



**ENVIRONMENTAL HEALTH
AND SAFETY**

HAZARDOUS MATERIAL FACT SHEET
Nebraska Medicine Laser Protective Equipment

Laser protective eyewear (LPE) shall be used for Class 3B and Class 4 lasers or laser systems. LPE is usually not required for Class 2 or Class 3R lasers or laser systems except in conditions where intentional long-term (> 0.25s) direct viewing is required. Additional laser protective equipment may be required. Please contact [UNMC EHS](#) if you have any questions.

Overview

American National Standards Institute (ANSI) Z136.3 Section 4.6

Protective equipment in the form of goggles, spectacles, face shields, barriers, or windows can provide eye protection. Clothing, gowns, gloves and other devices can provide suitable skin protection against laser radiation and biologic hazards. PPE is administratively required and shall be used by all people within the NHZ when a Class 3B or Class 4 laser is operating. PPE is considered the last line of defense against laser and biologic hazards, and shall be used when mitigation of laser hazards cannot adequately be performed using engineering or administrative (procedural) controls.

Laser Protective Eyewear (LPE)

LPE may include, but not be limited to goggles, face shields, spectacles or prescription eyewear using special filter materials, reflective coatings, or a combination of both, which are selected to reduce the potential ocular exposure below the applicable MPE.

LPE shall be accompanied by the following information:

- Optical density at appropriate wavelengths
- Manufacturer's recommendations on shelf life, storage conditions, and appropriate cleaning methods.

Eye protection devices specified by the manufacturer, or selected by the LSO and/or DLSO for protection against radiation from Class 3B and Class 4 lasers or laser systems, shall be administratively required. Their use shall be enforced within the NHZ, but not required outside the NHZ. LPE shall be specifically selected to withstand either direct or diffusely scattered beams. Important in the selection of LPE is the factor of flammability. Damaged or faded LPE shall be removed from service.

Selecting Appropriate LPE

Medical laser manufacturers are required to provide adequate LPE with the initial sale of their laser(s) or laser systems. The LSO and/or DLSO shall evaluate LPE options for the appropriate selection of eyewear to assure that ocular MPE value(s) for the laser(s) or laser systems are not exceeded. The manufacturer of the LPE is required to provide

product specifications (e.g., OD, visible light transmission – VLT, angle dependence), storage, cleaning and shelf life information as well as the appropriate locations and conditions for use of their specific LPE product.

The following factors shall be considered when selecting the appropriate LPE to be used:

- Laser power and/or pulse energy
- Wavelength(s) of laser output
- Potential for multi-wavelength operation
- Radiant exposure or irradiance levels for which protection (worst case) is required
- Exposure time criteria
- Maximum permissible exposure (MPE)
- Optical density requirement of eyewear filters at laser output wavelength(s)
- Angular dependence of protection afforded
- Visible luminous (light) transmission (VLT) requirement and assessment of the effect of the eyewear on the ability to perform tasks while wearing the eyewear. From a practical standpoint, when the VLT is less than 20%, there may be insufficient light to perform the intended task.
- Need for side-shield protection and maximum peripheral vision requirement; side shields shall be considered and should be incorporated where appropriate.
- Radiant exposure or irradiance and the corresponding time factors at which laser safety filter characteristics degradation occurs, including saturable absorption especially for the ultrashort (ultrafast) pulse lengths
- Need for prescription glasses
- Comfort and fit
- Strength of materials (resistance to mechanical trauma and shock)
- Compatibility of the front surface to produce a hazardous specular reflection
- Requirement for anti-fogging design or coatings

Labeling of LPE

All LPE shall be clearly labeled with the optical density and wavelength for which protection is afforded. In addition to the manufacturer's OD and wavelength labeling information, the user may choose to use distinctive identification of LPE in multi-laser environments to aid users in the selection and use of approved eyewear. Although distinctive identification of LPE may be used as a local mechanism to identify eyewear, it does not relieve users from making sure the eyewear is appropriate for their application.

Cleaning and Inspection of LPE

Cleaning the lenses of LPE shall be carried out periodically. The lenses should be cleaned carefully to avoid damage to the absorbing and reflecting surfaces. In some uses, such as surgery, eyewear may require cleaning and disinfection or sterilization after each use.

Methods for cleaning and disinfecting or sterilization are recommended by the manufacturer.

Periodic inspection of LPE shall be made to ensure the maintenance of satisfactory condition. This shall include:

- Inspection of the attenuation material for pitting, crazing, cracking, discoloration, delamination or lifting of dielectric coatings, etc.
- Inspection of the frame for mechanical integrity
- Inspection of straps or other retaining devices to ensure that they are not excessively worn or damaged
- Inspection for light leaks and coating damage that would permit hazardous intrabeam viewing

Eyewear in suspicious condition should be tested for acceptability or discarded. If, upon inspection, the LSO and/or DLSO is unsure of the severity of these defects as they relate to the efficacy of use, the LSO and/or DLSO should contact the manufacturer for guidance and recommendation as to replacement or acceptability of current LPE usage.

Review of Purchase of LPE

Purchasers of LPE should require that the following information accompanies each item:

- Wavelength(s) and corresponding optical density for which protection is afforded
- Pertinent data such as damage threshold for laser safety purposes
- Manufacturers recommendations on shelf life, storage conditions, cleaning and use

Laser Protective Barriers and Curtains

When the MPE for human skin is exceeded at the windows, exterior or interior, or entryways that are located within the NHZ of a Class 3B or Class 4 laser system, such windows and entryways should be protected with an appropriate material that reduces any transmitted laser radiation to levels below the applicable MPE. Important in the selection of the barrier are the flammability characteristics and decomposition products of the material. Some plastic material that appear opaque may transmit energy at IR or UV wavelengths. If the material used is not a certified product, the material should be tested for verification that it provides protection at the wavelengths for which it is being applied.

Drapes

Use only wet or flame retardant drapes in the operative field. When monopolar electrosurgical devices are used in combination with lasers, caution must be exercised to prevent skin burns due to electrical current conduction in wet drape material in the operative field.

Other Personal Protective Equipment

The manufacturer of HCLS or the LSO and/or DLSO shall specify the appropriate PPE by make and model or performance specifications, and the locations and conditions for use of the skin protective equipment. Skin protection may be required whenever engineering controls cannot provide protection from harmful ancillary agents. Hearing protection should not block an audible signal emission indicator.

Training and Issuance of Laser Protective Equipment

The LSO and/or DLSO is responsible for determining and providing the appropriate laser protective equipment and training on protective equipment needed for laser or laser system use. Laser users are responsible for inspecting their own protective equipment before and after use, reporting any defects to their DLSO, wearing protective equipment as instructed, and storing appropriately. Laser protective equipment training and issuance should be documented on the [Personal Protective Equipment \(PPE\) Training & Issuance Record](#).