University Health and Safety

Fact Sheet

Lasers

Lasers are used in many labs throughout the University. Lasers emit light through optical amplification, and are used for many purposes, including medical, cutting, measurements, and communication.

Laser Classification

There are 5 different classifications of lasers, each with their own hazards or effects.

Class I

- No possibility of harm. This is because they are either very low power, or because they are enclosed in something that prevents user access during operation. CD players are a good example.

Class II

- These can cause damage to the eye, but are unlikely to. This is because of the human blink reflex, which prevents long exposures. Damage could be caused if a person stares into the beam for a long period, however. Many laser pointers and barcode scanners are in this category. Output power can be up to 1 mW.

Class IIIa/IIIr

- These lasers are dangerous if combined with optical instruments that focus light. Even without the optical instruments, these lasers can still cause damage after over 2 minutes of eye exposure. Output power cannot exceed 5 mW.

Class IIIb

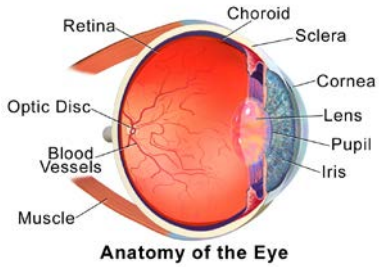
- These lasers can cause eye damage if the beam enters the eye directly. They can cause permanent eye damage with eye exposures of as little as 1/100th of a second. Reflections from mirror-like surfaces can be dangerous as well. Output power is between 5 to 500 mW. This category includes many of the University's research lasers.

Class IV

- Considered "high-powered lasers", these can cause severe, permanent damage to the eyes or skin without any optical instruments. Any sort of reflection can also be hazardous. Output power is more than 500 mW. This category includes many of the University's research lasers, as well as lasers in industry and medicine.

Hazards of Lasers

Lasers create a number of potential hazards, both from the beam and from the physical machinery of them.



Anatomy of the Eye

- *Eye damage* – the primary hazard of working with lasers is the potential for eye damage, resulting in temporary or permanent damage, and potential long-term changes in vision. Because of the characteristics of lasers, when they strike the eye, they can become concentrated onto the retina at the back of the eye. This causes a burn, as well as potential photochemical damage. This can cause temporary effects, such as dark spots in vision, flash-blindness, and pain. Long term effects can include permanent blindness, blurry vision, or other visual problems. Protective goggles that are appropriate for the type of laser you are using can protect against this hazard.
- *Skin burns and fire* – Lasers can burn skin, and may also be able to ignite combustible materials. Paper, cardboard, or other easily ignitable materials should be kept away from lasers. Lasers can cause severe burns to skin, leaving permanent scars.
- *High voltage equipment* – Many lasers use a high voltage power source. Because of this, there is a hazard of electrical shock. This can cause serious burns, long-term damage, or death.
- *Other related hazards* – Some lasers use toxic gases or dyes as part of their systems. Other systems use high-pressure arc lamps, which can cause explosions. If you are using lasers to cut or burn material, it can generate air contaminants that may also be harmful. Lasers also often have many cords, which can create a tripping hazard. These hazards are specific to the type of laser you might be using, and should be considered when working with them.

