Australian Government
Department of Defence

DEFENCE HEALTH SERVICE BRANCH

Just the Facts... Laser Eye Exposures

LASERS ARE USED TO RANGE TO TARGETS OR MARK (DESIGNATE) THEM FOR LASER GUIDED MUNITIONS. THEY ARE ALSO USED TO ILLUMINATE TARGET AREAS OR COVERTLY POINT TO TARGETS WHILE USING NIGHT VISION GOGGLES. THEY ARE MOST COMMONLY USED IN DIRECT-FIRE SIMULATORS SUCH AS THE IWESS.

GENERAL INFORMATION	Lasers are intense sources of visible or invisible light. The laser was invented in 1960 and has many diverse uses in the military, medicine and industry. Laser radiation outside the wavelength range 400 to 700nm cannot be seen with the naked eye but may be seen through night vision goggles (NVGs). Laser radiation is hazardous to the eye within the Nominal Ocular Hazard Distance (NOHD) for unaided vision, or within the Extended NOHD (NOHDe) for magnified vision (through binoculars or magnified sights). See attached sheet for the categories of lasers.
ROUTINE USES IN THE DEPLOYED SETTING	Lasers are used to mark (designate) targets for laser guided munitions or to range to targets. The Infantry Weapons Effect Simulation System (IWESS) is used in tactical training. Laser can also be used to aim small arms while using night vision goggles. The enemy may also have similar laser devices.
PERSONAL PROTECTIVE EQUIPMENT (PPE) and COUNTERMEASURES AVAILABLE FOR PERSONNEL	Day sights in vehicles and helicopters may have built-in laser filters to protect the viewer from laser exposure, however if a filter is fitted, sights must be checked for correct optical density and wavelength prior to use. Individual soldiers have laser eye protectors available that will provide protection against most laser exposures. Aviators have visors that provide the same level of protection as the individual soldier. Laser eye protection and possibly skin protection (anti-flash) for war ships is specific to Class and is clearly defined in Class RADHAZ and Laser SOPs. Lasers can be a line-of-sight hazard, or hazardous from specular reflections (such as still water, metal surfaces or glass), or diffuse reflections (such as soil, vegetation or cloth). Eliminating the line-of-sight between you and the laser source may not prevent direct exposure and the potential for eye injury.
LEVELS OF POSSIBLE EXPOSURE	Laser rangefinders and target designators emit levels of laser light that are capable of causing blindness from direct exposure at considerable distances from the laser. IWESS equipment is safe for field use while tactical pointers used with NVGs are above the safe limit but do not pose the acute injury risk that rangefinders and designators do. Classroom laser pointers may present a risk of injury for accidental exposures and should not be pointed directly into the eye.
SIGNS & SYMPTOMS OF ACUTE AND CHRONIC EXPOSURE	Lasers may interfere with vision either temporarily or permanently in one or both eyes. At low energy levels, lasers may produce temporary reduction in visual performance during critical military tasks, such as aiming weapons or flying aircraft. At higher energy levels they may produce serious long-term visual loss. A “black” spot may be present in the field of view. A very sore eye, distinct popping sound in the eye, or a flash may be felt during the actual exposure. A flash of light, hundreds of times brighter than the sun may indicate direct exposure to a laser beam within the visible light spectrum. Individuals may experience flash blindness, glare, decreased vision, and/or pain. There are no known ‘cumulative” exposure risks from military lasers.
REVERSIBILITY OF ACUTE AND CHRONIC HEALTH EFFECTS	Temporary effects such as after-images, and flash blindness are reversible. Long–term irreversible visual effects such as blindness are possible from a direct exposure to some rangefinders, most target designators and other laser systems at considerable range or if viewed through binoculars.
TREATMENT REQUIRED/ AVAILABLE FOR EXPOSURE	Prevention of laser exposure is desirable! There is no first aid for laser injuries. An individual diagnosed with a laser eye injury is to be evacuated to a hospital where examination by an ophthalmologist will be necessary.

Notes: The proponent for this Fact Sheet is the Directorate of Preventive Health, DHSB. This Fact Sheet was developed with the cooperation of the U.S. Army Center for Health Promotion and Preventive Medicine. All comments and questions should be forward to DPH, DHSB, Campbell Park Offices (CP 2-7-154), Canberra ACT 2600 or email DPH.DHS@defence.gov.au

LONG TERM MEDICAL SURVEILLANCE REQUIREMENTS OF HEALTH EFFECTS MONITORING	Personnel who employ lasers for targeting purposes do not require any routine medical monitoring. Laser workers as defined in ADFP 410, require an initial eye exam. Anyone involved in a laser accident/incident will require a comprehensive medical and ophthamological examination. This should be a rare occurrence in peacetime.
RISK COMMUNICATION ISSUES	Laser eye injury is not life threatening and the chances for some or full recovery are good. However permanent blindness may occur.

Lasers Classifications

Lasers are classified based on their capacity to cause eye or skin injury from direct or reflected exposure. Description of laser classes (refer to AS/NZS 2211.1:2004):

Class 1: Lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing. Class 1-laser products do not permit human access to laser radiation in excess of the accessible emission limits of Class 1 for applicable wavelengths and emission durations.

Class 1M: Lasers emitting in the wavelength range from 302,5nm to 4,000nm. Class 1M-laser products are safe under reasonably foreseeable conditions of operation, but may be hazardous if the user employs optics within the beam. Two conditions apply:

a. for diverging beams if the user places optical components within 100mm from the source to concentrate (collimate) the beam; or
b. for a collimated beam with a diameter larger than the diameter specified in table 1 for the measurements of irradiance and radiant exposure.

Class 2: Lasers that emit visible radiation in the wavelength range from 400nm to 700nm where eye protection is normally 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.

NOTE: Outside the wavelength range from 400nm to 700nm, any additional emissions of Class 2 lasers are required to be below the AEL of Class 1.

Class 2M: Lasers that emit visible radiation in the wavelength range from 400nm to 700nm where eye protection is normally afforded by aversion responses including the blink reflex. However, viewing of the output may be more hazardous if the user employs optics within the beam. Two conditions apply:

a. for diverging beams, if the user places optical components within 100 mm from the source to concentrate (collimate) the beam; or
b. for a collimated beam with a diameter larger than the diameter specified in table 1 for the measurements of irradiance and radiant exposure.

NOTE: Outside the wavelength range from 400nm to 700nm, any additional emissions of Class 2M lasers are required to be below the AEL of Class 1M.

Class 3R: Lasers that emit in the wavelength range from 302,5nm to 106nm 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 than for Class 3B lasers. The accessible emission limit is within five times the AEL of Class 2 in the wavelength range from 400nm to 700nm and within 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 NOHD). Viewing diffuse reflections is normally safe (see also AS/NZS 2211.1:2004 para 12.5.2c).

Class 4: Lasers that are also capable of producing hazardous diffuse reflections. They may cause skin injuries and could also constitute a fire hazard. Their use requires extreme caution.