



**University of Massachusetts Lowell**  
**Environmental & Emergency Management**

# Laser Safety Guide



*2015 Revision*

**In the event of a Laser Emergency:**

Call the *Radiation Safety Office:*

(978) 934-3373

(978) 934-3372

If unavailable or after regular working hours:

Call *University Police:*

(978) 934-4911

UNIVERSITY OF MASSACHUSETTS LOWELL

# Laser Safety Guide

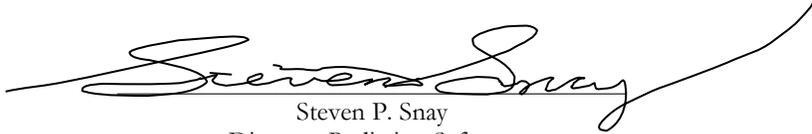
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Issued on February 5, 2015

by vote of the Non-Ionizing Radiation Safety Subcommittee. This document is to be followed under order of the Chancellor of the University of Massachusetts Lowell

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APPROVALS:



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# PREFACE

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This Laser Safety Guide contains the policies, regulations, and recommended procedures for the safe use of lasers and laser systems at the University of Massachusetts Lowell. The guide is incorporated as a condition that upon registering with the Massachusetts Department of Public Health each laser or laser system at the university must be adhered to by all laser users. Although overall responsibility for laser safety rests with the university, basic responsibility for the protection of life and property must be assumed by the individual user of the laser system. Thus, an individual desiring to use lasers or laser systems must possess acceptable qualifications and follow designated policies and procedures as outlined in this guide.

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## Introduction

*The use of lasers and laser systems are strictly regulated by federal and state agencies to ensure the safety of the laser worker and the public. It is important for all individuals within this university who use lasers or laser systems to read and abide by the rules documented within this guide.*

**L**asers and lasers systems are valuable tools used in areas as diverse as medicine, biology, chemistry, engineering, and physics. Yet, if used improperly, they have the potential of being hazardous to us or our environment. Therefore, individuals using lasers must understand the hazards and precautions associated with them and are required to comply with relevant federal, state, and university laser safety regulations and standard practices.

Lasers at the University of Massachusetts Lowell (UML) are regulated by the Commonwealth of Massachusetts Department of Public Health (DPH). Through this agency, the University has authority to manage its campus laser safety program. As part of the state regulations, the University is required to register all applicable lasers with the DPH and to appoint a Laser Safety Officer (LSO) to develop and manage the university laser safety program. The LSO has created a Non-Ionizing Radiation Safety Subcommittee (NIRSS) that will convene to discuss and regulate laser safety on the campus. This program is subject to periodic audits by the DPH to verify our regulatory compliance and to ensure the safety of university personnel and members of the public.

This Laser Safety Guide describes the organization of the Non-Ionizing Radiation Safety Subcommittee, the Radiation Safety Office and the services available to all users of laser and laser systems. This guide is consistent with the applicable Federal and State regulations. Since registration of lasers with the DPH does not in itself ensure a safe program, additional rules and procedures have been specified in this Guide to enhance our Laser Safety Program.



## Laser Safety Policy

*The University of Massachusetts Lowell is committed to maintaining the highest standards of laser safety to that end it is prudent to practice laser safety techniques and protocols to minimize unnecessary exposures to laser radiation.*

The objective of this laser program is to “provide reasonable and adequate guidance for the safe use of lasers and laser systems.” (ANSI Z136.1-2014)

The laser safety program at UML primarily consists of the following elements:

- A. Training: A laser safety training program is provided by the radiation safety office. The goal of this program is to allow those individuals who may come in contact with lasers or laser systems to recognize and protect themselves from lasers. A more comprehensive lab specific training is required from the labs Primary Investigator, or designee, to detail the standard operating procedures and laser specific requirements of that lab.
- B. Laser Surveys: A laser survey program is used to check each area where lasers are used. Laboratories are checked to ensure proper techniques are used during procedures involving Lasers and Laser systems.
- C. Safety Reviews: The LSO and the UML Non-ionizing Radiation Safety Subcommittee reviews and approves new lasers users and laboratories. The LSO approves minor alterations to an already approved laser laboratory in which the potential for laser injury increases or the laser system will be altered.

# ORGANIZATION, AUTHORITY, AND RESPONSIBILITY

The organization, authority, and responsibility for the UMass Lowell laser safety program are presented in Figure 1. The main components of the UMass Lowell Laser Safety Program are:

- A. Radiation Safety Office,
- B. Radiation Safety Committee and Non-ionizing Radiation Safety Subcommittee,
- C. Primary Investigator of lasers and laser systems,
- D. Laser Worker (denoted as laboratory staff).

