. Notification should be in the form of a copy of the Purchasing Requisition. The LSO will contact the PI to determine if the appropriate laser safety controls are in place and to help remedy any problems or deficiencies.

RESPONSIBILITY OF THE UTSA SURPLUS DEPARTMENT

1. The UTSA Surplus Department will inform the LSO of all requests submitted for pickup of lasers. The LSO will determine the disposition of any surplus lasers and update the UTSA Registration with TXDSHS accordingly.

LASER SAFETY AT A GLANCE

Summary of the minimum requirements to work with radiation.

APPROVALS

Committee	Oversight	Website
RLSC	Use of lasers	RLSC
IBC	rDNA/RNA, Infectious agents, Biohazards	IBC
IACUC	Use of animals	IACUC
IRB	Human subjects	IRB

TRAINING

How	Content	Where
Radiation Safety Training	Laser Safety	https://utsa.scishield.com
Written document	Laser Safety Plan	Laser Safety Plan
Written document	Lab specific safety plans and training	Keep documents and records in the lab

OCCUPATIONAL HEALTH

What	Contact Information	Who
Medical Surveillance	Occupational Health: 210-458-5304	Works with/exposed to hazards
Lab Animal Occupational Health Program	Occupational Health: 210-458-5304	Works with/exposed to animals

SAFETY

Tools	When	How
Laser Inventory	Annual	Contact the LSO
Personal Protective Equipment	Per risk assessment	Contact the LSO

Please contact the Laboratory Safety Division with questions or to request a consultation:
Email: LabSafety@utsa.edu Telephone: 210-458-6697

SAFETY CULTURE

WHAT IS SAFETY CULTURE

Safety culture is a part of organizational culture and is often described by the phrase “the way we do things around here. According to the American Chemical Society, safety culture at an academic institution is a “reflection of the actions, attitudes, and behaviors” demonstrated by the faculty, staff and students concerning safety.

Several high-profile accidents in the research world have led to the realization that ensuring excellence in research requires a strong, positive safety culture throughout the University. This means that safety is viewed as an operational priority, because of the benefits thoughtful, safe procedures and attitudes bring to research.

SAFE RESEARCH AT UTSA

Research and education in science laboratories involves a variety of hazards. It is the University of Texas at San Antonio’s (UTSA) policy to protect and promote the health and safety of students and employees as well as the environment. As an educational institution UTSA endeavors to impart a foundation of safety culture that will prepare students to be safe and skilled scientists in academia or industry.

Safety in the laboratory can be achieved only with the exercise of sound judgment and proper use of facilities by informed, responsible individuals.

Safe research starts with recognizing that safety is a fundamental part of the scientific process, adding value by exerting greater control, reducing uncertainty, and increasing the safety and quality of your results or product.

RESEARCH SAFETY EXPECTATIONS

The University expects that all members of our research community integrate safety into their research activities and go beyond minimum compliance. The following elements (Fig 1) help lay the foundation to build and support a safe and productive research environment:

Figure 1. Four Elements of Research Safety

A. Leadership

Lead by example, adhere to the rules, and be willing to speak up if you see unsafe practices. Faculty and other supervisors are urged to include safety on the agenda and incorporate it into their group thinking and practices.

- *Lab members openly discuss safety concerns.*
- *PI/laboratory manager and research group members maintain an environment in which personnel feel free to raise concerns.*
- *Actions confirm safety as a priority that supports and is compatible with good research.*
- *The feedback loop on safety issues (bottom-up and top down) is closed (addressed) at the PI/lab management level.*

B. Design

Take the time to systematically assess risk and plan for the hazards identified. Incorporate safety into laboratory procedures.

- *PI/lab manager understands the risks of the research being conducted, are actively involved in the laboratory safety program, and integrate safety into the laboratory research culture.*

C. Execution

Take action to control your risks. Make sure you have the right protective equipment, engineering controls are working correctly, and researchers are trained to safely perform their work. Principal investigators must enforce the established controls in their lab.

- *PI/lab manager ensures that the personnel, equipment, tools, procedures, and other resources needed to ensure safety in the academic research laboratory are available.*
- *Lab members identify and manage their own safety environment and are receptive and responsive to queries and suggestions about laboratory safety from their lab colleagues.*
- *Lab members conduct their research using protocols and procedures consistent with best safety practices in the lab.*

D. Adaptability

Research is not a static endeavor; managing safety requires ongoing reassessment, feedback, and reinforcement. Encourage reporting by members when identifying and reviewing lessons learned after and using these as teaching opportunities. Involve all lab incidents and near-misses.

- *PI/lab manager evaluates the laboratory safety status themselves and knows what and how to manage changes to enhance safety in the laboratory.*
- *The PI/lab manager and lab group support a continuous learning environment in which opportunities to improve safety are sought, communicated, and implemented.*
- *Safety discussions become part of regular lab meetings; near misses within the lab are reported in a timely manner and safety information is requested by lab members to prevent future mishaps through understanding HOW and WHY.*

A. Delegation

Within a lab responsibility for various activities and training may be delegated, by the PI, to a Laboratory Manager, Senior Researcher or Graduate Student. This can provide valuable experience and ensure there are several individuals assisting less experienced researchers. However, there are often two potential issues associated with this model: (1) the delegation involves responsibility but may have little or no authority or power to enforce practices, and (2) communication between the PI and Manager can be affected by numerous demands on PI time. Preparing for these challenges assists in developing and maintaining a strong and healthy research environment. Some key aspects of effective delegation include matching the correct skill level to the task, having firm goals, and providing solid support.

B. Psychological Safety

Cultivating psychological safety within the culture of a research group provides the basis for a sense of openness and trust. These group-level interactions provide a conducive environment for lab members to feel accepted and respected (Fig 2). When psychological safety is rooted in a lab's culture, the ability to address the potential physical safety and health issues inherent in conducting research is enhanced. With greater safety comes greater control and better science.

Psychological Safety has been shown to provide workplace benefits in different ways, including:

- *Acknowledges limits of current knowledge and improves team innovation.*
- *Improves likelihood that an attempted process innovation will be successful.*
- *Promotes active listening and learning from all members.*
- *Increases capacity to learn from mistakes.*

Good lab management and leadership provides a closed loop for Psychological Safety. The two most essential actions identified for this functionality are (1) participatory management and (2) Inclusive management. A clear team structure and strong team relationships are characteristics most conducive to Psychological Safety.

