Boston University/ Boston Medical Center

Laser Safety Manual

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1. Statement of Commitment to Environmental health and Safety

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BOSTON UNIVERSITY

Statement of Commitment to Environmental Health and Safety

Boston University is committed to maintaining a healthy and safe environment for its students, faculty staff, visitors, and neighbors and to fostering a culture of safety among users of all campus facilities. Members of the Boston University community should therefore comply with all environmental health and safety laws and regulations and with current best practices, especially in laboratory settings. In addition, members of the community should commit to continuous improvement in their efforts to minimize adverse environmental impacts and safety risks and to supporting a culture of safety in the University's operations by:

- Accepting the critical role each person has in protecting his or her own safety as well as that of others.
- Recognizing the critical importance of adherence to the highest standards for safety and occupational health for our students, our staff, and the communities around us.
- Minimizing air and water pollution and waste generation.
- Incorporating safety as an integral aspect of all operations, including but not limited to experimental design, facility construction, and equipment specifications.
- Providing students and employees with safety education targeted to maximize safe work practices and to minimize the potential for injury or illness.
- Creating an environment where individuals are able to recognize and to report errors without fear of reprimand or punishment.
- Providing appropriate and timely information in response to questions or concerns about environmental health and safety issues.
- Investigating incidents, disseminating lessons learned in such reviews, and modifying programs, as appropriate, to incorporate any potential improvements identified.
- Creating an environment of collaboration among all stakeholder, including researchers, safety specialists, students, and staff from facilities management and public safety, to identify safety issues and to find solutions to safety problems.

The University's Environmental Health and Safety staff, working closely with oversight committees, has developed policies and procedures designed to further the above goals.

Deans, directors, department heads, managers and other supervisors at the University are responsible for implementing this commitment within their areas of responsibility. I ask every member of the Boston University community to cooperate in these important matters.

Robert A. Brown

January 2012

2. Purpose

Laser Safety Manual provides guidance for safe use of lasers and laser systems at Boston University and Boston Medical Center. This manual serves as comprehensive resource for all research and medical laser users and contains information on the structure, responsibilities, hazards, laser laboratory requirements and emergency response.

3. Definitions

See appendix: **BU-01** (Definitions)

4. Laser Safety Program Structure

Radiation Safety Committee, Laser Safety Subcommittee, Laser Safety Officer, Division Medical Physics and Radiation Safety, Permit Holders, Supervisors and Laser Users have an important role in developing, improving and monitoring safe use of Lasers at BU/BMC.

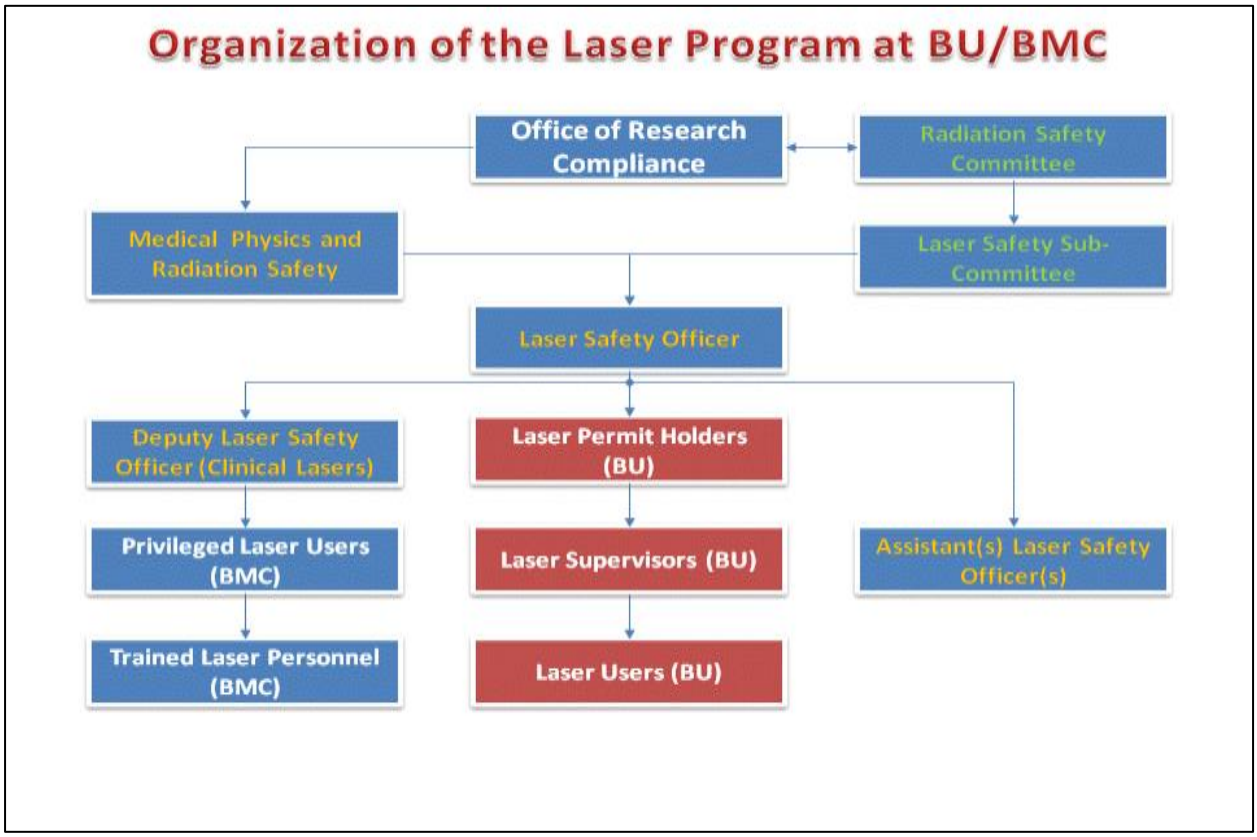


Figure 1

4.1. Radiation Safety Committee (RSC)

The Radiation Safety Committee (RSC) oversees use of all radiation generating devices (including Lasers) and radioisotopes at Boston University and Boston Medical Center. The Radiation Safety Committee oversees the work of the Laser Safety Subcommittee.

4.2. Laser Safety Subcommittee (LSS)

The BU/BMC Laser Safety Subcommittee (LSS) is responsible for continuing review of the laser safety program at the Boston University and Boston Medical Center. The Laser Safety Subcommittee ensures that all laser related work and research is conducted in compliance with federal, state, local, and internal laser safety regulations and standards. The Laser Safety Subcommittee meets quarterly to review the status of the Laser Safety Program.

The responsibilities of the LSS are listed below:

a. Developing and approving new Laser Safety Policies and guidance;
b. Reviewing new applications for Laser Permits and proposed method of use;
c. Reviewing renewal of permits applications;
d. Reviewing results of inspections, findings, and corrective actions;
e. Following up on incidents and abnormal events;
f. Suspending or revoking privileges of any user of lasers on Boston University or the Boston Medical Center; and
g. Recommending the expenditure of funds for the laser safety program.

4.3. Laser Safety Officer (LSO)

The Laser Safety Office (LSO) operates out of the Environmental Health & Safety's Division of Medical Physics and Radiation Safety

The responsibilities of the LSO are listed below:

a. Classifying or verifying classifications of lasers and laser systems;
b. Evaluating laser hazards;
c. Establishing Nominal Hazard Zones (NHZ) where class 3b And 4 Lasers are used;
d. Determining adequacy of control measures;
e. Recommending substitute or alternate controls;
f. Approving SOPs, alignment procedures, and alternative administrative controls as

required;

g. Recommending or approving protective equipment (i.e., eyewear, clothing, barriers, screens, etc.);
h. Ensuring that protective equipment is audited periodically;
i. Approving the wording of area signs and equipment labels;
j. Approving new and/or modified lasers and laser facilities prior to use;
k. Auditing laser systems and facilities periodically; and
l. Developing and overseeing administration of adequate laser safety training.

4.4. Division of Medical Physics and Radiation Safety (DMPRS)

DMPRS provides services to assist the laser users in maintaining a comprehensive laser safety program.

The responsibilities of the DMPRS are listed below:

a. Registration of class 3b and 4 lasers with appropriate regulatory agencies;
b. Oversight of purchasing new lasers systems;
c. Supervision of transfers and disposal of laser systems;
d. Providing laser safety training;
e. Assisting in laser incident investigation;
f. Monitoring the implementation of the Laser Safety Program;
g. Providing support necessary to assist Laser Safety Program; and
h. Reviewing and maintaining relevant program documentation.

4.5. Research Laser Permit Holder

The Laser Permit Holder is responsible for:

a. All safety and compliance issues as specified on the application for a Permit to Use Class 3b and Class 4 Laser Systems;
b. Providing the necessary equipment and work environment for the safe use of lasers;
c. Ensuring that all laser users receive an initial laser safety training and bi-annual refresher training;
d. Developing Standard Operating Procedures (SOP) which include safety aspects for all Class 3b and 4 lasers;
e. Providing all lasers users with laser specific trainings (SOPs)

f. Reviewing all SOPs annually;
g. Training and authorizing laser users to independently perform laser system alignments;
h. Informing all individuals working in proximity to laser systems of the existing hazards;
i. Updating Laser Permits with accurate information (i.e. new laser users, inventory changes, and locations of use.);
j. Renewing permits biannually; and
k. Assisting in laser safety inspection and post incident investigations.

4.6. Research Laser Supervisor

A Permit Holder may designate a laser supervisor who can perform all administrative tasks associated with laser operations and permit maintenance. However, all liability for safety and compliance issues remains under the exclusive responsibility of the Permit Holder.

4.7. Research Laser Users

Each laser user is responsible for:

a. Complying with all requirements of the Boston University/Boston Medical Center Laser Safety Program;
b. Conducting all laser activities in accordance with the standard operating procedures and accepted laboratory safety practices;
c. Completion of the online Laser Safety training via RIMS;
d. Completion and submission of the "*Laser Safety User Certification*" form;
e. Utilizing appropriate laser eye protection; and
f. Reporting any unsafe practices or usage of lasers to the Permit Holder and/or Office of Medical Physics and Radiation Safety.

5. Research Laser Permits

All research laboratories possessing **any** Class 3b and/or Class 4 laser systems not contained within a confocal, flow cytometer or other class 1, 2 or 3a interlocked enclosure, whether active or inactive, must be permitted through the DMPRS. To initiate the permitting process, an application for "*Class 3b and Class 4 Laser Use Permit (Non-Human Use)*" must be submitted to the DMPRS. The application must include locations of use, complete inventory, approved personnel list, Standard Operating Procedures (SOPs), and necessary safety requirements for all Class 3b and Class 4 lasers.

Upon receipt of the "*Class 3b and Class 4 Laser Use Permit (Non-Human Use)*", the DMPRS will conduct a laser safety inspection. After review of all pertinent information, the application will be acted upon by the LSS. All permits shall be renewed biannually.

The Permit Holder shall submit a "*Permit Amendment*" if changes in location of use, laser inventory, personnel, or Standard Operating Procedures (SOPs) occur.

5.1. Laser Procurement

Researchers who intend to purchase any laser systems that are classified as, or otherwise contain, a Class 3b or Class 4 laser must request pre-approval from the LSO prior to purchase. Following pre-approval, permitted laboratories may place orders through the purchasing liaison in their department or center.

5.2. Laser Inventory and Registration

The following classes of lasers are required to be inventoried with the DMPRS and will be registered with the state Massachusetts (MA DPH):

a. Class 3b lasers
b. Class 4 lasers

Note: This does not include embedded 3b or 4 laser systems. When the embedded system is disabled and the interlocks are open, it should be treated with its appropriate laser classification.

All previously mentioned laser systems must be registered utilizing the Laser Registration form, or online at: http://www.bu.edu/ehs/programs/rpo/radioisotope-safety/equipment-purchase/laser-registration/.

The registration requires detailing the following equipment specifications:

a. Laser Permit Holder code,
b. Manufacturer,
c. Laser Model,
d. Serial Number,

e. BU Property Tag (where applicable),
f. ANSI Class,
g. Laser Medium,
h. Wavelength or Range "λ" in nanometers,
i. Max Power "Φ" in milliwatts,
j. Beam Diameter "a" in millimeters,
k. Beam Divergence "ϕ" in milliradians, and
l. Mode type.

