

TECHNICAL REPORT

Safety of laser products –
Part 3: Guidance for laser displays and shows
(standards.iteh.ai)

IEC TR 60825-3:2008

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY OF LASER PRODUCTS –

Part 3: Guidance for laser displays and shows

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 60825-3, which is a technical report, has been prepared by IEC technical committee 76: Optical radiation safety and laser equipment.

This second edition cancels and replaces the first edition published in 1995. It constitutes a technical revision. The main changes since the first edition include clarification of the scope; specific guidance on factors to take into account regarding scanning safeguards; clarification of the records to be maintained; and modification of the requirements for the zones where unattended laser projectors are used.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
76/371/DTR	76/379/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60825 series, published under the general title *Safety of laser products*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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SAFETY OF LASER PRODUCTS –

Part 3: Guidance for laser displays and shows

1 Scope and object

1.1 Scope

This part of IEC 60825, which is a technical report, gives guidance on the planning and design, set-up and conduct of laser displays and shows that make use of high power lasers. The laser power needed to produce effective theatrical or artistic displays in large spaces such as theatres, arenas, or architectural sites is great enough to pose a severe accidental exposure hazard, even when personal exposure is very brief. For this reason, subclause 4.1.5 of IEC/TR 60825-14 specifies that only laser products that are Class 1, Class 2 or visible-beam Class 3R should be used for demonstration, display or entertainment purposes in unsupervised areas. Laser products of other classes should only be permitted under carefully controlled conditions and under the control of a trained experienced operator.

The guidance provided in this technical report is not intended to include the display or demonstration of scientific, medical or industrial laser products. However, many of the principles in this guidance may be relevant. This guidance provides recommendations for safety for those laser displays or demonstrations that are shows, artistic displays, advertising or light sculptures, or museum pieces used to demonstrate optical principles, etc.

Laser products available for use in a domestic environment or for use by people who cannot be expected to have received a suitable level of training should be Class 1, Class 2 or visible beam Class 3R. Therefore, such equipment is outside the scope of this guidance.

1.2 Object

This guidance is intended to be used by those who:

- design, manufacture, assemble, install or operate laser products that are Class 4, Class 3B, or non-visible beam Class 3R for display and entertainment purposes;
- operate arenas, theatres, planetaria, discotheques or other places where such laser products may be installed and operated; or
- are responsible for reviewing the safety of such equipment, installations or displays.

This guidance is not normative, but rather a code of practice for the design, installation, operation and evaluation of the safety of laser light shows and displays, and the equipment employed in their production. This guidance is also intended for persons who modify laser display installations or equipment.

This guidance contains safety criteria for the protection of the public or persons in the vicinity of laser displays in the course of their employment.

In some countries, there may be specific requirements, such as government permissions or notifications of shows, or prohibitions, such as against laser scanning of spectators without appropriate safeguards. This guidance is not to be understood as in conflict with such requirements but merely to be supplementary.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60825-1:2007, *Safety of laser products – Part 1: Equipment classification and requirements*.

IEC/TR 60825-14:2004, *Safety of laser products – Part 14: A user's guide*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

ancillary personnel

ancillary personnel include backstage workers, ushers, security guards, technicians, food and beverage suppliers, etc., who may be working at the venue or facility at which a laser display or show is being set up or presented, but who are not directly involved with the laser display or show

NOTE Ancillary personnel may have access to areas from which spectators are excluded.

3.2

barrier

device to separate spectators from zones where potentially hazardous laser radiation exists

IEC TR 60825-3:2008

NOTE 1 Barriers should not be capable of being readily displaced or traversed by spectators.

NOTE 2 A barrier may be a wall, a fence, stage front, etc.

NOTE 3 Less substantial barriers such as stanchions or ropes may be used if the entire barriered area is visible to and monitored by the laser operator or other safety personnel during the laser display.

