Laser Protective Eyewear Guide

Use of Laser Protective Eyewear

According to the directives from the Ministry of Health, Labor and Welfare [On Measures to Prevent Injury from Laser Radiation], laser protective eyewear appropriate for the laser type is required in laser controlled areas of the Class 3R laser equipments that emit lasers at wavelengths other than 400 to 700nm, as well as Class 3B and Class 4 laser equipments as safety and preventive measures.

Selection of Laser Protective Eyewear

(1) Confirm laser output wavelengths.
(2) Confirm laser output.
For CW output: Output power
For pulse: Energy per pulse, pulse duration, pulse recurrence frequency, etc.
(3) Calculate MPE (maximum permissible exposure).
(4) Determine the maximum exposure duration.
(5) Calculate the maximum radiation exposure value.
(6) Calculate the required optical density.
(7) (Confirm whether it is required to see beams in case of visible lasers.)
(8) (Select the shape of protective eyewear (whether users will wear prescription glasses).)

What Is MPE (Maximum Permissible Exposure)

The MPE is the value that indicates a safety level for the human body, and defined as 1/10 of the strength of laser output at which probability of causing hazard is 50%.
Although the MPE is determined by two axes, wavelength and exposure time, attention is required since the MPE value is given as power density (W/m^2) or energy density (J/m^2) per unit surface area.
This area is based on the limiting aperture size, and the value varies according to the wavelength, eye or skin, exposure time and other conditions, considering hazard types.

What Is OD Value (Optical Density)

Optical transmission is generally indicated by transmittance (%).
It is commonly expressed in percentage, and indicated by logarithm. That is the OD value (optical density).
Optical density (OD) is the attenuation rate of incident light that passes through the optical filter, in this case laser protective eyewear, and calculated with the following formula.

$$OD(\lambda) = \mathrm{Log}_{10}(PI(\lambda)/PT(\lambda)) = -\log_{10}T(\lambda)$$

(PI: Incidence PT: Transmission T: Transmittance of characteristic wavelength)

∗The larger the OD value, the larger the attenuation rate of incident light, thus providing higher protective function.
∗If the OD value increases, then the transmittance decreases.

Optical Density (OD value)	Transmittance	Attenuation Rate	Protective Function
0	100%	0	Weak
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

Differences in Usage of Complete Absorption Type, Multi-wavelength Compatible Type and Partially Transmitting Type

Complete absorption type
Normally, you cannot see visible laser light because the optical density (OD) is set to high.

Multi-wavelength compatible type
Appropriate for work involving multiple wavelengths.

Partially transmitting type for maintenance
Appropriate for maintenance involving 100mW or less (OD 1 – 2), and 10W or less (OD 4). Use this type for checking optical paths or adjusting optical axes.

Reinforced glass (complete absorption) type
Optical density (OD) and damage threshold are high enough to prevent damage from direct beam exposure.

YL-760 model (three-way type)

This model offers improved fitting functions including angle adjustment for the gap with the face and flexible temples. Inner frames (optional) customized according to lens prescriptions are available for people who wear prescription glasses.

YL-717 model (over prescription glasses type)

Can be used over prescription glasses.
This model is fitted with top canopy and sides, and the angle of the front frame and the length of temples are adjustable.

YL-335 model (over prescription glasses type)

Can be used over prescription glasses. This model is well cushioned and comfortable to wear. (Some large glasses may not fit.)

YL-290 model (eyeglass shaped)

Light and compact two-lens type is easy to wear and remove.
This model features a highly protective cover frame and wide temples.

YL-250G model (over prescription glasses, reinforced glass type)

This model uses reinforced glass for lenses, provides high visible light transmittance, and offers improved visibility and permeability of light. Lenses also offer excellent chemical resistance.

YL-130 model (goggle shaped)

This model fits the face snugly, and can be worn over prescription glasses. Appropriate for use when the angle of beam or scattering light cannot be identified.

YL-120H model (goggle shaped)

With its laminated glass structure, this model provides high visible light transmittance and ensures safety with high damage threshold against laser.

Attention

- Do not directly look into the laser beam through laser protective eyewear.
- Do not irradiate the laser beam directly at laser protective eyewear because it may damage the eyewear.
- Do not use with incompatible lasers or wavelengths. (Even if laser names are the same, their wavelengths might be different.)
- Do not take off laser protective eyewear during work.
- Do not use as protective eyewear for welding.
- Complete absorption type eyewear is not protective equipments that completely absorb laser light. (Refer to the absorption characteristic graph.)
- Do not use products with visible light transmittance of 20% or less in a darkroom.
- Cease use of eyewear that is damaged or once it has received high laser energy.