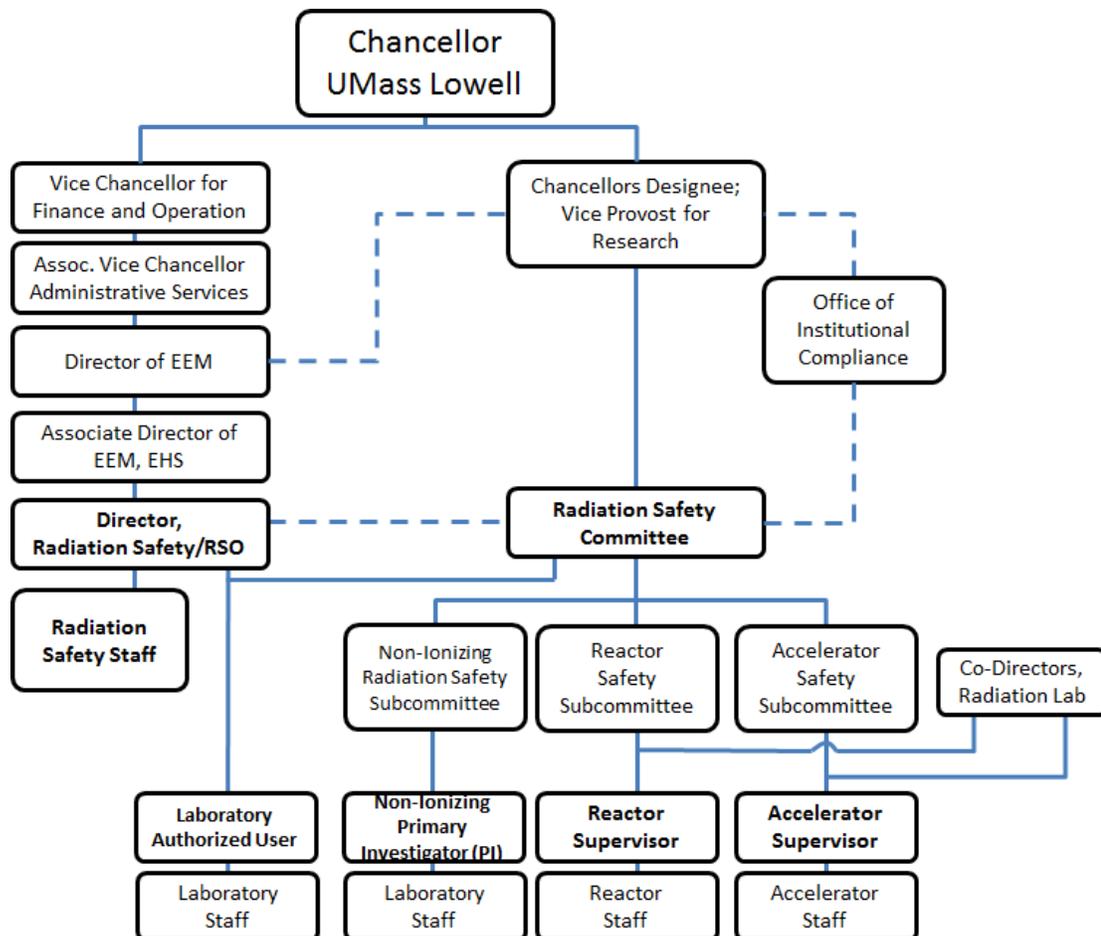


Figure 1: Organizational Chart of the UMass Lowell Radiation Safety Program



## Radiation Safety Office

### **General:**

The Radiation Safety Office, managed by the Director of Radiation Safety, is responsible for assuring compliance with relevant Federal, State, and University regulations and enforces policies established by the Radiation Safety Committee. The Assistant Radiation Safety Officer is a member of the Radiation Safety Office and is the campus designated Laser Safety Officer. The Radiation Safety Office maintains the staff adequate to assure the safe use, storage, and disposal of lasers and is authorized to intervene to prevent hazardous conditions from developing or to eliminate existing unsafe conditions on any matter related to laser safety.

*In this capacity, the Radiation Safety staff is granted the right to immediately stop all laser related work in a laboratory determined to be out of compliance with accepted laser safety standards and practices.*

Such stoppages may proceed for no more than forty eight hours without the expressed approval of either the Laser Safety Officer or the Chairman of the Non-Ionizing Radiation Safety subcommittee or, in their absence, their designee. Members of the Radiation Safety Office have the right to petition the Radiation Safety Committee to ban workers or laboratories from using lasers or laser systems if these individuals or laboratories have been identified as exhibiting a history of non-compliance with university, state, or federal rules and regulations. The Laser Safety Officer reserves the right to revoke any member's ability to use lasers in the event that they are found to abuse this policy.

### **Laser Safety Officer:**

The laser safety program is managed by the Assistant Radiation Safety Officer (ARSO). The ARSO oversees the daily affairs of the campus laser safety program and is registered with the commonwealth of Massachusetts department of public health as the Laser Safety Officer (LSO). As the Laser Safety Officer, the ARSO is responsible for developing and managing the laser safety program within the limits set forth by federal and state regulations. This program contains the policies and procedures relating to the safe use of lasers in the University and is distributed in the form of a Laser Safety Guide for the university.

Applications for the purchase, use, or disposal of lasers shall be reviewed by the LSO and may approve the purchase of lasers. With agreement from the laser Primary



Investigator, or their designees, the LSO may also approve applications for routine laser use provided that such use has been previously reviewed by the Non-ionizing Radiation Safety Subcommittee. The LSO can implement alternative control methods as long as they are in accordance with the state regulations.

Researchers wishing to perform a new, and therefore un-reviewed, experiment using lasers or laser systems must submit an application to the LSO for a laser safety review. The LSO shall review the protocol (description of research, training criteria, facility layout, standard operating procedures and alignment procedures) for content and, when complete, submit it to Non-ionizing Radiation Safety Subcommittee (NIRSSC). The Committee will directly review the application for issues relating to safety. The LSO can approve a lab and laser use but the NIRSSC can review, require additional information, and if needed, overturn the LSO's approval of a lab. As a requirement of the UMass Lowell radiation safety program, the LSO will serve as secretary to the Non-ionizing Radiation Safety Subcommittee and report back to the Radiation Safety Committee.

In his/her absence, the LSO may designate an individual to act on their behalf for all management, safety, and approval issues related to the campus laser safety program.

### **Radiation Safety Office List of Laser Services:**

The Radiation Safety Office provides the following laser safety related services:

1. Laser hazard evaluation and classification,
2. Procedure and protective equipment approvals,
3. Facility and equipment reviews, surveys, and inspections,
4. Emergency Medical surveillance,
5. Consultation services,
6. Emergency assistance,
7. Laser safety training and retraining,

These services are explained in Appendix II.



## Radiation Safety Committee and Subcommittees

### **Membership:**

The members of the Radiation Safety Committee are appointed by the Chancellor (or designee) of the University of Massachusetts Lowell (UML) and are selected to represent broad areas or divisions within the university of individuals who use or encounter radiation sources.

### **Committee Responsibilities, Delegation of Authority, and Subcommittees:**

The Radiation Safety Committee is responsible for assuring that an adequate safety program is developed and implemented within the university and publicizes campus radiation safety policy, regulations, and procedures. The Radiation Safety Committee may delegate its authority to various persons, ad hoc subcommittees, and standing subcommittees. To ensure good communication between programs and to verify that activities are carried out according to established policies and procedures, the Director of Radiation Safety shall be a permanent member of the Radiation Safety Committee and of all of its subcommittees."

The Radiation Safety Committee is responsible to hold quarterly meetings to discuss radiation related safety issues and to review issues discussed in the Safety Subcommittees. The RSC shall also provide an annual review or audit of the UML radiation safety program.

The Non-Ionizing Radiation Safety Subcommittee reviews the safety aspects of laser and other non-ionizing use at UMass Lowell. Subcommittee members are appointed by the Radiation Safety Committee and include the Laser Safety Officer, Director of Radiation Safety (DRS), Laser Primary Investigator, persons with training and experience in laser safety and operations, and persons with specific expertise in various laser related scientific and engineering experimental disciplines. Decisions of the Subcommittee are binding subject to the ultimate approval by the Committee.

### **Committee Meetings:**

The Radiation Safety Committee and Reactor Safety Subcommittee are required to hold quarterly meetings. All committees must hold a meeting within thirty days of a committee member presenting a formal request to the DRS. Binding committee decisions require a majority of the members to be present including the DRS or his/her designee. Minutes of the meeting will be recorded and kept on file for review.



## Primary Investigator

The Primary Investigator (PI) is responsible for safe and proper use, storage, and disposition of lasers or laser systems within an approved laser laboratory. An approved laser laboratory is a laboratory which has been reviewed by and approved for laser use through the Non-Ionizing Radiation Safety Subcommittee (NIRSSC).

*No laboratory or individual shall use or dispose of lasers of classes 3b or 4 unless it has been approved by the LSO.*

The Primary Investigator shall verify that all persons within his/her laboratory are properly trained and aware of the laser hazards and responsibilities associated with operating a laser laboratory. The PI assumes responsibility for assuring that his/her laser laboratory is fully compliant with all federal, state, and university regulations and that the laboratory follows the procedures documented in this guide.