5.3. Laser Users

Prior to working with Class 3b and Class 4 laser systems, or any entry into a laser nominal hazard zone, all persons are required to:

a. Complete the online Laser Safety Training (LASER101).
b. Be included as an authorized user on a current Laser Permit.

With a valid Kerberos password, individual can complete the LASER101 training module at any time. This training is available online through the Research Information Management System (RIMS) training page: http://www.bu.edu/rims/. Additionally, the course materials can be located at: http://rims.bu.edu/rims/bostonu/trainingcourses/LaserSafety.pdf. A record of trainings and permits will be maintained by DMPRS. For any additional laser safety trainings, contact DMPRS.

Laser Safety Training expires after two years. All laser users and permit holders must retake training prior to expiration to remain in compliance. If a laser user's training expires, his or her laser use privileges will be suspended until training is retaken. If a permit holder's training expires, all laser activity in his or her lab must cease until training is retaken. It is the user's responsibility to ensure his or her training is up to date.

5.4. Standard Operating Procedures (SOPs)

SOPs are required for the safe operation of laser systems. The Permit Holder utilizing a Class 3b or Class 4 laser system must submit an SOP for each laser system. Procedures shall address system alignment and accurately describe the research, potential hazards, and methods to operate

the laser system.

SOP review or modification should occur:

a. Prior to all new experimental uses of an existing laser system;
b. Prior to PPE modifications;
c. Prior to room layout modifications;
d. Following inventory or associated personnel changes;
e. Prior to modifying beam alignments;
f. Biannually; and
g. Following all incidents and near misses regarding exposure of personnel or property to laser emissions.

Please refer to appendix **BU-03** (Alignment Guidance) for helpful safety guidelines.

6. Introduction to Lasers

The acronym **LASER** stands for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. A laser is a device which when energized can emit a highly collimated coherent beam of intense monochromatic electromagnetic radiation. This radiation can be emitted over a wide range of the electromagnetic spectrum from the ultraviolet region through the visible to the infrared region. The range of commonly available lasers is from 200 nanometers to 10.6 micrometers. These emissions may be in either continuous or pulse form depending on the laser system.

Since laser operations normally fall outside of the wavelengths required to produce ionizing radiation, the primary mechanism of beam damage is thermal. However, it should be noted that photochemical damage might occur while dealing with lasers operating in the ultraviolet region. The irradiance and the associated potential hazards depend upon the type of laser, beam characteristics, and the application of the laser system.

Common Laser Wavelengths

Spectral Region	Medium	Wavelength (nm)
Ultraviolet (180–400)	Argon Fluoride (ArF)	193
	Krypton Chloride (KrCl)	222
	Krypton Fluoride (KrF)	248
	Xenon Chloride (XeCl2)	308
	Nitrogen (N2)	337
	Helium-Cadmium (HeCd)	325
Visible (400-700	Argon (Ar)	488-515
	Copper Vapor (CVL)	511, 578
	Helium-Neon (HeNe)	543; 594; 612; 633
	Krypton (Kr)	647
	Ruby	694
Infrared (700-1000)	Titanium-Sapphire (Ti:Al2O3)	650-1100
	Gallium-Arsenide (GaAs)	850
	Neodymium-YAG (Nd:YAG)	1,064
	Holmium-YAG (Ho:YAG)	2,100
	Carbon Dioxide (CO2)	10,600

6.1. Laser Classifications

The American National Standards Institute (ANSI) has established a laser hazard classification system in publication, ANSI Z136.l-2007. The objective of the system is to provide reasonable and adequate guidance for the safe use of lasers and laser systems. Laser manufacturers are required to label all laser products, excluding Class 1, with appropriate class and beam characteristic information.

Note: Any class laser system could potentially have an embedded laser of a higher class inside of it that may be accessible during maintenance or repair.

The following is a summary of the ANSI classification scheme and the hazard(s) associated with each class of laser:

- **Class 1 laser system is:**
    a. Considered to be incapable of producing damaging radiation levels during operation “Eye Safe”, and
    b. Exempt from any control measures or other forms of surveillance.

Note: Items previously classified as Class IIa under the Federal Laser Product Performance Standard (FLPPS) should be treated the same as Class 1.

- **Class 1M laser system is:**
    a. Considered to be incapable of producing hazardous exposure conditions during normal operation unless the beam is viewed with an optical instrument such as an eye-loupe (diverging beam) or a telescope (collimated beam), and
    b. Exempt from any control measures or other forms of surveillance other than to prevent potentially hazardous optically aided viewing.

- **Class 2 laser system:**
    a. Emits in the visible portion of the spectrum (400-700 nm), and
    b. Eye protection is normally afforded by the "aversion response", < .25 seconds.

- **Class 2M laser system:**
    a. Emits in the visible portion of the spectrum (400-700 nm),
    b. Eye protection is normally afforded by the "aversion response" for unaided viewing; and
    c. Potentially hazardous if viewed with optical instrument such as an eye- loupe (diverging beam) or a telescope (collimated beam).

- **Class 3R laser system:**
    a. Is potentially hazardous under direct and specular reflection viewing conditions if the eye is appropriately focused and stable,
    b. Does not pose a diffuse reflection hazard, and
    c. Does not pose a fire hazard.

- **Class 3b laser system:**
    a. May be hazardous under direct and specular reflection viewing conditions,
    b. Is normally not a diffuse reflection or fire hazard,
    c. Requires laser safety PPE and controls (Interlocks are required to be connected to

laser in use signage for all Class 3b and 4 laser systems installed or modified after 2012.), and

d. Barriers, shields, and curtains may be recommended by the LSO and/or LSS when deemed appropriate following a hazard evaluation.

Note: Formerly labeled Class IIIa lasers with a "Danger" logo have been reclassified as 3R.

- **Class 4 laser system:**
  a. Is a hazard to the eye and skin from specular reflection and intrabeam exposures under all conditions,
  b. Is a fire hazard,
  c. May produce laser generated air contaminants (LGAC),
  d. May produce plasma (UV) radiation,
  e. Requires laser safety PPE and controls (Interlocks are required to be connected to laser in use signage for all Class 3b and 4 laser systems installed or modified after 2012.), and
  f. Barriers, shields, and curtains may be recommended by the LSO and/or LSS when deemed appropriate following a hazard evaluation.

Note: During maintenance and service the classification associated with the maximum level of accessible laser radiation shall be used to determine the applicable control measures.

Since laser pointers are the most commonly used laser devices considerations should be observed when using these devices regardless of the classification. Please see appendix: **BU- 02** (Laser Pointer Guidance) for additional information.

6.2. Categories of Active Laser Medium

One way to characterize lasers is by their active medium. Each medium exhibits it own unique set of advantages as well as challenges with regard to the amount of energy that can be stored, ease of handling and storage, secondary safety hazards, cooling properties, and physical characteristics of the laser output. Common gain mediums include crystals, glasses, gases,

semiconductors, and liquids.

6.2.1. Solid-State

The term "solid state", as related to lasers, refers to a group of optically “clear” materials such as glass or a "host" crystal with an impurity dopant. In this group, the host material is chosen for its optical, mechanical, and thermal properties. While the dopant is selected for its ability to form a population inversion and emit laser light, the material determines the output wavelength.

The most common example of this group are the Nd(III):YAG (Neodymium: Yttrium/Aluminum/Garnet) lasers, where neodymium ions are the impurity in the solid crystalline host material known as "YAG". These lasers are often high powered and pumped by a flashtube or laser diodes.

Also very common in this group are the Ti:Saphire (Ti:Al2O3) lasers, where the titanium ions are the impurity in a Sapphire crystal. Like the Nd:YAG lasers, Ti: a secondary laser such as an Argon-Ion often pumps Sapphire lasers or frequency doubled Nd:YAG. These lasers are often high powered and tunable in nature and can be operated in either the continuous wave (CW) or pulsed modes.

6.2.2. Semiconductor (Diode)

Diode lasers are the most numerous lasers currently in use. The two common families of diode lasers are composed of GaAlAs (Gallium/Aluminum/Arsenide), with output wavelengths in the 750 to 950 nm (commonly used in CD and CD/ROM players), and InGaAsP (Indium/Gallium/Arsenide/ Phosphide), which has a wavelength in the 1100- 1650 nm range (used in optical telecommunications).

Semiconductor lasers are commonly seen in research environments in conjunction with higher-powered solid-state lasers as a pump or as semiconductor arrays.

6.2.3. Liquid (Dye)

Liquid lasers utilize a flowing dye as the active medium, and are pumped by a flash lamp or by another laser, such as an Argon-Ion laser. Dye lasers are typically complex systems

requiring more maintenance and upkeep. They are operated in either pulsed or continuous wave mode depending largely on pumping configuration. One advantage of dye lasers is that dyes are wavelength tunable over a range of approximately 100 nanometers each. Common availability of dye types yields sub 400 nanometers to over 850 nanometers tunability ranges.

6.2.4. Gas

Gas laser systems utilize a gas, or gas mixture, confined to a tube. An electric current passes through the tube exciting the atoms and causing them to emit light. Mirrors at the ends of the tubes form a resonant cavity and primarily determines the laser wavelength.

Gas laser systems use different gas mixtures and solid particles to produce variety wavelengths. Common examples of these gas systems are the Carbon Dioxide (CO2) and Argon-Ion (Ar) laser types. A sub-category of this grouping is known as the Excimer lasers ("excited dimer"), such as the Xenon-Chloride (XeCl) laser. Excimer lasers operate in the ultraviolet region of and poses acute chemical hazards that must be accounted for.

7. Hazards

7.1. Beam Hazards

Laser emissions demonstrate the unique characteristic of posing an exposure hazard by both direct and indirect means. The following are forms by which laser emissions may expose individuals.

7.1.1. Intrabeam (direct)

An intrabeam exposure is a situation where an object intersects an unimpinged emission of a laser. These emissions have not been diffused, deflected, or reflected in a manner that would mitigate the irradiance of the beam. Power, distance, and beam divergence are important variables to consider during intrabeam exposure.

7.1.2. Focused

Although similar to an intrabeam exposure, a focused beam exposure is a situation where a lens or other collecting optic intersects an emission of a laser. It is important to note that the secondary emission’s characteristics (irradiance, beam diameter, etc.) are often substantially

different from the initial beam and dependent on the composition of the optic. The most important change in these characteristics is that of the convergence of the beam at a focal spot creating a substantially larger irradiance. This phenomenon of increased irradiance can be readily observed in the focusing of 400-1400 nm emissions in the human eye.

7.1.3. Reflections

Although often exhibiting lower irradiances than intrabeam or focused exposures, the unanticipated nature of a reflected emission poses a substantial risk. Variables such as wavelength, retinal focal location, and relative smoothness of a material can greatly impact actual exposure risks.

7.1.3.1. Specular

Specular reflection is defined to be the reflection from a "smooth" or mirrored surface. Depending on incidence angle and the refractive index of a material, exposure to specular reflections can be comparably dangerous to an intrabeam exposure. As a general rule, users should avoid using any glossy or smooth surfaced items in proximity to laser emissions. Items such as jewelry, wristwatches, and metallic tools are likely to produce specular reflections and should be removed prior to laser usage.

7.1.3.2. Diffuse

Diffuse reflection is defined as reflection from a "rough" or non-uniform surface. Diffuse reflections scatter the beam and cannot transmit the full irradiance of an emission like specular reflection. However, high power Class 4 laser systems may generate diffuse reflections that are still powerful enough to ignite materials or otherwise pose an exposure risk. Where diffuse reflection hazards need to be limited, specialized beam blocks, traps, and dumps should be utilized.

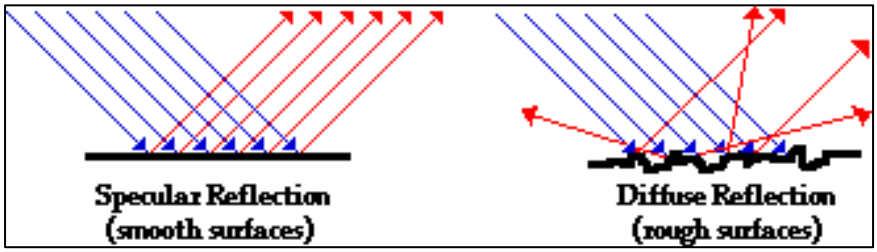


Figure 3

7.2. Non-Beam Hazards

7.2.1. Electrical Hazards

The most common hazard encountered with laser use is electric shock. Potentially lethal electrical hazards may be present especially in high-powered laser systems. There have been several electrocutions in the U.S. from laser-related electrical accidents.

