

**D**irect or reflected laser beams (Class 3B and 4) have the potential to permanently damage an unprotected human eye. Laser glasses, laser goggles, or laser shields/barriers are recommended to provide some level of defense against injury. Consult with EH&S' Laser Safety Officer (LSO) for appropriate eye protection.

To select the right laser glasses/goggles for the application, the following information is needed:

**Wavelength of the Laser** - Wavelength is expressed in nanometers (nm) or micrometers (µm). There are typically two wavelengths associated with a laser: the aiming beam wavelength and the operating wavelength. The aiming beam is "eye safe" while the operating beam presents hazards to the eye (or exposed tissue). Multiple wavelength systems may require a custom filter or multiple eyewear.

**Power/Energy** - Lasers operate as continuous wave or pulsed systems. For continuous wave, the power of the laser is expressed in Watts (W). For single or multi-pulsed lasers, the energy (joules), pulse length (seconds), and repetition rate (Hertz) are factors in determining proper eyewear.

## SELECTING LASER EYEWEAR

- Match Wavelength Ranges.** Choose eyewear that covers the wavelength (or wavelengths) of the laser. Note that more than one filter may be needed to cover a wide variety of wavelengths. Contact [radsafety@usc.edu](mailto:radsafety@usc.edu) or the laser manufacturer for more information.
- Determine Optical Density (OD).** Optical Density is the protection factor provided by a filter. Each unit of OD represents a ten-fold increase in protection (see table in next column). Select a filter that is equal to or greater than the OD needed. The formula for calculating OD is:  $OD = \log_{10}(H_0/MPE)$  where  $H_0$  is the anticipated worst case radiant exposure.
  - Calculate OD using the free OD calculator at <http://www.lia.org/evaluator/od.php>.
  - Refer to the laser equipment manual for a listed OD minimum or call the laser manufacturer for its recommendation
  - Contact LSO at [radsafety@usc.edu](mailto:radsafety@usc.edu) for guidance.
- Select Frame Style.** Select a frame style that meets individual needs. Consider frames that fit over prescription glasses or adjustable frames to accommodate different face sizes.



## WHAT I NEED TO KNOW...

- Wavelength range and OD factor are the key determiners in selecting eyewear.
- Consider visible light transmission (VLT) - amount of visible light that passes through a filter and is usable to the eye - when selecting eyewear. The higher the VLT, the lighter the color of the filter.
- Contact [radsafety@usc.edu](mailto:radsafety@usc.edu) for more information regarding appropriate eye protection.

Optical Density (OD value)	Transmittance	Attenuation Rate	Protective Function
0	100%	0	
1	10%	1/10	
2	1%	1/100	
3	0.1%	1/1000	
4	0.01%	1/10000	
5	0.001%	1/100000	
6	0.0001%	1/1000000	
7	0.00001%	1/10000000	
8	0.000001%	1/100000000	
9	0.0000001%	1/1000000000	
10	0.00000001%	1/10000000000	High

## EYEWEAR INSPECTION

- Ensure that the eyewear markings (laser OD and wavelength) are legible and meet the OD and wavelength requirements of the laser(s) in use.
- Inspect lens and frame for scratches/damage and all working parts (retainer straps included) for operability. Discoloration or worn areas may indicate chemistry change and possible frame brittleness.
- Evaluate the Fit
  - Is the fit secure and stable?
  - Is it comfortable to wear?
  - Does eyewear impede orbital and peripheral light?

## REFERENCES

ANSI Z136.1 - 2014 American National Standard for Safe Use of Lasers, Section 4.4.4.