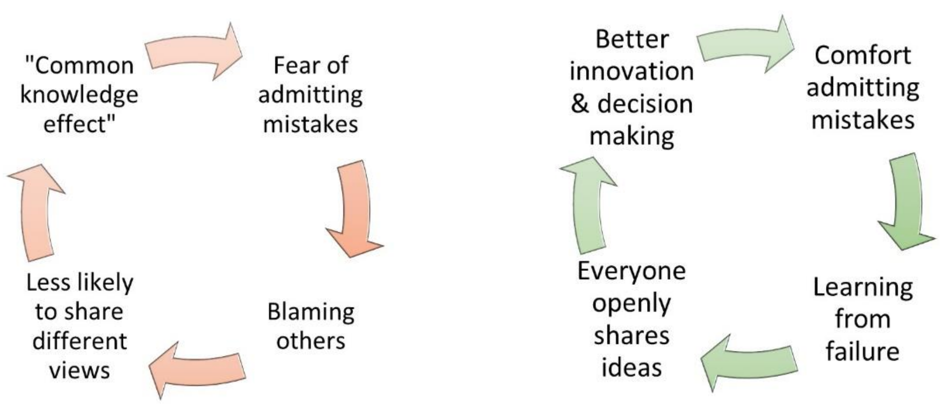

Figure 2. Psychological Danger vs Psychological Safety

RISK ASSESSMENT FOR RESEARCH

Evaluation and assessment of risk is a key part of designing and conducting an experimental protocol. Not only does a thorough risk assessment allow researchers to systematically identify and control hazards, but it also improves the quality of science through more thorough planning, a better understanding of the variables, and by sparking creative and innovative thinking. It allows one to implement tighter controls which reduces uncertainty and increases the safety and quality of your results/product. Failure to consider risk and hazards from the beginning of experimental design can produce delays, roadblocks, and frustration later in the process.

The Risk Assessment process is broken down into four steps: and by sparking creative and innovative thinking.

A. Explore

Determine the scope of your work, beginning with research objectives. What question(s) are you trying to answer? Conduct a broad review of the literature. Speak with others who have done similar work. Are the risks different for different approaches?

B. Plan

Outline your procedure/tasks. This may include a deeper dive into specific topics in literature. Determine hazards associated with each step, and control measures for reducing risk. The Laboratory Safety Division can help with more detailed guidance on how to handle certain hazards.

C. Challenge

What assumptions did you use? Question the importance of each step. Seek advice from others. Ask yourself "what could go wrong?" Have I missed anything? Consider all possible outcomes, how high is the risk?

D. Assess

Implement a model, prototype, or trial run. Can you perform a dry run to familiarize yourself with equipment and procedures? Can you test your experimental design on a smaller scale or with a less hazardous material? Determine if any design changes are needed. Run your experiment and monitor how your controls perform. Assess as you go and make changes as needed.

HIERACHY OF CONTROLS

Controlling exposure to hazards is a fundamental reference for protecting individuals against hazards. The hierarchy of controls is commonly represented as:

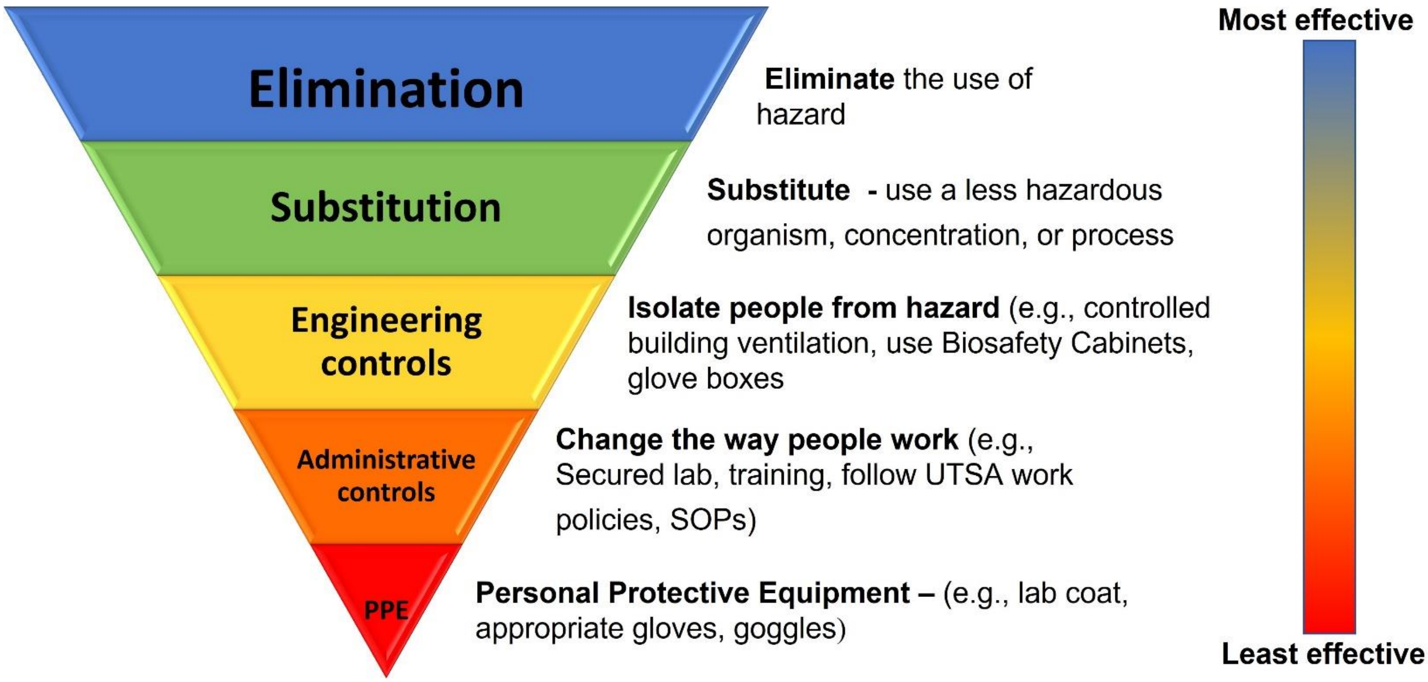

Figure 3. Hierarchy of controls for minimizing hazards.

A. Elimination

While elimination of a hazard is always the safest option it is often not practical in the research environment. Elimination of hazards can be effective when designing new projects but difficult or impossible for existing studies. An example of eliminating a hazard would be autoclaving biological materials therefore removing the biohazard potential.

B. Substitution

Substitution is often an easier option in procedures. Substitution can be common in many biological studies involving infectious agents where a virulent pathogen is replaced with a less virulent, or attenuated strain.

C. Engineering Controls

Engineering controls are a key laboratory feature and are designed to remove the hazard at the source before it can encounter the worker. Engineering controls are highly effective as a safety measure if they are used correctly. Examples of the most used engineering controls in biological facilities are Biosafety Cabinets. These are highly effective at protecting the worker and the samples. However, to be effective the worker must understand how to safely use the equipment and maintain it.

D. Administrative Controls

Administrative controls are used extensively to support safety in facilities. Examples of administrative controls include Standard Operating Procedures (SOPs), Safety Committee protocols, training, and safety plans. The effectiveness of administrative controls is often overlooked as it can be time-consuming. However, they are an essential component of any strong safety program.