The following are recommendations and guidelines to prevent electrical shock:

a. Avoid wearing rings, metallic watchbands, and other metallic objects.
b. When possible, use only one hand while working on a circuit.
c. Assume that all floors are conductive when working with high voltage.
d. Do not work with electrical equipment while standing on a wet floor or perspiring.
e. After powering down a laser control circuit, check that each capacitor is discharged, shorted, and grounded before allowing access to the capacitor area.
f. Inspect the integrity capacitor containers.
g. Use insulated tools and equipment.
h. Do not work alone. Work with a buddy.
i. Ensure laser system is properly grounded.
j. Ensure the laser power is off before working with electrical equipment.
k. Do not work while fatigued.
l. Do not perform any task if you are not trained and approved to do so.
m. Check with manufacturer's guidelines and obtain facilities approval to ensure proper wiring.

7.2.2. Biological Hazards

Laser Generated Air Contaminants (LGACs) may be produced from a biologic target being vaporized during beam interaction. LGACs are a resultant hazard that must be properly managed in both the clinical and research environments. Infectious material that is present in a biological target may survive beam exposure and become airborne or otherwise dispersed through pluming. Analysis of biological LGACs during laser surgical procedures has shown the presence, and viability, of numerous infections agents. Bio- aerosols, viable and non-viable cellular material, and viruses have been identified in analyzed LGACs.

The LSS will not approve Class 3b or Class 4 laser research projects using hazardous biological materials without written approval from the Biological Safety Officer, a completed laboratory safety inspection, and an evaluation of agent specific and operation hazards. This hazard evaluation may include an industrial hygiene assessment resulting in additional control measures.

Refer to the Boston University Biological Safety Manual for the proper handling and authorizations for biological materials.

7.2.3. Chemical Hazards

In both clinical and research environments, laser induced reactions and target decomposition products may produce hazardous particles and/or gases. When target irradiance reaches a threshold of approximately 107W/cm2, target materials (plastics, composites, metals, and tissues) may liberate hazardous and/or noxious airborne contaminants. In addition to these LGACs, some components of laser systems (flow- through gases, assist gasses, dyes, solvents, etc.) may also be hazardous substances. Gases should be stored per laboratory safety guidance and applicable municipal regulations to minimize any hazardous effects.

Example: Users should be aware of the extreme toxicity of chlorine and fluorine gases associated with Excimer laser systems. Concentrations as low as 0.1ppm of fluorine are considered toxic.

The LSS will not approve Class 3b or Class 4 laser research projects using hazardous chemicals without written approval from the Chemical Safety Officer, a completed laboratory safety inspection, and evaluation of chemical specific and operational hazards. This hazard evaluation may include an industrial hygiene assessment resulting in additional control measures.

Refer to the Boston University Chemical Hygiene Plan for the proper handling and authorizations for h

7.2.4. Fire Hazards

Fire hazards involving laser systems are a significant risk and should always be considered during hazard evaluations. Interactions with emissions from Class 3b laser systems that are direct beam or specular in nature may cause combustion of flammable materials. However, diffuse reflections from Class 3b laser systems generally do not pose a fire hazard. All exposures to emissions from Class 4 laser systems are considered fire hazards and should be treated with extreme caution.

Some potential fire hazards are ancillary electrical component failure, loose fitting clothing, flammable byproduct gases, and solvents. It should be noted that many solvents associated with dye laser systems may be extremely flammable and proper shielding from sources of ignition should be implemented. Although the most likely source of ignition to any of these items is from beam exposure, the ability for high voltage pulses from improper grounding, proximity to flash lamps, or other circumstances should not be overlooked.

Enclosures and other laser barriers should be fire rated and comply with all applicable building and fire codes.

Contact Boston University Office of Campus and Clinical Safety for specific fire regulations and guidance.

7.2.5. Animal Use Hazards

The use of lasers in conjunction with animals presents a unique set of challenges and hazards; Boston University's Institutional Animal Care and Use Committee (IACUC) and the Laser Safety Sub- Committee (LSS) must approve all laser work involving animals. When necessary, other institutional committees and other divisions of EHS will be contacted for supporting documentation or expertise for protocol approval.

7.2.6. Miscellaneous

There are a variety of ancillary hazards that may be encountered during laser operation. These hazards include, but are not limited to, the following:

a. Capacitor banks- Explosion, Electrocution

b. Unsecured wires- Slip, Trip and Fall
c. Robotics- Mechanical
d. Work station setup- Ergonomic
e. Excessive noise- Noise

Note: Please contact DMPRS for miscellaneous hazard evaluation.

8. Biological Effects

Laser exposures are hazardous both ocularly and dermally at varying wavelengths and irradiances. These hazardous levels are avoided through the observance of threshold values limiting exposure to laser emissions. The sections below describe both the limits and the injury mechanisms associated laser exposures.

8.1. Maximum Permissible Exposure (MPE)

Conservative standards for threshold levels of "laser radiation to which an unprotected person may be exposed to without adverse biological changes in the eye or skin" have been established by American National Standards Institute (ANSI Z136.1-2007). Although both ocular and skin MPEs are below hazardous levels they are used as regulatory thresholds to avoid the likelihood of hazardous exposures. MPEs are closely related to laser classifications in terms of its ability to surpass an MPE for that wavelength.

8.2. Ocular

Laser eye exposures can result in thermal, photochemical, and acoustic damage. Each of these effects results from the deposition of energy into the attenuating ocular media. The location and extent of injuries are dependent upon wavelength of the light, energy absorption characteristics of the ocular media, and duration of exposure. Infrared, visible, and ultraviolet emissions are all capable of causing damage to the eye. The cornea, lens, and retina are the three ocular structures of concern.

All MPE values for visible light are based on a pupil diameter of 7mm; which is considered the maximum opening of the iris. However, wavelength emissions outside of this range are averaged out over a 1mm diameter. All ocular MPEs are below hazardous levels but are used as regulatory threshold level to avoid the likelihood of hazardous exposures.

Ocular hazards are easily controlled with the use of appropriate laser safety eyewear, or other engineering safety controls.

8.2.1. Near-UV (200-400 nm)

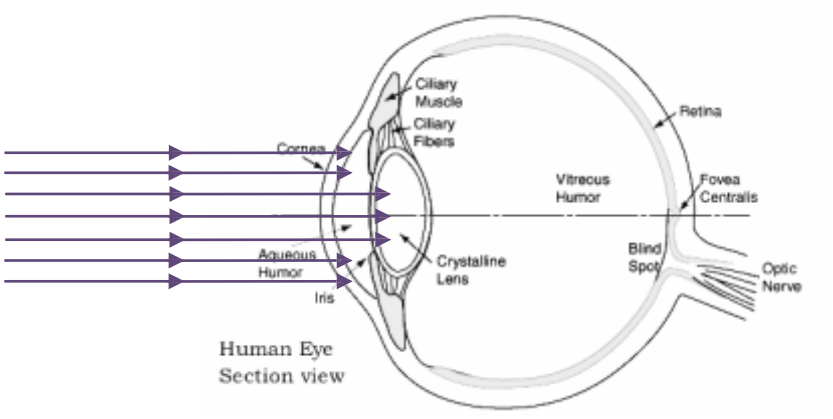


Figure 4

Near-UV region (200-400 nm) emissions are quickly attenuated by the eye making the structure of concern the **lens**.

Clouding of the lens (*photochemical cataract*) is a likely result of a near-UV overexposure. Additionally, it should be noted that there is an increased risk of corneal opacities (*cataracts*) from chronic exposures to levels of UV radiation below MPE limits.

8.2.2. Visible & Near Infrared (400-1400 nm)

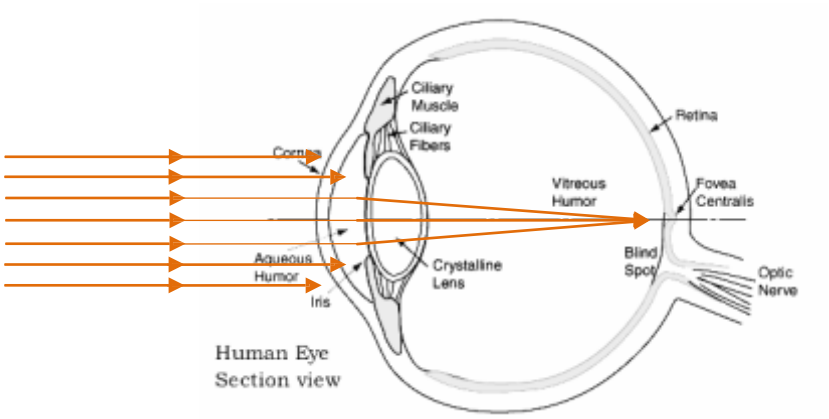


Figure 5

Visible and Near Infrared (400-1400 nm) emissions may transverse many structures of the

eye, however the structure of concern is the **retina**.

Light entering the eye from a collimated beam in this region is concentrated by a factor of 100,000 as it passes through the lens onto the retina. The lack of a repair mechanism of the retina makes most retinal damage irreversible, enhancing the relative risk. It should be noted the transient biological effects such as flash blindness, glare, after images, and startle effects may occur as a result of limited low level exposures.

8.2.3. Far-UV (122-200 nm) & Far-IR (1400-10600 nm)

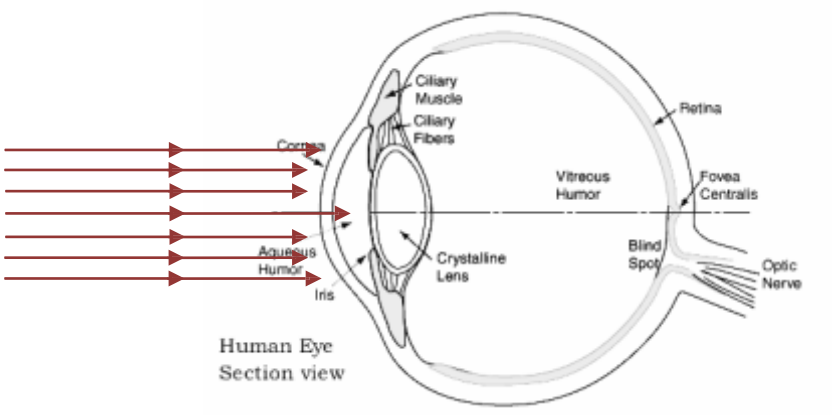


Figure 6

Far-UV (122-200 nm) and far-IR (1400-10600 nm) emissions are nearly fully attenuated by the exterior of the eye, making the **cornea** the structure of concern.

Corneal burns (*Photokeratitis*), opacities, and protein leakage (*aqueous flare*) are possible results of over exposure. Emissions outside of the visible spectrum are especially dangerous because the eye does not have a natural aversion to these wavelengths.

8.2.4. Pulsed

Under pulsed conditions of all wavelengths, it is important to note the risk of acoustic damage. The instantaneous boiling of water found in the tissue causing a localized explosion causes this form of damage. This explosion may even be violent enough to be locally audible. The resulting shockwaves propagate through the entirety of the eye possibly causing hemorrhaging and other physical damage in excess of thermal burns.

8.3. Dermal

Although largely reversible, dermal injuries may occur from interaction with laser emissions. Thermal burns are possible from acute exposure to high irradiance IR and Visual spectral region emissions. While Hyperpigmentation, Erythema (*sunburn*), types of skin cancers, and accelerated skin aging are possible with both acute and chronic exposures to UV emissions.

9. Hazard Controls

Laser safety procedures can best be evaluated by grouping them according to the class of the lasers.

The hazard controls necessary for the safe use of laser radiation depends upon:

a. Laser classification;
b. Environment where the laser is used;
c. Laser operating characteristics; and
d. The general population within the vicinity of the laser.

The most common causes of laser incidents are associated with the following:

a. Exposure during alignment,
b. Misaligned optics,
c. Non-utilization of eye protection,
d. Equipment malfunction,
e. Improper method of handling high voltage,
f. The unfamiliar operation of laser equipment,
g. Improper assembly of equipment following maintenance and service,
h. Inadvertent beam discharge,
i. Insertion of flammable materials into beam path, and
j. Intentional exposure of unprotected personnel.

