



Laser Safety Manual



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Table of Contents

1. Introduction
 - a. Purpose
 - b. Scope
 - c. Regulatory Basis
 2. Authority, Roles, and Responsibilities
 - a. Laser Safety Officer
 - b. Laser Safety Committee
 - c. Laser Supervisor
 - d. Authorized Laser User
 - e. Affected Worker
 3. Laser Classifications
 - a. Class 1
 - b. Class 2
 - c. Class 2M
 - d. Class 3R
 - e. Class 3B
 - f. Class 4
 4. Laser Safety Guidelines
 - a. Acquisition
 - b. Laser Registration
 - c. Laser User Registration
 - d. Laser Warning Signs
 - e. Protective Barriers
 - f. Non-beam Hazards
 5. Standard Operating Procedures
 - a. General Laser Laboratory Safety
 - b. Entryway Controls
 - c. Shared Laser/Non-Laser Space
 - d. Laser Eye Protection
 6. Emergencies and Incident Procedures
 7. Contact Information
- Appendix A: ANSI Z136.1
- Appendix B: Laser Registration Form
- Appendix C: Laser User Registration & Training
- Appendix D: Standard Operating Procedures Template
- Appendix E: Control Measures for Laser Classes
- Appendix F: Medical Surveillance
- Appendix G: Training Checklist
- Appendix H: Laser Laboratory Safety Checklist

1. Introduction

a. Purpose

The primary objective of Western Kentucky University's laser safety program is to ensure that no laser radiation in excess of the maximum permissible exposure (MPE) limit reaches the human eye or skin. Additionally, the program is designed to ensure that adequate protection against collateral hazards is provided. These collateral hazards include, but are not limited to, the risk of electrical shock, fire hazard from a beam or from use of dyes and solvents, chemical exposures from use of chemicals and vaporization of targets, and the emission of ionizing and non-ionizing radiation from power supplies associated with the operation of the laser or laser system.

b. Scope

Western Kentucky University's laser safety program is applicable to all research and academic applications and uses of laser radiation. This manual is designed to function in conjunction with the Chemical Hygiene Plan, existing laboratory standard operating procedures; as well as, in submission to the authorities of the Institutional Biosafety Committee, Institutional Review Board, and Institutional Animal Care and Use Committee.

This manual shall be available for reference by all laser users at the university. It is the responsibility of the Laser Supervisor (i.e. principal investigator, faculty member, laboratory coordinator/supervisor) to maintain this manual for reference purposes. All persons using lasers shall be familiar and comply with all requirements of this manual.

c. Regulatory Basis

It is considered a privilege to use lasers (non-ionizing radiation) at Western Kentucky University (hereafter, "WKU"). That privilege requires each individual user to follow and adhere to the American National Standard Institute guidelines on laser safety.

WKU requires that all Class 3B and Class 4 lasers and laser systems be operated in accordance with the American National Standards Institute (ANSI) Z136.1, "Safe Use of Lasers" and other applicable federal and state regulations. To that end, WKU adopts ANSI Z136.1 as its laser safety program. Exceptions to this standard will be considered on a case-by-case basis by the Laser Safety Officer (LSO). The LSO shall document and keep record of any policy decisions that are exceptions to the ANSI Z136.1 standard.

All Class 3B and Class 4 laser operations at the university shall be registered with, reviewed and approved by the LSO. The LSO shall subsequently notify the Kentucky Supervisor of Radiation Producing Machines, Radiation Health Branch, Cabinet for Health and Family Services, Department of Public Health, of any Class 3B and Class 4 lasers or laser systems

possessed by the university. The LSO shall also notify this person of the disposal of any Class 3B or Class 4 lasers or laser systems.

Though not required by this policy, guidance is available from the LSO and in ANSI Z136.1 for Class 1, Class 2, and Class 3R lasers.

2. Authority, Roles, and Responsibilities

a. Laser Safety Officer

The Laser Safety Officer (LSO) is an individual that will affect the knowledgeable evaluation and control of laser hazards, and have the responsibility and authority to monitor and enforce the control of laser hazards. At the current time, WKU's LSO is Sarah Grant. In an effort to make the laser safety program effective, the LSO will be given authority to accompany the responsibility of the position.

