

# 13. Lasers

\*For inquiries and questions about lasers, see the Yellow-Page.

- Since lasers have high energy densities, not only the direct but also the scattered light may cause burns, fires or damage to eyes. Since laser lights are sometimes obscure or invisible depending on their wavelengths, it is important to use the laser instruments carefully by understanding their specifications.
- To use a laser in Classes 1M, 2M or 3R, it is required to submit a “Report of Laser Use” to the Administration of Safety and Hygiene. The form can be downloaded from the homepage of the Administration of Safety and Hygiene.
- To use a laser in Classes 3B, 4, or 3R with the wavelength shorter than 400nm or longer than 700nm, it is required to submit an attached document in addition to the “Report of Laser Use” to the Administration of Safety and Hygiene, and is necessary to get permission before beginning to use. The forms are available at the homepage of the Administration of Safety and Hygiene.
- To avoid any injury not only to the users but also to the others, it is necessary to take the decided measures.
- Indicate a warning sign at the operation area.
- Set up a cover to prevent leakage of a laser.
- Be sure to wear protective equipments like protective glasses.
- Users of a laser in Classes 3R, 3B or 4 should have examinations of eyesight and fundus, lenses and corneas beforehand and once a year.

## < General Information >

### ■ Safety levels and rules

- (1) The international standards for laser use and production of laser products are regulated by IEC60825-1.
- (2) The safety level in Japan JIS C6802 is based on IEC60825-1. It was revised in 2011.
- (3) 'Rules for Prevention of Laser Hazards' is laid down in RCNP according to the above international and Japanese regulations.

### ■ Classification of lasers

Safety levels of laser instruments are classified into the following seven classes according to the regulation JIS C6802:2005.

#### (1) Classes of laser instruments

Ministry of Health, Labor and Welfare determines the outline for prevention of injury in the use of laser instruments in Classes 1M, 2M, 3R, 3B and 4, and provides regulations for installation, indication, handling, and health care. The definition of laser classes is indicated in Table 1.

#### Class 1M :

A Class 1M laser is safe for all conditions of use except when passed through magnifying optics such as microscopes and telescopes. Class 1M lasers produce large-diameter beams, or beams that are divergent. The *maximum permissible exposure* (MPE) for a Class 1M laser cannot normally be exceeded unless focusing or imaging optics are used to narrow the beam. If the beam is refocused, the hazard of Class 1M lasers may be increased and the product class may be changed. A laser can be classified as Class 1M if the power that can pass through the pupil of the naked eye is less than the *accessible emission limits* (AEL) for Class 1, but the power that can be collected into the eye by typical magnifying optics (as defined in the standard) is higher than the AEL for Class 1 and lower than the AEL for Class 3B. For example, a He-Ne laser with the power smaller than 10  $\mu$ W belongs to Class 1M.

**Class 2M :**

A Class 2M laser is safe because of the aversion response if not viewed through optical instruments.

For example, a He-Ne laser with the power smaller than 1 mW belongs to Class 2M.

**Class 3R :**

A Class 3R laser is considered safe if handled carefully, with restricted beam viewing. With a Class 3R laser, the MPE can be exceeded, but with a low risk of injury. Visible continuous lasers in Class 3R are limited to 5 mW. For other wavelengths and for pulsed lasers, other limits apply.

**Class 3B :**

A Class 3B laser is hazardous if the eye is exposed directly, but diffuse reflections such as from paper or other matte surfaces are not harmful. The AEL for continuous lasers in the wavelength range from 315 nm to far infrared is 0.5 W. For pulsed lasers between 400 and 700 nm, the AEL is 30 mJ.

Other limits apply to other wavelengths and to ultrashort pulsed lasers.

Protective eyewear is typically required where direct viewing of a Class 3B laser beam may occur. Class-3B lasers must be equipped with a key switch and a safety interlock.

**Class 4 :**

Class 4 lasers include all lasers with beam power greater than Class 3B. By definition, a Class-4 laser can burn the skin, in addition to potentially devastating and permanent eye damage as a result of direct or diffuse beam viewing. These lasers may ignite combustible materials, and thus may represent a fire risk. Class 4 lasers must be equipped with a key switch and a safety interlock. Many industrial, scientific, military, and medical lasers are in this category.

Class	long-term viewing		short-term viewing		scattered light	skin exposure
	through optical instruments	via naked eye	through optical instruments	via naked eye		
1	○	○	○	○	○	○
1M	×	○	×	○	○	○
2	×	×	○	○	○	○
2M	×	×	×	○	○	○
3R	×	×	▲	▲	○	○
3B	×	×	×	×	▲	▲
4	×	×	×	×	×	×

(○ safe, ▲ caution, × dangerous)

## (2) Installation of lasers

- Before installing the lasers, read the RCNP Rules for Prevention of Laser Hazards.
- Before installing the lasers in Classes 1M, 2M and 3R, it is required to submit a “Report of Laser Use” to the Administration of Safety and Hygiene. The form can be downloaded from the homepage of the Administration of Safety and Hygiene.
- Before installing the lasers in Classes 3B, 4, or 3R with the wavelength shorter than 400nm or longer than 700nm, it is required to submit an attached document in addition to the “Report of Laser Use” to the Administration of Safety and Hygiene, and is necessary to get permission. The forms are available at the homepage of the Administration of Safety and Hygiene. Also it is necessary to assign an administrator of the laser apparatus and notify the Administration of Safety and Hygiene.
- Laser apparatuses should not be placed in common rooms or areas. To use a laser in Classes 3B or 4, it is necessary to define the controlled area and forbid entry of the persons who are not concerned.
- A laser path should be kept away from the place near human eyes.
- A laser path should be terminated with an appropriate absorber or scatterer.
- Do not store inflammable materials near a laser apparatus in order to avoid a fire.

### (3) Laser warning sign

- A laser warning sign should be posted at the beam exit of a laser in Classes 3R, 3B or 4. It should be posted near the entrance of a controlled area clearly.
- A laser in Classes 3B, 4 or 3R with the wavelength between 400 nm 700 nm is required to be equipped with a light which automatically turns on when the laser is active.

### (4) Administration

- Users of a laser in Classes 3R, 3B or 4 should have examinations of eyesight and fundus, lenses and corneas beforehand and once a year.
- If any hazard due to a laser in any Class is suspected, consult a medical doctor immediately. It is also required to inform the RCNP director and the general affairs section of the RCNP office. The administrator should take an appropriate measure such as temporal shutdown of the laser instrument.
- Class 3B or Class 4 lasers must be equipped with a safety interlock, key switch, and a beam shutter.
- In operation of a laser in Classes 3B, 4 or 3R with the wavelength shorter than 400 nm or longer than 700 nm, one should wear a safety glass and working clothes which cover the body up, in order to avoid the risk due to scattered or reflected laser light. Noncombustible working clothes are highly recommended in operating a Class 4 laser.
- When a laser is modified, it should be classified again according to its specification after the modification.
- Tuning of a laser instrument is to be performed by mechanical or electric means. Especially a Class 4 laser should be operated by remote control.
- It is quite dangerous to view a laser light through optical instruments.
- Be careful to the light reflected by glossy things like rings, watches, etc.
- Never view directly or block off with body a laser light.
- An administrator of a laser instrument must educate and give information to beginners and students beforehand.
- A beginner should use a laser under the guidance by a skilled person.
- Some imported laser pointers are very bright and classified as Class 3 according to the JIS C6802 safety level. Use of such laser pointers should be avoided in RCNP.