9.1. Engineering Controls

The preferable control method is to either remove the hazard or place a barrier between the worker and the hazard. These controls are meant to be independent of human interactions and provide the highest level of protection.

The following are some examples of engineering controls that are generally required for Class 3b and Class 4 laser systems:

a. *Activation of Warning Devices:* Illuminated "Laser in Use" signs or audible signals.
b. *Protective Housings:* Enclosures that limit the access to hazardous laser emissions.
c. *Beam Stops or Attenuators:* Devices incorporated into a laser system to terminate hazardous emissions.
d. *Interlocks on Removable Protective Housings:* Switches that terminate power when an enclosure is opened or removed.
e. *Key Control:* Keyed control switch that can initiate or terminate the laser system's operation and otherwise limit use by untrained individuals.
f. *Viewing Windows, display screens, and collecting optics:* Incorporation of suitable means to view laser emissions while attenuating exposures below MPE.
g. *Beam Path:* Designed route of laser emissions used to limit the degree of accessibility.

Note: Although highly beneficial in terms of hazard reduction, the initial cost and structural limitations may prove to make them impractical in some circumstances. Please contact DMPRS for further evaluation

9.1.1. Facility Window Protection (Shades, Acrylics, and Window treatments)

Windows that are located within a NHZ must be covered with an appropriate absorbing filter, blocking barrier, scattering filter, or screen to reduce any laser emissions to levels below the applicable MPE. All window protection must follow the guidance of laser curtains and barriers as identified below (see 9.1.2.).

Acrylic is ideal for viewable window protection, workstation viewing ports, and optical enclosures as long as the acrylic provides sufficient OD for a particular laser wavelength. For specific wavelengths and OD requirements, some acrylic materials are coated to prevent laser transmission. The benefits of acrylic include ease of use, durability, and scratch resistance.

Laser shades are best installed on outside facing windows to prevent any hazards from exiting the laboratory (hallway) or building. Laser shades must also follow the guidance of laser curtains (see 9.1.2.).

Window protection must be approved by LSO, or qualified designee, prior to installation.

9.1.2. Laser Curtains and Barriers

Laser curtains and barriers should be used for class 3b and 4 laser systems to prevent laser emissions from exceeding the MPE outside the controlled area.

Important factors for the selection of laser curtains or barriers include:

a. Ability to withstand direct and diffusely scattered beams;
b. Flammability;
c. Associated biological usage (i.e. ability to withstand 10% bleach or 70% Ethanol cleaning and maintain laser properties); and
d. Decomposition products (i.e. do not release toxic fumes or other substances during interaction with laser emissions.)

Note: All Laser curtains at BU/ BMC must meet the standards of ANSI Z136.1, NFPA 701, and the Boston Fire Department (BFD).

9.1.3. Laser Signage

The purposes of "Laser in Use" and laser warning signs are to identify potential safety hazards within the laboratory. Particular attention should be used with placement of signage, as it must be conspicuously displayed. Personnel, who may need to enter areas where lasers are used, must be provided appropriate instructions and explanation of theses warning signs. For Class 3b and 4 lasers installed or modified after 2012, the power to the laser must be interlocked with the LIU sign. All other power should not be interlocked with the LIU signs.

Note: The DMPRS will provide Permit Holders with appropriate laser warning signs. However, all illuminated "Laser In Use" signage is the sole responsibility of the Permit Holder and Facilities.

9.1.3.1. Laser Warning Signs

ANSI Z136.1 requires laser warning signs for Class 3b and 4 laser systems to list the classification, wavelength, pulse duration, maximum output, and required optical density of eyewear. In addition the terms “Danger”, “Caution”, and “Notice” should be present to express the severity of the hazard. When appropriate, special instructions should also be included. The warning sign should be located on all usable entrances to the laboratory space.

Additionally, when Class 3b and Class 4 lasers are being serviced and/or undergoing maintenance, a laser “notice” sign is required to be posted.

Please see appendix **BU-06** (Laser Warning Signs) for warning signage specifications.

9.1.3.2. Illuminated Warning Signs

Illuminated warning, "*Laser in Use*" (LIU) sign(s), are required for Class 3b and 4 laser systems. The LIU sign shall illuminate while the laser is operational and the controls shall be located in the vicinity of the optical table. Interlocks are required to be connected to laser in use signage for all Class 3b and 4 laser systems installed or modified after 2012.

The LIU sign should be located above the door at all useable entrances for all laser laboratories. If the laboratory requires the use of multiple nominal hazard zones, an illuminated sign will be located at all laboratory entrances and the DMPRS shall approve the location(s) for additional LIU signage.

9.1.3.3. Equipment Labels

All lasers or laser systems shall have appropriate warning labels as demonstrated in International Electrotechnical Commission (IEC 60825-1 Standard). This standard requires a starburst logo be permanently affixed on a laser or its housing. The manufacturer provides the classification for most lasers. For custom-built and modified lasers, the LSO will assist you in classifying your laser.

Please see appendix **BU-06** (Laser Warning Signs) for warning signage specifications.

9.2. Administrative and Procedural Controls

Where hazards cannot be completely avoided through engineering controls, administrative controls are implemented to marginalize or remove the hazardous environment. In general, these controls consist of policies and work practices that will be instituted by BU/BMC at an administrative level to ensure a safe working environment. Since there is significant dependence on human interaction with administrative controls, there will be extensive oversight and review involved to ensure safety and compliance.

The following are some examples of administrative controls that are generally required for Class 3b and Class 4 laser systems:

a. *Standard Operating Procedure (SOPs):* Detailed instructions for normal operation, emergency shutdown, and alignment.
b. *Output Limitations:* Setting the power, or radiant energy, to minimum levels required for usefulness that may be accessible during operations or maintenance.
c. *Education and Training:* Safety/ awareness training provided for all users or individuals who could be potentially exposed to hazardous laser environments.
d. *Restricted Access:* Only trained and approved users shall have access to laser usage areas where a NHZ may exist under normal working conditions.

9.2.1. Unattended Use of Laser Systems

Under special circumstances the LSO may grant permission to operate a laser system for an extended period of time where direct supervision may not be feasible.

This permission will only be considered and granted where the environment meets the following requirements:

a. *Security of Laser:* The laser system is not accessible during operation.
b. *Prevention of Exposure:* Emissions do not pose an inadvertent risk to personnel or

facility.

c. R*estricted access and viewing:* Untrained individuals cannot enter or be exposed to a nominal hazard zone.

In such cases where special written permission is granted, this written permission shall be issued by the LSO and Chair of the LSS.

9.3. Personal Protective Equipment (PPE)

When engineering controls and administrative controls cannot completely remove a hazardous environment, personal protective equipment must be utilized.

9.3.1. Ocular PPE

Since overall sensitivity and permanence of damage lies with the eye, protective eyewear is the main component of protective equipment when it comes to laser usage. *ANSI Z136.1-2007* requires that protective eyewear be available and worn whenever hazardous conditions may result from laser radiation or laser related operations. Appropriate protective eyewear should be worn whenever working with Class 3b or Class 4 laser systems. Additionally, protective eyewear should be used during extended (>.25 second) intrabeam viewing of Class 2 or Class 3R laser emissions.

The eye is protected against laser emissions by the use of protective eyewear that attenuates the intensity of laser light while transmitting enough ambient light for visibility (luminous transmission). The ideal eyewear provides maximum attenuation of the laser light while transmitting the maximum amount of ambient light. Since no single lens material is useful for all wavelengths, it is important that careful consideration is given to the operating parameters, MPEs, and wavelengths associated with the hazardous emissions. Laser eyewear must be specifically selected to withstand either direct or diffusely scattered beams and shall meet all applicable provisions of *ANSI/ISEA Z87.1- 2010*. The LSO, or qualified designee, will approve the appropriate laser safety eyewear during the permitting and/ or laser registration processes.

Note: Always check the OD and inspect the protective eyewear prior to usage.

Factors to consider for selecting laser protective eyewear:

a. Laser power and/or pulse energy,
b. Wavelength(s) of laser emission,
c. Nominal Hazard Zone (NHZ),
d. Maximum Permissible Exposure (MPE),
e. Exposure time(s),
f. Prescription lenses requirement(s),
g. Comfort and fit,
h. Visible light transmission,
i. Anti-fogging design or lens coatings,
j. Need for side protection (goggles), and
k. Damage threshold (Optical and Physical).

Note: Laser alignment/tuning goggles are available and may provide acceptable protection during reduced power alignment procedures while allowing the beam to be visible. Alignment/tuning goggles are not permitted for use of full laser power unless the OD is rated appropriately for that laser.

9.3.2. Dermal PPE

In general, skin protection can best be achieved through engineering controls. However, if potential skin damaging exposures still exists, skin covers and/or "sunscreen" creams should be utilized. Other methods of minimizing exposure to UV radiation are beam shields and clothing (opaque gloves, tightly woven fabrics, laboratory coats) that attenuate the laser emissions to levels below the MPE for specific UV wavelengths.

9.3.3. Other PPE

All PPE for non-laser hazards must be evaluated and addressed by BU/BMC Office of Environmental Health & Safety.

10. Laser Safety Audits

All laser laboratories will be inspected annually by the DMPRS to ensure compliance with applicable safety and regulatory standards.

10.1. Inspections

Inspections may be unannounced or scheduled in advance with the Permit Holder. Inspection reports will be sent to Permit Holders and findings will be reviewed by the LSS. All required corrective actions will be conveyed in writing to the Permit Holder.

10.2. Enforcement

Upon approval of the LSO or qualified designee, inspection findings and summaries will be presented to the LSS. Any comment or corrective actions brought by the LSS will be communicated to Permit Holder.

The LSO and/ or LSS have the authority to immediately stop operations posing imminent serious safety hazards.

To ensure safety and regulatory compliance the LSO and LSS may issue "Finding", "Warning", and "Suspension" notices to the Permit Holder.

10.2.1. Finding

Upon observation of deficiency, the LSO will notify the Permit Holder. A FINDING notice will be issued and contain a description of the infraction and will set a date by which corrective measures must be completed.

10.2.2. Warning

If the Permit Holder fails to provide a satisfactory response to a FINDING as described above or if the same violation is repeated, the Permit Holder will be issued a WARNING. The WARNING will set a date by which corrective steps must be completed and will state that the permit will be suspended if corrective measures are not completed by that date.

A copy of the WARNING will also be sent to the Chairman of the Department and LSS.

10.2.3. Suspension

If the Permit Holder fails to perform the required corrective actions or submit a written response to the LSO, prior to the due date previously set by the WARNING; a letter of SUSPENSION of operations will be issued. The LSS has been empowered to temporarily suspend or permanently revoke a laser permit.

Upon suspension of permit, all users listed on the permit will be prohibited from activities utilizing laser systems and locations detailed on the suspended permit. Laser privileges for the Permit Holder and Laser Users can be reinstated when the LSS determines that effective corrective action has been implemented.

11. Medical Surveillance

Personnel working with Class 3b and/or Class 4 lasers or laser systems are not required to obtain either a pre- or post-employment medical examination specific to laser use. However, employees must report any suspected laser injury to a supervisor and Employee Occupational Health. See appendix **BU-04** (ROHP Flip Chart).

12. Emergencies and Incidents

During an emergency please follow applicable BU/BMC emergency procedures as detailed on posted Emergency Flip Charts.

If a known or suspected over exposure to laser radiation occurs within Boston University, individuals must report all laser incidents to the Permit Holder no matter how minimal of an event. It is the Permit Holder's responsibility to formally report any accidents causing injury or property damage to ROHP and the LSO. In the event of a laser exposure please refer to: **BU-04** (ROHP Flip Chart)

12.1. Incident Reporting

The Permit Holder will immediately document and forward the following information for review by the LSS and LSO:

a. Date, time and location of the incident,
b. Department,
c. Name of reporting person's or Permit Holder,

d. Manufacturer, Model, and serial number,
e. Name(s) of individual(s) alleged or suspected to have been over exposed.
f. Laser characteristics and operating parameters at the time of the incident (Wavelength, peak and average power, pulse width and frequency, beam diameter and divergence, etc.).
g. Duration of the exposure and the individual's position relative to the laser.
h. Identify protective equipment being used at the time of the event.
i. Facility configuration at the time of the event.
j. Written statements and descriptions of the incident by involved individuals,
k. If indicated, the LSS/LSO will respond on-site to the department reporting the incident.

