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| Calculating Nominal Ocular Hazard Distance Guidance |

The Maximum Permissible Exposure (MPE) are limits for laser exposure for eyes and skin that have been incorporated into various standards, including the current British Standard BS EN 60825-1:2007. The MPEs have a safety factor built in and if they are not exceeded then no injury from laser exposure should result.

MPEs are used to calculate Nominal Ocular Hazard Distance (NOHD) and the Hazard Distance (HD) for eye and skin exposure respectively. If you are accidentally exposed to a laser it is unlikely you will be harmed if your exposure distance from the laser aperture is greater than the NOHD or HD. If your exposure distance is less than the NOHD and HD you are at risk from serious harm.

Calculating the NOHD and HD for your laser will help you understand and manage the risk it presents. However, it is only part of the health and safety management of working with lasers and should not be relied on as the sole means to controlling the laser and non-laser hazards. For information on laser risk assessment and controls go to [AURPO Guidance on the safe use of lasers on education and research](http://www.essex.ac.uk/ohsas/consultation/condocs/NIR_Standard/aurpogn7.pdf).

For more information on:

* pulsed laser MPE and NOHD calculations
* MPE and HD for skin exposure
* affects of viewing optics
* extended sources

contact the UNIRPA for guidance.

Below is a basic step by step guide to calculating a NOHD for a continuous wave laser with two worked examples.

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| **Information** | **Units** | **Example 1** | **Notes** |
| Basic laser information | None | Argon-ion laser 400 – 700 nm wavelength, continuous wave | Find out as much information you can about the laser: type, wavelength and power output. |
| Laser output (radiant power) | W (watts) | 100 mW (0.1 W) | The output power from a continuous wave laser. |
| Initial beam diameter | m (meters)  | The beam diameter is 1mm (0.001m) | Beam area is circular and is the diameter leaving the laser. It might be provided by the manufacturer and does not take into account the affect of optics on the beam. |
| Beam divergence |  radians | 3 millradians (0.003 radians).  | How much the beam spreads once it is away from the laser |

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| MPE (continuous wave) | W m-2 (watts per square meter) | 25 W m-2 is the eye MPE for a single accidental exposure to a CW laser beam from 400 to 700nm. | The MPE is the maximum permissible exposure for a continuous wave laser. You can find this out from UNIRPA |
| Equation 1$$NOHD=\frac{\sqrt{\frac{4 ×radiant power}{π ×MPE}}- initial beam diameter}{beam divergence}$$ |
| Example 1$$23.5 m=\frac{\sqrt{\frac{4 ×0.1W}{π ×25 Wm-2}}- 0.001m}{0.003 radians}$$ | Example 2Radiant power = 0.004WAperture diameter = 0.003mDivergence = 0.002 radiansMPE for this laser = 25.4 Wm-2$$5.58 m=\frac{\sqrt{\frac{4 ×0.004W}{π ×25.4 Wm-2}}- 0.003m}{0.002 radians}$$ |

Source: HPA Laser Safety Refresher: Laser Safety Training 2012, section 5 Revision of MPE Calculations.