

EN207/EN208 Classification of Eye Protection

Laser goggles work by dissipating laser energy in a similar fashion to neutral density filters, however, unlike ND filters, laser goggles only block a narrow range of wavelengths thus allowing the user some degree of visibility. Whilst a laser goggle may have a sufficient density to protect the user it must also be able to offer this level of protection without immediately burning out.

The EN207 directive requires that a laser goggle must be able to protect the user for a minimum of 10 seconds (D rating) or 100 pulses (I and R rating), without failure, when exposed to laser radiation.

The D rating applies to continuous wave lasers or lasers with a pulse duration of longer than 0.2 seconds, the power is measured in W/m^2 . Care should be taken to use the maximum average power of the laser. The I standard applies to pulsed lasers of duration between 0.25 seconds to 10^{-6} seconds and the R standard to pulse lasers of duration between 10^{-6} and 10^{-9} seconds, both are measured in J/m^2 . Additionally there is also an M rating for lasers with pulse lengths shorter than 10^{-9} seconds, however none of our current line of goggles protect against such high frequencies.

The L scale is a measure of how well a goggle is able to cope with laser radiation and consists of 10 levels corresponding to the optical density. It takes into account the maximum power or energy density that the goggle can absorb in the minimum timeframe, without performance degradation, and also the spectral transmittance at the laser wavelength. If these two measures denote different L levels then the lower L number is used.

The L scale is further subdivided into 3 bands which account for the eyes natural ability to block shorter wavelengths. Band 1 covers the range of wavelengths between 180 to 315nm, band 2 covers 316nm to 1400nm, band 3 covers 1401nm to 1000 microns.

EN207 – Classification and Specifications of filters and eye protection against Laser										
Scale number	Max spectral transmittance At Laser Wavelength	Maximum power (E) and/or energy (H) density in the wavelength range								
		180nm to 315nm			>315nm to 1400nm			>1400nm to 1000 microns		
		D W/m^2	I,R J/m^2	M W/m^2	D W/m^2	I,R J/m^2	M J/m^2	D W/m^2	I,R J/m^2	M W/m^2
L1	10^{-1}	10^{-2}	3×10^2	3×10^{11}	10^2	5×10^{-2}	1.5×10^{-3}	10^4	10^3	10^{12}
L2	10^{-2}	10^{-1}	3×10^3	3×10^{12}	10^3	5×10^{-1}	1.5×10^{-2}	10^5	10^4	10^{13}
L3	10^{-3}	1	3×10^4	3×10^{13}	10^4	5	0.15	10^6	10^5	10^{14}
L4	10^{-4}	10	3×10^5	3×10^{14}	10^5	50	1.5	10^7	10^6	10^{15}
L5	10^{-5}	10^2	3×10^6	3×10^{15}	10^6	5×10^2	15	10^8	10^7	10^{16}
L6	10^{-6}	10^3	3×10^7	3×10^{16}	10^7	5×10^3	1.5×10^2	10^9	10^8	10^{17}
L7	10^{-7}	10^4	3×10^8	3×10^{17}	10^8	5×10^4	1.5×10^3	10^{10}	10^9	10^{18}
L8	10^{-8}	10^5	3×10^9	3×10^{18}	10^9	5×10^5	1.5×10^4	10^{11}	10^{10}	10^{19}
L9	10^{-9}	10^6	3×10^{10}	3×10^{19}	10^{10}	5×10^6	1.5×10^5	10^{12}	10^{11}	10^{20}
L10	10^{-10}	10^7	3×10^{11}	3×10^{20}	10^{11}	5×10^7	1.5×10^6	10^{13}	10^{12}	10^{21}

The above classification offers complete protection for the user by not allowing any of the laser beam to reach the eye, however there are some applications that require the user to be exposed to some of the beams power for the purposes of alignment. In these situations the European standard EN208 is used.

The EN208 standard only applies to lasers that emit wavelengths in the visible section of the wavelength (400 to 700nm), this also has an optical density and power requirement but only has 5 levels, compared to the 10 for EN207. The scale used for EN208 is the R scale. The power and Energy values given relate to the maximum laser beam diameter of 7mm. If the laser is considerably larger, then the selection can be based on the fraction of the power that would pass through a 7mm aperture.

EN208 – Classification of Eye protection filters for Laser alignment			
<400nm to <700nm			
Scale number	Spectral Transmittance	Power ⁽¹⁾ W	Energy ⁽²⁾ J
R1	10^{-1}	0.01	2×10^{-6}
R2	10^{-2}	0.1	2×10^{-5}
R3	10^{-3}	1	2×10^{-4}
R4	10^{-4}	10	2×10^{-3}
R5	10^{-5}	100	2×10^{-2}

(1) Maximum Instantaneous laser power for continuous wave lasers for emission durations $>2 \times 10^{-4}$ S

(2) Maximum Laser energy for Pulsed Lasers for Pulse Durations from 1×10^{-9} to $<2 \times 10^{-4}$ S