### **Requirements for Authorization:**

1. The individual desiring to become an AU must be on staff or formally associated with either the University of Massachusetts Lowell or the UML Research Foundation. In certain cases where technically qualified individuals from outside UML request use of a particular source/facility to carry out a relatively long-term or repetitive experiment such individuals may be given temporary use authorizations. Under such authorizations the individuals are governed by the same requirements as any other UML Primary Investigator.
2. The individual must have adequate experience and training for the requested authorization.
3. The individual must be familiar with the requirements of this guide and have made adequate provisions for radiation safety and control.
4. Facilities and equipment for safe conduct of activities must be available. A laser laboratory must also meet other applicable safety requirements (e.g. those requirements of the Environmental Health & Safety Department).
5. The individual must receive written authorization from the Non-Ionizing Radiation Safety Subcommittee or the Laser Safety Officer (usually in the form of an approved use permit)
6. The use of lasers by graduate and undergraduate students for educational purposes will be under the direct supervision of a Primary Investigator.



## **Becoming a Primary Investigator:**

Individuals desiring to become a Primary Investigator must submit the application form HP-2L: "Application form to become a Primary Investigator of Laser or Laser Systems" along with a C.V. or resume to the Laser Safety Officer. Form HP-2L may be obtained from the Radiation Safety Office website. Once the application and all its relevant appendices are determined to be complete by the LSO, it will be reviewed, conditionally approved (or denied), then submitted for review by the Non-Ionizing Radiation Safety Subcommittee. This is only required for Class 3b or 4 lasers or laser systems, the Radiation Safety Office can assist with this determination.

Individuals are designated as authorized Primary Investigators by the Non-Ionizing Radiation Safety Subcommittee after careful consideration of their training and experience with lasers. Adequate training and experience for an applicant is demonstrated through the following:

1. The applicant should have, at a minimum, a college degree at the bachelor level or equivalent training and experience in physical, chemical, biological sciences, or engineering. Extensive laser-related work experience (>7 yrs.) may be used as a substitution.
2. The applicant shall have training and experience commensurate with the scope of the proposed activities. Training should include the following subjects:
  - a. Characteristics of non-ionizing radiation,
  - b. Laser protection principles and controls,
  - c. Laser beam measurement and monitoring,
  - d. Units of laser quantities,
  - e. Biological hazards of lasers,
  - f. Hands-on use of lasers and laser measurement.

*If the applicant wishes to be a Primary Investigator of a laboratory that has not been previously approved by the Non-Ionizing Safety Subcommittee or if the applicant wishes to use or store new / additional lasers at a previously approved laser Laboratory, the application must also include:*

1. a list of all or additional lasers to be used within the laboratory,
2. the laser beam characteristics,
3. a description of the areas in the laboratory where the lasers shall be used,



4. a list of all laser safety equipment available (beam enclosure, beam dumps, goggles with quantity for applicable wavelengths and OD, interlocks, etc.),
5. a list of all laser detection devices (if applicable),
6. details on how laser controls shall be used including Standard and Alignment Procedures (templates online)
7. in addition, the applicant must describe how the lasers will be used within an experiment. Therefore, the application must contain:
  - a. a brief list of the experiments to be performed within the laboratory which use lasers,
  - b. a list of materials potentially in the beam path including non-beam hazards like flammables and laser generated air contaminants in the area,
  - c. standard operating procedures for the laser,
  - d. a list of all potential users, and
  - e. an estimate of the frequency of each experiment.

Before conducting any experiments involving lasers within the laboratory, the applicant must receive written authorization from either the Chairman of the Non-Ionizing Radiation Safety Subcommittee, the Laser Safety Officer, or their designee's stating that they have been accepted by the Non-Ionizing Radiation Safety Subcommittee as a Primary Investigator with lasers.

The Radiation Safety Committee has granted the Non-Ionizing Radiation Safety Subcommittee the authority to approve applications to become a Primary Investigator with lasers of a pending or already approved laser laboratory.



### **Responsibilities of a Primary Investigator:**

Primary Investigators (PI) are responsible for implementing laser safety rules, regulations, and procedures within their assigned laser laboratory and are directly responsible for the following laboratory safety issues:

1. The PI is responsible for the safety of each person within the AU's assigned laboratory.
2. The PI is also responsible for assuring compliance with UML, state, and any federal rules and regulations regarding lasers or laser systems.
3. The PI must verify that lasers are properly stored, used, and disposed.
4. The PI must assure that appropriate records documenting the safe use of lasers and laser systems are maintained by the laboratory. These records include but are not limited to:
  - a. Current primary investigator permit form
  - b. Current laser inventory,
  - c. Standard Operating Procedures (SOP's) and alignment procedures,
  - d. Documentation of final disposition of lasers,
  - e. Proof of training,
  - f. Memos documenting laser related issues within the laboratory.
5. Primary Investigators are responsible for having their laboratory members trained in specific laser safety procedures and techniques practiced within the laboratory. This is in addition to the introductory laser safety training provided by the Radiation Safety Office.

### **Reauthorization:**

Primary Investigators must be reauthorized to use lasers in their lab. Before reauthorization, the LSO must certify that the Primary Investigator is in compliance with this Safety Guide.



## Laser Workers

Persons working under a Primary Investigator must follow the policies and procedures as outlined in this guide. They must use lasers only under the supervision of the Primary Investigator and in the manner specified in the application for authorization to use such sources. Before working with lasers, a laser worker must have received basic laser protection training by the Radiation Safety Office and must receive site specific laboratory training by the laboratory Primary Investigator or his/her designee.

### **Becoming a Laser Worker:**

1. Individuals who desire to work with lasers or work in areas where lasers will be used are required to complete basic laser protection training offered by the Radiation Safety Office. Visit the office website or call the Radiation Safety Office (x43373 or x43372) to schedule training (Online trainings and in-person trainings are available).

The goal of basic laser protection training is to familiarize the radiation worker with the following:

- Basic laser science,
  - Laser risk, protection, and safety,
  - Federal, state, and university rules and regulations,
  - The responsibilities of the laser worker, the Primary Investigator, and the UMass Lowell laser safety program,
  - Basic laboratory safety procedures,
  - Emergency response procedures.
2. Before the radiation worker is allowed to operate or be around a laser, the worker must undergo site specific safety training by the laboratory's Primary Investigator or designee.

### **Responsibilities of a Laser Worker:**

Any individual at UMass Lowell who works in an area where Lasers are used is considered a laser worker. Laser workers at the university are responsible for:

1. Participating in basic laser safety training provided by the Radiation Safety Office prior to entering the designated laser work site.
2. Being trained by the laboratory's Primary Investigator (or designee) on specific laser safety practices within the laboratory.



