



# SLOVENSKI STANDARD

## SIST EN 60825-2:2005

01-junij-2005

Nadomešča:  
SIST EN 60825-2:2001

---

**Varnost laserskih izdelkov – 2. del: Varnost komunikacijskih sistemov z optičnimi vlakni (OFCS) (IEC 60825-2:2004)**

Safety of laser products -- Part 2: Safety of optical fibre communication systems (OFCS)

Sicherheit von Lasereinrichtungen -- Teil 2: Sicherheit von Lichtwellenleiter-Kommunikationssystemen (LWLKS)

(standards.iteh.ai)

Sécurité des appareils à laser -- Partie 2: Sécurité des systèmes de télécommunication par fibres optiques (STFO)

[SIST EN 60825-2:2005](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

[https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

[f136c7749183/sist-en-60825-2-2005](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

**Ta slovenski standard je istoveten z: EN 60825-2:2004**

---

**ICS:**

31.260	Optoelektronika, laserska oprema	Optoelectronics. Laser equipment
33.180.01	Sistemi z optičnimi vlakni na splošno	Fibre optic systems in general

**SIST EN 60825-2:2005**

**en**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 60825-2:2005](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

<https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005>

EUROPEAN STANDARD

**EN 60825-2**

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2004

ICS 31.260 ; 33.180.01

Supersedes EN 60825-2:2000

English version

**Safety of laser products**  
**Part 2: Safety of optical fibre communication systems (OFCS)**  
(IEC 60825-2:2004)

Sécurité des appareils à laser  
Partie 2: Sécurité des systèmes  
de télécommunication par fibres optiques  
(STFO)  
(CEI 60825-2:2004)

Sicherheit von Lasereinrichtungen  
Teil 2: Sicherheit von Lichtwellenleiter-  
Kommunikationssystemen (LWLKS)  
(IEC 60825-2:2004)

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

This European Standard was approved by CENELEC on 2004-09-01. 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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and 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**

## Foreword

The text of document 76/288/FDIS, future edition 3 of IEC 60825-2, prepared by IEC TC 76, Optical radiation safety and laser equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60825-2 on 2004-09-01.

This European Standard supersedes EN 60825-2:2000. It constitutes a technical revision to bring the hazard level nomenclature used in this document into correspondence with the revised classification system introduced in amendment A2:2001 to EN 60825-1:1994. Additionally, the standard has been thoroughly revised throughout.

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) 2005-06-01
- latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 2007-09-01

Annex ZA has been added by CENELEC.

---

## iTeh STANDARD PREVIEW Endorsement notice (standards.iteh.ai)

The text of the International Standard IEC 60825-2:2004 was approved by CENELEC as a European Standard without any modification.

[SIST EN 60825-2:2005](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

<https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005>

## Annex ZA (normative)

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

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.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60825-1	1993	Safety of laser products Part 1: Equipment classification, requirements and user's guide	EN 60825-1 + Corr. February	1994 1995
A1	1997		A1	2002
A2	2001		A2	2001

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 60825-2:2005](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

<https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005>

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 60825-2:2005](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

<https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005>

# INTERNATIONAL STANDARD

# IEC 60825-2

Third edition  
2004-06

---

---

## Safety of laser products –

### Part 2: Safety of optical fibre communication systems (OFCS)

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 60825-2:2005](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

<https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005>

© IEC 2004 — 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, PO Box 131, CH-1211 Geneva 20, Switzerland  
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: [inmail@iec.ch](mailto:inmail@iec.ch) Web: [www.iec.ch](http://www.iec.ch)