The LSO shall be designated for all circumstances of operation, maintenance, and service of a Class 3B or Class 4 laser or laser system.

- i) LSO Specific Responsibilities
 - a. Classification or verification of laser classification for Class 3B or Class 4 lasers or laser systems
 - b. Hazard evaluation of laser areas, including Nominal Hazard Zones (NHZ)
 - c. Recommendation or approval and auditing of functionality of control measures
 - d. Approval of Standard Operating Procedures (SOPs) and alignment procedures
 - e. Provide guidance for proper protective eyewear, barriers, etc.
 - f. Provide appropriate warning signs for posting and labeling
 - g. Approve of laser facilities, laser equipment, and modification of existing prior to use
 - h. Conduct periodic safety audits of laser facilities and equipment
 - i. Assist Laser Supervisors with safety education and training
 - j. Determine need for medical surveillance
 - k. Additional
 - 1. Provide consultative services on laser hazard evaluation and controls and on personnel training programs
 - 2. Establish and maintain adequate policies/procedures for the control of laser hazards
 - 3. Suspend, restrict, or terminate laser or laser system operation if laser hazard controls are determined inadequate

4. Maintain records of all Class 3B and Class 4 lasers and laser operators as property of the university.
5. Survey by inspection all areas where laser equipment is used and ensure corrective action is taken where required
6. Participate in accident investigations involving lasers
7. Approve laser or laser systems for operation

b. Laser Safety Committee

At this time, it is not considered necessary to create a formal Laser Safety Committee at Western Kentucky University due to the limited number of Class 3B and Class 4 lasers and laser systems. However, the LSO will consult with various laser-knowledgeable people for the review of Laser Registrations and for the consideration of laser issues as deemed necessary by the LSO.

c. Laser Supervisor

The laser supervisor, for the purpose of authority and responsibility, is any WKU principal investigator, laboratory supervisor, or faculty member operating or overseeing the operation of lasers on any of its campuses in research or academic settings. The laser supervisor must be knowledgeable of the requirements for laser safety, the potential laser hazards and associated control measures for all lasers and laser systems, education and all policies, practices and procedures pertaining to laser safety at locations under the supervisor's authority.

- i) Laser Supervisor Specific Responsibilities
 - a. Comply with the requirements of the Laser Safety Manual and the LSO
 - b. Provide training on laser hazards and their control to all personnel who may work with lasers under his/her jurisdiction
 - c. Write and be familiar with the standard operating procedures for Class 3B and Class 4 lasers and ensure that these procedures are provided to/upheld by users of such lasers
 - d. Not permit the operation of a laser unless there is adequate control of laser hazards to employees, visitors, and the general public
 - e. Submit the names of individuals scheduled to work with lasers to the LSO
 - f. Submit information as requested by the LSO for medical surveillance and training completion
 - g. Immediately notify the LSO of known or suspected accidents resulting from lasers operated under his/her authority
 - h. Not permit operation of a new or modified laser under his/her authority without approval of the LSO

- i. Make sure that plans for laser installation or modifications of installations are submitted to the LSO for approval

- d. Authorized Laser User

Laser Users include faculty members, researchers, graduate and undergraduate students, operators, technicians, engineers, maintenance and service personnel, and any other personnel, working with lasers.

Laser Users shall use laser equipment in accordance with this Laser Safety Policy, ANSI Z136.1 and direction from his/her Laser Supervisor and the LSO. A laser user will not energize or work with or near a laser unless authorized to do so by the supervisor for that laser. The laser user will be familiar with all operating procedures. Laser users are required to be trained annually and registered with the LSO prior to using lasers. See [Appendix C](#).

When a laser user knows or suspects that an accident has occurred involving that laser, or a laser operated by another employee, and that such accident has caused an injury or could potentially have caused an injury, he or she will immediately inform the supervisor. If the supervisor is not available, the employee will notify the LSO.

- e. Affected Workers

Affected workers include non-operators that share or occupy laser-user laboratory space, encounter laser equipment, or enter laser facilities or laboratories commonly in the course of their day-to-day activities.

The university determined that affected workers need to know the risks and hazards associated with laser use, as well as how to safeguard themselves against accidental exposure or encountering lasers or laser systems that are in use.