E. Personal Protective Equipment

Personal Protective Equipment (PPE) is generally considered one of the least effective safety controls. PPE does not control the hazard at the source but rather protects the worker if all other control methods have failed. As with engineering controls, PPE is only effective if used and maintained correctly.

INTRODUCTION TO LASER SAFETY

LASER CLASS

All lasers sold in the U.S. are required to have a label listing the class of the laser (Fig 4. Example of a laser identification label). No lasers at UTSA are allowed without a classification.

Fig 4. Laser identification label

1. **Class 1 Lasers**
   a. Incapable of producing damaging radiation levels during operation.
   b. Example: Completely enclosed machine with a higher-powered laser inside.
2. **Class 1M Lasers**
   a. Incapable of producing damaging radiation levels during operation unless the beam is viewed with an optical instrument (e.g., loupe or telescope).
   b. Example: Fiber-optic communication systems.
3. **Class 2 (Low Power)**
   a. Output below 1mW.
   b. Emit visible light only (400 – 700nm).
   c. Example: Barcode scanners
4. **Class 2M**
   a. The output upper limit is 1mW.
   b. Emit visible light only (400 – 700nm).
   c. Potential hazard if viewed with an optical aid.
   d. Example: Leveling instruments.
5. **Class 3R**

a. Potentially hazardous under some direct and specular reflection.

b. Does not pose a diffuse-reflection or fire hazard.

c. Example: Laser pointer

6. **Class 3b**

a. Operate between 5mW and 500mW.

b. Normally does not pose a diffuse viewing or fire hazard. However, they can heat skin and materials.

c. Hazardous under direct and specular reflection viewing.

d. Example: therapeutic medical lasers.

7. **Class 4**

a. Output greater than 500mW.

b. Hazardous to eyes and skin from direct viewing, diffuse and scattered reflections.

c. Present a fire hazard if directed at combustible material.

d. Can produce air contaminants and plasma radiation.

e. Example: Surgical lasers.

LASER HAZARDS

The foremost hazard lasers pose is to the eyes. Direct or indirect exposure to lasers can lead to irreparable damage to parts of the eye and permanent partial or complete loss of vision. Depending on the wavelength of the laser light, your cornea, lens, or retina may absorb the light. When too much absorption occurs, the cells are burned, leading to damage.

- High-power lasers usually have large power supplies designed to deliver large currents, often at high voltages. Accidents during troubleshooting can be fatal. **NEVER** work on power supplies. This work should be done by a certified technician or manufacturer's representative.
- High-power lasers can ignite laboratory equipment, leading to fire and smoke damage to the laboratory.
- Direct exposure to the beam may cause skin damage. Effects on the skin are both photochemical and thermal depending on the wavelength of the laser light. Symptoms range from mild reddening (erythema) to blistering and charring. Additionally, there are possible carcinogenic effects.
- Excimer lasers make use of reactive gases requiring special safety precautions and procedures to prevent exposure.
- The severity of effects of laser hazards depends on the type of laser, the wavelength, pulse energy (or power for a continuous wave laser), pulse duration (or exposure duration for a continuous wave laser), and the type of application.

- Non-beam hazards include fumes, compressed gases, cryogenic materials, noise, electrical hazards, fire, explosion, and collateral radiation.
- Hazards of a class 1, 2, or 3R laser are much less significant than those of a Class 3b or 4 lasers. The blink reflex or normal human aversion reflex is considered sufficient to protect against lower-powered laser hazards. Even for these low power class lasers, direct exposure of the eye to the output beam can be damaging. Laser beams viewed through collecting optics can cause eye damage. In addition, many of these lasers, regardless of class, have high-voltage power supplies that can be hazardous.

EXPOSURE LIMITS

1. Refer to the American National Standard for Safe Use of Lasers, ANSI Z136.1, for hazard analysis of several different laser types. This ANSI standard is available for checkout from the LSO or the UTSA library.

2. Refer to APPENDIX B for information on common types of lasers and check the laser identification label. If the data you are looking for is not there, contact the LSO.

PRECAUTIONS

1. Follow the safety procedures for the laboratory and the laser being used.

2. Wear R&LSC and ANSI Z136.1 approved laser safety goggles with the proper optical density for the specific wavelength(s) of the laser. Even with goggles, direct exposure to a laser beam is hazardous. Laser safety goggles are meant to protect even during short exposures.

3. One simple rule is to keep the beam horizontal and at waist level so the eyes of personnel standing in the laboratory are well above the beam plane. Keep reflective surfaces out of the beam path as specular reflections present a hazard. With higher-powered lasers, even matte surfaces may cause a specular reflection.

4. Question practices that appear unsafe. Are they necessary or outdated? Can the same function be performed in a manner that is less dangerous? Can the unsafe practices be replaced by some other safer practice? Are work practices designed for expediency at the expense of safety?

OPERATING PROCEDURES

1. Operating procedures must be developed for each class 3b or 4 laser and any IPL device. They are recommended for all other lasers. The LSO is available to provide assistance in developing operating procedures.

2. Procedures at UTSA are based on Texas regulations and guidelines developed by professional organizations such as ANSI. The Texas regulations may be downloaded from the TXDSHS website (https://www.dshs.texas.gov/radiation/lasers/laws-rules.aspx). ANSI standards must be purchased, but the LSO maintains copies.

CONTROL MEASURES

INTRODUCTION

Control measures for Class 3b and 4 lasers are designed to reduce the possibility of eye and skin exposure to hazardous levels of radiation and to other hazards associated with the laser systems. The major causes of laser accidents in the laboratory are:

1. Unanticipated eye exposure during alignment.
2. Misaligned optics and upwardly directed beams.
3. Available laser eye protection not used.
4. Equipment malfunction.
5. Improper methods of handling high-voltage circuits.
6. Intentional exposure of unprotected personnel.
7. Operators unfamiliar with laser equipment.
8. Lack of protection from non-beam hazards.
9. Improper restoration of equipment following service.
10. Eyewear worn not appropriate for laser in use.
11. Fires resulting from the ignition of materials.
12. Failure to follow SOPs.
13. Introduction of foreign materials (loose paper, paper clips, falling items, or objects).
14. Modification of the beam path.
15. Poor communication.

Laser control measures are classified as engineering control measures and administrative and procedural control measures. Engineering controls are those that are incorporated into the laser system and the laser laboratory. Administrative and procedural controls are methods or instructions which specify rules and/or work practices to supplement engineering controls and may require the use of personal protective equipment. An example of an engineering control measure would be a laser beam stop, and an example of an administrative and procedural control measure would be the SOPs. When feasible, engineering controls are always the preferred method to provide safety in a laser laboratory.