3.3

designer

person who determines the visual effects to be produced, the planning of the projections, and the locations of the equipment to be used. The designer may, in addition, act as installer or operator and may be considered to be a manufacturer or supplier

3.4

display safety record (DSR)

a written record of safety information relevant to a specific laser display or show

3.5

installer

person who places the equipment in the designated locations or participates in the adjustment and alignment to produce the desired effects. An installer may also be a manufacturer or supplier if the installation activities result in modification of the display laser product effects

3.6

laser display or show

an activity where at least one laser beam is projected onto a surface or made visible in the air, usually intended to be viewed by a non-specialist audience

NOTE This definition includes demonstrations, such as in museums or educational establishments, and laser shows such as in planetariums, nightclubs, concert halls and other entertainment venues.

3.7

laser projector

a laser, used alone or with beam-manipulating components, to produce laser displays or show effects. Laser projectors are considered laser products subject to the applicable provisions of IEC 60825-1

3.8

manufacturer

any person (or persons) who constructs, assembles or produces one or more laser projectors, or the displays or shows (physical set up of equipment) which use laser projectors. This applies whether or not the manufacture is done for profit

NOTE The equipment used to produce a laser display or show is considered to be a laser product.

3.9

mask (baffle/physical or software)

a physical mask is generally a sheet or panel of durable material (often with a small aperture in the centre for the passage of the useful laser beam) designed to stop a laser beam travelling in unwanted directions. A physical mask should be capable of withstanding, without penetration, the maximum anticipated level of laser radiation, and should not slip or move relative to the impinging laser beam. Beams controlled by electronics or computers can have 'software masks' so the beam is prevented from entering, or is reduced in power, in certain areas. Performance of masks, whether physical or software, should be evaluated under reasonably foreseeable single fault conditions

NOTE In some situations more formal assessments, such as described in the IEC 61508 series, may be required.

3.10

modifier

person who changes the performance, layout, or effects of a laser display or show, or who makes changes in the components of the system that impact the safety characteristics. A modifier is also considered to have the same responsibilities as a manufacturer, supplier or designer

3.11

operator

person who has direct operational control of the laser or projection system(s)

NOTE Operators should be trained on the hazards involved with the lasers being used and are expected to comply with the safety instructions that are provided. An operator may also be designated as the laser safety officer (see subclause 3.3 of IEC/TR 60825-14) for the laser display or show.

3.12

performers

persons who entertain the public during a show. They may be dancers, singers or other musicians, etc.

NOTE Performers are expected to have been instructed on the hazard involved with the lasers being used and may be reasonably expected to comply with the safety instructions that are provided.

3.13

performer zone

area in which only performers may be present and within which laser radiation may exceed the spectator MPE

NOTE The performer zone is usually located on a stage.

3.14

scan pattern

effect produced when a laser beam is scanned, often using a pair of mirrors mounted on galvanometers

3.15

spectator

person who is present at the laser display or show who, by location or proximity, could potentially be exposed to hazardous direct or reflected laser beams (in the absence of any safety features, or in a worse-case situation) and who is the intended audience for the laser-created effects. This does not include the laser display operator and their staff, or performers

NOTE Spectators can neither be expected to have been briefed on the safety procedures regarding the lasers in use, nor be expected to comply with safety instructions.

3.16

spectator MPE

maximum level of ambient laser radiation that may exist in a spectator zone

3.17

spectator zone

area in which spectators may be present and within which laser radiation is restricted to the spectator MPE

4 Zone limits and maximum permissible exposures (MPE) for laser radiation

4.1 Compliance with maximum permissible exposure (MPE)

Under no circumstances should any person be exposed to laser radiation in excess of the applicable eye or skin MPE. The maximum permissible level of laser radiation to which a particular group of individuals can be exposed depends on the maximum exposure time assumed for that group.

4.2 Spectator MPE

[IEC TR 60825-3:2008](https://standards.iteh.ai/catalog/standards/sist/a2ee0b10-80c2-4332-8cd3-0192bdcac689/iec-tr-60825-3-2008)

The level of laser radiation that may be present in a spectator zone should not exceed the MPE for direct ocular exposure of Clause 5 of IEC/TR 60825-14. The applicable MPE to be considered is determined using Tables 5, 6, or 7 of IEC/TR 60825-14 for all possible durations of exposure, t , including the maximum duration of the laser display or show, as appropriate (see below if the use of binoculars is likely). If the level of laser radiation is maintained as a result of scanning of the laser radiation, the MPE for direct ocular exposure should also not be exceeded for the response time of the scanning safeguard (see 4.11 of IEC 60825-1 and Figure 1 below) or for the CW level of the laser radiation (if there is no scanning safeguard).

