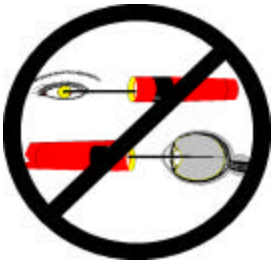
USACHPPM
Readiness thru Health
25-012-0498

Just the Facts... *Visible Laser Pointers: Effects on Vision*



Do not deliberately stare into a laser beam.

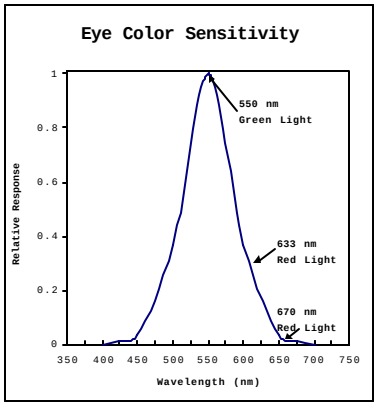


Figure 2

Do not allow children to play with lasers.

Take safe advantage of modern technology.

Purpose.

To provide information and facts on commercially available, visible laser pointers and their potential for adverse effects on vision and the eye.

Forward.

Laser pointers, bar code readers, and other Class 2 laser products are certified as safe for brief ocular exposure. Light-induced retinal injuries are rare. It is highly unlikely an injury will occur from a laser pointer -- even Class 3a. To further minimize the risk associated with laser pointers, it is recommended that a Class 2 laser be used instead of a Class 3a laser.

Laser Pointer Characteristics.

Figure 1

- Available in a variety of styles and sizes such as the laser pointer pictured in Figure 1.
- Manufactured in a variety of "colors" (wavelengths) ranging from green (532 nm) to red (670 nm). Our eyes respond best to green light (~555 nm). A green laser pointer (532 nm) appears brighter than a same power red laser pointer. Currently the most common and inexpensive laser pointer wavelength is red (670 nm). Figure 2 shows the eye's color sensitivity.
- Prices range from $15 to $500 depending on quality, wavelength, and power.

Laser Pointer Classification and Labeling.

Figure 3

The United States Federal Government regulates lasers and requires most lasers to be appropriately labeled with a warning of their potential hazards. Class 1 lasers are the safest, considered incapable of causing eye damage, and require no labeling or warning. Class 2 lasers are slightly more dangerous than Class 1 lasers, produce up to 1 milliwatt of output power, and are safe for momentary viewing. Class 3a lasers, which currently cover most red-beam laser pointers, have an output power between 1 and 5 milliwatts. Individuals viewing a Class 3a laser can exceed the maximum permissible exposure (MPE) but are unlikely to be injured. Class 3a lasers are required to be labeled with the exit aperture (opening where the laser light is emitted) marked. Figure 3 and Figure 4 show the appropriate labeling and correct label placement on a typical laser

Figure 4

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pointer. The labels, unfortunately, when affixed to small laser pointers, are difficult to read. Lasers above the 5-milliwatt power level are either a Class 3b or Class 4 laser, require further controls, and are extremely dangerous.

Discussion.

Laser pointers are very common and are becoming more available. They are prevalent in lecture halls and classrooms. Federal Regulations permit only Class 1, 2, or 3a laser pointers. Laser pointers are generally classified as Class 3a devices or lower, with an output power of less than 5 milliwatts of power. The basic reaction when a high-power laser strikes tissue is destruction of tissue, called photocoagulation. The degree of photocoagulation will depend mainly upon power density of the laser beam, laser wavelength, absorption, reflection, and transmission of the tissue. Laser pointers are safe for a momentary incidental exposure and cannot produce retinal photocoagulation. Other adverse effects can result from continually staring into a laser pointer for more than 10 seconds. In most individuals, the aversion response, such as blinking and turning away, will terminate accidental laser exposures to less than 1/4 of a second. Due to this aversion response, there is no realistic risk of a retinal injury from viewing a Class 3a laser pointer. For some individuals, especially children, forcing a direct stare into the laser beam for more than 10 seconds may circumvent this natural aversion. It is important and prudent to keep laser pointers away from children and educate them about the dangers associated with them. Although permanent effects upon the eye are highly unlikely, temporary visual effects are possible.

Laser Pointer Visual Effects and General Terms.

Afterimage. A reverse contrast, shadow image left in the visual field after a direct exposure to a bright light, such as a laser pointer. Afterimages may persist for several minutes.

Dazzle. A temporary loss of vision or a temporary reduction in visual acuity.

Glare. A reduction or total loss of visibility, such as that produced by an intense light source, such as oncoming headlights or a momentary laser pointer exposure, in the central field of vision. These visual effects last only as long as the light is actually present. Visible laser light can produce glare and can interfere with vision even at low energies well below those that produce eye damage.

Flashblindness. A temporary visual interference effect that persists after the source of illumination has been removed. This is similar to the effect produced by flashbulbs, and can occur at exposure levels below those that cause eye damage.

Power. The rate at which energy is emitted, transferred, or received. Unit: watts (joules per second).

Startle. Refers to an interruption of a critical task due to the unexpected appearance of a bright light, such as a laser beam.

Wavelength. The distance between two successive points on a periodic wave that have the same phase. It is commonly used to provide a numeric description of the color of visible laser radiation.

Conclusions.

- Momentary laser pointer exposure is safe. In most individuals, aversion response, such as blinking and turning away, will terminate accidental laser exposures to less than 1/4 of a second. Due to this aversion response, there is no realistic risk of retinal damage from viewing a Class 3a laser pointer.
- Forcing a direct stare into the laser beam for more than 10 seconds may circumvent our natural aversion to bright light, possibly causing an eye injury.
- It is important and prudent to keep laser pointers away from children and educate them about the dangers associated with them.
- A Class 2 green (532 nm) laser may appear brighter than a Class 3a red (670 nm) laser. The Class 2 laser is safer than the Class 3a laser.
- It is good common sense not to stare into a laser beam, the headlights of an oncoming car, or point a laser at individuals or crowds, as even temporary visual effects may have safety implications due to impaired vision.

Questions?

Further questions or requests can be referred to USACHPPM, Laser/Optical Radiation Program, DSN 584-3932 or Commercial (410) 671-3932.

References.

1. Mainster MA, Timberlake GT, Warren KA, Sliney DH. Pointer on Laser Pointers, Opthalmology 1997;104: 1213-1214.

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