Lasers in Medicine

Presented by

Lec.Rusul Kadhim Aljader

Department of Medical Physics,

Al-Mustaqbal University College,

Babil, Iraq

Email: rusul.kadhom@mustaqbal-college.edu.iq

Third year students

laser safety classification

Laser radiation safety is the safe design, use and implementation of lasers to minimize the risk of laser accidents, especially those involving eye injuries. Since even relatively small amounts of laser light can lead to permanent eye injuries, the sale and usage of lasers is typically subject to government regulations.

Moderate and high-power lasers are potentially hazardous because they can burn the retina, or even the skin. To control the risk of injury, various specifications, for example 21 Code of Federal Regulations (CFR) Part 1040 in the US and IEC 60825[1] internationally, define "classes" of laser depending on their power and wavelength. These regulations impose upon manufacturers required safety measures, such as labeling lasers with specific warnings, and wearing laser safety goggles when operating lasers. Consensus standards, such as American National Standards Institute (ANSI) Z136, provide users with control measures for laser hazards, as well as various tables helpful in calculating maximum permissible exposure (MPE) limits and accessible exposures limits (AELs).

Thermal effects are the predominant cause of laser radiation injury, but photo-chemical effects can also be of concern for

specific wavelengths of laser radiation. Even moderately powered lasers can cause injury to the eye. High power lasers can also burn the skin. Some lasers are so powerful that even the diffuse reflection from a surface can be hazardous to the eye

Laser safety

Safety precautions will depend on which laser system is used and in what setting. They should include:

- Thorough training of personnel
- Eye protection for the patient and clinic staff
- Warning notice outside the procedure room
- Use of non-reflective instruments
- Avoidance of flammable materials

Laser Classes

Class 1 lasers

A Class 1 laser is considered to be incapable of producing damaging radiation levels and is therefore considered safe under normal working conditions. These lasers are exempt from most

control measures. Many lasers in this class are lasers which are imbedded in an enclosure that prohibits or limits access to the laser radiation.

Class 2 lasers

Class 2 lasers are low power lasers that emit visible radiation, but do not exceed a power output of 1 mW. For this laser class, the normal human aversion response of (0.25 seconds) to bright radiant sources affords eye protection if the beam is viewed directly. The potential for eye hazard exists if this normal reflex motion is overcome and the exposure time is greater than 0.25 seconds.

Class 1M lasers

A Class 1M laser is considered to be incapable of producing hazardous exposure conditions during normal operation unless the beam is viewed with an optical instrument such as an eye-loupe or a telescope.

Class 2M lasers

A Class 2M laser emits visible radiation (400 to 700 nm) with a power output below 1 mW. Like Class 2 laser products, Class 2M lasers pose ocular hazards to the unaided eye, but are potentially hazardous when viewed with optical aids.

Class 3R lasers

Class 3R lasers are potentially hazardous under some direct and specular reflection viewing conditions, but the probability of an injury is small. Class 3R lasers do not pose either a fire hazard or diffuse-reflection hazard. The output power of a Class 3R laser is between 1 and 5 times the Class 1 power limit for wavelengths shorter than 400 nm (UV lasers) or longer than 700 nm or a output power of 5 mW for 400 nm to 700 nm wavelengths (visible lasers).

