BRITISH STANDARD

BS EN 60825-1:2007

Incorporating corrigendum August 2008

Safety of laser products —

Part 1: Equipment classification and requirements

ICS 13.280; 31.260

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI British Standards

National foreword

This British Standard is the UK implementation of EN 60825-1:2007. It is identical to IEC 60825-1:2007, incorporating corrigendum August 2008. Together with BS EN 62471:2008, it supersedes BS EN 60825-1:1994 which is withdrawn.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by IEC corrigendum August 2008 is indicated in the text by ⟩AC1⟩ ⟨AC1⟨.

The UK participation in its preparation was entrusted to Technical Committee EPL/76, Optical radiation safety and laser equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2007

© BSI 2009

ISBN 978 0 580 64258 6

Amendments /corrigenda issued since publication

Date	Comments
31 March 2009	Implementation of IEC corrigenda August 2008

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60825-1

October 2007

ICS 13.110 ; 31.260

Partially supersedes EN 60825-1:1994 + A1:2002 + A2:2001

English version

Safety of laser products - Part 1: Equipment classification and requirements

(IEC 60825-1:2007)

Sécurité des appareils à laser - Partie 1: Classification des matériels et exigences (CEI 60825-1:2007)

Sicherheit von Lasereinrichtungen - Teil 1: Klassifizierung von Anlagen und Anforderungen (IEC 60825-1:2007)

This European Standard was approved by CENELEC on 2007-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

© 2007 CENELEC - All rights of exploitation in any form and by any means reserved worldwide for CENELEC members.

Ref. No. EN 60825-1:2007 E

Foreword

The text of document 76/338/CDV, future edition 2 of IEC 60825-1, prepared by IEC TC 76, Optical radiation safety and laser equipment, was submitted to the IEC-CENELEC parallel Unique Acceptance Procedure and was approved by CENELEC as EN 60825-1 on 2007-09-01.

This European Standard partially supersedes EN 60825-1:1994 (+ corrigendum February 1995) + A1:2002 + A2:2001 (+ corrigendum April 2004).

The user's guide has been removed from this part of the EN 60825 series and is now a separate document (Part 14). Light emitting diodes (LEDs) have been removed from the scope of this part of EN 60825, but may still be included in other parts.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2008-06-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2010-09-01

Annex ZA has been added by CENELEC.

_____

Endorsement notice

The text of the International Standard IEC 60825-1:2007 was approved by CENELEC as a European Standard without any modification.

CONTENTS

1 Scope and object 6
2 Normative references 8
3 Terms and definitions 8
4 Engineering specifications 21
4.1 General remarks 21
4.2 Protective housing 21
4.3 Access panels and safety interlocks 21
4.4 Remote interlock connector 22
4.5 Manual reset 22
4.6 Key control 23
4.7 Laser radiation emission warning 23
4.8 Beam stop or attenuator 23
4.9 Controls 23
4.10 Viewing optics 23
4.11 Scanning safeguard 24
4.12 "Walk-in" access 24
4.13 Environmental conditions 24
4.14 Protection against other hazards 24
5 Labelling 25
5.1 General 25
5.2 Class 1 and Class 1M 27
5.3 Class 2 and Class 2M 28
5.4 Class 3R 29
5.5 Class 3B 29
5.6 Class 4 29
5.7 Aperture label 29
5.8 Radiation output and standards information 29
5.9 Labels for access panels 30
5.10 Warning for invisible laser radiation 31
5.11 Warning for visible laser radiation 31
6 Other informational requirements 31
6.1 Information for the user 31
6.2 Purchasing and servicing information 33
7 Additional requirements for specific laser products 33
7.1 Other parts of the standard series IEC 60825 33
7.2 Medical laser products 34
7.3 Laser processing machines 34
7.4 Electric toys 34
7.5 Consumer electronic products 34
8 Classification 34
8.1 Introduction 34
8.2 Classification responsibilities 35
8.3 Classification rules 35

9 Determination of the accessible emission level 39
9.1 Tests 39
9.2 Measurement of laser radiation 40
9.3 Measurement geometry 50

Annex A (informative) Maximum permissible exposure values 56
Annex B (informative) Examples of calculations 63
Annex C (informative) Description of the classes and potentially associated hazards 73
Annex D (informative) Biophysical considerations 79
Annex E (informative) MPEs and AELs expressed as radiance 89
Annex F (informative) Summary tables 93
Annex G (informative) Overview of associated parts of IEC 60825 96
Annex ZA (normative) Normative references to international publications with their corresponding European publications 100

