SAFETY PRECAUTIONS 1/2

PRECAUTIONS FOR PROPER OPERATION OF LASER POINTERS

Please read the following notes before the installation:

1. Supply the laser pointers with transformer power supplies that give STABILIZED voltages: this means that a regulator and a voltage stabilizer are integrated in the unit (eg. 7805, 7824 etc.) and appropriate filters in order to eliminate all variations, disorders and transients that may originate from the supply line. In the case of pointers with power supply +5 Vdc provide for a power supply separated from the rest of the machine wiring.
2. You can also use SWITCHING power supplies, as long as they supply stabilized voltages and especially without voltage spikes and radio frequency disturbances, which cause the damage of the laser pointer over the time.
3. Choose high-quality switching power supplies.
4. ELIMINATE ALL electrostatic charges that may be generated on the machine. If the pointer works near materials such as cloth, paper, polyester and similar, apply appropriate antistatic bars, or other solutions in order to eliminate ALL ELECTROSTATIC DISCHARGES which can be generated and that can damage the pointer over the time.
5. ELIMINATE any noise with filters that AC motors can generate both starting-up and during their operation.
6. For pointers with metal casing, in the case of electrostatic charges CONNECT the housing of the pointer to the mass of the machine to allow electrostatic charges to be discharged to the ground.
7. Consider laser pointer CLASS SAFETY to take precautions.

SAFETY INSTRUCTIONS

1. These instructions must be read and kept together with the laser.
2. To avoid damages to third parties, the work area should be marked.
3. As the mirrors can reflect harmful rays, they should not be placed in the working area.
4. In case of malfunctions switch off the unit immediately!
5. To prevent noises, the lasers must work in accordance with the indicated voltage.
6. High temperatures reduce the life of the laser pointer.
7. Follow the protective classes as indicated in the table.

SAFETY CLASSES

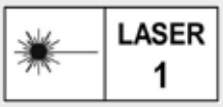
Laser devices are classified in different safety classes according to the risk of injury to eyes and to the skin of the operator, as well as to the power and the laser wavelength.
Electrical, mechanical, chemical hazards or risks of secondary optical radiation are excluded.
By increasing the risk of injury there is an increase of the safety class.
Classes details are available in english language on page 45.

OBLIGATIONS OF THE PRODUCER

The manufacturer must test and label the laser pointer carefully according to the specifications of the standard.
The labeling must include as minimum:

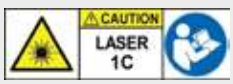
- a danger signal (not prescribed for Class 1)
- indication of the class and warning indication (from Class 1M)
- the identification plate

CLASS 1 LASER PRODUCT
or as alternative the following label:



LASER RADIATION
DO NOT EXPOSE USERS OF TELESCOPIC OPTICS
CLASS 1M LASER PRODUCT
or as alternative the following label:

LASER RADIATION
FOLLOW INSTRUCTIONS
CLASS 1C LASER PRODUCT
or as alternative the following label:



LASER RADIATION
DO NOT STARE INTO BEAM
CLASS 2 LASER PRODUCT
or as alternative the following label:

LASER RADIATION
DO NOT STARE INTO BEAM OR EXPOSE
USERS OF TELESCOPIC OPTICS
CLASS 2M LASER PRODUCT
or as alternative the following label:

LASER RADIATION
AVOID DIRECT EYE EXPOSURE
CLASS 3R LASER PRODUCT
or as alternative the following label:

WARNING — LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
or as alternative the following label:

DANGER — LASER RADIATION
AVOID EYE OR SKIN EXPOSURE
TO DIRECT OR SCATTERED
RADIATION
CLASS 4 LASER PRODUCT

SAFETY PRECAUTION 2/2

USER'S OBLIGATIONS

1. Before starting up the unit, the user must read the manual carefully and observe the safety requirements established from who has put the product on the market. For lasers in Class 1 the safety must be guaranteed by those who put the product on the market, while for lasers in Class 3R, 3B and 4 is the user that must take care of their security by providing the laser of a protective casing, if necessary, so that the device meets the requirements of Class 1. If this is not possible due to the machining process, the laser must be employed in a guarded area with controlled access. A risk assessment should illustrate in which cases may exist hazards and what protective equipments must the present people use to save themselves. Note: General provisions on security require the user and the employer to take all necessary measures to ensure the safety and the protection of health at work, to document these measures and to verify the compliance periodically. The rule for laser describes the objectives to be followed to ensure the safety of the users. The legal bases are provided by the Federal Law on Accident Insurance (AIL) and Ordinance Prevention of Accidents and Occupational Diseases (OPI). Another condition is the respect of the exposure limit values in the workplace.
2. Because of the variable range of risk, associated with the Class 3R, the applicability of specific user control (including administrative controls and the staff eye protection) should be clearly described in the instructions.
3. For each type of pointer the buyer has to examine the following two tables.

