



SLOVENSKI STANDARD

SIST EN 60825-1:2014

01-oktober-2014

Nadomešča:
SIST EN 60825-1:2009

Varnost laserskih izdelkov - 1. del: Klasifikacija opreme in zahteve (IEC 60825-1:2014)

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

Sicherheit von Lasereinrichtungen - Teil 1: Klassifizierung von Anlagen und Anforderungen

Sécurité des appareils à laser - Partie 1: Classification des matériels et exigences

Ta slovenski standard je istoveten z: EN 60825-1:2014

ICS:

13.280	Varstvo pred sevanjem	Radiation protection
31.260	Optoelektronika, laserska oprema	Optoelectronics. Laser equipment

SIST EN 60825-1:2014 **en**

EUROPEAN STANDARD

EN 60825-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 2014

ICS 13.110; 31.260

Supersedes EN 60825-1:2007

English Version

**Safety of laser products - Part 1: Equipment classification and requirements
(IEC 60825-1:2014)**

Sécurité des appareils à laser - Partie 1: Classification des matériels et exigences
(CEI 60825-1:2014)

Sicherheit von Lasereinrichtungen - Teil 1: Klassifizierung von Anlagen und Anforderungen
(IEC 60825-1:2014)

This European Standard was approved by CENELEC on 2014-06-19. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

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



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 76/502/FDIS, future edition 3 of IEC 60825-1, prepared by IEC/TC 76 "Optical radiation safety and laser equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60825-1:2014.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-03-19
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-06-19

This document supersedes EN 60825-1:2007.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60825-1:2014 was approved by CENELEC as a European Standard without any modification.

IEC 60027-1	NOTE	Harmonised in EN 60027-1.
IEC 60065	NOTE	Harmonised as EN 60065.
IEC 60079 (Series)	NOTE	Harmonised as EN 60079 (Series).
IEC 60204-1	NOTE	Harmonised as EN 60204-1.
IEC 60601-2-22	NOTE	Harmonised as EN 60601-2-22.
IEC 60825-2	NOTE	Harmonised as EN 60825-2.
IEC 60825-4	NOTE	Harmonised as EN 60825-4.
IEC 60825-12	NOTE	Harmonised as EN 60825-12.
IEC 60950 (Series)	NOTE	Harmonised as EN 60950 (Series).
IEC 61010-1	NOTE	Harmonised as EN 61010-1.
IEC 61508 (Series)	NOTE	Harmonised as EN 61508 (Series).
IEC 62115	NOTE	Harmonised as EN 62115.
IEC 62368-1	NOTE	Harmonised as EN 62368-1.
IEC/ISO 11553 (Series)	NOTE	Harmonised as EN ISO 11553 (Series).
ISO 11146-1	NOTE	Harmonised as EN ISO 11146-1.
ISO 12100	NOTE	Harmonised as EN ISO 12100.
ISO 13694	NOTE	Harmonised as EN ISO 13694.
ISO 13849 (Series)	NOTE	Harmonised as EN ISO 13849 (Series).
ISO 15004-2:2007	NOTE	Harmonised as EN ISO 15004-2:2007.
ISO 80000-1	NOTE	Harmonised as EN ISO 80000-1.

Annex ZA
(normative)

**Normative references to international publications
with their corresponding European publications**

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u> series	<u>Title</u>	<u>EN/HD</u>	<u>Year</u> series
IEC 60050		International Electrotechnical Vocabulary	-	
IEC 62471 (mod)	-	Photobiological safety of lamps and lamp systems	EN 62471	-



IEC 60825-1

Edition 3.0 2014-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE



GROUP SAFETY PUBLICATION
PUBLICATION GROUPEE DE SÉCURITÉ

**Safety of laser products –
Part 1: Equipment classification and requirements**

**Sécurité des appareils à laser –
Partie 1: Classification des matériels et exigences**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE **XE**
CODE PRIX