Bibliography 98

Figure 1 – Warning label – Hazard symbol 26
Figure 2 – Explanatory label 27
Figure 3 – Measurement set-up to limit angle of acceptance by imaging the apparent source onto the plane of the field stop 52
Figure 4 – Measurement set-up to limit angle of acceptance by placing a circular aperture or a mask (serving as field stop) close to the apparent source 53
Figure 5 – Experimental set-up for the determination of the accessible emission (above) and the angular subtense of the apparent source (below) for condition 2 when an extended source is to be considered (i.e. not using the default, simplified evaluation) 54
Figure B.1 – Flowchart guide for the classification of laser products from supplied output parameters 65
Figure B.2 – Flowchart guide for the classification of Class 1M and Class 2M laser products 67
Figure B.3 – AEL for Class 1 ultra-violet laser products for selected emission durations from 10^{-9} s to 10^{3} s 68
Figure B.4 – AEL for Class 1 ultra-violet laser products for emission durations from 10^{-9} s to 10^{3} s at selected wavelengths 68
Figure B.5 – AEL for Class 1 visible and selected infra-red laser products (case C_6 = 1) 69
Figure D.1 – Anatomy of the eye 79
Figure D.2 – Diagram of laser-induced damage in biological systems 81
Figure E.1 – Radiance as a function of wavelength 89

Table 1 – Requirements for safety interlocking 22
Table 2 – Additivity of effects on eye and skin of radiation of different spectral regions 36
Table 3 – Times below which pulse groups are summed 39
Table 4 – Accessible emission limits for Class 1 and Class 1M laser products and C_6 = 1 43
Table 5 – Accessible emission limits for Class 1 laser products in the wavelength range from 400 nm to 1 400 nm (retinal hazard region): extended sources 44
Table 6 – Accessible emission limits for Class 2 and Class 2M laser products 45
Table 7 – Accessible emission limits for Class 3R laser products and C_6 = 1 46
Table 8 – Accessible emission limits for Class 3R laser products in the wavelength range from 400 nm to 1 400 nm (retinal hazard region): extended sources 47
Table 9 – Accessible emission limits for Class 3B laser products 48
Table 10 – Correction factors and breakpoints for use in AEL and MPE evaluations 49
Table 11 – Measurement aperture diameters and measurement distances for the default (simplified) evaluation 51
Table 12 – Reference points 51
Table 13 – Limiting angle of acceptance γ_{ph} 54
Table A.1 – Maximum permissible exposure (MPE) for C_6 = 1 at the cornea for exposure to laser radiation 57
Table A.2 – Maximum permissible exposure (MPE) at the cornea for exposure to laser radiation from extended sources in the wavelength range from 400 nm to 1 400 nm (retinal hazard region) 58
Table A.3 – Maximum permissible exposure (MPE) of the skin to laser radiation 59
Table A.4 – Aperture diameters for measuring laser irradiance and radiant exposure 59
Table D.1 – Summary of pathological effects associated with excessive exposure to light 83
Table D.2 – Explanation of measurement apertures applied to the MPEs 87
Table E.1 – Maximum radiance of a diffused source for Class 1 90
Table F.1 – Summary of the physical quantities used in this Part 1 93
Table F.2 – Summary of manufacturer's requirements 94
Table G.1 – Overview of additional data in associated parts of IEC 60825 97

SAFETY OF LASER PRODUCTS –

Part 1: Equipment classification and requirements

1 Scope and object

IEC 60825-1 is applicable to safety of laser products emitting laser radiation in the wavelength range 180 nm to 1 mm.

A laser product may consist of a single laser with or without a separate power supply or may incorporate one or more lasers in a complex optical, electrical, or mechanical system. Typically, laser products are used for demonstration of physical and optical phenomena, materials processing, data reading and storage, transmission and display of information, etc. Such systems have found use in industry, business, entertainment, research, education, medicine and consumer products.

Laser products that are sold to other manufacturers for use as components of any system for subsequent sale are not subject to IEC 60825-1, since the final product will itself be subject to this standard. However, if the laser system within the laser product is operable when removed from the equipment, the requirements of this Part 1 apply to the removable unit.

NOTE 1 Operable equipment does not require a tool to prepare for operation.

Any laser product is exempt from all further requirements of this Part 1 if classification by the manufacturer of that product according to Clauses 3, 8 and 9 shows that the emission level does not exceed the AEL (accessible emission limit) of Class 1 under all conditions of operation, maintenance, service and failure.

NOTE 2 The above exemption is to ensure that inherently safe laser products are not unnecessarily subject to the standard.

In addition to the hazards resulting from laser radiation, laser equipment may also give rise to other hazards such as fire and electric shock.

NOTE 3 However, the classification and other requirements of this standard are intended to address only the laser radiation hazards to the eyes and skin. Other hazards are not included within its scope.

This Part 1 describes the minimum requirements. Compliance with this Part 1 may not be sufficient to achieve the required level of product safety. Laser products must conform to the applicable performance and testing requirements of the applicable product safety standards.

NOTE 4 Other standards may contain additional requirements. Consideration should also be given to the intended application and user group. For example, a class 3B or class 4 laser product may not be suitable for use as a consumer product.