Control measures are designed to ensure skin and eye exposures do not exceed the applicable MPE limit. The MPE defines the maximum safe exposure without hazardous effect or adverse biological changes in the eye or skin. The MPE depends upon the wavelength and exposure duration.

An important consideration when implementing control measures is to distinguish between operation, maintenance, and service. Control measures are based on the normal operation of the laser system. When either maintenance or service is performed, it is often necessary to implement additional control measures.

ENGINEERING CONTROLS

Engineering controls for Class 3b and 4 lasers as required by regulation are listed below (25 TAC§289.103). All Class 3b and 4 lasers at UTSA are covered by this policy and should have the listed design features unless otherwise approved by the LSO and R&LSC.

If the system is purchased in the United States, the system includes the controls stated below. This is often indicated on the laser by a "statement of certification.

1. Protective housing shall be provided for each laser system. The protective housing shall be interlocked such that removal of the protective housing will prevent exposure to laser radiation. Interlocks shall not be defeated or overridden during normal operation of the laser.

2. Service access panels that allow access to the beam during operation shall be interlocked and have an appropriate warning label.

3. A Class 3b or Class 4 laser shall have a key-controlled or computer-actuated master switch. The authority for access to the key shall be vested in the PI.

4. All viewing portals, display screens, and collecting optics shall be designed to prevent exposure to the laser beam above the applicable MPE for all conditions of operation and maintenance.

5. A laser control area shall be designated for all unenclosed beam paths. The laser control area is defined as the area where laser radiation is more than the MPE. The appropriate control measures must be implemented in the laser-controlled area.

6. A Class 3b and Class 4 laser shall have a remote interlock connector. The remote interlock connector will decrease the laser beam power to safe levels when activated. Exceptions must be approved by the LSO and R&LSC.

7. For pulsed lasers, interlocks shall be designed to prevent firing of the laser. For continuous wave lasers, interlocks shall turn off the power supply or interrupt the beam (e.g., shutters).

8. The R&LSC will follow the recommendations and requirements as set forth by ANSI Z136.1 and ANSI Z136.8 regarding interlocks for class 3b and 4 lasers. The R&LSC and/or the LSO have the authority to require more stringent entry controls based on a case-by-case analysis.

9. A Class 3b laser should have a permanent beam stop in place. A Class 4 laser shall have a permanent beam stop in place.

10. An alarm (for example, an audible sound such as a bell or chime), a warning light (visible through protective eyewear), or a verbal “countdown” command should be used at start-up of a Class 3b laser and shall be used with Class 4 lasers. For Class 4 laser systems, the warning should allow sufficient time to take appropriate actions to avoid exposure to the laser beam.

11. Whenever possible, Class 4 lasers should be operated and fired from a remote location.

ADMINISTRATIVE AND PROCEDURAL CONTROLS

1. Approval of the R&LSC is required for each laser laboratory. The application should be approved before work begins. The application is available at the ORI Laboratory Safety website in the Radiation/Laser section.

2. Standard written operating procedures with safety controls shall be provided to and reviewed with all laser users and be readily available for operation of the laser system. Refer to the laser application for a guide to assist in the development of SOPs. The instructions shall include clear warnings and precautions to avoid possible exposure to laser and collateral radiation more than the MPE. Operating procedures are to be maintained for inspection for the duration of the life of a laser.

3. Each laser operator and service personnel shall have the education and training level commensurate with the degree of hazard and responsibility and comply with appropriate control procedures.

4. Laser personnel shall keep a Laser Safety binder which will contain:

    a. Standard Operating Procedures (includes safety procedures, and emergency contacts).

    b. Laser Safety Manual.

    c. RLSC approval letter.

    d. Training/authorized personnel (On-the-Job Training (OTJ) and online safety training).

    e. Interlock checks (done monthly by lab personnel).

    f. Laser Eyewear Protection checks (done monthly by lab personnel).

    g. Inventory check of lasers and locations in lab (done monthly).

5. All personnel using the laser shall be listed on the application submitted by the PI.

6. Alignment procedures shall be developed to ensure that eye exposure to the primary beam or to a diffuse or specular reflection does not exceed the MPE.

7. The laser laboratory shall be designed in such a way to limit spectator access to the laser-controlled area.

8. Proper eye protection devices, specifically designed for laser radiation, shall be worn when engineering or other administrative and procedural controls are inadequate to eliminate exposures above the MPE. All laser eyewear protection must be inspected monthly by lab personnel to ensure material is free of scratches, cracks, pits, discoloration, and coating damage. Frames of glasses shall have good mechanical integrity and goggles shall be free of weak elastic bands. Inspection must be noted in Laser Eyewear Audit and Inventory Form (25 TAC 289.301 (t)(1)(E).

CLASS 3B AND 4 LASER CONTROL AREA

1. The area designated as the control area for Class 3b laser facilities shall have the following adequate control measures:

   a. Operation only by qualified and authorized personnel.

   b. Appropriate warning signs at all entryways and within the area.

   c. Supervision by an authorized PI.

   d. Limited spectator access. Visitors must be approved by the PI.

   e. Appropriate beam stops for terminating potentially dangerous beams.

   f. Only diffuse-reflective surfaces on non-optical structures in or near the beam path.

   g. Appropriate eye protection for ALL personnel within the area. This includes visitors.

   h. Laser beam is positioned well above or below eye level.

   i. All windows, doorways, and open portals are covered to prevent the laser radiation above the applicable MPE outside the laser facility.

   j. Secured storage of laser equipment.

2. In addition to the above control measures for Class 3b laser facilities, the controlled area for Class 4 laser facilities (Figure 2) **shall** have the following control measures:

   a. All entryway controls are designed to allow rapid egress.

   b. A "Panic Button" shall be clearly marked and readily accessible to the laser personnel. When activated, the "Panic Button" will reduce the output power of the laser to levels below the MPE. The following are acceptable examples of "Panic Buttons"

      i. Key switches deactivate the laser.

      ii. Master switch on power source to turn off power.

      iii. Red mushroom-type button on control panel or other readily accessible location within the area.

3. Limited Access Entryway. The PI shall implement one of the following mechanisms to protect personnel. The LSO will be available for consultative services.

   a. Non-Defeatable (non-override) Entryway Safety Controls

      i. Non-Defeatable entryway controls will reduce the output power of the laser to levels below the MPE when the door is opened unexpectedly.

   b. Defeatable Entryway Safety Controls

i. Defeatable entryway controls, with an override for safety latches and/or interlocks, may be used if it is clear that there is no laser radiation hazard at the point of entry. Only adequately trained and authorized personnel may operate the overrides to enter the facility.

c. Procedural Entryway Safety Controls

i. All authorized personnel shall be trained, and proper personal protective equipment (PPE) shall be available at entry (laser safety googles).

ii. A secondary barrier (laser curtain) shall be used to block the laser radiation at the entryway, screening the entrance from the entirety of the room.

iii. At the entryway, there should be a visible or audible indication that the laser is in operation.