ICS 13.110; 31.260

ISBN 978-2-8322-1499-2

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
1 Scope and object.....	8
2 Normative references	10
3 Terms and definitions	10
4 Classification principles	24
4.1 General.....	24
4.2 Classification responsibilities	24
4.3 Classification rules.....	24
4.4 Laser products designed to function as conventional lamps	29
5 Determination of the accessible emission level and product classification.....	29
5.1 Tests	29
5.2 Measurement of laser radiation.....	30
5.3 Determination of the class of the laser product.....	31
5.4 Measurement geometry.....	40
5.4.1 General	40
5.4.2 Default (simplified) evaluation.....	41
5.4.3 Evaluation condition for extended sources.....	42
6 Engineering specifications	44
6.1 General remarks and modifications	44
6.2 Protective housing	44
6.2.1 General	44
6.2.2 Service	45
6.2.3 Removable laser system.....	45
6.3 Access panels and safety interlocks.....	45
6.4 Remote interlock connector.....	46
6.5 Manual reset.....	46
6.6 Key control	46
6.7 Laser radiation emission warning	47
6.8 Beam stop or attenuator.....	47
6.9 Controls	47
6.10 Viewing optics.....	47
6.11 Scanning safeguard	47
6.12 Safeguard for Class 1C products	48
6.13 "Walk-in" access	48
6.14 Environmental conditions	48
6.15 Protection against other hazards.....	48
6.15.1 Non-optical hazards.....	48
6.15.2 Collateral radiation	49
6.16 Power limiting circuit.....	49
7 Labelling.....	49
7.1 General.....	49
7.2 Class 1 and Class 1M	51
7.3 Class 1C	52
7.4 Class 2 and Class 2M	53
7.5 Class 3R.....	53
7.6 Class 3B	54

7.7	Class 4	54
7.8	Aperture label	55
7.9	Radiation output and standards information	55
7.10	Labels for access panels	56
	7.10.1 Labels for panels	56
	7.10.2 Labels for safety interlocked panels	57
7.11	Warning for invisible laser radiation	57
7.12	Warning for visible laser radiation	57
7.13	Warning for potential hazard to the skin or anterior parts of the eye	57
8	Other informational requirements	58
	8.1 Information for the user	58
	8.2 Purchasing and servicing information	59
9	Additional requirements for specific laser products	60
	9.1 Other parts of the standard series IEC 60825	60
	9.2 Medical laser products	60
	9.3 Laser processing machines	60
	9.4 Electric toys	60
	9.5 Consumer electronic products	60
Annex A (informative) Maximum permissible exposure values		61
	A.1 General remarks	61
	A.2 Limiting apertures	66
	A.3 Repetitively pulsed or modulated lasers	67
	A.4 Measurement conditions	68
	A.4.1 General	68
	A.4.2 Limiting aperture	68
	A.4.3 Angle of acceptance	68
	A.5 Extended source lasers	69
Annex B (informative) Examples of calculations		70
	B.1 Symbols used in the examples of this annex	70
	B.2 Classification of a laser product – Introduction	71
	B.3 Examples	75
Annex C (informative) Description of the classes and potentially associated hazards		80
	C.1 General	80
	C.2 Description of classes	80
	C.2.1 Class 1	80
	C.2.2 Class 1M	80
	C.2.3 Class 1C	80
	C.2.4 Class 2	81
	C.2.5 Class 2M	81
	C.2.6 Class 3R	81
	C.2.7 Class 3B	82
	C.2.8 Class 4	82
	C.2.9 Note on nomenclature	82
	C.3 Limitations of the classification scheme	84
	C.4 References	85
Annex D (informative) Biophysical considerations		86
	D.1 Anatomy of the eye	86
	D.2 The effects of laser radiation on biological tissue	87

D.2.1	General	87
D.2.2	Hazards to the eye	89
D.2.3	Skin hazards.....	92
D.3	MPEs and irradiance averaging	93
D.4	Reference documents	93
Annex E (informative)	MPEs and AELs expressed as radiance	95
E.1	Background.....	95
E.2	Radiance values	95
E.3	Rationale	96
Annex F (informative)	Summary tables.....	99
Annex G (informative)	Overview of associated parts of IEC 60825.....	102
Bibliography.....		104

Figure 1 – Measurement set-up to limit angle of acceptance by imaging the apparent source onto the plane of the field stop	43
Figure 2 – 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	43
Figure 3 – Warning label – Hazard symbol.....	50
Figure 4 – Explanatory label	51
Figure 5 – Alternative label for Class 1	52
Figure 6 – Alternative label for Class 1M.....	52
Figure 7 – Alternative label for Class 1C.....	52
Figure 8 – Alternative label for Class 2	53
Figure 9 – Alternative label for Class 2M.....	53
Figure 10 – Alternative label for Class 3R	54
Figure 11 – Alternative label for Class 3B	54
Figure 12 – Alternative label for Class 4	55
Figure 13 – Alternative label for laser aperture	55
Figure B.1 – Flowchart guide for the classification of laser products from supplied output parameters.....	72
Figure B.2 – Flowchart guide for the classification of Class 1M and Class 2M laser products.....	73
Figure B.3 – AEL for Class 1 ultra-violet laser products for selected emission durations from 10^{-9} s to 10^3 s	74
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	74
Figure B.5 – AEL for Class 1 visible and selected infra-red laser products (case $C_6 = 1$).....	75
Figure D.1 – Anatomy of the eye.....	86
Figure D.2 – Diagram of laser-induced damage in biological systems	88
Figure E.1 – Radiance as a function of wavelength	95
Table 1 – Additivity of effects on eye and skin of radiation of different spectral regions.....	25
Table 2 – Times below which pulse groups are summed	28
Table 3 – Accessible emission limits for Class 1 and Class 1M laser products and $C_6 = 1$	34