Note: Please complete **BU-05** (Laser Incident Report) in the case of suspected incidents or exposures

12.2. LSS Incident Follow Up

Following the initial reporting of the alleged or suspected overexposure, the Permit Holder will file a report with the LSO who will coordinate the preparation of a detailed report of the incident. This report shall consist of a summary of the estimated exposure, timetable of medical evaluations, actions taken to prevent recurrence.

13. Clinical Laser Safety

13.1. Use of Clinical Lasers

All Boston Medical Center physicians using lasers in clinical setting must have the appropriate privilege to do so. Laser privileges are restricted to the **specific laser type(s) and procedure** for which approval has been granted.

All Boston Medical Center nursing staff participating in clinical laser activities and using laser accessories must have completed the education program developed by their departments and approved by the LSS.

All other personnel within Boston Medical Center associated with the use of lasers shall have appropriate training in laser safety and other pertinent material as determined by the

LSS and the individual departments.

13.2. Privileging Procedure

All physicians who use a laser system for patient care at Boston Medical Center must have the appropriate privilege to do so.

Applying for privileges is accomplished by completing:

a. "*Delineation of Privileges*" form (specific to the Division of the applicant), and
b. "*Application For Laser Use at Boston Medical Center*" form.

These forms and supporting documentation are required to be submitted to the Medical Affairs Office.

See appendix: **BMC-01** (Policy and Procedure for Obtaining Clinical Laser Privileges at the Boston Medical Center).

13.3. Clinical Laser Training

Dedicated Laser Assistants (Nurses, Technicians, etc.) who have been approved to operate the clinical laser equipment during surgical procedures shall be properly trained in laser safety and operation of the specific laser units. All laser trainings and in-services must be approved by the DLSOC or LSO. Laser assistants may be RN's, LPN's, PA's, Surgical Technicians, or other individuals deemed qualified by the Deputy Laser Safety Officer Clinical (DLSOC).

Each department involved in the use of lasers shall have relevant personnel trained in the following areas:

a. General laser concepts, tissue interactions, and laser safety.
b. Hands-on training with the facilities specific laser(s)
c. Awareness and comprehension of BMC's written laser safety policies and procedures.

Laser assistants will complete laser safety training annually and laser specific training as needed. Physicians will comply with applicable Credentialing training requirements. A list of laser trained personnel and credentialed physicians shall be maintained by the DLSOC or LSO.

13.4. Clinical Laser Procurement

Purchasing or acquiring Clinical lasers must be done only with the full knowledge and approval of the LSO or DLSOC. Before receiving the equipment, the LSO or DLSOC will verify that the acquiring department, location, personnel, and equipment meet Hospital, State, and Federal regulations.

Any laser purchased with a BMC "*Capital Purchase Requisition*" form must be signed by Clinical Engineering who will forward the request to DLSOC.

13.5. Location and Storage of Clinical Lasers and Laser Accessories

When not in use, laser systems and their accessories (i.e. goggles, fibers, and gas cylinders) should be stored in a designated location away from high traffic areas. Additionally, any ignition key should be removed and stored separately from the laser system. If the laser system is to be moved to another area for use, special care should be taken in the movement of the equipment. Avoid unnecessary bumping or banging which could knock the optics out of alignment.

13.6. Laser Maintenance

All BMC departments using lasers shall comply with the hospital's Medical Equipment Policy.

13.7. Request to Bring a Clinical Laser into the Operating Room

In order to accommodate a request for a clinical laser to be brought into the OR, the clinician must provide the OR Management Group the following information. (Both trial basis or permanent use):

a. The size of the laser, the mobility of the unit and the storage needs;
b. The particulars of safe operation which apply to this laser;

c. The accessories and their cost needed for the unit, such as fibers, fiber tips, protective eyewear, etc.
d. The persons or company responsible for maintenance costs of the unit.
e. The conditions under which the laser will be brought into the OR, (i.e., length of time, loan/trial)
f. Other areas, besides the OR, where the laser will be used.
g. The shipping fee.
h. A list of staff needing training, and a training plan.

The responsible Physician must understand and comply with the following:

a. A no cost purchase order must be established with the OR buyer;
b. The laser system must be checked for electrical safety by the Biomedical engineers prior to being used;
c. The Medical Staff Executive Committee must designate user approval prior to the laser system's arrival in the OR.
d. The physician-user must be responsible for coming to the OR to test fire the laser ahead of scheduled OR time, each time the laser will be used.

13.8. Endotracheal Tubes Used During Laser Surgery

A laser-safe endotracheal tube must be used for intubation during airway laser cases. Additionally, the cuffs should be filled with sterile water or saline in case of cuff perforation. A second tube should be kept on hand in the event of any damage to the first. "Venturi jet ventilation" may also be employed during laser surgery.

Note: It is important to minimize the hazards of laser surgery in or near the airway, since oxygen- rich mixtures of anesthetic gases passed through an unprotected endotracheal tube can cause the tube to burn vigorously in the presence of a laser beam, thereby causing a loss of airway control, as well as fires and explosions.

13.9. Laser Case Documentation

The dedicated Laser Assistant according to the parameters on the printed form shall maintain the laser log. The use of a laser log does not preclude or replace the need for

patient charting as required by law, and such a Laser Log is not a requirement of *ANSI Z136.3*.

The following case information should be documented:

a. Patient name and medical record number,
b. Operating Physician(s),
c. Procedure,
d. Laser Used, and
e. Procedural deviations (unusual occurrences).

13.10. Laser Accident/Incident

In the event of a laser related injury the following actions should be taken:

a. Health Care Personnel

An employee must immediately report any laser injury or eye exposure to his/her supervisor. The employee must be seen immediately following the injury at Occupational and Environmental Medicine (OEM) located on Yawkey first floor, Monday through Friday, 7:30 a.m. to 4:00 p.m. or at the Emergency Department at any other time.

The supervisor must ensure transportation of the employee to OEM or the Emergency Department and complete an Accident Report Form at that time. The supervisor must record all pertinent information about the accident on the form. The Accident Report Form should be passed through the proper channels (Work Related Injuries Policy #: 07.27.000). In addition, a copy of the incident report should be forwarded to both the LSO and DLSOC.

b. Patient

A physician should perform an examination of the injury. A STARS incident report shall be completed and passed through the proper channels (STARS Incident Reporting Policy #: 04.01.000). In addition, a copy of the incident report should be forwarded to both the LSO and DLSOC.

13.11. Clinical Laser Operation in the Event of a Disaster

If an emergency occurs while the laser is in use, the laser must be shut down immediately and the established *BMC Internal Fire and Disaster Plan* will be followed.

Shut down the laser by pressing the EMERGENCY STOP button. On some lasers the cooling pumps will continue to cycle. If all power to the unit is to be stopped, turn the ignition key to off, unplug the laser, and remove the keys.

Refer to the *BMC Internal Fire and Disaster Plan* for further information regarding the institutions disaster plans.

References

1. ANSI Z136.1-2007, American National Standard, *American National Standard for Safe Use of Lasers*, 2007.
2. ANSI Z136.8-2012, American National Standard, *American National Standard for Safe Use of Lasers in Research, Development, or Testing*, 2012.
3. ANSI Z136.3-2011, American National Standard, *American National Standard for Safe Use of Lasers in Health Care*, 2011.
4. NFPA 115,National Fire Protection Association, *Standard for Laser Fire Protection*, 2008.
5. NFPA 701, National Fire Protection Association, *Standards Methods of Fire Tests for Flame Propagation of Textiles*, 2010.
6. 105 CMR 121.000, Massachusetts Department of Public Health, *To Control the Radiation Hazards of Lasers, Lasers Systems and Optical Fiber Communications Systems Utilizing Laser Diode or Light Emitting Diode Sources*.
7. OSHA Technical Manual: http://www.osha.gov/SLTC/laserhazards.
8. OSHA General Duty Clause of Public Law 91-59
9. 21 CFR 1040.10 *Performance Standard for light emitting products*, Volume 8, April 1, 2011.

Appendices

BU-01 (Definitions):

Absorption: Transformation of energy to a different form of energy by interaction with matter.

Aperture: An opening, window or lens through which radiation can pass.

Attenuation: The decrease in the radiant flux as it passes through an absorbing or scattering medium.

Average power: The total energy in an exposure or emission divided by the duration of exposure or emission.

Aversion response: Closure of the eyelid, eye movement, papillary constriction or movement of the head to avoid an exposure to a noxious or bright light stimulant. The aversion response to an exposure from a bright, visible, laser source is assumed to occur within 0.25 seconds, including the blink reflex time.

Beam: A collection of light/photonic rays characterized by direction, diameter (or dimensions) and divergence (or convergence).

Beam diameter: The distance between diametrically opposed points in that cross-section of a beam where the power per unit area is l/e (0.368) times that of the peak power per unit area.

Beam divergence: The tendency of a laser beam to expand in diameter as it moves away from the source, measured in milliradians (mrad) at specified points.

Blink reflex: The involuntary closure of the eyes as a result of stimulation by an external event such as irritation of the cornea or conjunctiva, a bright flash, the rapid approach of an object, an auditory stimulus or with facial movements. The ocular aversion response for a bright flash of light is assumed to limit the exposure of a specific retina to 0.25 s or less.

Clinical Laser Liaison (CLL): The CLL will oversee laser activities in an identified laser use area. They

are the liaison between the clinical staff and the LSO/DLSOC. Duties include monitoring compliance with operational policies and procedures, assisting the LSO/DLSOC with auditing, assessing continuing education and training needs and maintaining unit inventory.

Coherent: A beam of light characterized by a fixed phase relation (spatial coherence) or single wavelength, i.e., monochromatic (temporal coherence).

Collimated beam: Effectively, a "parallel" beam of light with very low divergence or convergence.

Continuous wave (CW): The output of a laser, which is operated in a continuous rather than a pulsed mode. A laser operating with a continuous output for a period > 0.25 sec. is regarded as a CW laser.

Controlled area: An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from laser radiation hazards.

Cornea: The transparent outer layer of the human eye, which covers the iris and the crystalline lens. The cornea is the main refracting element of the eye.

Dedicated laser assistant: A dedicated laser assistant shall be assigned to set up and operate the laser equipment, and monitor the laser treatment controlled area for safety during the procedure. From the time the laser key switch is activated, to the time it is turned off, the laser assistant shall have no other duties except for direct operation of the laser control panel and to monitor the room for compliance with safety policies & procedures

Deputy Laser Safety Officer Clinical Lasers (DLSOC): Individual who oversees day to day laser safety operations in clinical settings that works closely with LSO, DMPRS and Clinical Engineering to ensure safe operations of Lasers at BMC. Individual is considered a technical expert who oversees training, equipment maintenance, inventory, and installation of new clinical lasers.

Diffuse reflection: Change of the spatial distribution of a beam of radiation when it is reflected in many directions by a surface or by a medium.

Divergence: The increase in the diameter of the laser beam with distance from the exit aperture, based on

the full angle at the point where the irradiance (or radiant exposure for pulsed lasers) is1/e times the maximum value. Symbol: Φ

Electromagnetic radiation: The flow of energy consisting of orthogonally vibrating electric and magnetic fields lying transverse to the direction of propagation. X-ray, ultraviolet, visible, infrared and radio waves occupy various portions of the electromagnetic spectrum and differ only in frequency, wavelength, or photon energy.

Embedded laser: An enclosed laser that has a higher classification than the laser system in which it is incorporated, where the system's lower classification is appropriate due to the engineering features limiting accessible emission.

Energy: The capacity for doing work. Energy content is commonly used to characterize the output from pulsed lasers, and is generally expressed in joules (J).

Eye-safe laser: A Class 1 laser product. The use of term Eye-safe laser is discouraged.

Hazardous light sources: Ultraviolet, intense pulsed light (IPL), and high-powered infrared LEDs are considered hazardous light sources. The same safety precautions should be taken with these sources as with lasers.

Health Care Support Staff: This includes the laser scrub nurse, the laser nurse/technician, the circulating nurse and anesthesia staff who assist during a laser procedure. The laser nurse will have no other responsibilities other than the laser during laser procedures.

Hertz (Hz): A unit expressing the frequency of a periodic oscillation in cycles per second

Infrared (IR) radiation: Invisible electromagnetic radiation with wavelengths that lie within the range of 0.70 to 1000 micrometers. This region is often broken up into IR-A, IR-B, and IR-C.