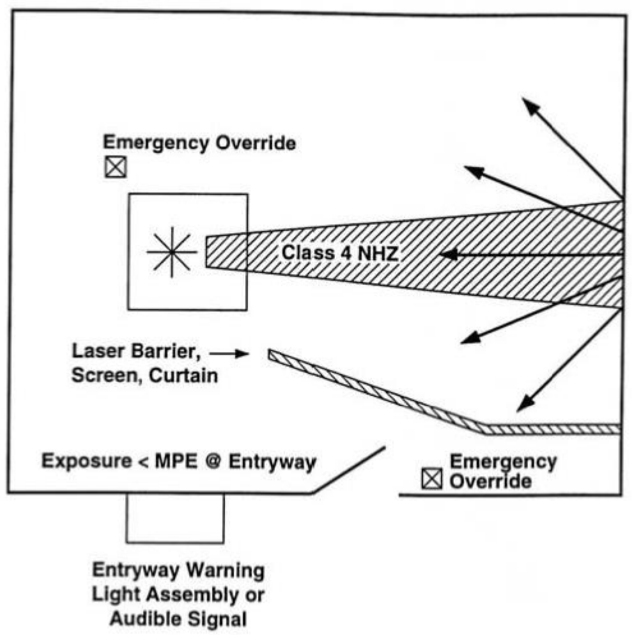

Fig.5 Class 4 Laser controlled area.

EQUIPMENT LABELS

All lasers (except Class 1) shall have appropriate warning labels with the laser sunburst logo and the appropriate cautionary statement (Figure 4). The labels shall be affixed to both the control panel and the laser housing. Ancillary hazards shall also be appropriately labeled.

AREA POSTING SIGNS

Areas that contain Class 2 or 3a laser systems should be posted with appropriate area postings as described in Figure 6. Areas which contain Class 3b or 4 laser systems shall be posted with appropriate area postings as described in Figure 7. In addition, the laser-controlled area should be indicated with the appropriate warning sign.

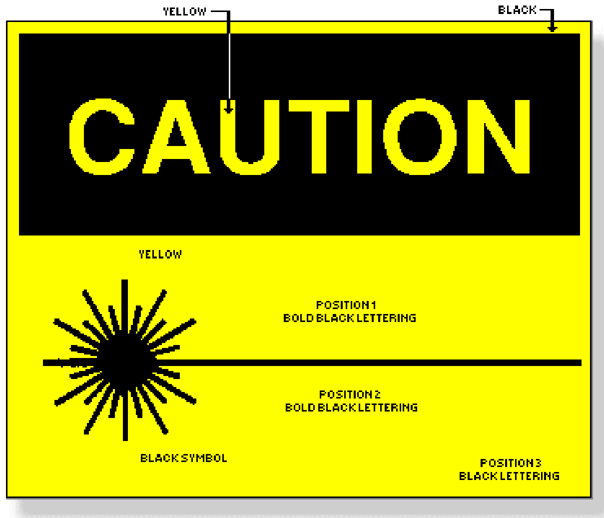

Fig 6. Area posting for Class 2 and 3R lasers (www.osha.gov)

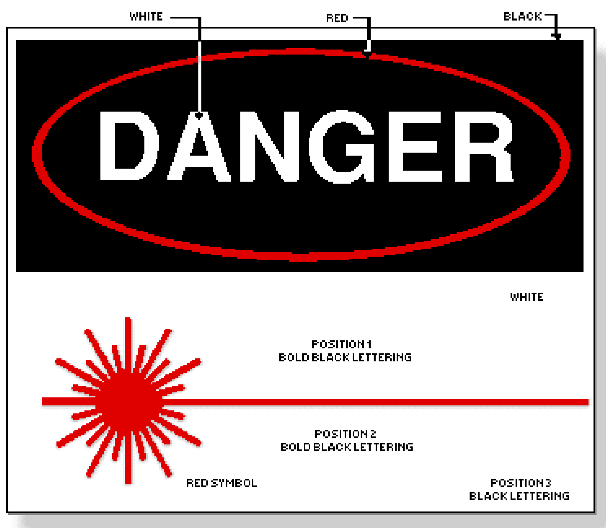

Fig 7. Area posting for Class 3b and 4 lasers (www.osha.gov)

APPENDIX A – DEFINITIONS OF LASER TERMS

Absorb – To transform radiant energy into a different form, with a resultant rise in temperature.

Absorption - Transformation of radiant energy to a different form of energy by the interaction of matter, depending on temperature and wavelength.

Accessible Emission Limit (AEL) - The maximum accessible emission level permitted within a particular class. In ANSI Z 136.1, AEL is determined as the product of accessible emission Maximum Permissible Exposure limit (MPE) and the area of the limiting aperture (7 mm for visible and near-infrared lasers).

Aperture - An opening or window through which radiation can pass.

Argon - A gas used as a laser medium. It emits blue-green light primarily at 448 and 515 nm.

Attenuation - The decrease in energy (or power) as a beam passes through an absorbing or scattering medium.

Aversion Response – Closure of the eyelid, movement of the eye or the head to avoid exposure to a noxious stimulant, bright light. It can occur within 0.25 seconds, and it includes the blink reflex time.

Beam - A collection of rays that may be parallel, convergent, or divergent.

Beam Diameter - The distance between diametrically opposed points in the laser-controlled of a circular beam where the intensity is reduced by a factor of e^{-1} (0.368) of the peak level (for safety standards). The value is normally chosen at e^{-2} (0.135) of the peak level for manufacturing specifications.

Beam Divergence - Angle of beam spread measured in radians or milliradians (1 milliradian = 3.4 minutes of arc or approximately 1 mil). For small angles where the cord is approximately equal to the arc, the beam divergence can be closely approximated by the ratio of the cord length (beam diameter) divided by the distance (range) from the laser aperture.

Blink Reflex – The involuntary closure of the eyes as a result of stimulation by an external event such as irritation of the cornea or conjunctiva, a bright flash, or rapid approach of an object. The ocular aversion response may include a blink reflex.

Brightness - The visual sensation of the luminous intensity of a light source. The brightness of a laser beam is closely associated with the radio-metric concept of radiance.

Carbon Dioxide - Molecule used as a laser medium. Emits far energy at 10,600 nm (10.6 µm).

Closed Installation - Any location where lasers are used which will be closed to unprotected personnel during laser operation.

CO_2 Laser - A widely used laser in which the primary lasing medium is carbon dioxide gas. The output wavelength is 10.6 µm (10600 nm) in the far-infrared spectrum. It can be operated in either CW or pulsed.

Coherence - A term describing light as waves which are in phase in both time and space. Monochromaticity and low divergence are two properties of coherent light.