3. Laser Classifications

The basis for laser safety requirements is provided by the ANSI Z136.1 standard and the Federal Laser Products Performance Standard that all lasers and laser systems in the United States are classified. The manufacturer or builder must classify lasers. The ANSI Z136.1 standard is enforced by the Occupational Safety and Health Administration (OSHA). Lasers and laser systems are classified by their potential hazard from Class 1 through Class 4 based on the laser beam's ability to cause biological damage to the eye and skin, and pose a fire hazard. Class 1 lasers and laser systems' beams are considered non-hazardous while Class 4 lasers possess the highest potential hazard. Laser hazard classification is based on the accessible laser emission during normal operation.

Below describes the classification for continuous-wave lasers.

- a. Class 1 Lasers

- i. Class 1 lasers or laser systems may produce visible or invisible laser radiation. Under all normal conditions of operation, Class 1 lasers are considered to be incapable of causing injury from directly viewing the beam unless the beam is viewed with an optical instrument such as an eye-loupe (diverging beam) or telescope (collimated beam)
 - ii. Exempt from any control measures other than to prevent potentially hazardous optically aided viewing; and is exempt from other forms of surveillance.
 - b. Class 2 Lasers
 - i. Class 2 lasers produce low-power visible laser radiation (usually 0.4 to 0.7 μm). The output power of a Class 2 laser does not exceed 1 mW, and eye protection is normally afforded by the natural aversion response time (blink reflex, 0.25s). Direct viewing of Class 2 laser radiation is prohibited by this standard.
 - c. Class 2M laser system
 - i. Emits in the visible portion of the spectrum (0.4-0.7 μm) and eye protection is normally afforded by the aversion response for unaided viewing. However, Class 2 M is potentially hazardous if viewed with certain optical aids.
 - d. Class 3R Lasers
 - i. May be hazardous under direct and specular reflection viewing conditions, but is normally not a diffuse reflection or fire hazard.
 - ii. Potentially hazardous under some direct and specular reflection viewing conditions if the eye is appropriately focused and stable, but that probability of an actual injury is small. The laser will not pose either fire hazard or diffuse-reflection hazard.
 - e. Class 3B Lasers
 - i. May be hazardous under direct and specular reflection viewing conditions, but is normally not a diffuse reflection or fire hazard.
 - f. Class 4 Lasers
 - i. A Class 4 laser system (high power) is a hazard to the eye or skin from the direct beam, and may pose a diffuse reflection or fire hazard
 - ii. May also produce laser generated air contaminants (LGAC) and hazardous plasma radiation.
- 4. Laser Safety Guidelines
 - a. Acquisition: Notify the Laser Safety Officer of any decision to purchase, fabricate, or otherwise acquire a 3R, 3B, or Class 4 laser or laser system. The LSO will review the hazards of the proposed device and assist the end user in compliance regarding the specific safety requirements that pertain to the proposed use, including but not limited to requirements for SOPs, laser control areas, training, and personnel protective equipment.

- b. All Class 3B and 4 lasers must be registered with the LSO in WKU Environmental Health and Safety prior to installation and use. This may be accomplished by completing the laser registration form in [Appendix B](#).
 - c. All Class 3B and 4 laser users must be registered with Environmental Health and Safety prior to working with Class 3B or 4 lasers. The laser user registration form is located in [Appendix C](#).
 - d. Laser Warning Signs
 - i. Lasers and laser systems shall have appropriate warning signs based on the hazard analysis and subsequent classification as Class 1, 1M, 2, 2M, 3R, 3B, or 4.
 - ii. Appropriate “signal” words such as “Caution”, “Danger”, “Do Not Stare into Beam”, and others shall be utilized to warn both trained and untrained personnel that may enter into areas where lasers or laser systems are in use.
 - iii. “CAUTION” shall be used for Class 1, 1M, 2, 2M, and 3A lasers/laser systems.
 - iv. “DANGER” shall be used for Class 3R, 3B, and 4 lasers/laser systems.
 - v. ANSI Z136 shall be consulted for requirements surrounding signage requirements.
 - e. Protective Barriers
 - i. A screen or curtain suitable to laser safety may be required in some laboratory setups in order to reduce the accessible emission levels to below the MPE in order to protect personnel in and out of the laser controlled areas of the laboratory.
 - 1. “Suitable”, as above, refers to laser resistant in the case of light emission, any wavelength, and fire retardant, if necessary.
 - ii. Barriers and curtains shall be labeled with appropriate wavelength and optical density capabilities.
 - f. Non-beam Hazards
 - i. Lasers are physical agents that can cause electric shock, sparking and ignition of flammable materials, as well as, generate airborne contaminants, and cause fires. These hazards should be addressed in laboratory-specific procedures, in conjunction with the university Fire Marshal.
 - ii. Compressed gases, laser dyes, and solvents must also be used in a safe manner when utilizing laser or laser systems which contain these aspects of operation.
 - iii. As previously stated, electrical, chemical, biological, radiological and other non-beam hazards will be under appropriate governing guidelines to best eliminate their threat.
- ## 5. Standard Operating Procedures