Ionizing radiation: Electromagnetic radiation having sufficiently large photon energy to directly ionize atomic or molecular systems with a single quantum event.

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

Irradiance (at a point of a surface): Radiant power incident per unit area upon a surface. Unit: W/cm2.

Joule (J): A unit of energy. 1 Joule = 1 Watt/second.

Laser diode: A laser employing a forward-based semiconductor junction as the active medium.

Laser Nurse/Technician: Nurse or technician who sets up laser procedure prior to physician use and completes laser log and ensures safety checklist is followed during an OR procedure.

Laser Operator: Person credentialed to perform specific laser procedures and who assumes responsibility for the laser and appropriateness of the procedure.

Laser pointer: A laser product that is usually hand held that emits a low-divergence visible beam and is intended for designating specific objects or images during discussions, lectures or presentations as well as for the aiming of firearms or other visual targeting practice. These products are normally Class 1, Class 2 or Class 3R.

Laser Safety Officer (LSO): Professional who provides consultative services on laser hazard evaluation and control and oversees laser use. This includes training, documentation, purchasing, monitoring and other safety concerns. LSO also has the authority to suspend, restrict or terminate the operation of a laser system if he/she deems that laser hazard controls are inadequate.

Maximum permissible exposure (MPE): The level of laser radiation to which an unprotected person may be exposed without adverse biological changes in the eye or skin.

Nominal hazard zone (NHZ): The space within which the level of the direct, reflected or scattered radiation may exceeds the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the applicable MPE.

Non-beam hazard: A class of hazards that result from factors other than direct human exposure to a laser

beam.

Optically aided viewing: Viewing with a telescopic (binocular) or magnifying optic. Under certain circumstances, viewing with an optical aid can increase the hazard from a laser beam

Optical density: Logarithm to the base ten of the reciprocal of the transmittance: Dl = log10(1/tl), where it is transmittance at the wavelength of interest.

Physician: Laser user credentialed in the usage of lasers for clinical applications and surgical procedures. In all cases, the physician must use the laser for its intended purpose within the scope of his/her practice, training, and experience and be familiar with safe laser practices to ensure the safety of patients, employees, and the environment.

Photochemical effect: A biological effect produced by a chemical action brought about by the absorption of photons by molecules that alter the molecule.

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

Protective housing: An enclosure that surrounds the laser or laser system that prevents access to laser radiation above the applicable MPE level. The aperture through which the useful beam is emitted is not part of the protective housing. The protective housing may enclose associated optics and a workstation and shall limit access to other associated radiant energy emissions and to electrical hazards associated with components and terminals, and may enclose associated optics and a workstation.

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

Pulse duration: The duration of a laser pulse; usually measured as the time interval between the half-power points on the leading and trailing ends of the pulse.

Pulse mode: Operation of a laser when the beam is on intermittently in fractions of a second.

Pupil: The variable aperture in the iris through which light travels to the interior of the eye.

Q-switch: A device for producing very short (»10 – 250 ns), intense laser pulses by enhancing the storage and dumping of electronic energy in and out of the lasing medium, respectively.

Q-switched laser: A laser that emits short (»10 – 250 ns), high-power pulses by means of a Q- switch.

Radiant energy: Energy emitted, transferred, or received in the form of radiation. Unit: joule (J).

Reflectance: The ratio of the total reflected radiant power to the total incident power, also called "reflectivity."

Reflection: Deviation of radiation following incidence on a reflective surface.

Retina: The sensory membrane, which receives the incident image formed by the cornea and lens of the human eye. The retina lines the inside of the eye.

Specular reflection: A mirror-like reflection. The exact definition of a specular surface is one in which the surface roughness is smaller than the wavelengths of the incident light.

Transmission: Passage of radiation through a medium.

Ultraviolet radiation: Electromagnetic radiation with wavelengths between 0.18 to 0.4 mm (shorter than those of visible radiation).

Visible radiation (light): Electromagnetic radiation, which can be detected by the human eye.
This term is commonly used to describe wavelengths that lie in the range 0.4 to 0.7 mm.

Watt: The unit of power or radiant flux. 1 Watt = 1 Joule/ second.

Wavelength: The distance in the line of advance of a sinusoidal wave from anyone point to the next point of corresponding phase (e.g., the distance from one peak to the next).

BU-02 (Laser Pointer Guidance):

Laser Pointers

Laser pointers are readily available to all individuals and can be obtained from the Internet, electronic stores, and novelty stores for a marginal cost.

Laser pointers must provide warning labels, as required by the FDA Center for Devices and Radiological Health (CDRH). Each label must include the laser hazard symbol, laser classifications, maximum power output and operating wavelength(s). In addition, both ANSI and the International Electro Technical Commission (*IEC- 60825-1*) standards are applicable.

Laser Pointer Characteristics:

Diode laser pointers operate in the visible range of 400-760 nanometers (nm). Power emitted by these lasers range form 1-5 mW. Eye damage may occur from the unsafe usage of laser pointers. A hazardous exposure can occur from a prolonged direct beam exposure or from a specularly reflected beam. There is no known associated skin hazard with laser pointers.

The majority of red and green laser pointers are rated as Class 2 or 3R. Please do not purchase higher-powered laser pointers as they may be hazardous and require extensive administrative and safety measures.

Green Lasers Pointer:

Green laser pointers are discouraged from use because they are more likely to be classified as a higher hazard class and may pose an eye hazard. Green laser pointers produces a wavelength of green light at 532 nm that is more readily absorbed by the human eye. At this wavelength, the human eye is much more sensitive to green light and the laser light will appear brighter. Estimates for the human eye sensitivity for green lasers ranges from 10 times to 50 times more sensitive than that of red laser sensitivity. The best practice is to use a red laser pointer and follow all manufacturer safety notices.

Laser Safety Pointer Recommendations:

1. Do not intentionally aim any laser beam directly at your eyes or the eyes others, regardless of classification.
2. Do not point a laser at a mirror or other shiny objects that exhibit reflective properties.
3. Do not aim a laser pointer at any individuals, automobile, plane, train, or building window.
4. Do not purchase a laser pointer that has an output power of greater than 5 mW and without proper warning labels.
5. Do not purchase laser pointers that are classified as greater then Class 2 for use in training or meetings.

BU-03 (Alignment Guidance):

Caution: Majority of all laser accidents occur during alignment.

Laser Alignment, Beam Manipulation, and Pre-alignment beam procedures

a. The Permit Holder will be responsible for training and authorizing individuals who are allowed to perform pre-alignment procedures.
b. Beam alignments must be performed with a trained and approved buddy designated by the permit holder.
c. Familiarize yourself with approved alignment procedure.
d. Post a laser alignment warning sign at the entry to the laser laboratory and restrict access.
e. Remove all unnecessary reflective items from the optical table. (Shiny tools, extra mirrors)
f. Do not wear any jewelry or any reflective items (jewelry, watch, plastic ID card, etc.).
g. Put on protective eyewear with appropriate optical density
h. Reduce the beam power to minimal setting.
i. When practical use a low-power (< 5 mW) visible beam laser such as a HeNe laser or a diode laser (i.e., a laser pointer) to align the optics.
j. All materials needed for the alignment should be readily available.
k. Isolate the beam from other areas of the laboratory using laser curtains, beam barriers, and beam stops.
l. Enclose as much of the beam as practical to protect your eyes and skin.

Alignment

a. Use an indirect means of viewing the beam (beam detector card, infrared viewer scope, Zap-it® paper) except when aligning low power (< 15 mW) visible beam lasers.
b. Keep the beam on the plane of the optical table and well below normal sitting eye level. Never direct a beam upwards or across a walkway!
c. Do not leave the laser unattended during the alignment procedure.
d. Put on protective eyewear with appropriate optical density

Note: The most hazardous lasers to align are near-infrared mode-locked and Q-switched lasers invisible or barely visible beams, very short pulse durations and thus very high peak powers. Use a high degree of caution when aligning these lasers. M-rated eyewear is needed to absorb picosecond and femtosecond-pulse laser radiation.

Post alignment

a. Be sure to reinstall all safety guards and barriers that were removed for the alignment procedure.
b. Remove the laser alignment warning sign at the entry to the laser laboratory.

BU-04 (ROHP Flipchart):

In the event of an exposure with laser use, the employee, student, manager, and laboratory safety or radiation safety officer should **call the ROHP 24/7 hour number 617-414-ROHP (7647); or 4-ROHP (7647) if calling from the Medical Campus** to be connected with the BU Research Occupational Health Program (ROHP) medical officer. ROHP will refer you to the appropriate health care location for appropriate treatment.

Major medical emergencies

Medical Campus: call or have a co-worker call the Control Center at 4–4444.
Charles River Campus: call or have a co-worker call BU Police at 617-353-2121.

You will be referred to or transported to the appropriate health care location by the emergency response team.

<table>
<tr><th colspan="4">ROHP HEALTHCARE REFERRAL LOCATIONS AND TIMES</th></tr>
<tr><th>LOCATION</th><th colspan="2">REGULAR WORKDAY HOURS</th><th>AFTER HOURS/ WEEKENDS</th></tr>
<tr><td>Medical Campus</td><td>BU ROHP
72 E. Concord St.
Evans Building 8th Floor, Room 825
617-414-7647
(M-F 8 AM – 4:30 PM)</td><td>BMC OEM
850 Harrison Avenue
Yawkey, ACC 1

617-638-8400
(M-F 7:30 AM – 4 PM)</td><td rowspan="2">BMC Emergency Dept.
751 Albany St

617-414-4075</td></tr>
<tr><td>Charles River Campus</td><td colspan="2">BU Occupational Health Center (OHC)
930 Comm. Ave., West
(Pleasant Street entrance)
617-353-6630
(M-F 9 AM – 5 PM)</td></tr>
</table>

BU-05 (Laser Incident Report):

Medical Physics and Radiation Safety
80 East Concord St
Boston, Massachusetts
02119-2511

LASER INCIDENT REPORT FORM

Completed by:		**E-mail:**	
Incident Date:		**Time:**	
Incident Location:		**Department:**	
Permit Holder:		**E-mail:**	
Reported to:		**Reported on:**	

Incident involved:

Patient □

BU Employee □

BMC Employee □

Visitor(s) □

Individuals involved:

Incident type:	√
Injury	
Potential Injury	
Unintended Laser Exposure	
Loss/theft of Laser System	
Others	

Laser Involved:	
Activity/Machine Settings: **(**Wavelength, peak and average power, pulse width and frequency, beam diameter and divergence, exposure time, etc.).	
Part of body injured/exposed:	

Description of incident: *(Attach additional items as needed)*

Immediate Actions Taken: *(Attach additional items as needed)*

RPO OFFICE USE ONLY

Attached:	Check if attached
Injury evaluation(s)	
Copy of additional reports generated	
List of local/state/Federal agencies notified.	
Other relevant documents *(e.g., written directive, pictures, records)*	

Apparent Root Cause/Corrective Action: *(Attach additional items as needed)*

BU-06 (Laser Warning Signs):