Collimated Light - Light rays that are parallel with very low divergence or convergence. Collimated light is emitted by many lasers. Diverging light may be collimated by a lens or other device.

Continuous Mode - The duration of laser exposure is controlled by the user (by foot or hand switch).

Continuous Wave (CW) - Constant, steady-state delivery of laser power. In this standard, a laser operating with a continuous output for a period of 0.25 s or longer is regarded as a CW laser.

Controlled Area - Any locale where the activity of those within are subject to control and supervision for the purpose of laser radiation hazard protection.

Diffuse Reflection - Takes place when different parts of a beam incident on the surface are reflected over a wide range of angles in accordance with Lambert's Law. The intensity will fall off as the inverse of the square of the distance away from the surface and obey a Cosine Law of reflection.

Divergence - The increase in the diameter of the laser beam with distance from the exit aperture. The value gives the full angle at the point where the laser radiant exposure or irradiance is e^{-1} or e^{-2} of the maximum value, depending upon which criteria is used.

Embedded Laser – An enclosed laser with an assigned class number higher than the inherent capability of the laser system in which it is incorporated, where the system's lower classification is appropriate to the engineering features limiting accessible emission.

Emission - Act of giving off radiant energy by an atom or molecule.

Enclosed Laser Device - Any laser or laser system located within a protective housing of itself or of the laser or laser system in which it is incorporated. It does not permit hazardous optical radiation emission from the enclosure. The laser inside is termed an "embedded laser."

Energy (Q) - The capacity for doing work. Energy is commonly used to express the output from pulsed lasers, and it is measured in Joules (J). The product of power (watts) and duration (seconds). One watt-second = one Joule.

Excimer "Excited Dimer" - A gas mixture used as the active medium in a family of lasers emitting ultraviolet light.

Fail-safe Interlock - An interlock where the failure of a single mechanical or electrical component of the interlock will cause the system to go into, or remain in, a safe mode.

Gas Discharge Laser - A laser containing a gaseous lasing medium in a glass tube in which a constant flow of gas replenishes the molecules depleted by the electricity or chemicals used for excitation.

Gas Laser - A type of laser in which the laser action takes place in a gas medium.

Helium-Neon (HeNe) Laser - A laser in which the active medium is a mixture of helium and neon. Its wavelength is usually in the visible range. Used widely for alignment, recording, printing, and measuring.

Infrared Radiation (IR) - Invisible electromagnetic radiation with wavelengths which lie within the range of 0.70 to 1000 µm. These wavelengths are often broken up into regions: IR-A (0.7-1.4 µm), IR-B (1.4-3.0 µm) and IR-C (3.0-1000 µm).

Intrabeam Viewing - The viewing condition whereby the eye is exposed to all or part of a direct laser beam or a specular reflection.

Irradiance (E) - Radiant flux (radiant power) per unit area incident upon a given surface. Units: Watts per square centimeter. (Sometimes referred to as power density, although incorrect).

Laser - An acronym for light amplification by stimulated emission of radiation. A laser is a cavity with mirrors at the ends, filled with material such as crystal, glass, liquid, gas, or dye. It produces an intense beam of light with the unique properties of coherency, collimation, and monochromaticity.

Laser Accessories - The hardware and options available for lasers, such as secondary gases, Brewster windows, Q-switches, and electronic shutters.

Laser Controlled Area - See Controlled Area.

Laser Device - Either a laser or a laser system.

Laser Medium (Active Medium) - Material used to emit the laser light and for which the laser is named.

Laser Rod - A solid-state, rod-shaped lasing medium in which ion excitation is caused by a source of intense light, such as a flash lamp. Various materials are used for the rod, the earliest of which was synthetic ruby crystal.

Laser Safety Officer (LSO) - One who has authority to monitor and enforce measures to control laser hazards and affect the knowledgeable evaluation and control of laser hazards.

Laser System - An assembly of electrical, mechanical, and optical components which includes a laser. Under the Federal Standard, a laser in combination with its power supply (energy source).

Lens - A curved piece of optically transparent material which, depending on its shape, is used to either converge or diverge light.

Light - The range of electromagnetic radiation frequencies detected by the eye, or the wavelength range from about 400 to 760 nm. The term is sometimes used loosely to include radiation beyond visible limits.

Limiting Aperture - The maximum circular area over which radiance and radiant exposure can be averaged when determining safety hazards.

Maintenance - Performance of those adjustments or procedures specified in user information provided by the manufacturer with the laser or laser system, which are to be performed by the user to ensure the intended performance of the product. It does not include operation or service as defined in this glossary.

Maximum Permissible Exposure (MPE) - The level of laser radiation to which a person may be exposed without hazardous effect or adverse biological changes in the eye or skin.

Nd: Glass Laser - A solid-state laser of neodymium: glass offering high power in short pulses. An Nd-doped glass rod used as a laser medium to produce 1064 nm light.

Nd: YAG Laser - Neodymium: Yttrium Aluminum Garnet. A synthetic crystal used as a laser medium to produce 1064 nm light.

Neodymium (Nd) - The rare earth element that is the active element in Nd: YAG laser and Nd: Glass lasers.

Nominal Hazard Zone (NHZ) - The nominal hazard zone describes the space within which the level of the direct, reflected, or scattered radiation during normal operation exceeds the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the appropriate MPE level.

Optical Cavity (Resonator) - Space between the laser mirrors where lasing action occurs.

Optical Density - A logarithmic expression for the attenuation produced by an attenuating medium, such as an eye protection filter.

Optical Fiber - A filament of quartz or other optical material capable of transmitting light along its length by multiple internal reflections and emitting it at the end.

Optical Pumping - The excitation of the lasing medium by the application of light rather than electrical discharge.

Optical Radiation - Ultraviolet, visible, and infrared radiation (0.35-1.4 µm) that falls in the region of transmittance of the human eye.

Output Power - The energy per second measured in watts emitted from the laser in the form of coherent light.

Power - The rate of energy delivery expressed in watts (Joules per second). Thus: 1 Watt = 1 Joule x 1 §

Protective Housing - A protective housing is a device designed to prevent access to radiant power or energy.

Pulse - A discontinuous burst of laser, light or energy, as opposed to a continuous beam. A true pulse achieves higher peak powers than that attainable in a CW output.

Pulse Duration - The "on" time of a pulsed laser, it may be measured in terms of milliseconds, microseconds, or nanoseconds as defined by half-peak-power points on the leading and trailing edges of the pulse.

Pulsed Laser - Laser which delivers energy in the form of a single or train of pulses.

Pump - To excite the lasing medium. See Optical Pumping or Pumping.

Pumped Medium - Energized laser medium.

Pumping - Addition of energy (thermal, electrical, or optical) into the atomic population of the laser medium, necessary to produce a state of population inversion.

Radiant Energy (Q) - Energy in the form of electromagnetic waves usually expressed in units of Joules (watt-seconds).