Table 4 – Accessible emission limits for Class 1 and Class 1M laser products in the wavelength range from 400 nm to 1 400 nm (retinal hazard region): extended sources	35
Table 5 – Accessible emission limits for Class 2 and Class 2M laser products	36
Table 6 – Accessible emission limits for Class 3R laser products and $C_6 = 1$	37
Table 7 – Accessible emission limits for Class 3R laser products in the wavelength range from 400 nm to 1 400 nm (retinal hazard region): extended sources	38
Table 8 – Accessible emission limits for Class 3B laser products	39
Table 9 – Correction factors and breakpoints for use in AEL and MPE evaluations	39
Table 10 – Measurement aperture diameters and measurement distances for the default (simplified) evaluation	41
Table 11 – Reference points for Condition 3	42
Table 12 – Limiting angle of acceptance γ_{ph}	43
Table 13 – Requirements for safety interlocking	45
Table A.1 – Maximum permissible exposure (MPE) for $C_6 = 1$ at the cornea expressed as irradiance or radiant exposure	62
Table A.2 – Maximum permissible exposure (MPE) at the cornea for extended sources in the wavelength range from 400 nm to 1 400 nm (retinal hazard region) expressed as irradiance or radiant exposure ^d	63
Table A.3 – Maximum permissible exposure (MPE) of Table A.1 ($C_6 = 1$) for the wavelength range from 400 nm to 1 400 nm expressed as power or energy ^{a, b}	64
Table A.4 – Maximum permissible exposure (MPE) of Table A.2 (extended sources) for the wavelength range from 400 nm to 1 400 nm expressed as power or energy ^{a, b, c, d, e, f, g}	65
Table A.5 – Maximum permissible exposure (MPE) of the skin to laser radiation	66
Table A.6 – Aperture diameters for measuring laser irradiance and radiant exposure	67
Table D.1 – Summary of pathological effects associated with excessive exposure to light ...	90
Table D.2 – Explanation of measurement apertures applied to the eye MPEs	93
Table E.1 – Maximum radiance of a diffused source for Class 1	96
Table F.1 – Summary of the physical quantities used in this Part 1	99
Table F.2 – Summary of manufacturer's requirements (1 of 2)	100
Table G.1 – Overview of additional data in associated parts of IEC 60825	103

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY OF LASER PRODUCTS –

Part 1: Equipment classification and requirements

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). 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. 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 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60825-1 has been prepared by IEC technical committee 76: Optical radiation safety and laser equipment.

This third edition of IEC 60825-1 cancels and replaces the second edition published in 2007. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a new class, Class 1C, was introduced;
- the measurement condition 2 (“eye loupe” condition) was removed;
- classification of the emission of laser products below a certain radiance level that are intended to be used as replacement for conventional light sources can, as an option, be based on the IEC 62471 series;
- the accessible emission limits (AELs) for Class 1, 1M, 2, 2M and 3R of pulsed sources, particularly of pulsed extended sources, were updated to reflect the latest revision of the

ICNIRP guidelines on exposure limits (accepted for publication in Health Physics 105 (3): 271 – 295; 2013, see also www.icnirp.org).

This part of IEC 60825 has the status of a Group Safety Publication, in accordance with IEC Guide 104¹⁾, for aspects of laser radiation pertaining to human safety.

The text of this standard is based on the following documents:

FDIS	Report on voting
76/502/FDIS	76/506/RVD

Full information on the voting for the approval of this standard 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.

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

This part of IEC 60825 is also referred to as "Part 1" in this publication.

The committee has decided that the contents of this publication will remain unchanged until the stability 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

1) IEC Guide 104:2010, *The preparation of safety publications and the use of basic safety publications and group safety publications*

It gives guidance to IEC technical committees and to writers of specifications concerning the manner in which safety publications should be drafted.

This guide does not constitute a normative reference and reference to it is given for information only.