ACCESS PANELS AND SAFETY SWITCHES

If the following two conditions occur simultaneously, a safety switch must be mounted at the access to the panels:

1. When you want to remove or move the access panel during maintenance operations
2. When the transfer or removal of the panel allows the access to levels of laser radiation indicated by X in the following table

Laser pointer Class	Radiation levels which may be accessible during or after the removal of the access panels, if lock switches are not present				
	1, 1M	2, 2M	3R	3B	4
1, 1M, 1C	-	-	X	X	X
2, 2M	-	-	X	X	X
3R	-	-	-	X	X
3B	-	-	-	X	X
4	-	-	-	X	X

SM.PROX srl - Via della Beverara 13 - 40131 Bologna - Italy - Tel. +39 051 6350755 - Fax +39 051 6353462
www.smprox.it/en/ - info@smprox.it

DESCRIPTION OF THE CLASSES 1/2

C.1 - General

This annex contains a description of the classes as well as potentially associated hazards.
The annex is intended as a guide far the manufacturers in their task of describing the hazards associated with the product. This annex also points out limitations of the classification scheme, i.e. situations where the generally associated meaning of the class is not appropriate.
Classification was developed to aid the user in hazard evaluation of the laser and to determine necessary user control measures. Laser classification relates to the potential hazard of the accessible laser radiation in respect to skin or eye damage and does not relate to other potential hazards such as electrical, mechanical or chemical hazards, or hazards from secondary optical radiation. The intent of classification is to recognize the increased risk of injury with increasing powers accessible above the base-line, Class 1 condition and most accurately describes the risk from potential exposures at short distances from the laser. The hazard zone can differ greatly far different lasers within one class. The potential hazard could be greatly reduced by additional user protective measures, including additional engineering controls such as protective housings.

C.2 - Description of classes

C.2.1 - Class 1
Laser products that are safe during use, including long-term direct intra-beam viewing, even when exposure occurs while using telescopic optics. Class 1 also includes high power lasers that are fully enclosed so that no potentially hazardous radiation is accessible during use (embedded laser product). Intra-beam viewing of Class 1 laser products which emit visible radiant energy may still produce dazzling visual effects, particularly in low ambient light. The term “eye-safe” may only be used far Class 1 laser products. The term “eye-safe laser” should not be used to describe a laser, based solely on its output wavelength being greater than 1 400 nm. Lasers of any wavelength with sufficient output power can cause injury .

C.2.2 - Class 1M
Laser products that are safe, including long-term direct intra-beam viewing far the naked eye (unaided eye). The MPE can be exceeded and eye injury may occur fallowing exposure with telescopic optics such as binoculars far a collimated beam with a diameter larger than the measurement diameter specified far Condition 3 (see Table 10).
The wavelength region far Class 1M lasers is restricted to the spectral region where most glass optical materials used in optical instruments can significantly transmit, i.e., between 302,5 nm and 4 000 nm. Intra-beam viewing of Class 1M laser products which emit visible radiant energy may still produce dazzling visual effects, particularly in low ambient light.

C.2.3 - Class 1C
Laser products that are intended far direct application of laser radiation to the skin or internal body tissues far medical, diagnostic, therapeutic or cosmetic procedures such as hair removal, skin wrinkle reduction, acne reduction. Although the emitted laser radiation may be at Class 3R, 3B or 4 levels, ocular exposures are prevented by one or more engineering means. The exposure level of the skin depends on the application, therefore this aspect is covered by vertical standards. This class was introduced in this standard because these products currently exist in the marketplace, and the control measures normally specified far Class 3B or 4 laser products are inappropriate far them. Technical committees who use Class 1 C must develop the required specifications far safety in their vertical standards.