Standard operating procedures are a tool to reduce risk of inappropriate conduct, accidental hazards, and undue hazards.

- a. General Laser Safety Procedures

- i. Only trained, authorized users may operate lasers. Authorization is received from the Laser Safety Officer.
 - 1. Laser operation is discouraged in the presence of visitors.
 - ii. Never put yourself into any position where your eyes approach the axis of a laser beam (with or without eye protection).
 - iii. Keep beam paths below or above standing or sitting eye level.
 - iv. Do not damage laser protective housings, or override the interlocks on these housings.
 - v. Eliminate all reflective materials from the vicinity of the beam paths.
 - vi. Before operating the laser, warn all personnel and visitors of the potential hazard, and ensure all safety measures are satisfied.
 - vii. Never use viewing instruments to look directly into a laser beam or its specular reflection. An appropriate filter should be installed into the optical element assembly, if it becomes necessary.
 - viii. Keep ambient light levels as high as operations will permit
 - ix. Do not work alone when performing high power laser operations.
- b. Entryway Controls
- i. Class 3B Laser Laboratories
 - 1. Doors must be closed and locked during laser operations.
 - 2. Doors must be properly posted and the warning light energized during operations.
 - 3. Door windows and laboratory windows must be covered to prevent the escape of a laser beam, unless an interlocked laser beam path enclosure is provided.
 - ii. Class 4 Laser Laboratories
 - 1. Class 4 Laser Laboratories must have either LSO approved entryway controls or an installed LSO certified laser enclosure system.
 - 2. Overriding any safety control is considered a serious violation of safety rules. Overriding actions include, but are not limited to, defeating of interlocks, removal of external shutter from the beam path, rewiring laser interlock connectors.
- c. Shared Laser/Non-Laser Space
- i. Class 3B and Class 4 Laser laboratories should be arranged so that non-laser personnel will not have to pass through laser areas to enter or leave the laboratory. This can be accomplished through laboratory design, movable partitions or interlocked curtains.
- d. Laser Eye Protection
- i. Laser protective eyewear must be worn whenever you are within the Nominal Hazard Zone (NHZ).

- ii. The NHZ is defined as that area within which the laser beam power exceeds maximum permissible exposure levels. During maintenance or alignment operations, the NHZ extends to the entire laboratory or to the partitioned laser use area.
- iii. Eyewear must be of the correct optical density and offer protection at the wavelength(s) of the laser(s) being used.
- iv. Eyewear will only protect your eyes for short time periods, based on laser power. Do not look directly into any laser beam, even with laser eye protection on.
- v. Periodically inspect and replace damaged or defective eyewear.

6. Emergencies and Incident Procedures

- a. A clearly marked “Emergency Stop” button or other actuating device shall be available and clearly marked for deactivating the laser output.
 - i. In the event of an unplanned event or emergency, laser beam termination should be the utmost priority, if possible.
- b. Emergency procedures must be posted and visible to the laser user.
- c. Persons receiving or suspected of having received a harmful laser beam or non-beam hazard exposure must report such a fact or suspicion immediately to his/her Laser Supervisor and to the Laser Safety Officer.
- d. Laser Supervisors’ contact information and emergency information shall be posted in a conspicuous location in the laser area.
- e. For emergencies, call 911 or 5-2548 from campus phones to reach the WKU Police Department.