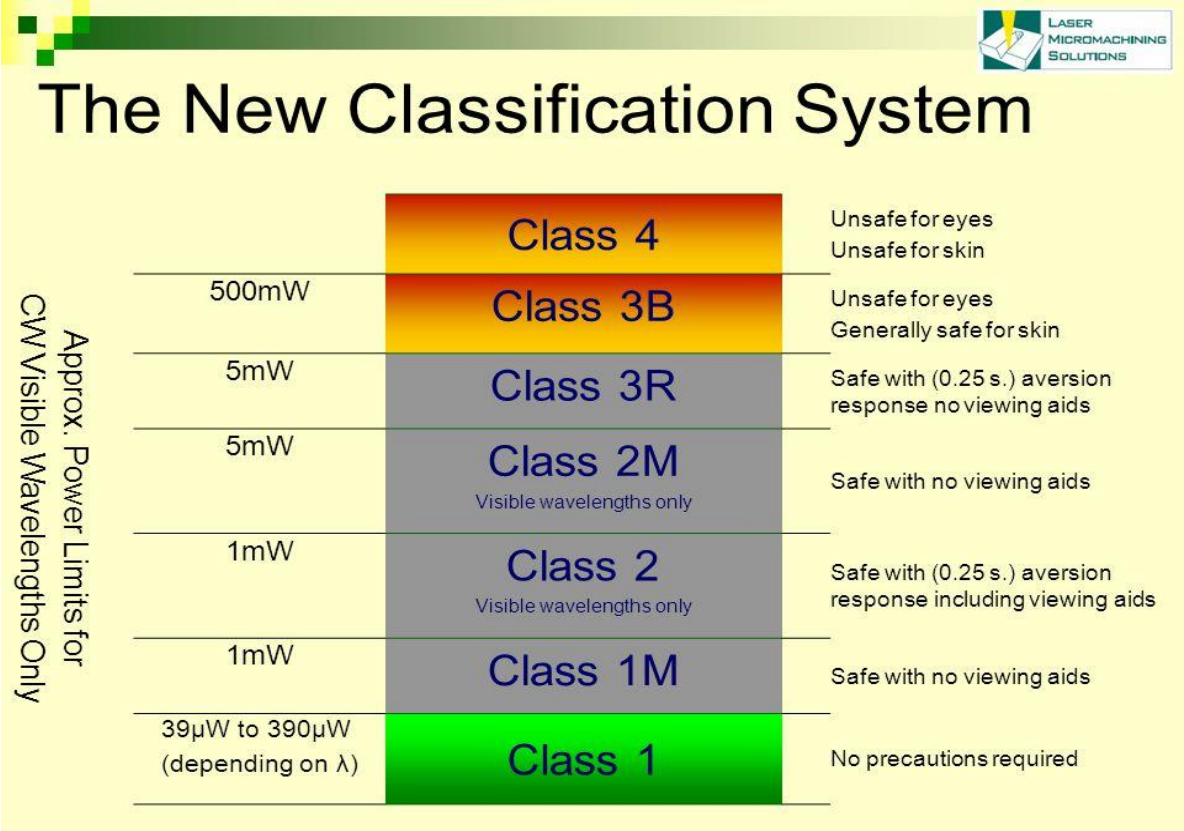
Class 3B lasers

Class 3B lasers are medium power lasers that have an output power of 5 mW – 500 mW. Viewing these lasers under direct beam and specular reflection conditions are hazardous. The diffuse reflection is usually not a hazard except for higher power Class 3B lasers. A Class 3B laser is not normally a fire hazard.

Class 4 lasers

Class 4 lasers are high power lasers with a power output above 500 mW. Exposure to the direct beam, specular reflections, or diffuse reflections presents a hazard to both the eye and skin. A Class 4 laser may be a fire hazard (radiant power > 2 W/cm^2 is an ignition hazard). In addition, these lasers can create hazardous airborne contaminants and have a potentially lethal high **voltage powersupply**. Always enclose the entire laser beam path, if

possible, or enclose most of the beam path to reduce the potential hazards.



precautions for the safe use of lasers

Laser Safety Operating Procedures

- Only trained, authorized personnel may operate lasers, Authorization is received from the authorized laser user and the Laser Safety Officer.
- NEVER put yourself into any position where your eyes approach the axis of a laser beam (even with eye protection on).
- Keep beam paths below or above standing or siting eye level. Do not direct them towards other people.
- Do not damage laser protective housings, or defeat the interlocks on these housings.
- Eliminate all reflective material from the vicinity of the beam paths.
- Never use viewing instruments to look directly into a laser beam or its specular reflection. If this is necessary, install an appropriate filter into the optical element assembly.
- Keep ambient light levels as high as operations will permit.
- Do not work alone when performing high power laser operations.

- Visitors would not be permitted to observe a laser experiment without first receiving a laser safety briefing and being issued laser eye protection. Knowledgeable personnel will escort them at all times.
- LSO approval is required for deviations from this procedure.

Use of Laser Eye and Skin Protection

Laser protective eyewear must be worn whenever you are within the Nominal Hazard Zone (NHZ). The NHZ is defined as that area within which the laser beam power exceeds maximum permissible exposure levels. During maintenance or alignment operations, the NHZ extends to the entire lab or to the partitioned laser use area. Once the laser beam path is well defined and contained to a specific area, the NHZ may be reduced in size to the area where the experiment is taking place. Note that Class 4 lasers can produce hazardous diffuse reflections, and that the NHZ for laser experiments must be extended to account for diffuse reflection hazards from your experiment.

- Eyewear must be of the correct optical density and offer protection at the wavelength(s) of the laser(s) being used.

- Eyewear will only protect your eyes for short time periods, depending on the laser power. Therefore do not look directly into any laser beam, even with laser eye protection on.
- Periodically inspect and replace damaged or defective eyewear.
- Exposure to direct or diffuse reflections from ultraviolet lasers (particularly excimers) can result in short and long term skin hazards. Cover your exposed skin areas when working near these lasers (use long sleeve shirts or lab coats, cloth gloves, etc. as necessary).