LASERS

LEARNING OUTCOME

Describe the legislative requirements for lasers under the Work Health and Safety Regulation and describe the processes for managing a worker's exposure to lasers.

ASSESSMENT CRITERIA

- Describe the different classes of lasers
- List potential hazards to workers when using lasers
- Understand the effective controls that may be used to eliminate or reduce the risks of using a laser.

REFERENCES

- Work Health and Safety Act 2011 – Duties
- Work Health and Safety Regulations 2011
    - Section 223 Lasers
- Managing the Risks of Plant at the Workplace Code of Practice 2013
- AS/NZS IEC 60825.1 – Safety of Laser Products – Equipment Classification and Requirements
- AS 2397 - Safe use of lasers in the building and construction industry
- AS/NZS 1337 – Eye and face protection – filters and eye protectors against laser radiation

ATTACHMENTS

Safe Work Australia – Laser classifications and potential hazards

LASERS

LASER is an acronym which stands for Light Amplification by Stimulated Emission of Radiation. The laser produces an intense, highly directional beam of light. Lasers are commonly used for alignment, levelling, control and survey tasks, cutting, welding, marking, scanning and visual effects.

The most common cause of laser-induced tissue damage is thermal in nature, where the tissue proteins are denatured due to the temperature rise following absorption of laser energy.

A laser is a light source that can be dangerous to people exposed to it. Even low power lasers can be hazardous to a person's eyesight. The coherence and low divergence of laser light means that it can be focused by the eye into an extremely small spot on the retina, resulting in localised burning and permanent damage in seconds. Certain wavelengths of laser light can cause cataracts or even boiling of the vitreous humor, the fluid in the eyeball. Infrared and ultraviolet lasers are particularly dangerous, since the body's "blink reflex", which can protect an eye from excessively bright light, works only if the light is visible.

Laser devices are sources of light which differ from all other sources of light. Low-powered lasers usually emit light in the form of a narrow, concentrated light beam of low divergence (spread). The wavelength (colour) of this light (radiation) is usually confined to the visible or to the invisible near infrared parts of the spectrum. X-rays, ultraviolet radiation and microwaves are not emitted from the low-powered lasers used for alignment, levelling, control, and survey tasks in the building and construction industry.

Lasers are devices that produce optical radiation with unique properties. They have varying power and applications. High power laser devices can present a hazard over considerable distances from the source. While exposure to some higher powered laser products may cause skin burns, most laser injuries are to the eyes. For example, some laser pointers available on the market are of sufficient power to cause eye injury. Laser products may consist of a single laser with or without its own power supply or multiple lasers in a complex system.

Laser devices sold in Australia should be classified in accordance with AS/NZS IEC 60825.1:2014 Safety of laser products - Equipment classification and requirements. All laser devices must be sold with appropriate information about their safe use. This generally takes the form of a label with both the classification details and the warnings-for-use that are appropriate to that classification. The warning labels appropriate to the class should be permanently affixed to the housing in a highly visible position.

WHO HAS DUTIES IN REGARDS TO HEALTH AND SAFETY?

Duty holders under the Work Health and Safety (WHS) legislation have an obligation to provide information, instruction, training and supervision to workers using laser equipment to ensure the health and safety of their workers and others. Training should be provided by a competent person, following guidelines provided by the designer, manufacturer or supplier.

Designers should consult with manufacturers, suppliers, owners and end users to ensure that the correct strength of laser is used and the housing of the laser unit is designed according to safe design principles. The designer should ensure that complete written information on the safe use of laser products is provided to manufacturers, erectors, installers, suppliers, owners and end users.

LASERS – WORK HEALTH AND SAFETY REGULATION S223

The Work Health and Safety Regulations (WHS Regulations) impose certain requirements in relation to the safe use of laser equipment at the workplace. The WHS Regulations are as follows:

WHS Regulation 2011 s233 – Lasers:

- This section applies to the person with management or control, at a workplace, of laser equipment that may create a risk to health and safety.
- The person must ensure that laser equipment intended for use on plant is designed, constructed and installed so as to prevent accidental irradiation of any person.
- The person must ensure that laser equipment on plant is protected so that any operator of the plant or other person is not exposed to direct radiation, radiation produced by reflection or diffusion or secondary radiation.
- The person must ensure that the visual equipment used for the observation or adjustment of laser equipment on plant causes no risk to health or safety from laser rays.
- The person must ensure that the workers operating the laser equipment are trained in the proper operation of the equipment.
- The person must ensure that Class 3B and Class 4 lasers (within the meaning of AS 2397 - Safe Use of Lasers in the Building and Construction Industry) are not used in construction work.