3. Using standard laboratory protective measures when working with lasers. Such measures include, but are not limited to:
  - a. Wearing appropriate protective clothing and eyewear (note: shorts and open toe shoes are not appropriate laboratory clothing). Exposed skin with certain lasers can cause biological effects.
  - b. Using appropriate laser shielding (barriers, enclosures, curtains, beam dumps).
  - c. Performing work in an approved hood, glove box, or assure proper exhaust ventilation of the beam if it is possible that laser generated airborne contaminants may be released into the air.
4. Ensuring that no eating, drinking, or smoking occur in areas where lasers are present. It is against regulations to store food or beverages in any laboratory on campus.
5. Maintaining good work habits and safe laboratory techniques as specified in Appendix V.
6. Performing a laser survey, documenting the survey, and placing the survey results on file (see Appendix VII to learn how to perform a survey). It is your responsibility to ensure a safe laser lab, and as such you should conduct a survey/lab audit:
  - a. Prior to initial laser operation (with the safety office) or when new controls are implemented,
  - b. If the target medium is changed and drastically increases the diffusion hazard.
7. Keeping the laboratory neat and organized.
8. Proper labeling and isolating of lasers and laser equipment.
  - a. Laser eyewear (appropriate and functional)
  - b. Effective barriers, curtains and other engineering controls.
  - c. In multi-laser labs, care should be taken to isolate controls specific to each laser.
9. Understanding how to procure/purchase laser as described in Section 6.
10. Being familiar with the safe use and storage of lasers and laser systems as described in Section 7.
11. Contacting the Primary Investigator or a member of the Radiation Safety Office if you are unsure of a laser safety related issue.
12. Immediately notify the laser Primary Investigator and LSO or UMass Police if there was a laser related injury



# LASER SAFETY REGULATIONS AND POLICIES

*This section describes fundamental regulations, policies, and procedures on which this guide and the radiation safety program are based. These Federal and State regulations are legally binding and require the maintenance of certain records and the fulfillment of certain obligations by all **primary investigators**. Failure to meet these legal requirements could place our state registration in jeopardy, and failure to comply with established policies and procedures could compromise laser safety.*

## **Federal Regulations:**

The Occupational Safety and Health Administration (OSHA) has established regulations to ensure that the employer has done due diligence to ensure a safe place of employment that is free from hazards that could cause death or serious injury. Since lasers have the ability to cause injury The OSH act of 1970 general duty clause is followed and enforced. Other federal regulations do apply to specific laser uses.

## **State Regulations:**

The Commonwealth of Massachusetts specified its own rules and regulations for the control of lasers and laser systems in code regulation 105 Code of Massachusetts Regulations 121 (105 CMR121). This regulation has required all laser users to follow the American National Standards Institute document titled "ANSI Z136.1 the American National Standard for Safe Use of Lasers." Laser users must comply with the applicable requirements of both state and federal regulations.

## **University Policy and Procedures:**

The University of Massachusetts Lowell, as registrant with the commonwealth of Massachusetts for laser use, recognizes its responsibility to both the Occupational Safety and Health Administration and the Commonwealth of Massachusetts to establish appropriate policies and procedures for the safe use of lasers. To this end the University has appointed a Non-Ionizing Radiation Safety Subcommittee (NIRSSC) to develop such policies and procedures. This committee is directly responsible to the Radiation Safety Committee and ultimately to the Chancellor in all matters of laser safety.

The Committee has established in this Laser Safety Guide the policies and regulations to be followed by all users at the University. Any additions or modification of policy remain the responsibility of the NIRSSC. Changes will occur as revisions or additions to this guide and become necessary for purposes of clarification, changes in title or positions, and other reasons which in no way shall result in a lessening of the safe use



of lasers and laser systems. More information can be found on the radiation safety office website.

### Definition of a Laser and Laser System:

A Laser is any device that produces radiant energy predominantly by stimulated emission. A laser system is an assembly of electrical, mechanical, and optical components which includes a laser and is subject to the provisions of this guide.

### Occupational Laser Exposure Limits

UMass Lowell Laser workers shall conform to the safety limits specified in ANSI Z136.1 and Massachusetts regulation 105CMR121 regarding the classification of lasers and their associated hazard. Here, a laser classification is divided based on effective biological hazards. Table 1 and 2 presents a summary of the classifications and hazards.

Table 1: Laser Classification

Class	Power limit	Hazard
1	Wavelength dependent	Incapable of producing damaging radiation levels
1M	Wavelength dependent exceeds class 1 but less than class 3B AEL	Highly divergent beam where only optically aided viewing is a hazard.
2	CW laser <1mW, pulsed depends on the pulse	(Visible only class 400-700nm) eye protection is the bodies aversion or blink response
2M	exceeds class 2 but less than class 3B AEL	(Visible only class 400-700nm) highly divergent beam where only optically aided viewing is a hazard
3R	1mw to 5mw (Visible) or less than 5 times the class 1 AEL (shorter than 400nm and longer than 700nm)	Direct reflection hazard if the aversion response is ignored or exposure duration is exceeded for non-visible lasers
3B	5mW to 500mW	<ul style="list-style-type: none"><li>◆ not a significant diffuse hazard,</li><li>◆ direct or specular (mirror like) reflection hazard,</li><li>◆ not a significant fire hazard</li></ul>
4	greater than 500mW	<ul style="list-style-type: none"><li>◆ hazardous to eye and skin from direct viewing and possibly diffuse reflection</li><li>◆ potential fire hazard,</li><li>◆ may produce laser generated air contaminants,</li><li>◆ may produce hazardous plasma radiation.</li></ul>



Table 2: Laser hazards by wavelength

Wavelength range(nm)		Ocular hazard region	Adverse Effects			
Ultra Violet 180-400	UV-C (100-280)	Cornea	Photokeratitis Erythema	Thermal skin burns	Color + night vision degradation	
	UV-B (280-315)					
	UV-A (315-400)	Lens	Cataracts			
Visible 400-700	Visible (400-700)	Retina	Retinal burns			Cataracts
Infrared 700-1E6	IR-A (700-1400)					
	IR-B (1400-3000)	Cornea	Corneal burns			
	IR-C (3000-1E6)					

### Offsite use of Lasers:

This guide and the radiation safety office are responsible for only Class 3b and 4 lasers used at authorized locations (“laser labs”) within the University of Massachusetts Lowell in Lowell, MA. All other classes of lasers don’t require authorized locations. Temporary laser labs can be setup with the approval of the Laser Safety Officer and under the direct supervision of a Laser Primary Investigator.

### Regulations Regarding the Control of Lasers:

To maintain public safety and meet relevant state and federal regulations, all lasers are controlled for the duration it stays on campus as a functioning laser. The UMass Lowell Laser Safety Program therefore has set up the following controls:

1. Any laboratory in which lasers are to be used or stored must first be authorized by the Non-Ionizing Radiation Safety Subcommittee for such tasks and must have at least one Primary Investigator to accept responsibility for enacting the requirements of this manual.
2. Ordering and purchasing lasers are controlled through the Radiation Safety Office. Individuals wishing to purchase a laser source should review Section 6.



3. The use or storage of lasers within a laboratory must meet the conditions and standards of this manual. Section 7 of this manual presents the requirements for storing and using lasers.
  
4. The final disposition of a laser (shipped off campus, or broken) shall meet the requirements of section 8 of this manual.



# AUTHORIZATION TO USE LASERS

## **General Requirements:**

Authorization to operate laboratories in which laser systems will be used is obtained from the Non-Ionizing Radiation Safety Subcommittee (NIRSSC) prior to operating the laser. Individuals who work with lasers must either obtain specific approval from the Committee to use such sources or perform their activities under the supervision of a Primary Investigator. A Primary Investigator must be a member of the UMass Lowell (UML) faculty, staff, or Research Foundation (refer to section 3).

Applications for laser authorization must be submitted to the Radiation Safety Office. The Laser Safety Officer has authority to conditionally authorize laser use based on submitted material (protocol, procedures, trainings, credentials, etc.) until the NIRSSC can meet to approve and/or set additional requirements. An application permit form can be found on the radiation safety office website.