---

---



Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

## CONTENTS

FOREWORD.....	4
1 Scope and object.....	6
2 Normative references .....	7
3 Terms and definitions .....	7
4 Requirements .....	10
4.1 General.....	10
4.2 Protective housing of OFCS.....	10
4.3 Fibre cables .....	10
4.4 Cable connectors.....	10
4.5 Automatic power reduction (APR) and restart pulses .....	11
4.6 Labelling or marking .....	12
4.7 Organizational requirements .....	13
4.8 Assessment of hazard level .....	15
4.9 Hazard level requirements by location type .....	16
Annex A (informative) Rationale.....	17
Annex B (informative) Summary of requirements at locations in OFCS.....	18
Annex C (informative) Methods of hazard/safety analysis .....	19
Annex D (informative) Application notes for the safe use of OFCS .....	20
Annex E (informative) Guidance for service and maintenance .....	44
Annex F (informative) Clarification of the meaning of "hazard level".....	47
Bibliography .....	49
Figure D.1 – PON (passive optical network)-based system .....	30
Figure D.2 – Simple laser drive circuit .....	32
Figure D.3 – Risk graph example from IEC 61508-5 Clause D.5.....	35
Figure D.4 – Graph of FIT rate and mean time to repair .....	38
Table D.1 – OFCS power limits for 11 $\mu\text{m}$ single mode (SM) fibres and 0,18 numerical aperture multimode (MM) fibres (core diameter < 150 $\mu\text{m}$ ) .....	23
Table D.2 – Relation between the number of fibres in a ribbon fibre and the maximum permitted power (example).....	29
Table D.3 – Identification of components and failure modes (example).....	32
Table D.4 – Beta values (example).....	33
Table D.5 – Determination of failure rates (example) .....	34
Table D.6 – Consequence classification from IEC 61508-5 Table D.1.....	35
Table D.7 – Frequency classification from IEC 61508-5 Table D.1 .....	36
Table D.8 – Possibility of avoiding hazard classification from IEC 61508-5 Table D.1 .....	36
Table D.9 – Classification of the probability of the unwanted occurrence from IEC 61508-5 Table D.1 .....	36
Table D.10 – Modes of operation – Definitions from IEC 61508-4, 3.5.12 .....	37



Table D.11 – SIL Values from IEC 61508-1, 7.6.2.9 .....	37
Table D.12 – Determination of equipment monitoring classification .....	39
Table D.13 – FIT rates from example above .....	40
Table D.14 – Examples of power limits for OFCS having automatic power reduction to reduce emissions to a lower hazard level .....	43

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 60825-2:2005](https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005)

<https://standards.iteh.ai/catalog/standards/sist/fd1bed6b8-6866-4c49-a0cf-f136c7749183/sist-en-60825-2-2005>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## SAFETY OF LASER PRODUCTS –

## Part 2: Safety of optical fibre communication systems (OFCS)

## 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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 60825-2 has been prepared by IEC technical committee 76: Optical radiation safety and laser equipment

This third edition cancels and replaces the second edition published in 2000. It constitutes a technical revision to bring the hazard level nomenclature used in this document into correspondence with the revised classification system introduced in IEC 60825-1(2001). Additionally, the standard has been thoroughly revised throughout.

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

FDIS	Report on voting
76/288/FDIS	76/293/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.

IEC 60825 consists of the following parts, under the general title *Safety of laser products*:

- Part 1: Equipment classification, requirements and user's guide
- Part 2: Safety of optical fibre communication systems (OFCS)
- Part 3: Guidance for laser displays and shows
- Part 4: Laser guards
- Part 5: Manufacturer's checklist for IEC 60825-1
- Part 6: Safety of products with optical sources, exclusively used for visible information transmission to the human eye
- Part 7: Safety of products emitting infrared optical radiation, exclusively used for wireless 'free air' data transmission and surveillance
- Part 8: Guidelines for the safe use of medical laser equipment
- Part 9: Compilation of maximum permissible exposure to incoherent optical radiation
- Part 10: Application guidelines and explanatory notes to IEC 60825-1
- Part 12: Safety of free space optical communication systems used for transmission of information
- Part 14: A user's guide

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 standard may be published at a later date.

## SAFETY OF LASER PRODUCTS –

### Part 2: Safety of optical fibre communication systems (OFCS)

#### 1 Scope and object

This Part 2 of IEC 60825 provides requirements and specific guidance for the safe operation and maintenance of optical fibre communication systems (OFCS). In these systems optical power may be accessible outside the confinements of transmitting equipment or at great distance from the optical source.

This Part 2 requires the assessment of hazard levels at accessible locations as a replacement for classification according to IEC 60825-1. It applies to the complete installed end-to-end OFCS, including its components and subassemblies that generate or amplify optical radiation. Individual components and subassemblies that are sold only to OEM vendors for incorporation into a complete installed end-to-end OFCS need not be assessed to this standard, since the final OFCS should itself be assessed according to this standard.

NOTE The above statement is not intended to prevent manufacturers of such components and subassemblies from using this standard if they wish to do so, or are required to do so by contract.

This standard does not apply to optical fibre systems primarily designed to transmit optical power for applications such as material processing or medical treatment.

In addition to the hazards resulting from laser radiation, OFCS may also give rise to other hazards, such as fire.

This standard does not address safety issues associated with explosion or fire with respect to OFCS deployed in explosive atmospheres.

