PPE is the third level of control against laser hazards. You are the limiting factor with PPE. If you choose not to wear the appropriate laser protection you will not be protected. After completing this module, you will be able to: Recognize when laser eyewear or skin PPE is required, understand how laser eyewear works, recognize vital elements in selecting laser eyewear, identify common problems associated with laser eyewear, know how to store your laser eyewear properly, and match eyewear labels to warning sign information.
Laser Safety – Module 7: PPE

**Slide 2 PPE**

Laser eyewear is not the only type of laser PPE. When clothing is worn as PPE, it usually means there are UV exposure hazards. Such exposures can lead to both acute and chronic health effects such as skin burns or skin cancer. Wear protective clothing when required by the safety documentation or your supervisor. Working with ultraviolet wavelengths may require gloves, a long sleeve shirt or a face shield. For example: as little as 10 milliWatts laser power at UV wavelengths shorter than 300 nanometers may warrant needing gloves to protect against long exposures to diffuse reflections.

But remember - laser eyewear and skin PPE are the last line of defense! UV laser operation requires increased emphasis on employing barriers and enclosures, and on reducing intensity when there are open beams.
Laser eyewear protection is required whenever there are accessible Class 3B or Class 4 laser beams. Full-protection eyewear is designed to reduce exposure to a level safely below the Maximum Permissible Exposure (MPE). It is required for all routine laser operations and for almost all alignment procedures. Alignment eyewear has a reduced optical density from full protection. It is only used for specific visible wavelength procedures that require review and approval by the LSO. This type of eyewear will let you see an attenuated visible beam. Alignment eyewear will NOT stop a full-power direct beam. Store alignment eyewear in a different location from full protection eyewear. Before using alignment eyewear consider how to use cameras and other diagnostics!
Here is a pair of tinted safety glasses. As you can see, the beam passes directly through the lens. Here is a pair of laser protective eyewear. The beam does not penetrate the lens and thus protects your eyes. And here is another pair of eyewear. But it has the wrong filter for the laser’s green wavelength, and the laser beam passes through it with little attenuation. Correct laser eyewear has a filter designed to lower the intensity of the incident laser beam, either by reflection or absorption, to a safe level no higher than the Maximum Permissible Exposure, or MPE. Exposure below the MPE will not cause an eye injury.
To be effective, laser eyewear must be chosen for the specific work environment involved. The key factors to consider in selecting laser eyewear are: Optical Density, or OD, at each accessible wavelength; Visible Light Transmission, or VLT; fit and comfort; compatibility with prescription eyewear; ability to view monitors and diagnostics thru laser eyewear, and field of vision and side shield protection.
OD is calculated in base 10. That is, as OD increases, the protection against laser radiation increases by a factor of ten. OD 1 filters allow 10% transmission of the laser radiation. OD 2 allows 1%, OD 3 allows 0.1%, and so on.
Visible Light Transmission, or VLT, is another important selection factor with laser eyewear. The higher the VLT, the easier it is to see through the eyewear. VLTs below 20% are very dark, as seen here. Working in a low-light environment with low-VLT eyewear is like working in the dark - which can present its own unique safety hazards, such as tripping. Move the 2 sliders back and forth to see the effect of different room lighting levels and eyewear VLTs.
Eyewear does not have to be light-tight but it must fit snugly. Beware of gaps that are too large. If needed, use head bands or tightening straps on frames to ensure a good fit. Both comfort and proper coverage must be considered. If your laser eyewear is clumsy, heavy, or just plain uncomfortable, you probably won’t want to wear it. Don’t find reasons not to wear eye protection. Your eyesight is too valuable! Weight is a particular concern when multi-wavelength or prescription eyewear is needed. Many framestyle options are available and often lightweight polycarbonate filters can be used. Contact your laser safety officer to help you find the right PPE for the job.
Sensor cards are commonly used to locate laser beams. The beams strike the card and produce visible fluorescence that you can view through protective eyewear. Use caution with coated sensor cards – they can produce hazardous reflections. Cameras and viewers are other common beam diagnostics that are used. Good beam diagnostics will make it easier to do your work while wearing protective eyewear.
Another important consideration when choosing laser safety eyewear is your field of vision. Being able to see in a safe manner is of obvious importance. Look for eyewear that provides good peripheral vision. Pictured here is a pair of orange eyewear with protective side shields which provides good peripheral vision. These green goggles limit peripheral vision.
The primary problem with laser eyewear is when people don’t use it or use the wrong filter eyewear. Remember: laser eyewear MUST be used when there are accessible Class 3B or Class 4 laser beams! Other problems include, improper fit, finding eyewear that meets multi-wavelength needs, limited Visible Light Transmission. Eyewear degradation (that is, aging or bleaching) may occur after prolonged exposure to ultraviolet wavelengths. The absorptive material is depleted to the point where the eyewear gets darker or the optical density is affected. Also, studies have shown that saturable absorption effects may cause the optical density of some filters to decrease significantly for short pulses at high irradiance levels. Never think your eyewear is a magic force-field. Eyewear has limitations.
Store your eyewear in a clean, dry place. Good storage organization will: Reduce scratches and extend the life, keep eyewear from getting misplaced or lost, and help indicate the eyewear filter required for the wavelengths in use.
All laser safety eyewear must meet the ANSI Z-136.1 standard. Thus, at a minimum, all eyewear will be marked with the wavelength range and optical density for those wavelengths. Observe eyewear requirements for wavelengths being used in a given laboratory. Check to see that the eyewear you have selected matches the postings and warning signs. If you have any questions contact your laser supervisor or LSO. Experienced people have picked up the wrong pair before. Don’t risk an eye injury!