## **Application for Authorization to Procure, Use or Dispose of a Laser:**

An application form (Form HP-2L) must be properly filled out by the person desiring to procure, use, or dispose of a laser. Written authorization is granted for a specific laser, wavelength, power, use and shall not apply to activities not specified on the authorization form or procedures submitted. Authorizations are valid only for the period of time specified on the application. Similar activities to be conducted at a later date will require a new application or renewal. Authorizations may be renewed if there are no significant changes in the user's program.

## **Approval of Applications:**

Applications for the use, storage, or disposal of a laser shall be submitted to the Laser Safety Officer (LSO). The LSO will review the application and, may act to submit the application to the NIRSSC or delay action on the application if the LSO decides that more information is needed regarding the application. If an applicant has his/her application denied by the LSO, he/she may appeal this decision to the NIRSSC. The NIRSSC may delegate authority to the LSO to ultimately approve certain applications.

## **Amendment to Authorization:**

Significant changes in the procedures or protocols specified in a Primary Investigator's application will require an amendment. Amended uses may not be implemented until authorization is received by the LSO and/or NIRSSC. Amendments in a Primary Investigator's authorization to procure, use, store, or dispose of Lasers shall be submitted to the Laser Safety Officer.



## Purchase of Lasers Systems

### **Introduction:**

Prior to purchase of lasers and laser systems, the Laser Safety Officer (LSO) must be notified and the Primary Investigator permit process must begin or be updated.

### **Purchasing:**

Please review Section 5 prior to purchasing any laser or laser system. All laser purchases must first be approved by the laboratory's Primary Investigator and then approved by either the Radiation Safety Office or Non-ionizing Radiation Safety Subcommittee (NIRSSC) as described in Section 5. This approval must occur prior to laser use. All lasers on campus must be registered with the Commonwealth of Massachusetts and in order to ensure compliance and a current inventory it is the responsibility of the Primary Investigator to notify the radiation safety office of any anticipated purchase.

### **Purchasing Procedure:**

The specific steps necessary to purchase Lasers or Laser systems include:

1. Update and send the Laser permit form (Form HP-2L), noting the new laser, to the Radiation Safety Office (an email with all applicable laser information can be supplemented but not preferred)
2. Update and send all standard and alignment procedures to the radiation safety office for review.
3. New lasers and/or new laboratories to house the laser will be reviewed by the LSO and/or the NIRSSC at their next meeting.
4. If the new unit is approved by the NIRSSC and/or the LSO, the Primary Investigator will be notified and can purchase/operate the laser.



# Working with Lasers and Laser Systems

## Storage of Lasers and Laser Systems:

All Lasers must be stored in a secure location (restricted access, minimum fire hazard, approved ventilation, sufficient barriers), labeled, and the location posted with the applicable door postings "Danger" or "Caution" laser radiation sign. The Radiation Safety Office will assure the laboratory has the proper signage and documentation to ensure compliance with the posting requirements of 105.CMR.121.

## Inventory:

To maintain proper control of lasers and to meet our regulatory requirements it is necessary for a laser laboratory to keep an inventory of all its lasers. This inventory shall include the following information:

1. Physical location, Primary Investigator, dept., and phone
2. Manufacturer, model, and serial number
3. Laser class (3B or 4),
4. Mode: pulsed or continuous wave (CW);
  - a. If pulsed, please include pulse frequency, duration, and energy per pulse,
  - b. If CW, include average laser power.
5. Medium (Nd:Yag),
6. Beam characteristics; wavelength, beam diameter, divergence
7. Disposition of material and date (if applicable)

Inventory form AU-1L is recommended for recording the above information and may be obtained from the Radiation Safety Office or on the website.

The following inventories are required:

1. An inventory to be submitted to the Laser Safety Officer (LSO) by all Primary Investigators (usually in the form of the AU permit form HP-2L or inventory form AU-1L) either initially or whenever a change occurs,
2. A periodic physical inventory of all lasers to be conducted by the Radiation Safety Office with assistance from all Primary Investigators.



## **Labeling:**

Each individual laser (or laser housing) shall be labeled with an identification tag clearly indicating it emits laser radiation and the extent of its emission (Class Label, Aperture Label, etc.), call the Radiation Safety Office if a label is not found on a laser.

## **Engineered Laser Controls:**

Engineering controls are hardware controls that will help prevent beam exposure. They decrease human error by making a system more failsafe. The following are a list of controls to help decrease chances of an exposure to a laser beam (if applicable for your laser):

1. an intact protective housing on the laser,
2. interlocks,
3. key controls,
4. viewing windows,
5. diffuse (non laser reflective) display screens,
6. full enclosure of the beam path,
7. remote interlock connector,
8. beam stop or attenuator,
9. laser area warning signs
10. activation warning systems (illuminated while beam on),
11. audible warning devices,
12. entryway controls (defeat able and non-defeat able).

Refer to laser trainings for more details about the above mentioned controls.

## **Administrative and Procedural Laser Controls:**

Administrative and procedural controls are a method or instruction that lay out safe work practices and rules. The following are a list of controls to help decrease chances of an exposure to a laser beam (if applicable for your laser):

1. standard operating procedures and alignment procedures (required for all 3B and 4 lasers),
  2. education and (re)training (required for all 3B and 4 lasers),
  3. authorization of select personnel to operate or be around the laser,
  4. eliminate spectators in a laser laboratory
  5. remove optically enhancing devices from a laser lab (binoculars, microscopes, etc., prescription eyeglasses are not considered enhancing devices).
  6. required protective clothing will be specified and shall be provided to laser workers.
  7. Use of the buddy system for laser use is recommended as a safe work practice
- One responsibility of the laser user is to follow and abide by all laser safety controls.



## Control Zones:

Control zones will be established for controlling movement into and out of a laser lab. These zones will protect personnel and property from accidental laser exposure and unnecessary radiation exposure. Every individual working or visiting such areas should observe signs and directions indicating actions to be taken in a specified area. The laser users assume responsibility of the visitors in the laser lab and must ensure they are informed and following all laser procedures.

The restricted area control zone is an area where access is controlled for purposes of personnel protection. A restricted area is to be controlled by the below engineering controls (LSO will designate applicability):

- a. Laser signage posted on the doors and must contain
  - i. the laser symbol ,
  - ii. laser type (ex. Nd:Yag)
  - iii. safety alert symbol ,
  - iv. laser class (ex. 4),
  - v. Special precautionary instruction (eyewear required, etc.)
  - vi. Signal words;
    1. "Danger" used for class 3R,3B, and 4,
    2. "Caution" used for class 2 and 2M,
    3. "Notice" used for temporary laser controlled area.
- b. Interlocks or fasteners must be used on enclosures of embedded lasers.
- c. Activation warning systems and audible devices can be used to warn potential entrants of the hazard
- d. Entryway controls:
  - i. Laser Eyeglass station outside the laser lab or behind an secondary barrier (laser approved curtain)
  - ii. Lockable doors
  - iii. Key or remote control of the laser (Interlocks can be used on powering down a laser if the exit door is inadvertently opened).

