



Laser Hazard Evaluation

Introduction

The use of lasers is becoming increasingly widespread in academic research at Harvard University. This increase in use is also extended to the general public as more laser devices are introduced into consumer products. Lasers can present a serious hazard to the eyes and skin. High power lasers can produce a fire hazard. There are other associated hazards inherent with certain laser systems such as electrical, chemical, air contaminants, compressed gases, and cryogenics.

It is important that laboratories implement the appropriate control measures to reduce the chance of exposure to these hazards.

Eye Hazards

Injuries can occur to various parts of the eye depending on the laser wavelength. Corneal and retinal injuries can occur from acute exposure. Injuries such as lenticular opacities (cataracts) are possible from chronic exposures to laser radiation. Within the visible and near-infrared wavelengths (ocular hazard region), light entering the eye can be focused and amplified (100,000 times) onto a small area on the retina. The following table summarizes the effects of laser radiation on the eye:

<u>Wavelength</u>	<u>Primary Affected Area</u>
200 nm – 315 nm	cornea
315 nm – 400 nm	lens
400 nm – 1,400 nm	retina
1,400 nm – 3,000 nm	cornea/lens

Skin Hazards

Skin injuries are possible from acute exposure to high-powered laser systems. Chronic skin exposure to wavelengths in the ultraviolet region may lead to carcinogenesis and accelerated skin aging. If the laser system represents a serious skin hazard, appropriate barriers and/or skin protection must be implemented.

Fire Hazards

Class 4 lasers may present a fire hazard. Fire hazards are usually associated with continuous wave lasers operating with a power density of $> 2\text{W}/\text{cm}^2$. Laser systems with embedded class 4 lasers can result in a potential fire hazard. Flame retardant materials should be used within the enclosure to withstand ignition from the associated laser system. Laser curtains and other barriers can be used to prevent the laser beam from leaving the useful work area during operation. It is important to note that

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these barriers are usually constructed to withstand only a short duration of high power levels before they are damaged or fail to contain the laser beam.

Electrical Hazards

The high-energy electrical power supply associated with many lasers represents a potential lethal hazard. Injuries from electrical hazards most often occur during laser set-up and servicing when protective housings are removed, exposing active components. Only qualified personnel should be allowed to work on the laser's electrical components. The OSHA Lockout/Tagout standard "1910.147" should be followed when servicing laser systems. Call Radiation Safety Services at 617-496-3797 for further information regarding this standard.

Chemical Hazards

Dyes used in the lasing medium for dye lasers can be toxic or carcinogenic. These dyes are mixed with a solvent and pumped through the cavity of the dye laser. Procedures in the lab need to be established for handling these materials. Consideration should also be given to the proper disposal of hazardous material. Call Radiation Safety Services at 617-496-3797 for information on the safe handling and disposal of these materials.

Compressed Gases

The gases used in operating excimer lasers such as fluorine and HCl can pose a significant hazard in the laboratory. Gas storage, containment, and room exhaust need to be considered when setting up the laser system. Call Radiation Safety Services at 617-496-3797 for safety information on handling compressed gas cylinders.

Air Contaminants

High power lasers used for cutting, welding or drilling may give rise to respiratory hazards in the form of toxic fumes and gases. Isolation of the process, exhaust ventilation and respiratory protection are control measures used to protect personnel involved with this kind of operation. Call Radiation Safety Services at 617-496-3797 for industrial hygiene information on controlling air contaminants.

Cryogenic Liquids

The use of cryogenic coolants with laser systems can cause skin burns, displacement of oxygen in poorly ventilated areas, and explosions because of bad connections. Call Radiation Safety Services at 617-496-3797 for safe handling information on cryogenics.

Laser Hazard Evaluation

The EH&S Radiation Safety Services will conduct a laser hazard evaluation and review the manufacturer's classification of lasers and laser systems. Lasers constructed, modified or used under special circumstances in the laboratory must be reviewed by the RSO and appropriately classified. A hazard evaluation will be made of the laser work area and appropriate control measures prescribed based on recommendations in ANSI Z136.1. Routine inspections are conducted to ensure that control measures are in effect and all information is updated. The LSO will review the laboratory's written operating procedures which reflect the safe use of the specified laser or laser system.

Email radiation_safety@harvard.edu to send comments and suggestions to the EH&S Radiation Safety Services.