C.2.4 - Class 2
Laser products that emit visible radiation in the wavelength range from 400 nm to 700 nm that are safe far momentary exposures but can be hazardous far deliberate staring into the beam. The time base of 0,25 s is inherent in the definition of the class and presumption is that there is very low risk of injury far momentary exposures that are somewhat longer.
The following factors contribute to precluding injury under reasonably foreseeable conditions:
- unintentional exposures would rarely reflect worst-case conditions, far example, of beam alignment with the pupil far a stabilised head, worst-case accommodation;
- the inherent safety margin in the MPE upon which the AEL is based;
- natural aversion behaviour far exposure to bright light.

Far Class 2, in contrast to Class 2M, the use of optical instruments does not increase the risk of ocular injury.
However, dazzle, flash-blindness and after-images may be caused by a beam from a Class 2 laser product, particularly under low ambient light conditions. This may have indirect general safety implications resulting from temporary disturbance of vision or from startle reactions. Such visual disturbances could be of particular concern if experienced while performing safety-critical operations such as working with machines or at height, with high voltages or driving.
Users are instructed by labelling not to stare into the beam, i.e. to perform active protective reactions by moving the head or closing the eyes and to avoid continued intentional intra-beam viewing.

C.2.5 - Class 2M
Laser products that emit visible laser beams and are safe far short time exposure only far the naked (unaided) eye. The MPE can be exceeded and eye injury may occur following exposure with telescopic optics such as binoculars far a collimated beam with a diameter larger than the measurement diameter specified far Condition 3 (see Table 10).
However, dazzle, flash-blindness and after-images may be caused by a beam from a Class 2M laser product, particularly under low ambient light conditions. This may have indirect general safety implications resulting from temporary disturbance of vision or from startle reactions. Such visual disturbances could be of particular concern if experienced while performing safety-critical operations such as working with machines or at height, with high voltages or driving.
Users are instructed by labelling not to stare into the beam, i.e. to perform active protective reactions by moving the head or closing the eyes and to avoid continued intentional intra-beam viewing. Labelling of Class 2M products also instructs against exposing users of telescopic optical instruments.

C.2.6 - Class 3R
Laser products that emit radiation that can exceed the MPE under direct intra-beam viewing, but the risk of injury in most cases is relatively low. The AEL far Class 3R is limited to 5 times the AEL of Class 2 (visible laser radiation) or 5 times the AEL of Class 1 (far non-visible laser radiation). Because of the lower risk, fewer manufacturing requirements and control measures for the user (depending on national regulations) apply than far Class 3B. While Class 3R laser products are not considered intrinsically safe, the risk is limited because:
- unintentional exposures would rarely reflect worst-case conditions of (e.g.) beam alignment with a large pupil and worst-case accommodation with the entire beam energy entering the eye,
- of the inherent reduction factor (safety margin) in the MPE,
- of natural aversion behaviour far exposure to bright light far the case of visible radiation and by the response to heating of the cornea far far infrared radiation.

DESCRIPTION OF THE CLASSES 2/2

The risk of injury increases with exposure duration, and exposure may be hazardous far ocular exposure under worst-case conditions or far intentional direct intra-beam viewing.
Due to the varying range of the risk that is associated with Class 3R lasers, the applicability of specific user controls (including administrative controls and personal eye protection) should be clearly described in the user instructions.

NOTE: Compared to ocular MPE values as well as AEL values for Class 1, 1M, 2, 2M and 3 R specified in the second edition of IEC 60825-1, the respective values in this third edition were decreased for some single-pulsed point sources, but in creased for most repetitively pulsed sources, and al so in creased for most pulsed extended sources; reduction factors (safety margins) in these values were changed correspondingly. Consequently, some pulsed products that were classified as Class 3R under Edition 2 are Class 2 under Edition 3, and some pulsed products that were classified as Class 3B under Edition 2 are Class 3R under Edition 3. For the latter, there is less practical experience available regarding the risk for injury as it exists for CW sources with collimated beams with powers up lo 5 mW being used for many years as alignment lasers.

Dazzle, flash-blindness and after-images may be caused by a beam from a Class 3R laser product in the visible wavelength range (as from a Class 2 laser), particularly under low ambient light conditions. This may have indirect general safety implications resulting from temporary disturbance of vision or from startle reactions. Such visual disturbances could be of particular concern if experienced while performing safety-critical operations such as working with machines or at height, with high voltages or driving.
Class 3R lasers should only be used where direct intra-beam viewing is unlikely.