Radiant Exposure (H) - The total energy per unit area incident upon a given surface. It is used to express exposure to pulsed laser radiation in units of J/cm^2.

Reflection - The return of radiant energy (incident light) by a surface, with no change in wavelength.

Refraction - The change of direction of propagation of any wave, such as an electromagnetic wave, when it passes from one medium to another in which the wave velocity is different. The bending of incident rays as they pass from one medium to another (e.g., air to glass).

Resonator - The mirrors (or reflectors) making up the laser cavity including the laser rod or tube. The mirrors reflect light back and forth to build up amplification.

Ruby - The first laser type; a crystal of sapphire (aluminum oxide) containing trace amounts of chromium oxide.

Scanning Laser - A laser having a time-varying direction, origin, or pattern of propagation with respect to a stationary frame of reference.

Secured Enclosure - An enclosure to which casual access is impeded by any appropriate means (e.g., door secured by lock, magnetically or electrically operated latch, or by screws).

Semiconductor Laser - A type of laser which produces its output from semiconductor materials such as GaAs.

Service - Performance of adjustments, repair, or procedures on a non-routine basis, required to return the equipment to its intended state.

Solid Angle - The ratio of the area on the surface of a sphere to the square of the radius of that sphere. It is expressed in steradians (sr).

Source - The term source means either laser or laser-illuminated reflecting surface, i.e., source of light.

Tunable Laser - A laser system that can be "tuned" to emit laser light over a continuous range of wavelengths or frequencies.

Tunable Dye Laser - A laser whose active medium is a liquid dye, pumped by another laser or flash lamps, to produce various colors of light. The color of light may be tuned by adjusting optical tuning elements and/or changing the dye used.

Ultraviolet (UV) Radiation - Electromagnetic radiation with wavelengths between soft X-rays and visible violet light, often broken down into UV-A (315-400 nm), UV-B (280-315 nm), and UV-C (100-280 nm).

Visible Radiation (light) - Electromagnetic radiation which can be detected by the human eye. It is commonly used to describe wavelengths in the range between 400 nm and 700-780 nm.

Wavelength - The length of the light wave, usually measured from crest to crest, which determines its color. Common units of measurement are the micrometer (micron), the nanometer, and (earlier) the Angstrom unit.

YAG - Yttrium Aluminum Garnet, a widely used solid-state crystal composed of yttrium and aluminum oxides and a small amount of rare earth neodymium.

APPENDIX B – LASER CLASSIFICATION

Class	Power Output	Description
1	<0.4 µW	Considered safe for continuously viewing or are designed in such a way that prevents human access to laser.
2	0.4 µW-1 mW	Visible light lasers will not cause eye injury if viewed momentarily. They can present an eye hazard if viewed directly for a long period of time.
3a/R	1 mW-5 mW	Cannot damage the eye within 0.25 second of the aversion response or blink reflex. Injury is possible if the beam is viewed with collecting optics or by staring at the direct beam.
3b	5 mW-500 mW	Present an eye and skin hazard from viewing the direct beam or a specular reflected beam. No production of a hazardous diffuse reflection except when viewed with collecting optics. No fire hazard is presented.
4	>500 mW	These are the most hazardous lasers and may cause eye and skin injury from direct viewing, specular reflection, and diffuse reflection. These lasers can produce fire and generate hazardous airborne contaminants.

APPENDIX C – COMMON LASER TYPES AND WAVELENGTHS

Table C1 – Ultraviolet (0.180 µm – 0.400 µm)

Laser Type	Wavelength (µm)
Argon Fluoride	0.193
Krypton Fluoride	0.248
Neodymium: YAG (4^{th} harmonic)	0.266
Argon	0.275, 0.351, 0.363
Xenon Chloride	0.308
Helium Cadmium	0.325
Nitrogen	0.337
Xenon Fluoride	0.351
Neodymium: YAG (3rd harmonic)	0.355

Table C2 – Visible (0.400 µm – 0.700 µm)

Laser Type	Wavelength (µm)
Helium Cadmium	0.442
Rhodamine 6G	0.450, 0.650
Argon	0.457, 0.476, 0.488, 0.514
Copper vapor	0.510, 0.578
Krypton	0.530
Neodymium: YAG (2nd harmonic)	0.532
Helium Neon	0.543, 0.632
Indium Gallium Aluminum Phosphide	0.670
Ruby	0.694

Table C3 - Near-infrared (0.700 µm – 1.400 µm)

Laser Type	Wavelength (µm)
Ti-Sapphire	0.700 – 1.000
Alexandrite	0.720 – 0.800
Gallium Aluminum Arsenide	0.780, 0.850
Gallium Arsenide	0.905
Neodymium: YAG	1.064
Helium-Neon	1.180, 1.152
Indium Gallium Aluminum Phosphide	1.310

Type C4 – Mid-infrared (1.400 µm – 3.000 µm)

Laser Type	Wavelength (µm)

Erbium Glass	1.540
Holmium	2.100
Hydrogen Fluoride	2.600 – 3.000
Erbium	2.940

Table C5 - Far-infrared (3.000 μm – 1 mm)

Laser Type	Wavelength (μm)
Helium-Neon	3.390
Carbon Monoxide	5.000 – 5.500
Carbon Dioxide	10.6

APPENDIX D – UTSA LASER SETUP GUIDELINES

The following guidelines are provided to assist a PI in planning the setup of a laser laboratory involving class 3b and class 4 lasers. No laser setup should be devised without consulting the LSO. No guidelines can universally apply for every laser because of differences in output wavelengths, output powers, and output modes. The R&LSC reserves the right to amend safety requirements and recommendations as needed for any single laser or combinations of lasers.

An application must be submitted and approved by the R&LSC for each laser. Each class 3b and 4 lasers must be on UTSA's registration through TXDSHS. The LSO must be notified when lasers are ordered to ensure they are promptly added to the registration.

The Office of Facilities will only perform construction and maintenance work on laser setups. Different lasers will have different requirements for use and may require different infrastructure and utility support. Specifications for each unique laser being installed must be provided for review by the Office of Facilities to assure appropriate design features are included in room infrastructure.

SETUP COSTS

New faculty should understand the responsibilities and costs of implementing the UTSA Laser Safety policy and the requirement that adequate safety measures be in place and R&LSC approval granted before commencing laser operations. Existing faculty acquiring class 3b or Class 4 lasers must also meet setup requirements and are responsible for securing adequate setup funds with the acquisition of any high-powered laser.