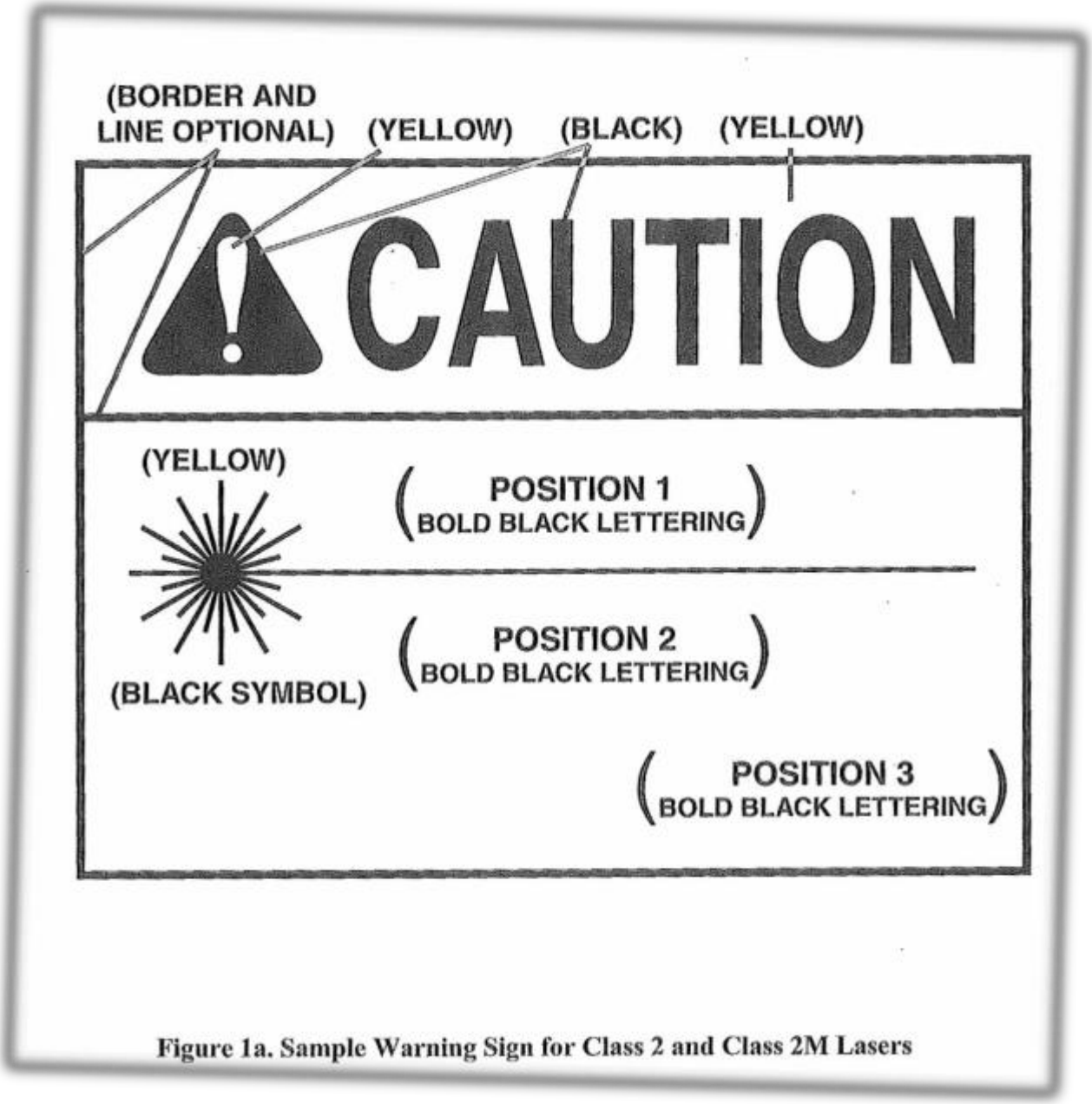


Figure 1a. Sample Warning Sign for Class 2 and Class 2M Lasers

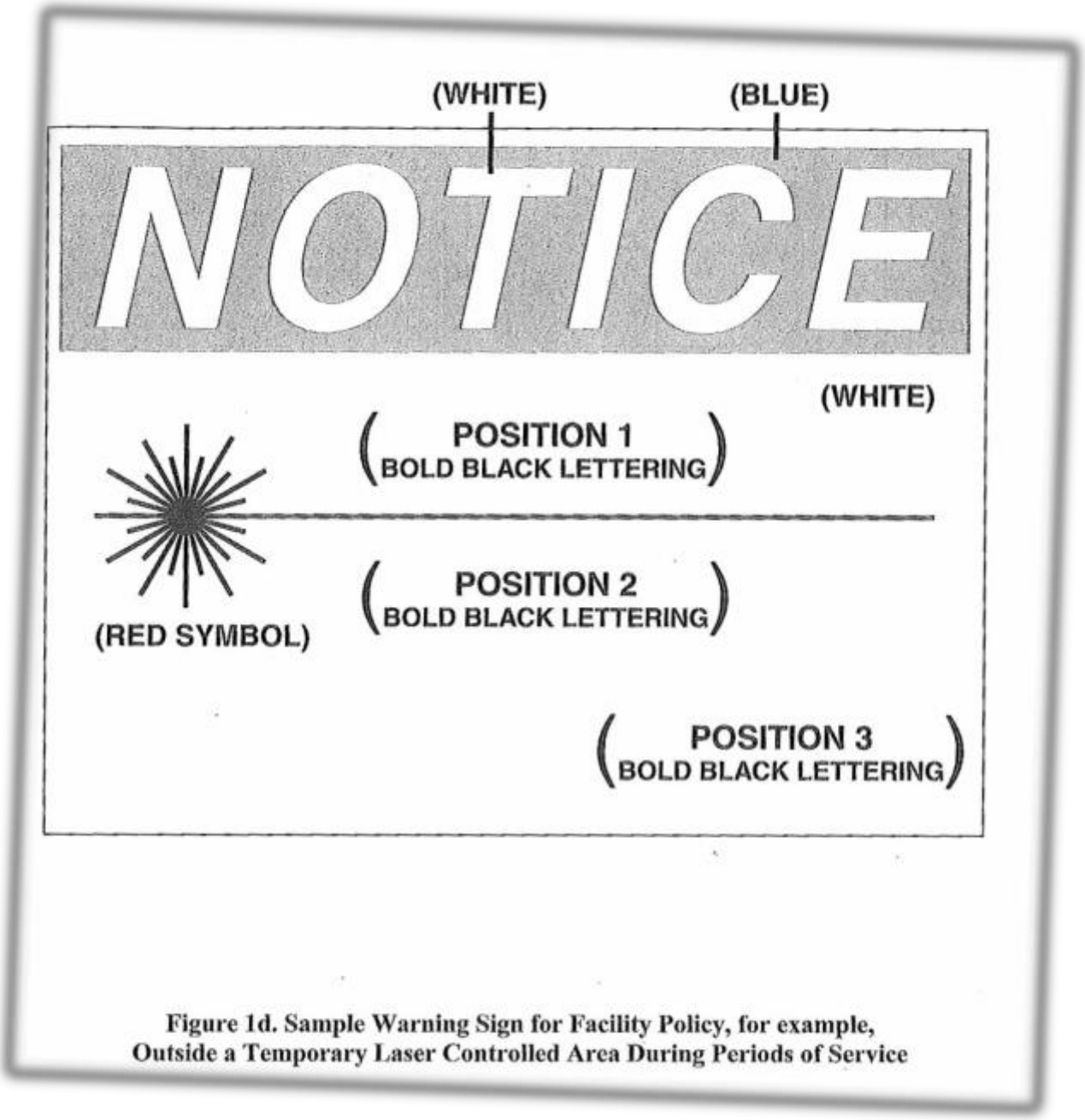


Figure 1d. Sample Warning Sign for Facility Policy, for example, Outside a Temporary Laser Controlled Area During Periods of Service

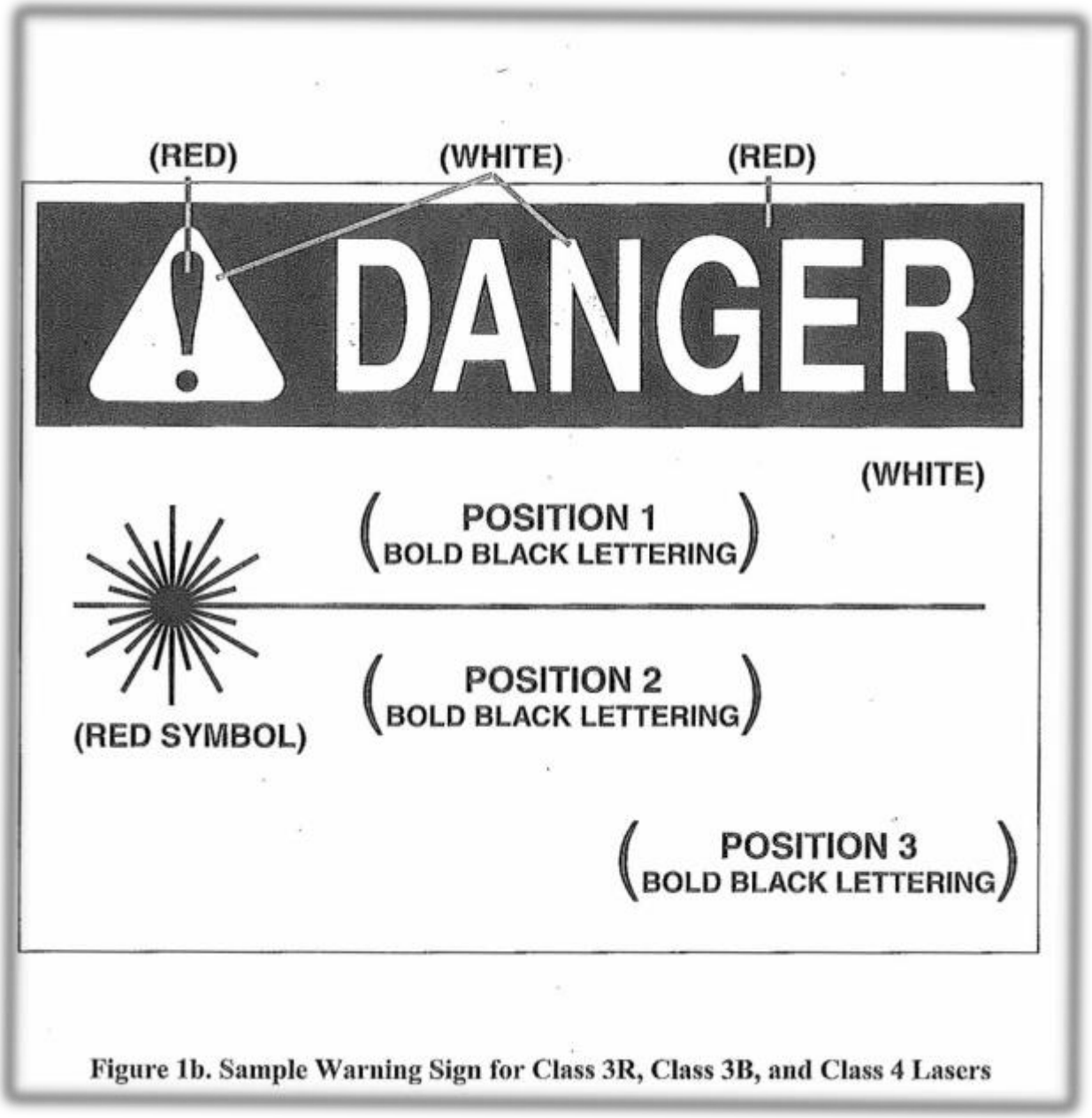
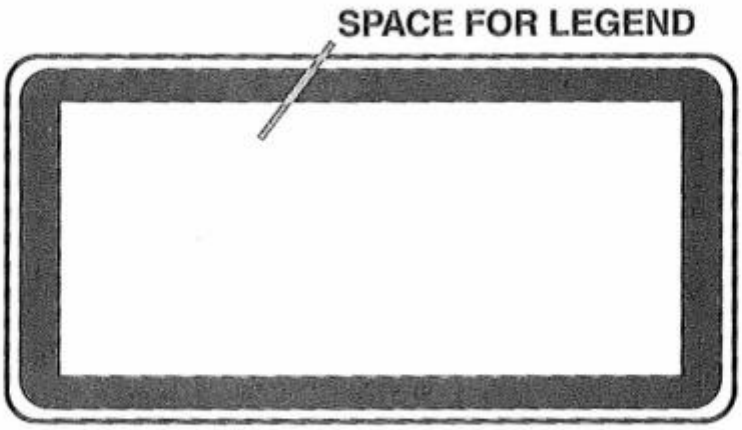


Figure 1b. Sample Warning Sign for Class 3R, Class 3B, and Class 4 Lasers

SYMBOL AND BORDER: BLACK
BACKGROUND: YELLOW



LEGEND AND BORDER: BLACK
BACKGROUND: YELLOW

BMC-01 (Obtaining Clinical Laser Privileges at the Boston Medical Center):

POLICY AND PROCEDURE FOR OBTAINING CLINICAL LASER PRIVILEGES AT THE BOSTON MEDICAL CENTER

Approved at the April 8, 2009 meeting of the Laser Safety Subcommittee

GENERAL PRINCIPLES

1. Permission to use class 3b and class 4 lasers in patient care at Boston Medical Center (BMC) requires approval from the Laser Advisory Committee, Chief of Service, Credentials Committee, the Medical Executive Committee (MEC), and the Board of Trustees.
2. Approval to use a laser as a surgical modality is part of the process of delineating privileges. If the physician wishes to perform surgical procedures with a laser, he/she must also be approved to perform these same surgical procedures by conventional means, where applicable. For example, to be able to perform a laser laryngoscopy, the surgeon must be currently approved to perform laryngoscopy by conventional surgical techniques.
3. Approval to use a laser is delineated for each type (wavelength) of laser and for each procedure and does not extend to other types of lasers or other procedures. Thus, laser privileges are restricted to the a) type of lasers and b) those specific procedures for which the applicant has been explicitly approved and are not transferrable.

