



LASER SAFETY FACTSHEET



IMPORTANT FACTS TO KNOW ABOUT LASERS

- * Lasers are sources of **non-ionizing radiation** (unlike x-ray machines, which produce *ionizing radiation* capable of knocking electrons out of atoms). Different types of lasers emit ultraviolet radiation, visible light, and infrared radiation — all forms of non-ionizing radiation.
- * Many lasers can only produce radiation at one wavelength. Some lasers, like Argon lasers, are capable of producing radiation at more than one wavelength.
- * **Lasers are classified with regards to beam-related safety** as follows:
 - a) **Class 1** (Exempt Lasers): Are not hazardous to the eyes. Generally have completely enclosed laser beams. *Examples: laser printers, compact disc players.*
 - b) **Class 2 and 2a** (Low Power Lasers): Use caution. *Examples: supermarket barcode scanners.*
 - c) **Class 3a and 3b** (Medium Power Lasers): Are often dangerous -- especially Class 3b. *Examples of Class 3a lasers: laser pointers used in seminars; Examples of Class 3b lasers: some lasers used in research (often HeNe or diode lasers).*
 - d) **Class 4** (High Power Lasers): Are almost always dangerous. *Examples: Most lasers used in medical procedures (laser eye surgery, etc.) ,in research, in laser light shows, and in industry.*
- * Even low power lasers are capable of exposing the eyes to levels of optical (“light”) radiation which can exceed that which occurs when staring at the sun. 
- * **Class 3b and Class 4 lasers present the potential for serious eye injuries from viewing the direct beam or reflections from mirror-like surfaces.**
- * Only Class 4 lasers generate sufficient power such that the reflection of the beam from non-shiny surfaces such as painted walls and white paper can produce hazardous eye exposure conditions.
- * **The deaths associated with lasers have been electrocutions caused by electrical hazards** such as improper grounding, uncovered or improperly insulated electrical terminals, and hidden "power-on" warning lights. 

- * Some lasers have substantial **non-beam hazards**:
 - a) Toxic gases such as F₂ or Cl₂ (excimer lasers, like the ones used in laser eye surgery).
 - b) Toxic dyes and solvents (liquid dye lasers). Many dyes are toxic and carcinogenic.
 - c) Explosion hazards from high-pressure arc lamps used to produce laser radiation.
 - d) Fire hazards presented by high power laser beams which can ignite flammables.
 - e) Laser-generated air contaminants (Class 4 lasers). Particles and gases are emitted after the beam impacts some surfaces. Very important in medical applications.
 - f) X-ray, ultraviolet or radiofrequency/microwave radiation.

METHODS TO AVOID LASER ACCIDENTS IN THE LABORATORY

- * Do not work with a Class 3b or Class 4 laser unless you have been:
 - a) Adequately trained in laser safety, and in the specific laser procedures to be used.
 - b) Provided with laser safety eyewear, if needed (it isn't always needed).
 - c) Authorized by the Principal Investigator (or his/her representative) to do the work. In other words, you have permission to do the work.
- * Always wear eye protection whenever Class 3b or Class 4 lasers are operated in a manner in which there is a reasonable possibility that your eyes may be exposed to hazardous levels of direct or reflected laser radiation.
- * Before you put on laser safety eyewear, make sure that:
 - a) They were manufactured for use with the type of laser (Argon, Ruby, Nd:YAG, etc.) that will be used.
 - b) They afford sufficient eye protection (**optical density**) at the appropriate wavelength(s).
 - c) They pass enough visible light so that your experiment may be conducted safely (without tripping, etc.).
- * Engineering control measures (protective covers on lasers, interlocks, beam stops, activation warning systems, etc.) are your first line of defense against laser hazards, and should be used to their full advantage. Do not defeat these control measures!!
- * **Always position laser beams above or below the normal eye levels of seated or standing personnel. Use the lowest possible laser power required for a study, and enclose as much of the beam as possible.**
- * Never stare directly into a laser beam, regardless of the class of the laser, and even if eye protection is worn. Use an indirect means (a device, not your eyes!) to observe the beam.
- * Post laser warning signs, specifying the type and class of the laser used, and any special precautionary instructions, at appropriate locations to alert those entering a laser use area of possible optical (and other) hazards. Do not allow janitorial staff into a laser use area during operation! **The “Gee whiz!” nature of laser radiation can lead to dangerous behavior.**

- * Properly attach lasers and the optical components (such as mirrors) used with them to the optical table to avoid eye injuries due to the inadvertent movement of such items during an experiment. If you drop something onto the table, mirrors, etc., might move if not attached.
- * It is best to exclude visitors from laboratories in which Class 3b or Class 4 lasers are in use. **Visitors are often unaware of the hazards presented by the lasers.**
- * Use the buddy system (make sure somebody else is nearby) when working with high voltage equipment; all personnel working with this equipment should be trained in cardiopulmonary resuscitation (CPR).
- * Give sufficient attention to non-beam hazards (toxic gases and chemicals, electrical hazards, etc.) to prevent injuries and illnesses which could be caused by them.

THE TEN MOST COMMON CAUSES OF LASER-PRODUCED EYE INJURIES

1. Unanticipated eye exposure during laser alignment. Most accidents occur during alignment!
2. Fatigue, leading to carelessness or inappropriate shortcuts; horseplay.
3. Misaligned optics, upwardly-directed beams, and beams at eye-level.
4. Available eye protection not worn, or the wrong eyewear worn.
5. Overconfidence; feeling of complacency or invincibility.
6. Equipment malfunction.
7. Operator unfamiliar with laser equipment (not sufficiently trained).
8. Improper restoration of equipment following service.
9. Failure to follow standard operating procedures due to hurrying, etc.
10. Manufacturer-installed safety features (protective housing, interlocks, beam stop, etc.) removed or bypassed.

If you have any questions concerned with laser safety, please contact Rick Mannix of EH&S at 949-824-6098 or rcmannix@uci.edu.