## Laser Monitoring:

Routine laser monitoring surveys are conducted by the Radiation Safety Office and by the users as part of good laser safety practice and to ensure compliance with our registration requirements as described in Appendix II.



*To protect both the radiation worker and members of the public, laboratories are required to notify the Radiation Safety Office of drastic changes to the beam path or control measures. Any change of these measures can result in unknown direct, diffuse, or specular reflected beam direction therefore causing inadvertent exposure.*

Laser surveys shall be done only if the lab is approved by the laser safety office and instructed on the correct laser survey techniques. The survey will include a functionality check of the laser engineering controls, postings, and eyewear as well as a review of the laboratories procedural controls.

## **Records:**

It is a legal requirement of our state registration that certain records be maintained and made available to the licensing agency. In accordance with this requirement and as part of good laser safety program, the Non-Ionizing Radiation Safety Committee (NIRSSC) requires that the following information be recorded:

1. The Primary Investigator shall:
  - a. keep an inventory of lasers and laser systems in their laser laboratory (recommended form: AU-1L),
  - b. keep a record of laser surveys made (recommended form online)
  - c. maintain current standard operating procedures (to include beam alignment).
  - d. maintain copies of training records
  
2. The Radiation Safety Office shall maintain:
  - a. up-to-date inventories of all lasers (supplied by the Primary Investigators),
  - b. records of transfer or disposal of class 3B and 4 lasers (supplied by PI),
  - c. hazard evaluations of all 3B and 4 lasers or laser systems
  - d. medical approval and records for emergency response to all incidents involving lasers,
  - e. training records (attendee list and material covered)
  - f. periodic checks and audits,
  - g. inspection reports,
  - h. minutes of NIRSSC meetings,
  - i. applications for authorization to use lasers and laser systems,
  - j. list of all Primary Investigators.



## Disposition of Laser Systems

### **Removal of the Laser from Service:**

Prior to disposal, lasers and laser systems must be removed from the state registered inventory (by notifying the laser safety officer) in order to keep the inventory current and ensure compliance. The Laser Safety Officer will need

1. *The updated inventory of lasers and laser systems in their laser laboratory (recommended form: AU-1L) must be submitted*
2. *A memo (email is satisfactory) documenting the laser disposition either that it is broken, or shipped off campus*
3. *Updated standard operating and alignment procedures (if applicable)*



## APPENDICES

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**Appendix I: Committee Membership**

**Appendix II: Radiation Safety Office Staff and Services**

**Appendix III: Laser Laboratory Rules and Regulations**

**Appendix IV: Laser Accident Response**

**Appendix V: Guide for the Primary Investigator**

**Appendix VI: Guide for the Laser Worker**

**Appendix VII: Guide for Performing Laser Surveys**

**Appendix VIII: Forms**



## Appendix I: Committee Membership

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**All Radiation Safety Committee and Subcommittees current membership can be found on the Radiation Safety Office website.**



## Appendix II: Radiation Safety Office Staff and Services for Lasers

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### Staff (Nominal):

Steven Snay M.S. CHP.,  
Director, Radiation Safety  
Phone: x43373  
Office: Pinanski 103a

Christopher Tavares  
Radiation Safety Specialist  
Designated Laser Safety Officer (LSO)  
Phone: x43372  
Office: Pinanski 103

### Services:

The following services shall be provided by the Radiation Safety Office for all authorized personnel at UML.

#### Laser hazard evaluation and classification

The Radiation Safety Office will complete hazard evaluations on all lasers and document the results. All hazard evaluation and classifications will be done in accordance with the "American National Standards Institute "Z136.1 For Safe Use of Lasers" document. If evaluation techniques change in newer versions of the ANSI Z136.1 the university will reevaluate within 2 years to conform to the updated standard.

#### Procedure and protective equipment approvals

All laser class 3b and class 4 procedures and protective equipment must be submitted to and approved by the Laser Safety Officer (LSO). The procedures and protective equipment will be reviewed based on the hazard evaluation and classification of the laser.

#### Facility and equipment reviews, surveys, and inspections

The Radiation Safety Office will periodically audit labs to verify approved measures for laser safety are being followed. Special monitoring can be requested by contacting the Radiation Safety Office. If any abnormal or hazardous conditions are noted during survey, the responsible person(s) will be notified immediately and remedial actions will be recommended.

#### Medical surveillance

Following and accident the LSO and the office will ensure a medical eye exam for the potentially exposed individual is conducted.



### Consultant Services

The Radiation Safety Office will discuss any matter relative to laser safety. They will also provide advice and assistance on the design of laser experiments, laser facilities, and on the purchase and use of laser detection instrumentation.

### Emergency Assistance

If a situation arises whereby laser safety has been compromised, or a potential hazard exists contact the LSO immediately (X43372, X43373). When a problem arises after hours, call the Campus Police (X44911) who will notify individuals on the emergency call list. The affected individual will be inspected by an ophthalmologist for eye injury or at a local hospital for other laser related injuries (usually within 48 hours).

### Laser Safety Training and Retraining

The LSO conducts a training program for all laser workers or others who frequent areas where lasers are used. The training is tailored to the category of worker and the type of work that they will be performing. Laser laboratory workers are required to participate in a provided training module followed by a site specific training detailing hazards of the area or equivalent on the above subjects. All laser workers and Primary Investigators are required to complete a refresher training every two years (either in person or online). Record of all initial and refresher courses, including topics, students, instructors, dates and the length of the training are maintained by the Radiation Safety Office (copies should be kept on file in the labs Chemical Hygiene Plan).



## Appendix III: Laser Laboratory Rules and Regulations

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These rules are designed to limit unnecessary laser exposures and to minimize the consequences of a laser accident if it should occur. Copies of these rules will be posted in the appropriate laboratories.

### General Procedures:

Eye protection	Always wear the correct Optical Density (OD) and wavelength eyewear. All eyewear supplied by the Primary Investigator must be certified for the applicable laser. Check the eyewear for burns, cracks, or other defects.
Protective Clothing	Minimize exposed skin when working around a laser that can damage tissue.
Procedural controls	All laser safety procedures must be followed and all users must understand and follow the approved Standard Operating Procedures (S.O.P's) and Alignment Procedures for their applicable laser.
Engineering Controls	All applicable laser engineered controls must be in working order prior to laser use (enclosures, curtains, interlocks, key controls, viewing windows, collecting optics, etc.).
Labeling + Posting	All equipment and laboratories containing laser radiation must have the doors properly placarded with caution signs.
Lab Security	Before leaving the lab, ensure the laser is in a safe condition and the area is secured so no one can enter the lab inadvertently and receive a laser injury.
Laser Injury	Seek medical assistance immediately then notify the Radiation Safety Office of the laser related injury.
Exhaust ventilation	Local ventilation, Hoods, or glove boxes must be used when there is a potential for creating Laser Generated Airborne Contaminants (LGAC's).



## **Regulations and Procedures for Laser Laboratories:**

### Procedures and conditions for operating a Laser:

- a. The Primary Investigator must notify the Radiation Safety Office prior to initial use of the machine so that an initial audit may be conducted.
- b. All personnel who use the laser must have adequate training in the proper use of the machine and be aware of the associated laser hazards.
- c. Laser users and Primary Investigator must follow the applicable requirements of the laser safety guide
- d. The Primary Investigator of the laser must notify the Radiation Safety Office of the following situations:
  - i A suspected exposure to a laser resulting in an injury,
  - ii failure of a safety device related to machine operation or personnel safety, or
  - iii Plans for making modifications of the laser or beam path that hasn't been approved.