7. Contact Information

The following positions will be the primary contact in WKU Environmental Health and Safety regarding collateral hazards such as electrical, radiation, fire, chemicals, and air contaminants.

In the case of emergency and/or after hours, please call the police department and the LSO.

- a. Laser Safety Officer, 270-745-3597
- b. Fire Safety/Fire Extinguisher Selection
 - i. Fire Marshal, 270-745-2931
- c. Hazardous Waste Disposal
 - i. Manager, Laboratory Safety and Environmental Compliance, 270-745-3268
- d. Chemical Hazards
 - i. Laboratory Safety Officer, 270-745-8730
- e. Air Contaminants/Air Quality
 - i. Air Quality Specialist, 270-745-2333
- f. Radiation Safety
 - i. Radiation Safety Officer, 270-745-3597

Appendix A: ANSI Z136.1

ANSI Z136.1-2014 Safe Use of Lasers is incorporated by reference. Contact the Laser Safety Officer for information on obtaining the most recent copy of this standard.

Appendix B: Laser Registration Form

All Class 3B and 4 lasers are required to be registered with the WKU Laser Safety Officer. Complete this form and forward to: Laser Safety Officer, Environmental Health & Safety, Fax: 270-745-5037

User Information

Laser Supervisor: _____ Phone: _____

Other Laser User: _____ Phone: _____

Other Laser User: _____ Phone: _____

Other Laser User: _____ Phone: _____

Laser Information

Laser Manufacturer: _____

Model Number: _____

Serial Number: _____

Laser Location: _____		
Department	Building	Room Number

Laser Status: Operable Inoperable Stored Other _____

Laser Type (Nd:YAG, CO₂, etc): _____

Classification (3B or 4): _____

Wavelength (nm): _____

Beam Diameter at Exit of Laser(mm): _____

Purpose or Use: _____

Laser Supervisor's Signature

Date

Appendix C: Laser User Registration & Training Form

All Class 3B and 4 laser users are required to be declared with the WKU Laser Safety Officer. Complete this form and forward to: Laser Safety Officer, Environmental Health & Safety, Fax: 270-745-5037

Name _____ Phone _____
 Department _____ Building _____
 Laser Supervisor _____ Room Number _____

List all laser or laser safety training course work completed. Note all the dates completed, duration (hours of course) and brief description. Affix training materials to the record. See [Appendix G](#) for list of training topics.

Date Completed	Duration of Training	Description of Training

Laser User Signature _____ Date _____

Laser Supervisor Signature _____ Date _____

Appendix D: Standard Operating Procedure (SOP) Template

This is an outline of the minimum requirements for a laser operation SOP. Certain applications may require additional information.

1. Introduction
 - a. Description of laser type and wavelength
 - b. Intended application
 - c. Location
 - d. Average power or pulse energy
 - e. Pulse duration and repetition rate
 - f. Beam diameter and divergence
2. Hazards
 - a. Eye and skin hazards from direct and diffuse exposures
 - b. Electrical hazards
 - c. Laser generated air contaminants
 - d. Other recognized hazards
3. Control Measures
 - a. List control measures for each hazard
 - i. Eyewear requirement, include wavelength and OD
 - ii. Description of controlled area and entry controls
 - iii. Reference to equipment manual
 - iv. Alignment procedures (or guidelines)
4. Training Requirements
 - a. State the specific training requirements for authorized users
5. Emergency Procedures
 - a. List actions to be taken in case of emergency and personnel to be contacted
6. Approved Personnel
 - a. List by name all individuals who are approved to operate the laser in a Class 4 state (may be maintained separately)

