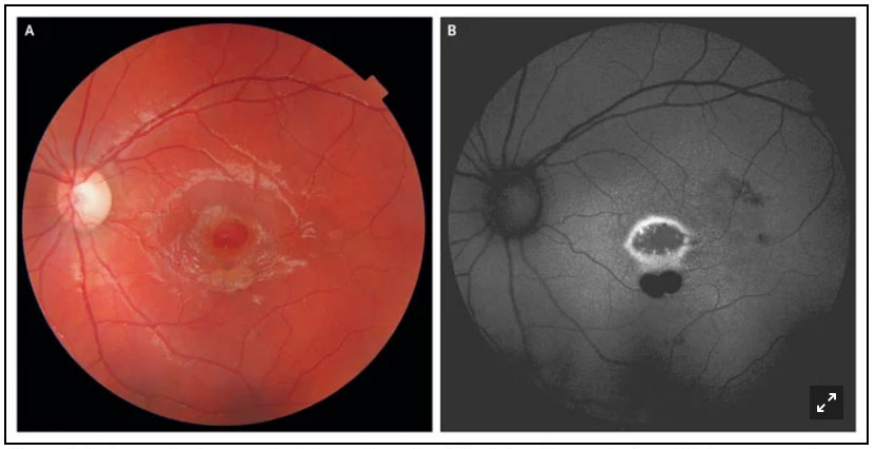
UMassAmherst | Environmental Health & Safety

Laser Eye Protection Fact Sheet

Enclosure is always the preferred method of protection from laser light as it will isolate or minimize the hazard. The protective equipment may not adequately reduce or eliminate the hazard and may be damaged by the incident laser radiation. Protective eyewear is necessary for Class 3 and 4 laser use where irradiation of the eye is possible. Laser irradiation of the eye may cause damage to the cornea, lens, or retina, depending on the wavelength of the light and the energy absorption characteristics of the ocular tissues.



Scans of a boy's eye, showing a macular hole near the centre of Panel A, and two spots of associated eye damage in Panel B. **New England Journal of Medicine**

Eye protection may include goggles, face shields, spectacles or prescription eyewear using special filter materials or reflective coatings (or a combination of both) to reduce exposure below the maximum permissible exposure.

Laser Safety Glasses

Laser Safety Goggles

Laser Safety Face Shields

Never look directly into any laser beam even with the eye protection.

While selecting the laser protective eyewear, please consider the following factors (You may find the table may be helpful below for wavelengths between 400 and 1400 nm.):

- Wavelength(s) of the laser output and potential for multi-wavelength operation

- Maximum permissible exposure (MPE)
- Exposure time
- Assuming the worst case on radiant exposure or irradiance levels
- Optical density (OD) requirement of the eyewear filter at laser output wavelength
- Angular dependence of protection afforded
- Visible light transmission requirement
- Need for side shield protection and peripheral vision
- Radiant exposure or irradiance and the corresponding time factors at which laser safety eyewear damage (penetration) occurs, including transient bleaching
- Need for resistance to mechanical shock or trauma
- Need for prescription glasses
- Comfort and fit
- Degradation of absorbing media, such as photobleaching
- Capability of the front surface to produce a hazardous specular reflection
- Need for anti-fogging design or coatings

Table 1. Selecting Laser Eye Protection for Intrabeam Viewing for 400 - 1400 nm Wavelengths

Simplified Method for Selecting Laser Eye Protection for Intrabeam Viewing for Wavelengths between 400 and 1400nm									
Q-Switched Lasers (1 ns to 0.1 ms)		Non-Q-Switched Lasers (0.4 ms to 10 ms)		Continuous Lasers Momentary (0.25 s to 10 s)		Continuous Lasers Long-Term Staring Greater than 3 hours		Attenuation	
Maximum Output Energy (J)	Maximum Beam Radiant Exposure ($J \cdot cm^{-2}$)	Maximum Laser Output Energy (J)	Maximum Beam Radiant Exposure ($J \cdot cm^{-2}$)	Maximum Power Output (W)	Maximum Beam Irradiance ($W \cdot cm^{-2}$)	Maximum Power Output (W)	Maximum Beam Irradiance ($W \cdot cm^{-2}$)	Attenuation Factor	OD
10	20	100	200	NR	NR	NR	NR	100,000,000	8
1.0	2	10	20	NR	NR	NR	NR	10,000,000	7
10^{-1}	2×10^{-1}	1.0	2	NR	NR	1.0	2	1,000,000	6
10^{-2}	2×10^{-2}	10^{-1}	2×10^{-1}	NR	NR	10^{-1}	2×10^{-1}	100,000	5
10^{-3}	2×10^{-3}	10^{-2}	2×10^{-2}	10	20	10^{-2}	2×10^{-2}	10,000	4
10^{-4}	2×10^{-4}	10^{-3}	2×10^{-3}	1.0	2	10^{-3}	2×10^{-3}	1,000	3
10^{-5}	2×10^{-5}	10^{-4}	2×10^{-4}	10^{-1}	2×10^{-1}	10^{-4}	2×10^{-4}	100	2
10^{-6}	2×10^{-6}	10^{-5}	2×10^{-5}	10^{-2}	2×10^{-2}	10^{-5}	2×10^{-5}	10	1
NR = Not Recommended									

References:

1. *Stanford University, Laser eyewear selection chart. https://ehs.stanford.edu/reference/eyewear-selection-chart*
2. *Penn State University, Laser Safety Laser Protective Eyewear. https://ehs.psu.edu/laser-safety/laser-safety-laser-protective-eyewear*