HAZARDS ASSOCIATED WITH LASERS

The coherence, the low divergence angle of laser light and the focusing mechanism of the eye means that laser light can be concentrated into an extremely small spot on the retina. If the laser is sufficiently powerful, permanent damage can occur within a fraction of a second, faster than the blink of an eye.

Sufficiently powerful visible to near infrared laser radiation (400-1400 nm) will penetrate the eyeball and may cause heating of the retina, whereas exposure to laser radiation with wavelengths less than 400 nm and greater than 1400 nm are largely absorbed by the cornea and lens, leading to the development of cataracts or burn injuries.

Infrared lasers are particularly hazardous, since the body's protective "blink reflex" response is triggered only by visible light. For example, some people exposed to high power laser may not feel pain or notice immediate damage to their eyesight. A pop or click noise emanating from the eyeball may be the only indication that retinal damage has occurred i.e. the retina was heated to over 100 °C resulting in localized explosive boiling accompanied by the immediate creation of a permanent blind spot.

LASER HAZARDS—CLASSIFICATION

The system of classification of laser devices is specified in AS/NZS IEC 60825.1:2014 – Safety of laser products equipment classification and requirements. A description of the different classes of laser products are as follows:

- Class 1 and 1M - laser products that are safe during use, including long-term direct intrabeam viewing for the naked eye (unaided eye)
- Class 1C - laser products that are intended for direct application of laser radiation to the skin or internal body tissues for medical, diagnostic, therapeutic or cosmetic procedures
- Class 2 and 2M - laser products emit visible radiation that are safe for momentary exposures but can be hazardous for deliberate staring into the beam.
- Class 3R (Restricted) - laser products that emit radiation that can exceed the maximum permissible exposure (MPE) under direct intrabeam viewing but the risk of injury in most cases is relatively low. Dazzle, flash-blindness and afterimages may be caused by a beam from a Class 3R laser product in the visible wavelength range, particularly under low ambient light conditions. This may have indirect general safety implications resulting from temporary disturbance of vision or from startle reactions. Such visual disturbances could be of particular concern if experienced while performing safety-critical operations such as working with machines or at height, with high voltages or driving.
- Class 3B – laser products that are normally hazardous when intrabeam ocular exposure occurs including accidental short time exposure. Viewing diffuse reflections is normally safe. Class 3B lasers which approach the accessible emission limit (AEL) for Class 3B may produce minor skin injuries or even pose a risk of igniting flammable materials. However, this is only likely if the beam has a small diameter or is focussed.
- Class 4 – laser products for which intrabeam viewing and skin exposure is hazardous and for which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard.

Recognition lasers used for surveying, levelling, control or alignment tasks in the building and construction industry shall be manufactured, calibrated, and labelled in accordance with the design limits specified in Section 4 of AS 2211.

Users of lasers must check the classification marking (labelling) on lasers used for alignment, levelling, control, and survey tasks to ensure that each laser is classified as either Class 1, Class 2, Class 3A or Class 3B (Restricted).

NOTE: It is the responsibility of the manufacturer or agent to provide correct classification of new lasers, in accordance with AS 2211.

SAFETY PRECAUTIONS

- Only qualified and trained persons should be assigned to install, adjust and operate the laser equipment.
- Use laser protective eyewear
- Areas in which these lasers are used should be posted with an appropriate laser warning sign.
- Wherever practicable, mechanical or electronic means should be used to assist in the alignment of the laser.
- Precautions should be taken to ensure that persons do not look directly into the beam (prolonged intrabeam viewing can be hazardous). Direct viewing of the beam through optical instruments (theodolite, etc.) may also be hazardous.
- The laser beam should be terminated at the end of its useful beam path and should in all cases be terminated if the hazardous beam path (to Nominal Ocular Hazard Distance) extends beyond the controlled area.
- The laser beam path should be located well above or below eye level wherever practicable.
- Precautions should be taken to ensure that the laser beam is not inadvertently directed at mirror-like (specular) surfaces (but, more importantly, at flat or concave mirror-like surfaces).
- When not in use the laser should be stored in a location where unauthorized personnel cannot gain access.
- A Laser Safety Officer (LSO) who is trained in the theory and practical applications of lasers may be appointed for lasers used in high risk applications. (AS2397)

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