

General Laser Safety Precautions by Class

Lasers are classified according to their potential to cause biological damage and depend on:

- Laser output energy or power;
- Laser emitted wavelength;
- Exposure duration;
- Cross-sectional area of the laser beam at the point of interest.

In addition to these general parameters, lasers are classified in accordance with the Accessible Exposure Limit (AEL), which is the maximum accessible level of laser radiation permitted within a particular laser class. The laser hazard classification is based on the potential for a laser to exceed the AEL and is described in Table 1.

Table 1: Laser Systems Classification scheme. ANSI Z136.1 2014

Class 1	<p>These lasers are considered to be incapable of producing damaging radiation levels during operation, and exempt from any control measures. A Class 1 laser system may contain a more hazardous laser embedded in the enclosure, but no harmful levels of the laser radiation can escape the system enclosure during normal operation. For Class 1 lasers containing an embedded higher class of laser, the enclosure must be interlocked.</p> <p><u>Precautions:</u> <i>No laser-specific safety precautions are necessary.</i></p>
Class 1M	<p>These lasers are considered to be incapable of producing hazardous exposure conditions during normal operation unless the beam is viewed with collecting optics (e.g. telescope) and is exempt from any control measures other than to prevent potentially hazardous optically aided viewing.</p> <p><u>Precautions:</u> <i>No laser-specific safety precautions are necessary.</i></p>
Class 2	<p>These lasers have a maximum output power of 1 mW. They emit in the visible portion of the spectrum (400 nm to 700 nm) and eye protection is normally afforded by the aversion response. The maximum emitted</p> <p><u>Precautions:</u></p> <ul style="list-style-type: none"> ○ <i>Do not allow anyone to stare continuously into the beam.</i> ○ <i>Do not point the laser into an individual's eyes.</i>
Class 2M	<p>Emits in the visible portion of the spectrum (400 nm to 700 nm) and eye protection is normally afforded by the aversion response for unaided viewing. However, Class 2M is potentially hazardous if viewed with collecting optics (e.g. telescope).</p> <p><u>Precautions:</u></p> <ul style="list-style-type: none"> ○ <i>Do not allow anyone to stare continuously into the beam.</i> ○ <i>Do not point the laser into an individual's eyes.</i>

Class 3R

These lasers have a maximum output power of 5 mW for visible wavelengths (400 – 700 nm) or an output power between 1 and 5 times the Class 1 power limit for wavelengths shorter than 400 nm (UV lasers) or longer than 700 nm (IR lasers). They are potentially hazardous under some direct and specular reflection viewing conditions if the eyes are appropriately focused and stable, but the probability of an actual injury is small. This laser will not pose either a fire hazard or diffuse reflection hazard.

Precautions:

- Do not aim the laser at an individual's eyes.
- Enclose as much of the beam path as possible.
- Place beam stops at the end of the useful beam path.
- Locate the plane of the laser beam and associated optical devices well above or below the eye level of observers sitting or standing positions.
- Firmly mount the laser to ensure the beam does not stray from the intended path.
- Use proper eye protection if eye exposure to the direct beam or a specular reflection is possible.
- Remove all unnecessary reflective surfaces from the area of the beam path.

Class 3B

These lasers are medium power lasers that have an output power between 5 mW and 500 mW. They may be hazardous under direct and specular reflection viewing conditions; however, they normally do not present a fire hazard, diffuse reflection hazard, nor a laser generated air contaminant (LGAC) production hazard. Protective eyewear is required when working with Class 3B.

Precautions:

- Operate the laser only in a Laser Controlled Area.
- Permit only properly trained and authorized personnel to operate the laser.
- Do not allow access to unauthorized personnel and control spectators/visitors.
- Display a warning light or buzzer at the entrance of the Laser Controlled Area to indicate when the laser is in operation.
- Display a warning sign at the entrance of the Laser Controlled Area.
- Do not aim the laser at an individual's eyes.
- Enclose as much of the beam path as possible.
- Place beam stops at the end of the useful beam path.
- Locate the plane of the laser beam and associated optical devices well above or below the eye level of observers sitting or standing positions.
- Firmly mount the laser to ensure the beam does not stray from the intended path
- Provide and ensure use of proper eye protection for everyone within the Laser Controlled Area.
- Do not view the beam or its specular reflection with collecting optics without sufficient eye protection.
- Remove all unnecessary reflective surfaces from the area of the beam path.

Class 4

These lasers have an output power exceeding 500 mW. They are a hazard to the eyes and skin from the direct beam, They may also pose a fire hazard or diffuse reflection hazard, and may also produce laser generated air contaminants (LGAC) and hazardous collateral radiation (e.g. plasma, etc.). Protective eyewear is required when working with Class 4.

Precautions (additional to the one stated for Class 3B):

- Use appropriate shielding between personnel and any beam having sufficient irradiance to pose a skin or fire hazard.
- Use remote viewing methods where feasible (video monitoring) to accomplish any necessary viewing of the beam.
- Ensure all enclosure (e.g. enclosure box, curtains, etc.) are made from fire-resistant materials.
- Construct beam stops of fire resistant material that create a diffuse reflection.

Laser manufacturers have been required to label the Class of their products since September 1985. If a laser is/was not manufactured or labeled in accordance with American, European, or acceptable international standards for laser classification, the laser might not be approved by the Laser Safety Officer (LSO) / Research Safety Team (RST). In addition, any modified commercial laser or new constructed laser in the laboratory must be classified and labelled as per the ANSI Standard. The Laser Safety Officer (LSO) can assist in determining the appropriate classification.

Additional Information

A summary table of the laser classes can also be found in this [link](#). Please note that this table only applies to laser that emits in the visible part of the spectrum.

Document History

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