Appendix E: Control Measures for Laser Classes

Table below is Table 10a of ANSI Z136.1-2014 for Safe Use of Lasers

Engineering Control Measures	Classification						
	1	1M	2	2M	3R	3B	4
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
Service Access Panel (4.4.2.1.4)	∇	∇	∇	∇	∇	X	X
Key Control (4.4.2.2)	—	—	—	—	—	•	•
Viewing Windows, Display Screens and Diffuse Display Screens (4.4.2.3)	Ensure viewing limited < MPE						
Collecting Optics (4.4.2.6)	X	X	X	X	X	X	X
Fully Open Beam Path (4.4.2.7.1)	—	—	—	—	—	X NHZ	X NHZ
Limited Open Beam Path (4.4.2.7.2)	—	—	—	—	—	X NHZ	X NHZ
Enclosed Beam Path (4.4.2.7.3)	Further controls not required if 4.4.2.1 and 4.4.2.1.3 fulfilled						
Area Warning Device (4.4.2.8)	—	—	—	—	—	•	X
Laser Radiation Emission Warning (4.4.2.9)	—	—	—	—	—	•	X
Class 4 Laser Controlled Area (4.4.2.10 and 4.4.3.5)	—	—	—	—	—	—	X
Entryway Controls (4.4.2.10.3)	—	—	—	—	—	—	X
Protective Barriers and Curtains (4.4.2.5)	—	—	—	—	—	•	•

LEGEND: X Shall
 • Should
 — No requirement
 ∇ Shall if enclosed Class 3B or Class 4
 NHZ Nominal Hazard Zone analysis required

Table below is Table 10b of ANSI Z136.1-2014 for Safe Use of Lasers

Administrative (and Procedural) Control Measures	Classification						
	1	1M	2	2M	3R	3B	4
Standard Operating Procedures (4.4.3.1)	—	—	—	—	—	•	X
Output Emission Limitations (4.4.3.2)	—	—	—	—	LSO Determination		
Education and Training (4.4.3.3)	—	•	•	•	•	X	X
Authorized Personnel (4.4.3.4)	—	—	—	—	—	X	X
Indoor Laser Controlled Area (4.4.3.5)	—	◦	—	◦	—	X NHZ	X NHZ
Class 4 Laser Controlled Area (4.4.2.9 and 4.4.3.5)	—	—	—	—	—	—	X
Temporary Laser Controlled Area (4.4.3.5)	∇ MPE	∇ MPE	∇ MPE	∇ MPE	∇ MPE	—	—
Controlled Operation (4.4.3.5.2.1)	—	—	—	—	—	—	•
Outdoor Control Measures (4.4.3.6)	X	◦ NHZ	X NHZ	◦ NHZ	X NHZ	X NHZ	X NHZ
Laser in Navigable Airspace (4.4.3.6.2)	•	•	•	•	•	•	•
Alignment Procedures (4.4.3.8)	∇	X	X	X	X	X	X
Spectators (4.4.3.7)	—	◦	—	◦	—	•	X
Service Personnel (4.4.3.9)	LSO Determination						

- LEGEND:
- X Shall
 - Should
 - No requirement
 - ∇ Shall if enclosed Class 3B or Class 4
 - MPE Shall if MPE is exceeded
 - NHZ Nominal Hazard Zone analysis required
 - May apply with use of optical aids

Table below is Table 10c of ANSI Z136.1-2014 for Safe Use of Lasers

Personal Protective Equipment PPE	Classification						
	1	1M	2	2M	3R	3B	4
Laser Eye Protection (4.4.4.1)	—	—	—	—	—	X	X
Skin Protection (4.4.4.3)	—	—	—	—	—	•	•
Protective Clothing (4.4.4.1 and 4.4.4.3.1)	—	—	—	—	—	•	•

LEGEND: X Shall
 • Should
 — No requirement

Appendix F: Medical Surveillance

Any individual with an actual or suspected laser-induced injury should report to their supervisor and be evaluated by a medical professional as soon as possible after the actual or suspected exposure.

Medical surveillance is recommended, not required, for Class 3B and Class 4 laser or laser system users at WKU. Medical surveillance is the responsibility of the Laser Supervisor for his/her personnel in the laboratory.

Appendix G: Training Checklist

The Laser Safety Officer shall ensure that all individuals using Class 2, 2M, 3R, 3B, and 4 lasers complete a comprehensive training program, commensurate with the hazards. The below topics are the minimum to be included.

