WHS Guidelines - Lasers

1. Scope

These guidelines are applicable to all environments where lasers are used. The purpose of this document is to detail the minimum safety requirements when working with lasers, to list the common hazards and mitigation strategies and to provide information to assist personnel when conducting risk assessments and developing proper and safe procedures and appropriate documentation.

2. Introduction

A wide variety of lasers are used in the School. Lasers are capable of producing intense beams of coherent radiation at optical, UV and infra-red wavelengths. While lasers vary greatly in the emitted output power, wavelength and purpose, the hazard potential of lasers used for research purposes can be significant. Laser radiation can be extremely hazardous to the eyes and the skin and in a number of cases of serious injury, including loss of sight, have been documented. As a result, a number of international and Australian standards which set out requirements for laser safety have been published or revised in recent years. The risk of injury of lasers is broadly related to the emitted output power and wavelength and lasers therefore are grouped into classes according to these parameters.

3. Definitions

In order to identify the potential hazard, a classification system for lasers has been developed. The class of a laser should be shown on the manufacturer's label. Only lasers that are appropriately labeled and classified are to be used. In Australian Standard AS/NZS 2211.1 the classes of laser products are based on the accessible emission limits. Modification of any laser product as supplied by the manufacturer may change the class of that laser product.

Class 1 and 1M lasers are those which are incapable of damaging the eyes or skin because of either engineered design or inherently low power output. The lasers used in CD players and barcode scanners are common examples of this category.

Class 2 lasers have sufficient power output to cause damage to the eyes if viewed continuously. However, their outputs are low enough to allow the natural aversion responses, such as blinking, to prevent damage. Additional hazard control measures take the form of cautionary signs or labels. The laser pointers often used by conference presenters are common examples.

Class 2M lasers can be hazardous if the beam is viewed directly with optical instruments.

Class 3R (Restricted) lasers have the potential to cause damage to the eyes from intra-beam viewing and precautions are required to prevent either direct viewing or viewing with optical instruments.

Class 3B lasers are more hazardous because of either higher output or operation outside visible wavelengths. These are powerful enough to cause eye damage in a time shorter than the aversion response, human blink reflex or the blink reflex is by-passed due to the invisibility of the beam. In addition, specular reflections may also be hazardous. In general, more stringent controls are needed to prevent exposure. Not a fire hazard.

Class 4 lasers are high power devices capable of producing eye damage even from diffuse reflection. Skin damage is also possible from even brief exposures. Class 4 lasers may also constitute a fire hazard. Examples of class 4 lasers include entertainment lasers, surgical lasers and those used in the plastic, wood and metal fabrication industries. They are a potential fire hazard.

Note: The defined energy and therefore laser classification for a user is based on an exposed beam. If the beam is totally embedded and cannot be accessed by a user/researcher then it can't be classed as a laser for user/researcher purposes. For example, it is possible for a beam to be Class 4 in the equipment but because of dispersion by the equipment function etc, when leaving the equipment it has been reduced to a beam density of a Class 1 laser. It is then a Class 1 laser for the user.

4. Minimum Requirements

Each laser and laser system must be designed to ensure that maximum protection is afforded to the operator. Only Class 1, 1M, 2 and 2M lasers may be used for demonstration purposes by authorised users.

Class 1 lasers require no safety control measures

Class 1M lasers are to be used without viewing aids

Class 2 lasers require the following controls:

(a) a protective housing;

(b) a "Caution" logo must be attached to the laser and must read "Do not stare into the beam".

Class 2M lasers require the same as Class 2 lasers with the addition that no viewing aids may be used. Precautions are required to prevent continuous viewing of the direct beam. While momentary viewing is not considered to be hazardous, lasers of these classes should not be intentionally aimed at people. It is preferable that beams are terminated at the end of their useful path or located well above or below eye level.

Class 3R lasers require the following controls in addition to the requirements needed for Class 2M lasers:

(a) The laser area must be posted with the appropriate "Caution" sign;

(b) Any protective housing must remain in place to prevent exposure to radiation from any source other than the defined aperture;

(c) The protective housing must be interlocked to prevent exposure of personnel to unnecessary laser radiation when opened. The interlock must not be overridden during normal operation;

(d) Beam stops for lasers must be permanently available, correctly positioned and be capable of preventing access to unnecessary laser radiation;

(e) Each laser laboratory must keep written Standard Operating Procedures outlining safety, emergency, and where applicable, alignment procedures. Copies and changes to these documents must be submitted to the laser safety officer upon request.

Class 3B and Class 4 lasers require the following controls in addition to requirements needed with Class 3R lasers:

(a) Class 3B and Class 4 lasers must only be operated in a suitable Controlled Laser Area (CLA), which must:

a. be only accessible to authorized personnel and ILUs by selective distribution of the CLA lab key;

b. not allow for any possibility of laser light to escape from the CLA, such as through windows or door panels;

c. have an appropriate "Danger" label affixed at the entry point(s);

d. have interlocks installed at the entry point(s) so that unannounced entry of any person results in an immediate removal of all hazardous laser light;

e. have an intercom installed to allow communication between persons inside and outside the CLA without opening the door;

f. have a flashing laser warning light located at the entry point(s) to indicate laser operation, activated with the interlock system prior to emission of the beam;

g. have appropriate protective eye wear (goggles) available at the entry point(s) that are to be worn before opening the CLA door when the laser is in operation;

h. have a clearly visible “power cut off” switch present;

i. have no chairs present as this may bring eyes to the level of the laser beams (stools are acceptable;

(b) When more than one Class 3B or Class 4 laser is present in a CLA, it must be indicated on the door which laser/lasers is/are in operation. Anyone entering the CLA should

confirm this by intercom. This ensures that the correct goggles can be worn before entering;

(c) The appropriate "Danger" label must also be affixed to the protective housing of the laser itself;

(d) A master switch (either a key or coded access) must be present, which, when removed, must make the laser inoperable.

(e) The laser beam path must be configured such that the beam is always well below eye level of a person in standing position.

(f) Protective clothing must be provided as required.

(g) Backstops must be constructed of diffusely reflecting material and, when practical, fire resistant material.

(h) Hazardous beams must be enclosed as much as possible and terminated in an appropriate beam stop;

(i) All materials capable of specular reflections should be avoided as much as possible and preferably should be entirely removed from the CLA; only diffusely reflecting materials may be near the beam path;

(j) Jewellery or watches must not be worn as they can lead to specular reflections. Failing to remove jewellery and watches forms one of the most common causes of laser eye injuries!

(k) Appropriate Fire extinguishers should be located in the vicinity of the CLA when the laser is deemed a fire hazard (Class 4) and flammable materials should be kept well clear of the beam path and preferably should be removed.

(l) When no goggles are available at the entry point of a CLA, entry is not permitted.

5. Laser Pointers

Laser pointers can present a hazard that is capable of causing harm to eyes. An incident in 1999 in Western Australia resulted in permanent eye damage to a 12 year old boy. NSW legislation requires that users of laser pointers whose power output is greater than 1 mW will need to obtain a “permit to use” from the Police Department. This requirement was effective from December 2008. The WHS Committee recommends that only laser pointers not exceeding 1mW should be used in the School. Pointers can be identified by their classification which should be on the warning label. The preferred laser pointers that do not require a permit are Class 2 [<1mW] laser products. Pointers requiring a permit are labelled Class 3R. If the class of the laser is unknown the pointer should not be used until this is determined.