TECHNICAL SPECIFICATION

IEC TS 60825-6

First edition
1999-07

Safety of laser products –

Part 6:
Safety of products with optical sources, exclusively used for visible information transmission to the human eye

Sécurité des appareils à laser –

Partie 6:
Sécurité des appareils avec des sources optiques, utilisés exclusivement pour la transmission d'information visuelle



Reference number
IEC/TS 60825-6:1999(E)

Numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series.

Consolidated publications

Consolidated versions of some IEC publications including amendments are available. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Validity of this publication

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology.

Information relating to the date of the reconfirmation of the publication is available in the IEC catalogue.

Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is to be found at the following IEC sources:

- **IEC web site***
- **Catalogue of IEC publications**
  Published yearly with regular updates
  (On-line catalogue)*
- **IEC Bulletin**
  Available both at the IEC web site* and as a printed periodical

Terminology, graphical and letter symbols

For general terminology, readers are referred to IEC 60050: *International Electrotechnical Vocabulary* (IEV).

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams.*

* See web site address on title page.

TECHNICAL SPECIFICATION

IEC TS 60825-6

First edition
1999-07

Safety of laser products –

Part 6:
Safety of products with optical sources, exclusively used for visible information transmission to the human eye

Sécurité des appareils à laser –

Partie 6:
Sécurité des appareils avec des sources optiques, utilisés exclusivement pour la transmission d'information visuelle

© IEC 1999 — Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http://www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE L

For price, see current catalogue

CONTENTS

Page

FOREWORD 3

INTRODUCTION 5

Clause

1 Scope and object 6

2 Normative references 6

3 Definitions 7

4 Manufacturing requirements 10

5 Labelling 10

6 Tests and measurements for categorization and labelling 11

6.1 General 11

6.2 Determination of the apparent source size 11

6.3 Determination of the angular subtense 12

6.4 Measurements of optical radiation 12

6.5 Nominal ocular hazard distance 13

6.6 Repetitively pulsed, modulated or scanned radiation 14

6.7 Simplified categorization procedure 14

Figure 1 – MPE-related maximum allowable luminous intensities of visible *DE*s in type 1 15

Figure B.1 – Examples of modified cosine distributions 20

Figure B.2 – Measurement cone: different radiant intensities for the same MPE corresponding to the spatial distribution of the radiation 21

Annex A (informative) Rationale 16

Annex B (informative) Conversion of the maximum permissible exposure (MPE) limits into luminous intensities of LEDs 19

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

SAFETY OF LASER PRODUCTS –

Part 6: Safety of products with optical sources, exclusively used for visible information transmission to the human eye

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this technical specification may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 60825-6, which is a technical specification, has been prepared by IEC technical committee 76: Optical radiation safety and laser equipment.

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

Enquiry draft	Report on voting
76/172/CDV	76/193/RVC

Full information on the voting for the approval of this technical specification 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 3.

Annexes A and B are for information only.

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

INTRODUCTION

Probably because of the increasing radiation power available from light emitting diodes (LEDs) and their physical similarity to laser diodes, these devices have been included in the scope of the laser safety standard IEC 60825-1. However, the optical radiation from LEDs differs in various aspects from laser sources; generally they lie between incoherent broadband sources and coherent laser sources.

The safety philosophy and classification requirements of IEC 60825-1, developed for coherent point sources (with the assumption of Gaussian radiation characteristics), have been transferred to incoherent intermediate sources (with typically Lambertian radiation characteristics) which are often made for intentional viewing. The result has been an overestimation of the real risk from this kind of source.

In Europe, and effective since January 1997, IEC 60825-1, which includes LEDs, is valid. Following the European product safety laws this means that each LED application or product has to be classified under single-fault conditions. LEDs in the visible wavelength range are increasingly used as a replacement for incandescent or fluorescent sources. However, contrary to conventional lamps, LEDs with the same or similar optical features for identical applications now have to be classified and potentially labelled.

Because this effectively discriminates against LED sources, technical committee 76 (jointly with subcommittee 100C) was established with the objective of preparing additional parts to the IEC 60825 series, for specific application-related requirements.

Due to problems with these LED sources the basic standard IEC 60825-1 is also under consideration and technical development. If a new edition of IEC 60825-1 with a changed safety philosophy becomes valid in the future, it will influence all subsidiary standards. This development will influence and/or change the basis for a more realistic assessment of the optical hazard of LEDs in the future. With this background, the value of this part could be temporary if a suitable treatment is developed in IEC 60825-1.

