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HEALTH RISKS FROM THE USE OF LASER POINTERS

Since first being developed in 1960, the LASER, an acronym for **L**ight **A**mplification **S**timulated **E**mission of **R**adiation, has become a commonplace device in industry, commerce, entertainment and medicine. Laser pointers – the hand-held, pen-like devices that project a beam of laser light – are rapidly replacing the traditional wooden pointers used by lecturers during presentations. However, these pointers can be misused, for example, by students in classrooms or by children at home, and this has generated safety concerns. There have been reports of temporary blindness, disorientation and headaches by bus drivers, airline pilots, police and teachers. Manufacturers are now using similar low powered laser devices in toys.

Two questions are raised: should these products be available to the general public and how dangerous are they? This Fact Sheet provides information about the properties of laser radiation, the different laser classes and summarizes the World Health Organization's (WHO) advice on the safe use of laser pointers.

Laser light

Lasers produce radiation, more commonly referred to as light, with unique properties that distinguish laser-produced light from light from more familiar sources such as the sun or common domestic lamps. Domestic lamps emit light that is highly divergent, i.e., that spreads out almost equally in all directions from the lamp. This light has many different wavelengths (colours), which together give the characteristic colour of the lamp. In contrast, a laser produces light in a very narrow wavelength band, so narrow that the laser is referred to as a monochromatic (one colour), or single wavelength, source. Lasers can also produce a very narrow beam that diverges little. This low divergence means that laser light is highly directional, forming a pencil-like beam and appears as a small spot when shone onto a surface, even at distances of hundreds of metres. As a consequence, high power lasers can be hazardous to the eye over considerable distances. Because laser light is monochromatic and basically low-divergent, the beam is better focused by the lens of the eye than any other light source, thus producing images on the retina with much greater intensities than is possible with domestic lamps.

Laser pointers

Laser pointers are portable, battery-operated, hand-held laser devices used by lecturers during their presentations. Commonly available laser pointers emit red-coloured light

(wavelength between 630 and 670 nanometres – nm (1 nm = 1/1000th of a millimetre), although more expensive pointers are available which emit green-coloured light (532 nm). The visual response of the human eye is wavelength-dependent and is at a maximum at around 550 nm and decreases at higher and lower wavelengths. As a result, the human eye perceives the red spot produced by a laser operating at 635 nm as being about 10 times brighter than the red spot produced by a laser operating at 670 nm, even though each device may emit the same light power.

Many laser pointers have interchangeable diffractive elements or selection knobs to produce various laser patterns such as stars, hearts, lines, etc. A popular format for these products is to attach them to key rings.

Safety standards and classification

Laser pointers are classified according to the International Electrotechnical Commission (IEC) standard on laser safety. This standard specifies requirements for the laser to ensure that the risk of accidental exposure is minimized through the use of engineering control features and that there is product labelling and safety information. The IEC also sets out five classes of laser: 1, 2, 3A, 3B and 4. This classification gives the user an indication of the degree of laser hazard.

Class 1 lasers have an output power that is below the level at which eye injury can occur.

Class 2 lasers emit visible light and are limited to a maximum output power of 1-milliwatt (mW). A person receiving an eye exposure from a Class 2 laser will be protected from injury by their natural blink reflex, an involuntary response which causes the person to blink and turn their head, thereby avoiding eye exposure.

Class 3A lasers may have a maximum output power of 5 mW. This limit restricts the power entering a fully dilated human eye (taken as a 7 mm aperture) to 1 mW. Thus, accidental exposure to a Class 3A laser should be no more hazardous than exposure to a Class 2 laser. However, Class 3A laser pointers are hazardous when viewed with an optical aid such as binoculars and are therefore not suitable for the general consumer.

Class 3B lasers have an output power up to 500 mW, sufficient to cause eye injury. The extent and severity of any eye injury will depend upon several factors including the laser power entering the eye and the duration of the exposure. Class 1, Class 2, Class 3A and Class 3B lasers do not have sufficient power to cause a skin injury.

Class 4 lasers have an output power greater than 500 mW and are capable of causing injury to both the eye and skin and will be a fire hazard if sufficiently high output powers are used.

The IEC provides advice on the use of lasers for demonstrations, displays and exhibitions and states that only Class 1 or Class 2 devices should be used in unsupervised areas unless under the control of experienced, well-trained operators. Laser pointers used by, for example, professional lecturers in the workplace are considered to fall within this category. Training requirements are specified for operators using lasers of a higher class for these purposes, as there is a risk of eye injury.

In the United States, a different laser classification exists for low powered devices. A class 3B laser classified by the IEC standard, and having powers up to 5 mW, is classified as IIIA in the American standard. The use of Roman numerals should indicate that the laser has been classified according to the American standard. In practice, examples occur where an inappropriate 3A label has been substituted for the IIIA label.

Laser pointers currently available

It appears that the output power of laser pointers currently available is generally less than 5 mW. The body's natural aversion responses are unlikely to provide adequate protection from eye injury for Class 3B laser pointers and Class 3A laser pointers used with optical aids. Although the risk of permanent eye injury from a laser pointer may be small, a person receiving even a transient eye exposure will experience a bright flash, a dazzling effect, which is likely to cause distraction and temporary loss of vision in the affected eye and possibly after-images. The time taken to recover from these effects will vary for different people and will also be dependent on the ambient light level at the time of exposure. Medical attention should only be sought if after-images persist for hours, or if a disturbance in reading vision is apparent.

WHO advice

In general, laser pointers are classified as Class 1, Class 2 or Class 3B products. However, national authorities making measurements of the power output of these lasers have noted that significant misclassification is occurring by manufacturers. In many cases, lasers have been classified as Class 2 when they were really Class 3B. More accurate classification needs to be enforced by appropriate authorities.

- On Laser Pointers

WHO considers the professional use of a Class 1 or Class 2 laser pointer as a training aid to be justified, and regards these classes of laser product as being adequate for such use. The use of Class 3B laser pointers up to 5 mW may be justified for some applications in the workplace where the user has received adequate training.

- On Lasers in Toys

There has been significant concern that laser pointers are used in children's toys. Lasers in children's toys should be restricted to class 1 and class 2 laser pointers should not be sold to children.

- On the General Commercial Availability of Lasers

Sale of laser products to the general public should be restricted to Class 1 or Class 2 devices and should be sold with sufficient accompanying information to enable the user to operate the product in a safe manner. Laser pointers higher than Class 2 are considered too powerful for general use as laser pointers and present an unacceptable risk in the hands of consumers because they may cause eye injury.

Reference

For further information on laser classification, see IEC publication number 60825-1: 1993 Safety of laser products Part 1. Equipment classification, requirements and user's guide. International Electrotechnical Commission, Geneva.

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