LASER BEAM

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UC IRVINE LASER SAFETY NEWSLETTER

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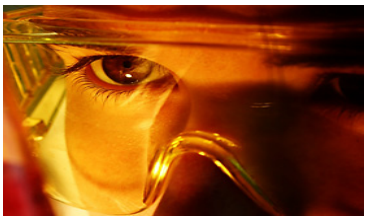
The purpose of this newsletter is to keep laser operators on this campus informed regarding laser safety news, bargains on laser safety equipment (including protective eyewear), novel/inexpensive methods for controlling laser hazards, lessons learned from laser accidents, and other tips to improve safety. These newsletters are distributed approximately every 6 months or whenever a laser safety issue with significant urgency arises. For past issues of this newsletter, please visit the UC Irvine Environmental Health & Safety website (www.ehs.uci.edu) and look under "Radiation & Laser Safety".

ONLINE LASER SAFETY COURSE

The EH&S online ***Laser Safety Course*** is now available on the UC Irvine Training & Employee Development (TED) website (www.ted.uci.edu). The course includes six topical learning modules that can be completed over any number of sessions or days. A UC Irvine Net ID and password are currently required to access the course. However, it is hoped that in the future the course will be available to laser users outside UC Irvine. *Note: To obtain credit for the course, it must be accessed via TED.*

Persons who complete the online course are not required to attend an EH&S ***Laser Safety Seminar***. For those who prefer classroom-type training, these seminars will continue to be offered every 3 months. Registration for the seminar is also at the TED website.



OPTICAL DENSITY

The degree of attenuation of laser radiation afforded by protective eyewear is referred to as the **optical density (OD)**. The definition of the OD given in the *American National Standard for Safe Use of Lasers* (ANSI Z136.1) is:

$$\mathbf{OD = - \log_{10} [transmittance]}$$

A simpler way to define OD is as follows:

$$\mathbf{OD = \log_{10} [(maximum\ possible\ exposure\ in\ W/cm^2) / (maximum\ safe\ exposure\ in\ W/cm^2)]}$$

Therefore, if the maximum quantity of laser radiation to which you can be exposed (in W/cm^2 = ***irradiance*** units) is 10 times the maximum safe level (also in W/cm^2) for that wavelength and exposure time, the OD needed to attenuate that beam would be 1 because the $\log_{10}$ [10] = 1. If you can be exposed to 1000 times the maximum safe level, the OD needed would be 3, and so on.

The maximum exposure times used in calculating OD are: 1) 0.25 second for visible beams because of the normal aversion response/blink reflex that occurs within that period of time; 2) 10 seconds for infrared beams due to heat sensations and normal eye movements that would normally limit exposures to that time or less; and 3) the entire time a laser in on during the day for ultraviolet beams due to the absence of any aversion or heat sensation effects.

The OD and wavelengths at which protection is afforded are always imprinted on laser eyewear. Before using laser eyewear, make sure that it provides adequate protection for your application. ***Never try to calculate the OD yourself as it can be difficult to do, especially for repetitively pulsed lasers. Contact EH&S for assistance with this.***

MEMORABLE QUOTE

"At the source of every error which is blamed on the computer, you will find at least two human errors, one of which is the error of blaming it on the computer."

Anonymous

LASER BEAM ALIGNMENT TIPS

About half of the laser accidents that have been reported in the United States during the past 20 years occurred during beam alignment. That is because it is during alignments that optics like mirrors are manipulated and the possibility of stray laser radiation is greatest. Also, some laser operators tend to avoid the use of protective eyewear when aligning visible beam lasers since they claim they need to "see the beam" during the procedure. Unfortunately, sometimes they end up seeing a lot more of the beam than they intended and an eye injury occurs.

In addition to ***always wearing protective eyewear whenever possible***, here are some other tips to follow to improve safety when aligning lasers:

1) Turn the laser power down as much as you can.

2) Whenever possible, use a low power alignment laser like a HeNe or visible diode laser to align the optics.

3) If possible, switch pulsed lasers to continuous wave operation. If that is not possible, maximize the pulse duration as much as you can. The shorter the pulse duration, the more dangerous the laser.

4) Never direct the beam upwards or across walkways unless the area where that happens is enclosed.

5) Enclose as much of the beam path as possible and back up optics with beam stops.

6) Position the beam well below sitting eye level.

7) Check the positioning of all optics before activating the laser.

8) Make sure you are not tired or distracted during the alignment procedure.

9) Do not manipulate optics in the beam by hand. Insert them into their proper location, lock them down, and then activate the laser (open the aperture, etc.).

10) Keep everybody not directly involved in the alignment out of the room, lock the lab door; and post a beam alignment sign *(available free of charge from EH&S)*.

11) If you have doubts about the safety of a particular manipulation, don't proceed unless you determine it is safe. Check with knowledgeable colleagues if you have any questions.

*Note: Low OD **alignment-type eyewear (OD ~ 2)** can sometimes be used when aligning visible beam lasers. This eyewear is only suitable for use when the average beam power is no more than about 100 mW.*

JEWELRY, WATCHES AND TOOLS

Before operating a laser, make sure that you remove all reflective items from your hands including wristwatches and jewelry. There have been laser accidents reported in the literature that were caused by stray radiation reflected off of these items. Shiny ID cards and other reflective items should be removed during laser use, as well.

In addition, keep other shiny items such as metal tools well away from the beam.

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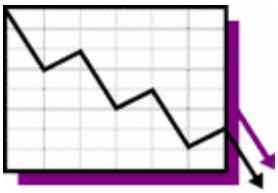
MEMORABLE QUOTE

"Whenever there is a hard job to be done I assign it to a lazy man; he is sure to find an easy way of doing it."

Walter Chrysler (1875 - 1940), American automobile pioneer



ULTRAFAST LASER EYEWEAR

Standard laser eyewear is generally DIR-rated, meaning it is certified for continuous wave lasers and lasers with pulse durations greater than 1 nanosecond.

Eyewear certified for use when operating ultrafast lasers with pulse durations less than 1 nanosecond is called ***M-rated eyewear***. Initially, all M-rated eyewear available had glass lenses and it was very expensive to purchase ($400 or more – often much more). Now polycarbonate M-rated eyewear is sold by several vendors and the cost has declined considerably. For example, M-rated eyewear with an OD of 5 between 720 nm and 830 nm *(i.e, primarily for mode locked Ti:Sapphire lasers)* can be purchased for about $115. Contact EH&S for ordering information regarding M-rated eyewear.

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If you have any questions concerning laser safety, please contact Rick Mannix from EH&S (949-824-6098; rcmannix@uci.edu).

✌ **BE SAFE!**