HAZARD CLASSIFICATION FOR LASERS

Lasers produce electromagnetic radiation at wavelengths extending from 100 nm in the ultra-violet, through the visible (400-700 nm), and the near infrared (700-1400 nm), to the far infrared (1400 nm – 1 mm). Thus, the light emitted can be either visible or invisible. Lasers can be operated in a number of different modes. Some lasers produce a continuous output and are known as continuous wave or CW lasers. The power outputs of CW lasers are usually expressed in terms of watts (W). Others operate in a pulsed mode producing short bursts of radiation. The power of the laser output can vary from less than 1mW to many watts in some CW devices. The energy output of pulsed lasers is generally expressed in joules (J) per pulse.

Because of the wide ranges possible for the wavelength, energy content and pulse characteristics of laser beams, the hazards arising from their use varies widely. It is impossible to regard lasers as a single group to which common safety limits can apply. A system of laser classification is used to indicate the level of laser beam hazard and maximum Accessible Emission Levels (AELs) have been determined for each class of laser. The previous classification system, which was based on five classes (1, 2, 3A, 3B & 4), has been replaced with a new system of seven classes (1, 1M, 2, 2M, 3R, 3B & 4) and these are described below.

Class 1: Lasers that are safe under reasonably foreseeable conditions of operation, either because of the inherently low emission of the laser itself, or because of its engineering design such that it is totally enclosed and human access to higher levels is not possible under normal operation. **NB** If access panels of a totally enclosed system are removed for servicing etc then the laser product is no longer Class 1 and the precautions applicable to the embedded laser must be applied until the panels are replaced.

Class 1M: Laser products emitting in the wavelength range 302.5 nm to 4000 nm, whose total output is in excess of that normally permitted for Class 1 laser products but because of their diverging beams or very low power density do not pose a hazard in normal use and comply with the measurement conditions for a Class 1M product. However they may be hazardous to the eyes under certain conditions if gathering optics are used with them, i.e.
a) With a diverging beam if optics are placed within 100mm of the source to concentrate/collimate the beam.
b) With a large diameter collimated beam viewed with binoculars or a telescope.

Class 2: Lasers that only emit visible radiation in the wavelength range from 400 nm to 700 nm and whose output is less than the appropriate AEL. They are safe for accidental viewing as eye protection is afforded by aversion responses, including the blink reflex. This reaction may be expected to provide adequate protection under reasonably foreseeable conditions of operation including the use of optical instruments for intrabeam viewing.

Class 2M: Laser products that only emit visible radiation in the wavelength range 400 nm to 700 nm, whose total output is in excess of that normally permitted for Class 2 laser products but because of their diverging beams or very low power density are safe for accidental viewing during normal use and comply with the measurement

conditions for a Class 2M product. However they may be hazardous to the eyes under certain conditions if gathering optics are used with them, i.e.
a) With a diverging beam if optics are placed within 100mm of the source to concentrate/collimate the beam.
b) With a large diameter collimated beam viewed with binoculars or a telescope.

Class 3R: Lasers that emit in the wavelength range from 302.5 nm to 1 mm where direct intrabeam viewing is potentially hazardous but the risk is lower than for Class 3B lasers, and fewer manufacturing requirements and control measures for the user apply. The AEL is restricted to no more than five times the AEL of Class 2 for visible wavelengths and no more than five times the AEL of Class 1 for other wavelengths.

Class 3B: Lasers that are normally hazardous when direct intrabeam exposure occurs (i.e. within the Nominal Ocular Hazard Distance, which is the distance within which the beam irradiance or radiant exposure will exceed the appropriate MPE). Viewing diffuse reflections is normally safe. Output levels must be less than the appropriate AELs for Class 3B devices.

Class 4: High power lasers that exceed the AELs for Class 3B products that are also capable of producing hazardous diffuse reflections. They may cause skin injuries, could also constitute a fire hazard and could cause hazardous fumes to be produced as well as being a hazard to the eyes. **Their use requires extreme caution.**