LASER LOCALITY

Laser laboratories that require large amounts of cooling water or power should be placed at ground-level, when possible, to facilitate the provision of these utilities and minimize the potential for damaging floods. Designs that require personnel in other laboratories to have emergency egress through laser laboratories should be avoided and no windows should be placed on doors leading to rooms housing lasers. A door, blocking barrier, screen, or curtains shall be used to block, screen, or attenuate laser radiation at laboratory entryway (25 TAC§289.301. (r)(3)(iii)(II)(-b-). High-powered lasers are ideally housed in interior rooms that do not have windows or open directly into building corridors. Otherwise, adequate controls must be used to prevent laser beams exiting through windows or into building corridors.

INTERLOCKS

Provision must be made to control access to a high-power laser lab. Wiring must be in place between the door and light table locations to permit the decision, on an individual basis, of whether the laboratory uses a card reader versus a real interlock, a laser light trap or not, etc. Sufficient wiring should be provided between an entrance control point and laser light tables to allow for the installation of an emergency cutoff (PANIC button) if, for example, a PI wanted to use an interlock-like device purely to provide emergency laser/power shutdown in the event of a burst cooling pipe or other catastrophic accident.

For pulsed lasers, interlocks shall be designed to prevent firing of the laser (e.g., dumping the stored energy into a dummy load). For continuous wave lasers the interlocks shall turn off the power supply or interrupt the beam (by means of shutters) 25 TAC§289.301(r)(3)(B)(ii-iii).

APPENDIX E – UTSA LASER SAFETY FORMS

LASER DEVICE STORAGE NOTIFICATION

GENERAL LASER INFORMATION

PRINCIPAL INVESTIGATOR	
BUILDING	
ROOM NUMBER	
TELEPHONE NUMBER	
MODEL NAME	
SERIAL NUMBER	
CLASS OF LASER	

STORAGE INFORMATION

DATE OF STORAGE	

REASON FOR STORAGE

The UTSA Laser Safety Officer (210-458-5807) must be contacted prior to any laser device returning to service. Prior to return to service will require that a Radiation and Laser Safety protocol be submitted to and approved by the Radiation and Laser Safety Committee. During the storage period, the laser may not be transferred to another Principal Investigator, building or room without first contacting the Laser Safety Officer or Radiation and Laser Safety Coordinator.

Date: ____________________________

Signature of the Principal Investigator

Date: ____________________________

Signature of the Laser Safety Officer

LASER DEVICE TRANSFER FORM

This form provides notice of relocation of a Class 3B or 4 laser system to or from an off-campus location.

LASER INFORMATION

PRINCIPAL INVESTIGATOR	
BUILDING	
ROOM NUMBER	
TELEPHONE NUMBER	
MODEL NAME	
SERIAL NUMBER	
CLASS OF LASER	

TRANSFER INFORMATION

DATE OF RELOCATION	
FROM (CURRENT LOCATION)	
TO (NEW LOCATION)	

COLLABORATOR(S) AT NEW LOCATION	
LASER LICENCE NUMBER	

DATE OF RETURN TO UTSA

The UTSA Laser Safety Officer (210-458-5807) must be contacted prior to any laser device being loaned out to another space at UTSA or off-campus. Once the device is back on campus, contact the LSO to confirm receipt of the device so records can be updated.

Date: ________________________________

Signature of the Principal Investigator

Date: ________________________________

Signature of the Laser Safety Officer

LASER EYEWEAR AUDIT AND INVENTORY FORM

Date:	P.I:	Laser Location:

Manufacturer	Model	Quantity	OD(s)	Wavelength (nm)	Passed* Inspection? (Y/N)	Notes
Comments:						

***Attenuation material must be clean and free of scratches, cracks, pits, discoloration, and coating damage. Frames on glasses shall have good mechanical integrity and goggles shall be free of weak elastic bands.**

Person Completing this Form		
Name:	**Signature:**	**Date:**

Keep form in Laser Safety Folder in laboratory. Laser eyewear inspection required to be performed and documented every six months per 25 TAC§289.301(t)(1)(E).

LASER ON-THE-JOB-TRAINING (OJT)

On-the-job-training (OJT) is designed to prepare trainees for job performance through one-on-one training and performance testing conducted by a qualified OJT instructor.

PI must develop a training package that can be used as a template in which all OJT steps are organized so it can be used by the OJT instructor at any time.

The OJT training SOP should cover the following points:

1. **Cover Page**: Title of training, PI, and/or trainer.
2. **Introduction**: List the purpose and scope of the training.
3. **Job description**: Provides a complete description of the job, duties, roles, and responsibilities of the laser user. This will state upfront what the user should be able to do once fully trained.
4. **Instructional Time**: Indicates an approximate time in hours, weeks, or months it will take to complete OJT training under ideal situations.
5. **Prerequisite Training**: Gives a list of prerequisite courses or reading required of the laser user before OJT training.
6. **List of skills as training objectives**: Includes a list of all skill objectives of the OJT training.
7. **List of knowledge objectives**: Includes a numbered list of all the skill objectives of the OJT training.
8. **Off-normal safety conditions**: Identifies what the OJT instructor and user will do during emergencies.
9. **Hazards and Safety Awareness**: Identifies the hazards associated with the performance of any of the tasks of which the laser user should be aware to work safely.
10. **Knowledge table**: Outlines each knowledge skill as taken from the list of knowledge objectives. This includes a sign-off and date section.
11. **Skills table**: Outlines each skill taken from the list of skills. This includes a sign-off and date section for a time and date entry for when the OJT trainer determines skill has been completed.
12. **OJT sign-off record page**: Provides a separate page at the end for the OJT trainer to date and sign after all the tasks have been satisfactorily completed.

LASER ON THE JOB TRAINING (OJT) TEMPLATE

PURPOSE: The purpose of this training is to provide sufficient practical training to work successfully and safely with Class 3B and 4 lasers. Users should be proficient on the OJT before PI/Manager signs off as complete.

This template can be used to create the Laboratory OJT SOP. Sign, date, and email LSO.

Name:

Employee I.D. (abc123):

Supervisor/ P.I:

Supervised On-The-Job-Training activities should include (but not limited to):

1. Completed Online Laser Training (SA465).
2. Laser Hazards (Specific to Laboratory Laser Device)
3. Good Laser Safety Practice
4. Emergency Procedures
5. Administrative and Engineering Controls for lasers
6. Proper Selection of Laser PPE (eyewear, clothing, barriers, etc.) and Use
7. Control Measures for Class 3b and Class 4 lasers
8. Non-Beam Hazards in the Laboratory (compressed gases, high voltage, cryogens, etc.)
9. Demonstrate Proper Use of Laser Interlock and Curtains.
10. Demonstrate Proper Emergency Shut-Down of Laser.
11. Hands-on Training On: Proper Clean-up of Laser Bench Area.
12. Hands-on Training On: Proper Set-up, Start-up, and Shut-Down of Laser.
13. Hands-on Training: On Proper Alignment Procedure
14. Hands-on Training: On Lock Out and Tag Out (LOTO) procedures

DATE	TIME	ACTIVITY	INSTRUCTOR	INITIAL