CRITERIA FOR INITIAL LASER PRIVILEGING

1. The decision to recommend approval of a physician's request for laser privileges to the Board of Trustees is reached by the Chief of Service, the Laser Advisory Committee, the Credentials Committee, and the MEC on the basis of verified training and/or current competence on behalf of the applicant, as well as consideration any other information considered pertinent by the reviewing body. Submission of documentation does not automatically result in approval of the physician's request for privileges.
2. Core Privilege If the laser privilege being requested is considered a Core Privilege (as defined by the department chair or section chief) for that specialty and is not a new privilege for the provider, then the applicant must submit one or more of the following documents with his/her request:
    a. Primary source verification from the Director of an **Accreditation Council for**

Graduate Medical Education (ACGME)-approved training program that the applicant has received applicable training in the use of the specific laser and procedure being requested.

b. A certificate or other document establishing completion of a comprehensive laser-qualifying course that includes didactic and hands-on training. It is recommended that the course be approved/ accredited by the Accreditation Council on Continuing Medical Education (a non-ACCME course will be considered if they meet all of the criteria below). The course should address at a minimum, laser physics, laser tissue interaction, clinical applications, and theoretical and practical uses of laser and safety aspects of laser use. The course should be a minimum 8 hours, but longer courses (14-16 hours) are strongly preferred, especially as a sole criterion of competence. At least 4 hours of the course time should involve hands-on training with no more than 4 persons to each laser.

c. A letter of recommendation from a recognized expert in the field specifying that the applicant has spent sufficient time with him/her to acquire proficiency and current competence in the use of the laser(s) for which privileges are requested. The letter must specify the total time spent in this preceptorship and the character of the preceptorship experience. A minimum of 6 hours or 6 cases, as appropriate, of observation and hands-on involvement is required. The letter of recommendation must be accompanied by proof of completion of a BMC Laser Safety Training session.

3. Primary source verification from another Joint Commission - or **National Committee for Quality Assurance** (NCQA)-accredited healthcare facility where a physician has had recent experience and is currently competent in the use of the requested laser(s) for the requested procedures(s). This must also be accompanied by copies of actual operative notes for at least 6 laser cases performed by the applicant as the primary surgeon.
4. Non-Core Privilege or New Privilege for a Currently Privileged Provider –If the laser privilege being requested is either considered a Non-Core Privilege (as defined by the department chair or section chief) or is a new privilege being requested by a provider with existing privileges at BMC, then the applicant must, in addition to steps 2a-d above, also follow the department's specialty specific criteria for the specific laser (wavelength) and procedure being requested. The specialty specific criteria must include a minimum of three cases proctored by a BMC physician (in the same specialty when possible) who already holds the privilege to use the laser in question.

PROCEDURE FOR INITIAL LASER PRIVILEGING

1. The physician wishing laser privileges will obtain an Application for Laser Use at Boston Medical Center form (see below) and a Delineation of Privileges form from the Medical Affairs Office (617-414-5529). The Delineation of Privileges form will be specific to the Division in which the applicant is requesting privileges and may be part of a request for initial appointment to the Medical-Dental Staff. The physician will complete both forms, providing the necessary documentation, and submit this material to the Medical Affairs Office.
    a. The verified request will be presented to the Laser Advisory Committee for review and approval. The verified request will then be forwarded on to the Chair/Chief of Service for signature and recommendation to the Credentials Committee.
    b. Upon Credentials Committee approval, the applicant will be presented to the MEC, which will recommend approval or disapproval to the Board of Trustees.
    c. A permanent record of the laser privileges application will be retained in the Medical Affairs Office. A list of physicians with laser privileges at BMC will be available to appropriate administrative and review bodies.
    d. If the request for laser privileges is not recommended for approval by any body, the applicant physician may exercise the appeal rights granted by the Medical-Dental Staff By-Laws.

PROCEDURE FOR ONGOING LASER PRIVILEGING

1. As part of Ongoing Professional Practice Evaluation of the clinical performance of its physicians, each Division/Department Section Chair/Chief will monitor individuals who are privileged to perform laser procedures in an appropriate manner.
2. Physicians who are privileged to perform laser procedures must reapply for these privileges biennially. The reapplication for laser privileges will occur simultaneously with a physician's application for reappointment to the Medical-Dental Staff.
3. The results of the Division/Department/Section's physician-specific Ongoing Professional Practice Evaluation will be utilized in the course of recommending approval for continued privileging in laser procedures
4. If a surgeon fails to use the specific Laser within a five-year period, the surgeon's privileges will lapse unless the surgeon is able to provide evidence of LASER use at another facility. Privileges may be restored by again following the specialty specific criteria for a new privilege outlined under Criteria for Initial Laser Privileging (item 3), above.

APPLICATION FOR LASER USE AT BOSTON MEDICAL CENTER

APPLICANT:_____

SPECIALTY/DEPARTMENT:_____

CAMPUS Menino:_____ Moakley:_____ East Newton:_____

CHIEF OF SERVICE:_____

Attached documentation of training and competence:

_____ Verification of laser training from residency program director

_____ Certificate of attendance at an ACCME-approved laser-training course

_____ Letter of recommendation from an expert practitioner of preceptorship experience AND proof of BMC Laser Safety training

_____ Documentation of laser privileges and laser surgery experience at another JCAHO- accredited hospital

_____ Other (attach description)

Type of laser(s) for which privileges are requested:

_____

_____

_____ _____

Signature Date

I recommend that laser privileges be granted:

_____

Chairman, Laser Advisory Committee (must be unanimously approved by a quorum of the committee)

_____

Chief of Service

Please return completed application with documentation to the
Medical Affairs Office, (617-414-5529)

BMC-02 (Clinical Use of Lasers):

Boston Medical Center
Policy and Procedure Manual

Policy #:	06.LS.001
Issued:	5/15
Reviewed/Revised:	
Section:	6.0 Safety

Clinical Use of Laser

Purpose: To provide safe and responsible use of clinical lasers at Boston Medical Center (BMC) and minimize the risk of laser exposure to patients and providers.

Policy Statement: The clinical use of lasers at BMC requires that the BMC Licensed Independent Practitioner (LIP) has laser privileges approved by the Trustees of BMC and an authorization to use a laser from the Radiation Safety Committee. Laser privileges are restricted to the **specific laser type(s) and procedure** for which approval has been granted.

Fellows, residents, physician assistants and nurse practitioners are not permitted to use lasers unless they are directly supervised by a privileged laser user AND have completed the proper training as detailed below.

Many lasers require a "dedicated laser assistant" to operate the control panel of a medical laser for the privileged "laser user". Laser assistants may be Registered Nurses, Licensed Practical Nurses, Physician Assistants, Surgical Technicians, Medical Assistants, or other individuals deemed qualified by the Deputy Laser Safety Officer Clinical Lasers (DLSOC).

Procedure:

Definitions:

Laser User: Licensed Independent Practitioner (LIP) authorized and privileged to perform specific laser procedures and who assumes responsibility for use of the laser and appropriateness of the procedure.

Dedicated Laser Assistant: Person assigned to set up the laser and operate the control panel for the laser user, and monitor the laser treatment controlled area for safety during the procedure. From the time the laser key switch is activated, to the time it is turned off, the laser assistant shall have no other duties except for direct operation of the laser control panel and monitoring the room for compliance with safety policies and procedures.

Deputy Laser Safety Officer Clinical Lasers (DLSOC): Individual who oversees day to day laser safety operations in clinical settings that works closely with the Laser Safety Officer (LSO), Division of Medical Physics and Radiation Safety (DMPRS) and Clinical Engineering to ensure safe operations of clinical lasers at BMC. Individual is considered a technical expert who oversees training, equipment maintenance, inventory, and installation of new clinical lasers.

LIPs:

Initial Privileges
The LIP requesting laser privileges will obtain an Application for Laser Use at Boston Medical Center form and a Delineation of Privileges form from the Medical Staff Office (credentialing@bmc.org). The Delineation of Privileges form will be specific to the Division in which the applicant is requesting privileges and may be part of a request for initial appointment to the Medical-Dental Staff. The physician will complete both forms, providing the necessary documentation, and submit this material to the Medical Staff Office. Also to be completed is the on-line "Physician Laser Safety" tutorial with a passing quiz grade of 80% (tutorial is assigned through HealthStream by the Medical Staff Office). The materials will be reviewed by the Radiation Safety Committee and approved authorization will be submitted to the Credentials Committee prior to the recommendation of laser privilege by the Trustees of BMC.

Biennial Renewal
LIPs who are "active" authorized laser users with privilege for the clinical use of lasers must 1) reapply for laser privilege every 2 years from the Trustees and 2) renew their laser training every two years to maintain an "active" authorized user status.

The reapplication for laser privileges will occur simultaneously with the LIP's application for reappointment to the Medical-Dental Staff and must include completion of the on-line "Physician Laser Safety" tutorial with a passing quiz grade of 80% (tutorial is assigned through HealthStream by the Medical Staff Office). Failure to renew the laser training will automatically change their status to an "inactive" laser user. Inactive users are not permitted to operate laser equipment or renew laser privileges.

Fellows/Residents:

All fellows and residents from department/services that use lasers must annually complete the on-line "Physician Laser Safety" tutorial during the three months (April, May and June) preceding the start of each new academic year (July 1) with a passing quiz grade of 80%.

Incoming Residents: Complete the on-line tutorial as part of their BMC onboarding process.

In each year following: Program directors will be responsible to confirm that annually their trainees have completed the on-line Laser Safety tutorial prior to July 1. Failure to renew the annual laser training will automatically change their status to an "inactive" laser user. Inactive users are not permitted to assist privileged laser users during clinical laser procedures until the training is completed.

Dedicated Laser Assistants:

Dedicated Laser Assistants (Nurses, Technicians, etc.) who have been approved to operate the control panel of the clinical laser equipment for a privileged laser user during surgical procedures shall be properly trained in laser safety and operation of the specific laser units. Laser assistants will complete laser safety training annually and laser specific training as needed. All laser trainings and in-services must be approved by the DLSOC or LSO. Each department involved in the use of lasers shall have relevant personnel trained in the following areas:

a. General laser concepts, tissue interactions, and laser safety.

b. Hands-on training with the facilities specific laser(s)

c. Awareness and comprehension of BMC's written laser safety policies and procedures.

Compliance

The Radiation Safety Committee and/or the Laser Safety Subcommittee will monitor compliance of this policy through inspection of documentation provided by applicable departments. Noncompliance will have the following repercussions:

LIPs will not be able to complete their biennial application for renewal of privileges from the Trustees unless the Medical Staff Office has documentation of completion of the on-line Laser Safety Tutorial with authorization from the Radiation Safety Committee.

The residency program directors of each department/service where lasers are used are to serve as the enforcers of this policy and insure only compliant personnel are allowed to assist privileged laser users during clinical laser procedures. If the on-line laser safety tutorial has not been completed by July 1, a letter will be sent to the resident/fellowship director and the trainee stating they are not to assist a privileged laser user until the training is completed.

Administrative Managers of each department/service where lasers are used will verify that only dedicated laser assistants that have maintained annual laser safety training and have hands-on training specific for their lasers will assist privileged laser users during clinical laser procedures.

Forms:

Application for Clinical Laser Use at Boston Medical Center (located in Medical Staff Office)

Other Related Policies:

Policy and Procedure for Obtaining Clinical Laser Privileges at Boston Medical Center
Laser Safety in the Operating Room (#15_02_040)

Policy No.: 06.LS.001

Title: Clinical Use of Laser

Initiated by: Radiation Safety Committee and the Credentials Committee

Contributing Departments:

1. Division of Medical Physics & Radiation Safety
2. Medical Staff Office
3. Graduate Medical Education Office
4. Quality and Patient Safety