

ILNAS

Institut luxembourgeois de la normalisation
de l'accréditation, de la sécurité et qualité
des produits et services

ILNAS-EN 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

08/2014



National Foreword

This European Standard EN 60825-1:2014 was adopted as Luxembourgish Standard ILNAS-EN 60825-1:2014.

Every interested party, which is member of an organization based in Luxembourg, can participate for FREE in the development of Luxembourgish (ILNAS), European (CEN, CENELEC) and International (ISO, IEC) standards:

- Participate in the design of standards
- Foresee future developments
- Participate in technical committee meetings

<https://portail-qualite.public.lu/fr/normes-normalisation/participer-normalisation.html>

THIS PUBLICATION IS COPYRIGHT PROTECTED

Nothing from this publication may be reproduced or utilized in any form or by any mean - electronic, mechanical, photocopying or any other data carries without prior permission!

EUROPEAN STANDARD ^{ILNAS-EN 60825-1:2014} **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	-



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**



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