This technical specification is considered as a “prospective standard for provisional application” in the field of optical radiation safety of LEDs. This is because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

SAFETY OF LASER PRODUCTS –

Part 6: Safety of products with optical sources, exclusively used for visible information transmission to the human eye

1 Scope and object

This technical specification details the requirements, and provides an adapted hazard categorization scheme and specific guidance for the safe use of visible optical sources that are within the scope of IEC 60825-1, but used exclusively for transmission of information to the human eye. These application-related sources can be categorized into:

– type 1: safe for intended viewers and personnel in service and manufacturing activities;

– type 2: safe for intended viewers only (i.e. protective measures are required for users engaged in maintenance, service and manufacturing activities).

Applications of sources that cannot be categorized into either type must be treated in accordance with IEC 60825-1.

The peak wavelength range covered by this technical specification is limited to 400 nm to 700 nm, in accordance with the Class 2-limitation (safety by aversion reactions in the visible spectra range) in IEC 60825-1.

This technical specification covers only sources which are intended to be viewed directly. Indirectly visible sources such as illuminating sources or laserpointers are not covered.

In most cases the selected application group diode emitter sources, which include laser diodes and LEDs will be used. However, throughout this technical specification all sources covered by the scope are included whenever the words "diode emitter" are used.

The objectives of this technical specification are:

– to protect persons from optical radiation arising from products incorporating visible diode emitter sources, such as displays, indicators, electronic signs and signals;

– to lay down requirements for manufacturers and installers, in order that procedures can be established and information supplied to enable correct precautions to be taken;

– to ensure adequate warning of hazards associated with accessible optical radiation from visible sources;

– to reduce the potential for injury by minimizing unnecessary optical radiation, to give improved control of optical radiation through protective features, and to provide safe usage of products by specifying user control measures.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this technical specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical specification are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(845), *International Electrotechnical Vocabulary (IEV) – Chapter 845: Lighting*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems*

3 Definitions

For the purpose of this technical specification, the following definitions apply. They repeat or supplement those given in IEC 60825-1, IEC 60825-2 and IEC 60050(845).

3.1
angular subtense
the visual angle α subtended by the *apparent source* (including diffuse reflections) at the eye of an observer or at the point of measurement. The angular subtense is measured from the apparent source at either the distance of intended use or, at the distance of the expected exposure, whichever is applicable. This distance must not be smaller than 100 mm

NOTE The requirements for the determination of the angular subtense are given in 6.2.2 and 6.3.

3.2
apparent source
the real or virtual object that forms the smallest possible retinal image

NOTE The size of the apparent source is the parameter that defines the limits of an *intermediate source.*

3.3
application types
this technical specification distinguishes two types of applications for *diode emitter (DE) products* with *peak wavelengths* within the range 400 nm to 700 nm:

type 1: for *DE products* which are safe under *reasonably foreseeable* conditions of operation for *intended viewers* and personnel in service and manufacturing;

type 2: for *DE products* which are safe under *reasonably foreseeable* conditions of operation for *intended viewers* only. Protective measures for service and manufacturing, in accordance with IEC 60825-1, clause 10 and subclauses 12.2, 12.4, 12.6.3, are obligatory.

NOTE The terminology reflects the safety classification philosophy of the basic standard (class 1: always safe, class 2: safety under realistic viewing conditions, e.g. aversion reactions), in that increasing hazard is denoted by increasing numerical category.

3.4
CIE standard photometric observer
ideal observer having a relative spectral responsivity curve that conforms to the $V(\lambda)$ function for photopic vision or to the $V'(\lambda)$ function for scotopic vision, and that complies with the summation law implied in the definition of *luminous flux*

3.5
diode emitter (DE)
any semiconductor pn junction device that can be made to produce optical, electromagnetic radiation by radiative recombination of excited carriers

NOTE The following designations for diode emitters are commonly used:

LED (Light Emitting Diode) emitting in the wavelength range from 380 nm to 780 nm. In this technical specification LEDs are limited to peak wavelengths between 400 nm and 700 nm. In some cases (IEC 60825-1) the term LED is used for all diode emitters except LDs.

IRED (Infra-Red Emitting Diode) emitting in the wavelength range from 780 nm to 1 mm (not covered by this technical specification).

LD (Laser Diode) emitting stimulated radiation at any wavelength.

In this technical specification, the term Diode Emitter (DE) is used for both LEDs and LDs.