Consideration should be given to any areas within the zone where the laser radiation hazard may be greater, for example if beams are focussed or static (such as at the end of scan patterns).

T_S is the start time of the fault.

T_E is the time when the exposure is terminated.

$T_E - T_S = T_1 + T_2 + T_3$, where T_1 is the time to react to the fault; T_2 is the time to trigger the control measure; and T_3 is the time for the control measure to become effective having been triggered.

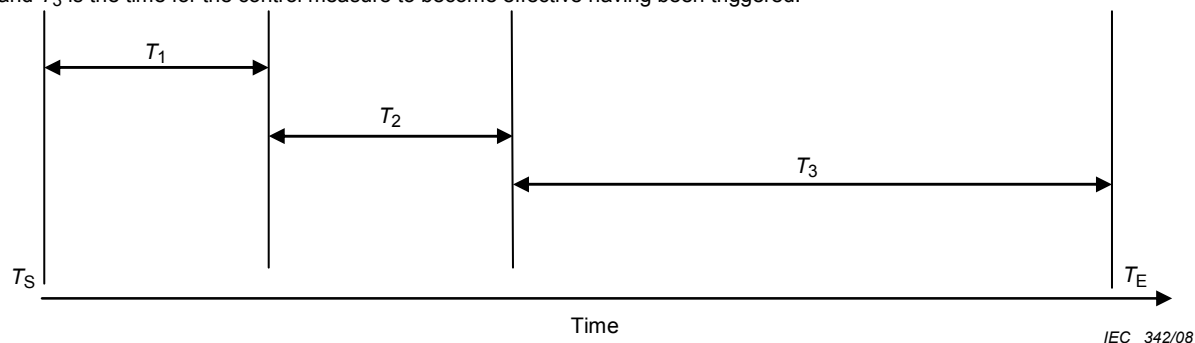


Figure 1 – Time for a scanning safeguard to be effective

Use of viewing aids, such as binoculars, can potentially increase the hazard to spectators. At some venues, such as nightclubs, planetariums and corporate events, binocular use is not a problem. However, if binocular use may be likely (e.g. at a large arena) and security is already used to prohibit cameras, recording devices, etc., it is suggested to additionally prohibit binoculars. If this is not possible (e.g. an open-air outdoor event), the Spectator MPE should be multiplied by a factor of 0,02 to account for the increased hazard.

4.3 Ancillary personnel MPE

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The MPE for ancillary personnel should be the MPE for direct ocular exposure (see Table 5 or Table 6, as appropriate, of IEC/TR 60825-14). This MPE anticipates that ancillary personnel are likely to be in locations other than the spectator zones, their movements are unlikely to be controlled, and they are unlikely to be provided with protective eyewear. However, they should be instructed to avoid looking directly into any incident beams, scanners or mirrors. For this reason, exposure durations up to 0,25 seconds should be considered.

4.4 Performer MPE

The MPE for performers or operators should be the MPE for direct ocular exposure (see Table 5 or Table 6, as appropriate, of IEC/TR 60825-14) or the MPE for the skin (see Table 7 of IEC/TR 60825-14) as appropriate. Performers should be expected to have their actions choreographed, to be provided with protective eyewear and costuming if appropriate, and to be instructed in procedures to avoid exposure to laser radiation in excess of the appropriate MPE. The maximum duration of exposure should be considered.

In some cases, performers may directly control laser safety features. For example, a performer may step on a switch to indicate he or she is in a safe location before beams can be emitted into the performance area. Any such control measures must be carefully designed both for normal conditions, and for cases when a performer may be off their mark or facing the wrong way (e.g., towards the laser) during a cue.

NOTE For some installations the safety features may need to be assessed using formal procedures such as those described in the IEC 61508 series.