## Appendix IV: Laser Accident Response

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### GENERAL PROCEDURES:

- a. Evaluate the accident and call for help. The first person to observe the accident should try to quickly estimate the severity of the situation and evacuate personnel to a safe place such as an assembly or check point. The Laser Safety Officer and the facility supervisor should be notified as soon as possible.
- b. De-energize the laser. If possible, with proper laser protection equipment, cut power to the laser by power switches and secure the area. Stand in a safe area nearby to provide information and assistance.

*If the situation requires additional assistance, emergency action personnel who have been notified of the situation will take over after this first phase of the accident. They will prescribe additional action to be taken and begin restoration to normal operating conditions. Be sure your laser Standard Operator Procedure (SOP) is consistent with the information provided in your lab Chemical Hygiene Plan (CHP)*

### INJURY:

If injured, use the emergency power shut off (if possible) for the laser and leave the area immediately. Stand in a safe area nearby to notify the UMass Lowell (UML) police department (X44911 or 978-934-4911). After getting medical attention complete the [UMass Lowell Emergency Incident Report Form](#).

### FIRE:

The primary concern in a fire is the prevention of personal injury. Proper response by individuals will assure the safety of others and minimize damage caused by smoke and fire.

If a laser ignition occurs in the beam path de-energize the laser and leave the room and notify the UML police department (X44911 or 978-934-4911). Warn other persons in the immediate vicinity and assist any persons who may be injured. The buddy system is recommended and sometimes required for laser operation.

If there is visible smoke or fire activate the fire alarm pull station and evacuate the building. Do not use elevators and use stairs that lead directly outside. Be familiar with at least two means of egress from your lab.



A portable fire extinguisher should only be used if you have been trained on its use and you can confirm it is the proper type of extinguisher for the fire. A fire alarm must already be activated. An extinguisher should only be used when fire is in the incipient stage and does not affect your personal safety.

If you smell smoke but can not see a visible fire call 44911 and describe the situation to the University Police. Notify your supervisor of the issue and be alert and suspicious until the first responders arrive.

When a fire alarm sounds immediately evacuate the building. Avoid all elevators and only take the stairs as a means of egress. If a physically challenged person is in your lab evacuate him/her to a stairwell that leads directly outside and notify the first responders. Do not reenter the building until the local Fire Department, University EHS, or University Police advise the building is safe.

### **LASER GENERATED AIRBORNE CONTAMINANTS (LGAC'S):**

If a laser generates airborne contaminants that can be identified by sight or smell, activate the emergency power shut off for the laser and safely evacuate all personnel from the area. Notify the UML police department (X44911 or 978-934-4911) and Environmental Health & Safety, EHS, (X42618 or 978-934-2618).

### **GENERAL POWER FAILURE OR FUME HOODS BLOWER FAILURE:**

During a loss of power, if the laser has power and the exhaust ventilation does not (if the lab generates LGAC's), the use of the laser could result in an elevated LGAC condition and could result in the spread of airborne contaminants. Notify the UML police department (X44911 or 978-934-4911) and EHS (X42618 or 978-934-2618).



## **CONTACT INFORMATION: RADIATION SAFETY OFFICE:**

Laser Safety Officer: Christopher Tavares  
Office: Pinanski 103  
Phone: 978-934-3372 or Extension 43372

Director of Radiation Safety: Steven Snay MS. CHP.  
Office: Pinanski 103a  
Phone: 978-934-3373 or Extension 43373

***IN THE EVENT OF AN EMERGENCY: IF YOU ARE UNABLE TO REACH THE LSO,  
CALL THE CAMPUS POLICE EMERGENCY HOT-LINE:  
x44911 or 978-934-4911  
IMMEDIATELY.***

*Note: The Massachusetts Department of Public Health Radiation Control program maintains an emergency 24-hour telephone number: (617-427-2913) which may be used in the event that you are unable to contact either the Radiation Safety Office or University Police.*



## Appendix V: Guide for the Primary Investigator

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### Primary Investigator Checklist:

Refer to this checklist regularly to ensure that your laser protection program is in compliance with university, state, and federal requirements.

#### 1) Laser or Laser System Receipt:

- a) Verify that all Lasers purchases or receipts have been pre-approved by the Laser Safety Officer (LSO) or the Non-Ionizing Radiation Safety Subcommittee (NIRSS). *This includes lasers for which payment is not required or received.*

#### 2) General laboratory safety compliance:

- a) All laboratory personnel working with or near lasers or laser systems have been trained in basic laser safety by the Radiation Safety Office.
  - i) Is the staff familiar with basic laser principals:
    - (1) wavelength, power, optical density and their properties,
    - (2) biological effects caused by lasers,
    - (3) direct, specular(mirror like), and diffuse laser beams,
  - ii) Do staff members understand when to survey the work area,
  - iii) And do they understand the importance of maintaining survey records?
  - iv) Does the staff know what to do in the event of an emergency?
- b) Have all laboratory personnel have been trained by a competent member of the laboratory in laser use (SOP's, alignment procedures, storage, and disposal within the laboratory)?
- c) Does the laboratory maintain an accurate and up-to-date laser inventory?
  - i) Initial laser receipt documented (form HP-1L, for example),
  - ii) If a laser is disposed was the LSO notified.
- d) Verify that lasers are properly used and stored in areas clearly demarcated for laser use.
- e) Do all laboratory personnel wear the proper laser protection equipment (laser goggles, gloves, etc.)?
- f) Are all lab personnel familiar with;
  - i) the hazards of having excess material on the optical bench?
  - ii) the importance of engineering and administrative controls and are they familiar with the ones applicable to the lasers they use?
  - iii) Their role in an emergency.



### 3) Laboratory Operations:

- a) Check that laboratory doors are posted with appropriate signs (Notice, Caution, or Danger Laser Radiation, Eyewear required, invisible laser radiation, knock before entering, do not enter when light is on, restricted area, etc.).
- b) Assure that all lasers and laser enclosures are properly labeled (IEC warning label and information label).
- c) Verify laboratory members are wearing proper laser eyewear (if required).
- d) Ensure that laboratory users are wearing lab coats or other appropriate protective clothing to prevent skin burns (if applicable).
- e) Assure that a complete laboratory survey is performed and documented, if the laser system has been altered and could potentially cause stray laser radiation beams.
- f) Make sure work with lasers is done so in accordance with the laboratories approved standard operating procedures and alignment procedures.
- g) Lastly, verify that all lasers are secured when not in use (key out of the power supply, power switch locked out, etc.).
- h) Contact the Radiation Safety Office prior to adding unapproved altering of the laser optics (e.g. Optical parametric oscillator, etc.).
- i) When possible (or required by the NIRSSC) using the buddy system when the laser is operating can help ensure safety in the lab.

