Laser Sharp Focus:
Tips for Laser Safety

According to AS/NZS2211.1 *Laser Safety Part 1: Equipment classification requirements and users guide*, there are six main laser classes in Australia, each with corresponding risk categories and safety measures that must be applied. While it is the duty of the laser manufacturer to classify each product (including the provision of warning labels) and implement safety features such as key-locks and interlock connectors, users must also take responsibility for safety precautions such as eye and skin protection, and medical surveillance.

Australia's six class laser system enables the prescription of tailored safety standards. The six classes of lasers are numbered 1, 2, 3a, 3b (restricted), 3b, and 4, becoming incrementally more dangerous as the numbers progress.

As such, if exposure to the direct or indirect effects of a laser is considered not hazardous, or safe by current medical standards, the laser is stated as belonging to Class 1. In comparison, exposure to a laser belonging to Class 4 has the potential to be fatal.

Class 1 laser technology poses no operational safety hazard. A laser with the strength to qualify for higher classes may qualify for Class 1 due to the built-in safety mechanisms of the laser technology itself. For example, if the laser is securely enclosed such that there is no possibility of human exposure.

Class 2 lasers pose a physical (optical) danger upon direct exposure of greater than 0.25 seconds.

Class 3A contains laser technology of medium power that poses modest potential for injury. Under normal conditions, the danger is purely eye-related. These lasers produce higher levels of radiation than those of Class 2, but are not necessarily more dangerous to the eye. Under altered viewing conditions (when using binoculars, for example), these lasers are significantly more dangerous.

For more information, download the WTIA's Technical Guidance Note 9: Laser Safety.

Class 3B (restricted) lasers are equal to Class 3A lasers when one faces exposure during daylight. But in dim lighting of less than 10 lux, these lasers pose the safety hazard of Class 3B.

Class 3B lasers emit both visible and invisible radiation; direct exposure is hazardous to the eye. These lasers are particularly dangerous because the human aversion mechanism of blinking is incapable of responding to the wavelengths emitted by these lasers. Class 3B lasers are strong enough to cause damage in under 0.25s, and have the potential to burn exposed skin.

Class 4 features high-power lasers that pose serious physical risk to both eyesight and skin, and has the potential to be fatal. These lasers require the highest degree of operational experience and safety equipment.

Operational Dangers of Laser Technology

Potential hazards related to the use of lasers can generally be divided into primary and secondary hazards. The laser beam itself represents the primary potential hazard, as it can affect humans or objects – in the form of raw beam, focused beam, directly reflected beam, or scattered radiation.

Secondary potential hazards are further subdivided:

- **Direct potential hazards** are caused by technical components of the laser installation (high voltage, excitation radiation, laser gases, optics)
- **Indirect potential hazards** are generated by the interaction of the laser beam with materials or the atmosphere, including the UV-radiation caused by plasma formation, hazardous substances generated during material processing, and also potential ignition of explosive materials and the danger of fire.

Laser Radiation

The primary hazard posed by laser technology is direct exposure to the beam itself, in the form of laser radiation. As a result of direct contact with lasers above the Maximum Permissible Exposure (MPE), there is a distinct risk of serious damage to the eyes and skin. There are a number of factors that influence the risk factor:

- The wavelength of laser radiation
- Tissue spectral absorption, reflection and transmission
- Irradiance levels
- The size of the irradiated area
- Exposure duration
- Pupil size
- Location of retinal injury
- Laser pulse characteristics

Lasers pose a threat of severe eye damage to the retina and cornea, and skin damage in the form of burns. Class 4 lasers are capable of causing deep, severe, and permanent damage. The most effective method of prevention is to ensure the encapsulation of the laser beam such that no operational exposure can occur.

Safety Measures

Eye Protection

High quality eye protection is an absolute must have when working with lasers of Class 3 and above, and highly recommended when working with Class 2. Choosing the correct eyewear can be complicated. AS/NZS1336 *Recommended Practices for Occupational Eye Protection* should be consulted for more comprehensive information.

You must take into account the wavelength of the laser technology to be used, the level of radiant exposure and the MPE, along with your practical user considerations. Protective eyewear is usually designed to withstand a maximum exposure of up to 10 seconds or 100 pulses. It does not allow you to purposefully gaze at a high strength laser beam unharmed. Class 4 lasers have unique requirements for protective eyewear.

Skin Protection

For certain instances of Class 3B laser usage, and for all instances of Class 4 laser usage, protective clothing must be worn to guard against the dangers of laser exposure, as well as the risk of fire.

Medical Surveillance

If your job demands that you place yourself at risk of exposure to laser radiation that exceeds the MPE, you should seek eye and skin examinations before you start, and after you leave your position. However, in many instances, it's wise to schedule eye examinations throughout your time in the role.

Laser Safety Officer

Organisations who utilise potentially harmful laser systems ought to employ a Laser Safety Officer. It is the responsibility of the Laser Safety Office to evaluate and oversee the implementation of recommended safety practices.