Important Laser Safety Information

Application Note

Version 1.0.0

Contents

1

Important Safety Information

1.1 General laser safety rules

Using laser light sources requires specific safety procedures. Even at low output power, laser radiation can permanently damage the eyes, induce skin burns and ignite flammable materials. Electrical hazards are also present if the driving electronics is not used properly.

- **BEFORE** the first use, proper procedures and contact persons should be known in case of accident.
- The laser area should be properly identified and secured by an interlock circuit linked to the laser system.
- People in the laser area should be properly trained or accompanied by trained personnel.

1.2 Ocular and skin safety

- **ALWAYS** wear laser safety glasses (goggles) **CERTIFIED** for the laser wavelength and power level.
- **NEVER** look directly into a laser beam, even when wearing laser safety glasses.
- **NEVER** block a laser beam with your hands.
- Wear tight clothing of non flammable materials and attach long hair.
- Remove rings, watch or any jewels that may accidentally reflect the laser beam outside the setup.
- Remove accessories (neck ties, etc.) that may accidentally be ignited by the laser beam.
- Laser safety glasses do not eliminate hazards since the laser beam can not be seen through them.
- Always use indirect viewing methods such as laser viewing cards, power detectors, etc.
- A laser beam should always be confined in the setup by using proper beam blocks or beam dumps.
- Do not add/remove/adjust optical components while the laser beam is not attenuated to a safe level.

1.3 Fire and material safety

- Ignition of flammable materials, either solid, liquid or gaseous may result from exposition to a laser beam, even at low power, if the beam is tightly focused.
- Most light detectors (photodiodes, CCD cameras, power meter heads, etc.) can be damaged by laser beams. Ensure that a proper laser beam attenuator is used **BEFORE** exposing any detector to the laser beam.
- Computer and laboratory instrument screens can reflect laser beams and be damaged by them.

1.4 Electrical safety

- Laser driving electronics may lead to electrical hazards when not used properly. Do not open the laser driving electronics housing.

2

Class 3B Laser Products

2.1 Ocular safety limits for point sources

According to ANSI Z136.1-2014[1], class 3B laser products have a maximum value of the so-called *accessible emission limit* (AEL) equal to 500 mW for wavelengths (λ) between 400 nm and 700 nm and exposure durations (t) between 0.25 s and 3×10^4 s.

The so-called ocular*maximum permissible exposure* (MPE) for point sources in the 450 nm to 700 nm range is 1 mW/cm^2.

Considering the angular divergence at the output of Doric *Connectorized Laser Diode Modules* and Doric *Laser Diode Fiber Light Sources*, the *nominal ocular hazard distance* (NOHD) is typically larger than one meter (model dependant) for the free-space optical beam exiting from the output FC connector. Direct viewing of the optical beam from any distance below the NOHD is hazardous for the eyes. Damages can occur within a fraction of a second, which is faster than the blink reflex of the eyes. Wearing certified laser safety glasses (goggles) is thus **highly recommended** when the output laser beam is not properly attenuated or confined in the optical setup.

2.2 General safety considerations for class 3B laser products

According to IEC60825-1[2], class 3B laser products are defined as follows:

> *Laser products that are normally hazardous when intra-beam ocular exposure occurs (i.e. within the NOHD: Nominal Ocular Hazard Distance) including accidental short time exposure. Viewing diffuse reflections is normally safe. Class 3B lasers which approach the AEL for Class 3B may produce minor skin injuries or even pose a risk of igniting flammable materials. However, this is only likely if the beam has a small diameter or is focused.*
>
> *NOTE: There exist some theoretical (but rare) viewing conditions where viewing a diffuse reflection could exceed the MPE. For example for Class 3B lasers having powers approaching the AEL, lengthy viewing of greater than 10 s of true diffuse reflections of visible radiation and viewing at distances less than 13 cm between the diffusing surface and the cornea can exceed the MPE.*

According to ANSI Z136.1-2014[1], class IIIB laser products:

> *May be hazardous under direct and specular reflection viewing conditions, but is normally not a fire hazard, diffuse reflection hazard, nor a laser generated air contaminant (LGAC) production hazard.*

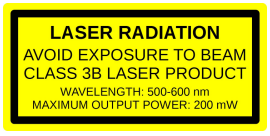
According to ANSI Z136.1-2014[1] and the FDA[3], the requirements for class IIIB laser products are:

- Engineering Controls
- Training
- Designation of a *laser safety officer* (LSO)

2.3 Engineering controls for class 3B laser products

1. **Safety labels**

   The laser class label are provided with the system and the laser aperture should be clearly identified by a laser warning label and/or the text *LASER APERTURE*.



Example of a laser classification label

Laser warning label

LASER APERTURE

Laser aperture identification

2. **Interlock connector**

   An interlock connector is located on the laser driving electronics for a proper connection to the interlock circuit of the laboratory.

3. **Master key switch**

   A keyed master key switch is located on the laser driving electronics.

4. **Laser emission LED indicator**

   For laser source emitting invisible laser radiation, a dedicated LED indicator is ON when the laser is energized and a laser beam is potentially exiting from the laser aperture.

2.4 References

1. American National Standards Institute (ANSI), ANSI Z136.1-20014,
   American National Standard for Safe Use of Lasers
   https://www.lia.org/store/product/106
2. International Electrotechnical Commission (IEC), IEC60825-1:2014-05, Edition 3.0
   Safety of laser products Part 1: Equipment classification and requirements,
   http://webstore.iec.ch/webstore/webstore.nsf/Artnum_PK/49687
3. U.S. Food and Drug Administration (FDA), 2014 21CFR1040.10
   Code of Federal Regulations, Title 21, Volume 8, Revised as of April 1, 2014
   PART 1040, Sec. 1040.10 Laser products.
   http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfCFR/CFRSearch.cfm?FR=1040.10

2.5 Disclaimer

The information and recommendations are based upon data collected by Doric Lenses Inc. and believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein, and Doric Lenses Inc. assumes no responsibility for the results of the use of products and processes described herein.

2.6 Abbreviations

AEL	Accessible Emission Limit
ANSI	American National Standards Institute
FDA	Food and Drug Administration
IEC	International Electrotechnical Commission
LIA	Laser Institute of America
LSO	Laser Safety Officer
MPE	Maximum Permissible Exposure
NOHD	Nominal Ocular Hazard Distance

357 rue Franquet - Quebec, (Quebec)
G1P 4N7, Canada
Phone: 1-418-877-5600 - Fax: 1-418-877-1008
www.doriclenses.com