### 4) Laser Material Disposition:

- a) Contact the Radiation Safety Office for any transfers or disposal of a laser or laser system so the campus laser inventory can be reconciled.
- b) Do not deface "LASER" labels on any laser or laser system.



## Appendix VI: Guide for the Laser Worker

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### Laser Worker Guide:

All laser workers should periodically review the items listed in this guide to gauge their knowledge and understanding of our laser safety program.

1. Have I undergone proper training for working in a laser lab?
  - a. Have I gone through the mandatory initial basic laser safety training session offered by the Radiation Safety Office?
  - b. Have I been given an introductory safety tour and site specific training by the Primary Investigator or his/her designee to help me become familiar with specific laboratory safety and safety related procedures?
  - c. Have I been trained in the procedures for which I am expected to perform?
  - d. Do I need retraining in any of the above topics (refresher training)?
2. Am I familiar with the lasers and laser systems located within the laboratory?
  - a. What lasers are used in the laboratory?
  - b. Where are the lasers located?
  - c. What are the safety protocols observed when the device is operational?
  - d. What optical density and wavelength are required for choosing proper laser goggles for each laser in the laboratory (do I have the correct goggles for the laser I am using)?
  - e. Are there any special safety concerns for any of these lasers (example, different wavelength and power lasers require different laser goggles)?
  - f. Am I familiar with the experimental protocols for these lasers?
  - g. If I am an operator of the device, have I been trained in its operation and safety features (interlocks, enclosures, etc.)? Is the training documented (memo, etc...)? Did I retain that document for review by the LSO in an inspection?
3. Do I understand the requirements for using lasers?
  - a. Do I wear proper safety gear when applicable (laser rated goggles, etc.)?
  - b. Do I know where to find the standard operating and alignment procedures?
  - c. Do I follow the laser safety procedures?
  - d. Do I need to be concerned about non beam hazards (fire, airborne contaminants, collateral radiation, explosions, noise, electrical shock, chemical, and biological hazards)?
  - e. Do I document a laser survey and place the results on file (if applicable)?
  - f. Do I properly notify the Primary Investigator of faulty equipment (interlocks, power systems, etc.)?
  - g. Do I ensure that all users are protected (PPE, etc.) prior to laser use?



4. Where are all laser related records/documents kept?
  - a. Area laser surveys (if applicable)
  - b. Current laser inventory (with type, power, divergence, and use)
  - c. Standard Operating Procedures
  - d. Alignment Procedures
  - e. Laser specifications (power, wavelength, etc.)
  - f. Laser related memos
  
5. Do I understand safe laser storage procedures?
  - a. Standard operating procedures.
  - b. Laser handling procedures specific to my laboratory or laser
  
6. Am I comfortable in using a laser power meter (if applicable)?
  - a. Do I know how and what it responds to?
  - b. Does it measure the applicable laser wavelength?
  - c. Does it cause a specular or diffuse beam reflection?
  - d. Does it reflect the laser back that could injure someone?
  
7. Am I familiar with the general laboratory emergency response procedures such as laser injury, fire, airborne contaminate, etc...?
  
8. Do I understand and follow posting requirements for lasers?
  - a. Does the door posting contain:
    - i. the laser symbol ,
    - ii. laser type (ex. Nd:Yag).
    - iii. safety alert symbol ,
    - iv. laser class (ex. 4),
    - v. Special precautionary instruction (eyewear required, etc.).
    - vi. Signal words:
      1. "Danger" used for class 3R,3B, and 4,
      2. "Caution" used for class 2 and 2M,
      3. "Notice" used for temporary laser controlled area.
  
9. Do I understand that I am responsible for the security of the laboratory and of the lasers used within?
  
10. Do I understand that I am responsible for the safety and conduct of any visitors?



## Appendix VII: Guide for Performing Surveys

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### **Introduction:**

Routine laboratory surveys are an important part of the UMass Lowell laser safety program and are required to be performed by laser laboratory personnel prior to initial use or after a substantial alteration of the beam path. Surveys provide documentation that the beam engineering and administrative/procedural controls have been tested and are fully functional. The survey may also contain a direct measure of the area laser power levels (if applicable) and detect the presence of inadvertent direct, specular, or diffuse laser beams. Diffuse measurements can be taken but usually the Nominal Hazard Zone calculations encompass the worst case diffusion beam distance. It is vital that individuals working with lasers are aware of procedures for performing such surveys. Guidelines and trainings for conducting surveys can be found by contacting the radiation safety office or from information on the website. The information which follows is a suggested guide for performing surveys of laboratory areas. Questions about the mechanics of performing surveys or the interpretation of this guide may be referred to the Radiation Safety Office.

### **What Is a Survey:**

A survey is an evaluation of work areas, instruments and apparatus, bench, controls, etc. for the presence of direct, specular, or diffuse laser beams that could cause injury. The following methods can be used to perform a survey:

1. Laser Field and Controls Survey

Survey results should be documented but certain actions within the laboratory require that surveys be performed and documented. Required actions prompting a laser survey are presented below. All survey records should be kept so that all information is readily obtainable by laboratory staff or members of the Radiation Safety Office.



### **How Often Are Surveys to be Performed:**

Individuals are required to survey their work areas on an "as changed" basis. The Radiation Safety Office recommends frequent surveys to identify a problem as soon as possible, thus preventing significant exposures.

The Primary Investigator of radiation laboratory *is required* to have a laser field survey conducted under the following conditions:

1. After an alteration of the laser beam not previously approved by the LSO (reflective material mounted in beam that could divert direct, specular, or diffuse reflections) or adding an enclosure.
2. After transfer of laser to a new location (new bench, optics, etc.).
3. After a laser emergency (fire, laser generated airborne contaminants, etc.)
4. After a new control (interlock, enclosure, etc.) is implemented.

***NOTE:** All Laser emergencies are to be reported to the Radiation Safety Office immediately!*

### **What Type of Survey Do I Need to Perform:**

The type of survey that you perform depends on the aforementioned requirements

#### Laser Beam Alterations

If you are using a laser that was altered (new beam direction, new beam target, enclosures, interlocks, entryway doors, etc.) prior to use you should do a laser survey to ensure no stray beams and that the procedures, postings, etc. are correct to handle the altered beam. If a damaged control (i.e. interlock, etc.) is replaced with an identical control then a survey shall be completed to ensure that the new control is fully functional. You should periodically perform these surveys to identify and prevent hazardous conditions from occurring. If unexpected results are found or you need assistance inform the Primary Investigator or a member of the Radiation Safety Office and we will provide assistance as necessary.

#### Initial Facility Inspection

The Radiation Safety Office must be notified of new lasers. They shall not be used until the office completes the initial inspection survey.

### **How to Perform a Mandatory Laser Field Survey:**

Refer to the website for detailed survey instructions and trainings materials



## Appendix VIII: Forms

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### **General:**

Basic forms can be found on the radiation safety office website and are for the Primary Investigator or laser user to use when performing the following functions within the laboratory:

- 1) Form: HP-1L: "Purchasing Lasers or Laser Systems."
- 2) Form: HP-2L: "Application to become a Primary Investigator of Lasers."
- 3) Form: AU-2L: "Laser survey form."
- 4) Other forms as required by the LSO or Non-Ionizing Radiation Safety Subcommittee