

INTRODUCTION TO LASER SAFETY

WHAT IS A LASER? ■

A laser beam is a special kind of light. The word LASER stands for Light Amplification by the Stimulated Emission of Radiation. This means that this kind of light can only be created under special conditions. To create this special beam of light, the following three basic components are required:

1. The **resonator cavity**, which is a tube with a mirror on one end and a partially transparent mirror on the other end so some light can escape.
2. The **lasing medium**, which is the material that goes inside the resonator cavity. The lasing medium can be a crystal, gas, liquid, or semiconductor.
3. The **excitation source**, which is what is used to excite the atoms of the lasing medium. The excitation source can be an electric current, a high intensity lamp, a radio frequency, or even another laser.

Basically, the excitation source dumps energy into the lasing medium where the atoms of the lasing medium become excited. Then they release their own energy in the form of light and this light bounces around inside the resonator cavity. Eventually the light will come out the end of the resonator cavity with the partially transparent mirror. Now we have a laser beam.

The beam of light that comes out is **monochromatic**, which means one color. It is **coherent**, which means the waves of light are in phase or in step with each other, like soldiers marching in a parade. The beam is very narrow or tight. A beam of light coming from a flashlight spreads very quickly the further out the light goes. A laser beam does not spread quickly and stays together for a long distance. We call this **directional**. The special properties of being monochromatic, coherent, and directional are what make the laser potentially harmful to the eyes and skin. (Figure 1)

HOW CAN LASERS HURT ME? ■

Laser light can be very powerful - powerful enough to cut through steel. It can also be very precise - precise enough to shave thin layers off of an eggshell. If a laser can do this, what do you think it could do to your eyes and skin?

Let's look more carefully at the monochromatic property of a laser beam. A beam of laser light that is one color means that it is made of one **wavelength**. A wavelength is the distance from the top of a wave to the top of the next wave, like the waves in the ocean. If you could take a picture of the ocean waves, then you could measure with a ruler the distance from the tip of one wave to the tip of the next wave. This distance is the wavelength (Figure 2). You can have different wavelengths of laser light. Every time you change the wavelength, you change the color. Some laser light you can't see and some laser light you can see, depending on the laser beam's wavelength. The laser beam's wavelength determines what part of your eye will get hurt if you look directly into the beam or look at the beam when it reflects off of a shiny surface. If the laser beam is powerful enough, you could get hurt from a reflection off of a dull or rough surface.

If people working with medium to high powered lasers (lasers that can cut through steel or mark part numbers in metal or surgical lasers) accidentally look directly into the laser beam or catch the beam from a reflection, the beam will burn either the front or back of the eyeball. A burn to the front part of the eyeball could result in partial blindness. A burn to the back of the eyeball could cause partial or permanent blindness. Accidental exposure to low power lasers (laser pointers, laser levels, laser bar code scanners) may cause a temporary reduction in your vision. An example of this is exposure to a flash from a camera or the bright headlights from an oncoming car. This can affect your performance with critical tasks such as driving a car or operating a forklift. Depending upon the power of the laser, your eyes could be injured even if you are far away from the laser beam source.

FACT SHEET

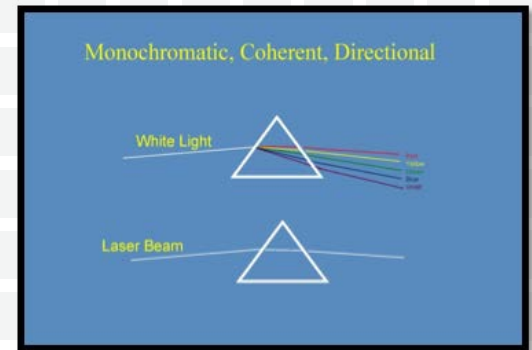


Figure 1

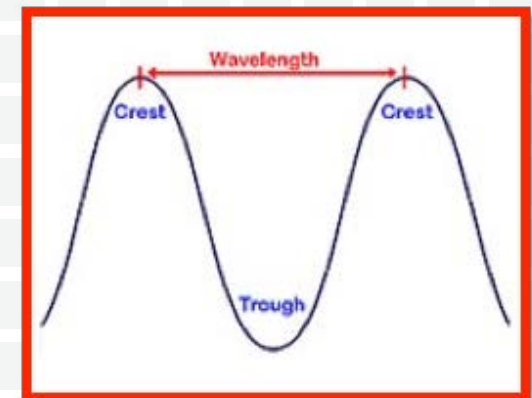


Figure 2

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WHAT SHOULD MY EMPLOYER AND I DO TO ENSURE THAT I'M PROTECTED?

If lasers can injure your eyes and skin, how do you and your employer ensure that you are protected from the laser beam? There are two ways to protect yourself from medium and high powered lasers.

1. Your employer can enclose the laser beam so that nothing can pass through the beam which can cause a reflection or where you could accidentally put your eyes or skin directly into the beam path.
2. Your employer can provide and you should wear laser eye protection in the form of goggles or glasses. Ordinary sunglasses will not protect you against laser light. The goggles or glasses must be made to protect you against the wavelength and power level that the laser is operating at. Each laser requires its own eye protection, as there is not one set of goggles or glasses that protects against all lasers. Lasers that are completely enclosed do not require eye protection.

WHAT ABOUT LOW POWER LASERS?

Eye protection is not required for low power lasers [as described previously]. Your eyes will automatically blink or you will turn away in the presence of a bright light. This is called the **aversion response**.

Laser eye injuries can be prevented as long as safety standards and best practices are followed.

FOR MORE INFORMATION:

This is a general introduction only. For more detailed information, see the [OSHA/LIA Alliance web page](http://www.osha-slc.gov) (www.lia.org/alliance/osha).

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