Basic Laser Safety

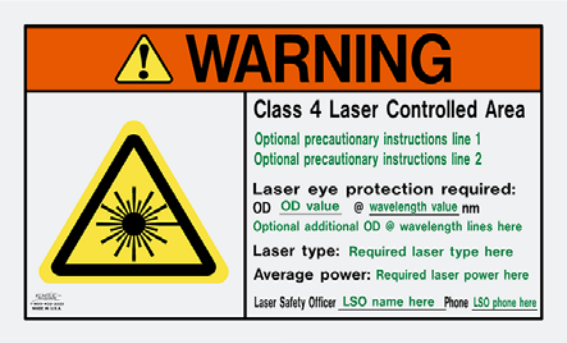
Preparation

- All laser users must complete laser user training before they use any equipment. You can request this training by contacting your department's Research Safety Professional. All users should also have their work approved by their PI before starting.
- If you will be using a Class IIIb or IV laser, you are required to have a laser hazard analysis done before starting work. This includes lasers that are being raised to Class IIIb or IV level, as well as new lasers. To request a laser hazard analysis, contact your department's Research Safety Professional.
- For Class IV lasers, Standard Operating Procedures (SOPs) are required. There should be a procedure written for any laser activities, including alignment, basic sample analysis, cutting, and anything else you will be doing. SOPs are recommended for Class IIIb lasers.
- When working with any high-voltage power systems, use the buddy system. Somebody should always be with you when working with potentially dangerous equipment.

- Visitors should be excluded from Class IIIb and IV laser labs when they are in use, and there should not be any extra observers, even if they are properly trained. Keep the lab to the minimum amount of people needed when the laser is in use.

Signage

- All labs with Class IIIb or IV lasers must have signs that indicate that there is a laser inside. These signs must include:
    - Hazard phrase – Caution for most lasers, Danger for Class IV lasers with very high (multi kilowatt) power output, or pulsed energies with exposed beams
    - Precautionary phrases – actions users should take to protect themselves. Examples include:
        - Laser Eye Protection required
        - Invisible Laser Radiation
        - Knock Before Entering
        - Do Not Enter When Light is Illuminated
        - Restricted Area, Authorized Personnel Only
    - Highest hazard class of laser (Class IIIb or IV), type of laser, pulse duration (if applicable), maximum output
    - Optical density required for laser eye protection
    - Name and contact information of the University Laser Safety Officer (David Paulu, 612-626-3293)



- Labs may want to consider a system that would enable them to indicate when the laser is powered up or active, so others entering the area are aware that it is in active use.

Alignment

- Alignment can be the most hazardous part of using lasers. Many injuries happen during this activity because people are less likely to wear their eye protection, the beam is unenclosed, and because of the active adjustment of the laser's position.
- Use the lowest power settings possible for alignment. Use a lower class laser, if available.
- Some alignments may not be possible while wearing laser safety eyewear, as it will be impossible to visualize. In these cases, consider alternatives, ensure all stray reflections are blocked, and proceed with caution.

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Using Lasers

- Before starting work, make sure to remove any rings, watches, earrings, or other shiny/reflective jewelry from your hands. Also remove any reflective objects from the optical table itself, including laminated paper, metal parts, glassware, goggles, or tools. These could cause reflections from the laser that could be harmful.
- All engineering controls that are part of the laser system should be working properly. This includes any safety interlocks, beam enclosures/covers, beam stops, and other safety mechanisms.
- The laser beam should be positioned below eye level for people who are standing or seated. This helps reduce the chance of eye contact.
- All elements on the optical table should be secured. In case the table is bumped, or something is dropped on it, this helps prevent the elements from misdirecting the laser and potentially causing harm.
- Move carefully when adjusting any part of the laser set-up during work. Handle samples carefully, and be careful not to bump into or drop anything on the table. Remember that if you disturb the table or drop something into the path of the laser, this can create reflections that could be harmful.
- All laser users must wear appropriate eye protection. All eye protection must be compliant with ANSI Z136, and must be labeled with the optical density and wavelength that it protects against.
- In order to choose the correct type of protection, you will need to know the wavelength, viewing conditions, and the power/energy of the laser you will be working with. If you need help choosing laser eye protection, contact your department's research safety specialist.

- Different lasers may need different types of glasses, with different types of protection. Even the same laser can require different types of glasses, if it operates at more than one wavelength. You may not be able to use the same glasses you used with another laser, or in another lab. Keep in mind that the protection provided by the laser vendor isn't necessarily the proper type. You should always check to ensure your protection is appropriate for the laser you are using.

If you have any questions about laser safety, controls, personal protective equipment, or training, contact your DEHS Research Safety Professional or call the DEHS main office at (612) 626-6002.