C.2.7 - Class 3B
Laser products that are normally hazardous when intra-beam ocular exposure occurs (i.e. within the NOHD) including accidental short time exposure. Viewing diffuse reflections is normally safe. Class 3B lasers which approach the AEL far 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 focussed.

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 al distances less than 13 cm between the diffusing surface and the cornea can exceed the MPE.

C.2.8 - Class 4
Laser products far which intra-beam viewing and skin exposure is hazardous and far which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard.

C.2.9 - Note on nomenclature
"C" in Class 1C is derived from the mode of operation where laser radiation above the AEL of Class 1 can be emitted only when the applicator is in contact with (or very close to) the skin or internal body tissue.
"M" in Class 1M and Class 2M is derived from magnifying optical viewing instruments. "R" in Class 3R is derived from reduced, or relaxed, requirements: reduced requirements both far the manufacturer (e.g. no key switch, beam stop or attenuator and interlock connector required) and the user. The "B" far Class 3B has historical origins, as in a previous version of this standard (IEC 60825-1:1993), a Class 3A existed, which had a similar meaning to what is now Class 1M and Class 2M.

It should be noted that far the above descriptions, whenever "hazardous" is used or there is a reference to a high risk of injury, this hazard and risk only exists within the area around the laser where the corresponding MPE levels are exceeded. Far exposure of the naked eye, this area is bounded by the NOHD, or far well collimated Class 1M and 2M viewed with binoculars or telescopes, the extended NOHD (ENOHD). It may well be that a particular (Class 3B or Class 4) laser product has a very short NOHD associated with it, so that far a particular installation or application, far personnel outside the NOHD eye protection is not necessary. Examples of such installations are scanning lasers or line lasers mounted on the ceiling of the manufacturing hall that project a pattern or line onto the work-piece in the work area below. While the power level and scan pattern could be such that the exposure in the work area is below the MPE and therefore safe, maintenance and service routines will need special consideration. Far example, exposure at closer distances might be hazardous, far instance, when the user is up on a ladder cleaning an exit window. Another example is that, whilst a scan pattern might be safe, a hazard may arise if the beam reverts to the non-scanning mode. In addition, far Class 4 laser products, there is a NOHD associated with diffuse reflections (although this NOHD is likely to be quite limited in extent). The characterisation of the hazard associated with a particular laser and application is part of a risk assessment.

Classification tests are designed to be rather "worst-case" and restrictive in order to ensure that a "low-class" (e.g. Class 1) product does not present a hazard to the eye or skin even in reasonably foreseeable worst-case situations; the test conditions are designed to consider a variety of worst-case situations (see Sliney et al.). Consequently, a Class 3B or Class 4 product can still be designed in such a way that it can be considered safe far its intended use and normal operation, since the hazard only becomes accessible in worst-case situations. Far instance, the product could feature a protective housing (which complies with IEC 60825-4) but fails to be an embedded Class 1 laser product because of the following reasons:

- the protective housing fails the test according to this Part 1 far an extended period (whereas far machines according to IEC 60825-4 a shorter evaluation time may be used)
- it has no top cover but would be considered safe far an environment where no persons are present above the guard
- it does not feature an automatic detection of walk-in access. (However, in a controlled environment, this can be replaced by an organisational safety measure of individualised locks that prevent closure of the door when somebody is inside the protective housing - which does not affect the classification but represents a procedure which achieves the desired level of safety far the user)

In cases where the hazard associated with a Class 38 and Class 4 laser product is limited to within the housing, organisational safety measures may be sufficient. Similarly, far a laser system with no roof, or a situation where burn-through of the guard may occur after some longer lasting fault, organisational safety measures may be sufficient.

Other examples exist where the hazards associated with Class 3B and Class 4 lasers arise only in specific situations. For example, consider the situation in which the classification is based on an accessory such as a collimating lens applied to a hightly divergent source far low level laser therapy. This product may be classified as Class 3B based on the accessory lens being screwed on, since this lens produces a potentially hazardous collimated beam. However use without the accessory being screwed on, which would result in a divergent beam, could be safe (i.e. any exposure to the eye would be below the MPE). Thus a hazard area would only exist around the laser once the accessory has been screwed on.

SM.PROX srl - Via della Beverara 13 - 40131 Bologna - Italy - Tel. +39 051 6350755 - Fax +39 051 6353462
www.smprox.it/en/ - info@smprox.it