✓	Date of Training	Topic
		Fundamentals of laser operation (physical principles, construction, etc.)
		Biological effects of laser radiation on the eye and skin
		Standard Operating Procedures (SOPs)
		Laser classification
		Laser protective equipment
		Laser signs and labels
		Control measures: engineering and administrative
		Emergency procedures in case of an accident/incident
		Non-beam hazards

Appendix H: Laser Safety Checklist

Building: _____ Room Number: _____ Laser Supervisor: _____

Date: _____ Laser Classification: _____ Phone Number: _____

General Laser Safety

These general precautions are applicable to all class 1, class 2, class 3, and class 4 laser systems. Class 1, 2, or 3A laser systems that enclose higher class lasers must comply with the requirement of the higher class laser during alignment, service procedures, and other operations that permit beam access. Fabricated or modified laser systems shall be evaluated by the Laser Safety Officer and, if necessary, reclassified. Areas in compliance with current standards should have all applicable items answered as “yes.”

	Yes	No	N/A
Administrative and Procedural Controls			
1. Is the laser system classified appropriately?			
2. Is the laser system included in the WKU inventory?			
3. Are the class designation and warning labels prominently affixed to the laser housing?			
4. Do the beam alignment procedures maintain exposures below MPE?			
5. Is the beam directed away from doors and windows?			
6. Has the beam path been leveled to avoid normal sitting or standing eye position?			
Engineering Controls and Protective Equipment			
7. Is a protective housing or enclosure present and in good condition?			
8. If the laser is operated without a protective housing, has a hazard analysis been conducted and the appropriate controls been implemented?			
9. Are protective housings enclosing class 3B or 4 lasers equipped with interlocks?			
10. Are the service access panels for any embedded 3B or 4 lasers equipped with an interlock, key access, or similar barrier?			
11. Do the viewing windows or portals attenuate radiation to below MPE?			
12. Can viewing windows or portals withstand direct and diffusely scattered beams?			
13. Do the collecting optics maintain exposures below MPE?			
14. Is a temporary laser controlled area established when MPE is exceeded?			
Non-Beam Hazards			
15. Is all high voltage equipment properly grounded?			
16. Is all high voltage equipment located away from wet surfaces or water sources?			
17. Are high voltage warning labels in place?			
18. Are compressed gases properly secured?			
19. Are flammable and oxidizing materials stored away from the laser area?			
20. Are hazardous chemicals stored away from laser area and NOT used?			

Class 3B and 4 Lasers - Additional precautions for class 3B or 4 laser systems.	Yes	No	N/A
Administrative and Procedural Controls			
1. Has a Laser Safety Officer(LSO) been designated?			
2. Is the LSO empowered with decision making and enforcement authority?			
3. Has the Nominal Hazard Zone been established and demarcated for unenclosed systems?			
4. Have warning signs and labels been placed at the entrance(s) to the nominal hazard zone?			
5. Are only authorized laser users permitted to operate lasers?			
6. Are education and training provided to all authorized laser users and documented?			
7. Has a laser controlled area been established?			
8. Have medical surveillance procedures been implemented for both incidental and laser personnel?			
Engineering Controls and Protective Equipment			
9. Is the service access equipped with an interlock, key access, or similar barrier?			
10. Are skin protection and protective eyewear used for open-beam UV lasers?			
11. Is skin protection used when UV exposures exceed MPE?			
12. Are barriers, screens, and curtains flame resistant?			
13. Do barriers, screens, and curtains avoid release of toxic fumes following laser exposure?			

Class 4 Lasers In addition to the requirements for lower class systems, class 4 laser systems must also meet the following:	Yes	No	N/A
Administrative and Procedural Controls			
1. Is the laser area free from polished or reflective surfaces?			
2. Is an activation warning system used during activation or startup?			
3. Are written SOPs for laser use and maintenance operations (including beam alignment available)?			
4. Are spectators only permitted with supervisory approval, appropriate training, and protective measures in place?			
Engineering Controls and Protective Equipment			
5. Is a master switch/key control available?			
6. Is a remote interlock connected an emergency disconnect/interlock?			
7. Is an "emergency stop" button available for emergency deactivation?			
8. Is laser protective eye wear available and in good condition?			
9. Is protective eye wear of appropriate optical density for the laser system?			
10. Is the protective clothing made of flame resistant materials?			
11. Is there a permanently attached beam stop or attenuator?			
12. Have control measures (e.g., isolation, local ventilation, PPE) been implemented for the vaporization of target materials and other laser generated air contamination?			