Throughout this part of IEC 60825, a reference to 'laser' is taken to include light-emitting diodes (LEDs) and optical amplifiers.

The objective of this Part 2 of IEC 60825 is to:

- protect people from optical radiation resulting from OFCS;
- provide requirements for manufacturers, installation organizations, service organizations and operating organizations in order to establish procedures and supply information so that proper precautions can be adopted;
- ensure adequate warnings are provided to individuals regarding the potential hazards associated with OFCS through the use of signs, labels and instructions.

Annex A gives a more detailed rationale for this part of IEC 60825.

The safety of an OFCS depends to a significant degree on the characteristics of the equipment forming that system. Depending on the characteristics of the equipment, it may be necessary to mark safety relevant information on the product or include it within the instructions for use.

Where required by the level of potential hazard, it places the responsibility for the safe deployment and use of these systems on the installer or end-user / operating organization or both. This standard places the responsibility for adherence to safety instructions during installation and service operations on the installation organization and service organizations as appropriate, and operation and maintenance functions on the end-user or operating organization. It is recognised that the user of this standard may fall into one or more of the aforementioned categories of manufacturer, installation organization, end-user or operating organization.

## 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, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide*<sup>1)</sup>

Amendment 1 (1997)

Amendment 2 (2001)

## 3 Terms and definitions

For the purposes of this document, the terms and definitions contained in IEC 60825-1 as well as the following terms and definitions apply.

### 3.1

#### **accessible location**

any part or location within an OFCS at which, under reasonably foreseeable events, human access to laser radiation is possible without the use of a tool

### 3.2

#### **automatic power reduction (APR)**

a feature of an OFCS by which the accessible power is reduced to a specified level within a specified time, whenever there is an event which could result in human exposure to radiation, e.g. a fibre cable break

NOTE The term "automatic power reduction" (APR) used in this standard encompasses the following terms used in recommendations of the International Telecommunication Union (ITU):

- automatic laser shutdown (ALS);
- automatic power reduction (APR);
- automatic power shutdown (APSD).

### 3.3

#### **end-user**

person or organization using the OFCS in the manner the system was designed to be used

NOTE 1 The end-user cannot necessarily control the power generated and transmitted within the system.

NOTE 2 If the person or organization is using the OFCS for a communications application in a manner other than as designed by the manufacturer, then that person/organization assumes the responsibilities of a manufacturer or installation organization.

### 3.4

#### **hazard level**

the potential hazard at any accessible location within an OFCS. It is based on the level of optical radiation which could become accessible in a reasonably foreseeable event, e.g. a fibre cable break. It is closely related to the laser classification procedure in IEC 60825-1

### 3.5

#### **hazard level 1**

hazard level 1 is assigned to any accessible location within an OFCS at which, under reasonably foreseeable events, human access to laser radiation in excess of the accessible emission limits of Class 1 for the applicable wavelengths and emission duration will not occur

---

<sup>1)</sup> A consolidated edition 1.2 exists including IEC 60825-1 (1993) and its Amendment 1 (1997) and Amendment 2 (2001).

### 3.6

#### hazard level 1M

hazard level 1M is assigned to any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation in excess of the accessible emission limits of Class 1 for the applicable wavelengths and emission duration will not occur, whereby the level of radiation is measured with the measurement conditions for Class 1M laser products (see IEC 60825-1)

NOTE If the applicable limit of hazard level 1M is larger than the limit of 2 or 3R and less than the limit of 3B, hazard level 1M is allocated.

### 3.7

#### hazard level 2

hazard level 2 is assigned to any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation in excess of the accessible emission limits of Class 2 for the applicable wavelengths and emission duration will not occur

NOTE If the applicable limit of hazard level 1M is larger than the limit of 2 and less than the limit of 3B, hazard level 1M is allocated.

### 3.8

#### hazard level 2M

hazard level 2M is assigned to any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation in excess of the accessible emission limits of Class 2 for the applicable wavelengths and emission duration will not occur, whereby the level of radiation is measured with the measurement conditions for Class 2M laser products (see IEC 60825-1)

NOTE If the applicable limit of hazard level 2M is larger than the limit of 3R and less than the limit of 3B, hazard level 2M is allocated.

### 3.9

#### hazard level 3R

hazard level 3R is assigned to any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation in excess of the accessible emission limits of Class 3R for the applicable wavelengths and emission duration will not occur

NOTE If the applicable limit of hazard level 1M or 2M is larger than the limit of 3R and less than the limit of 3B, hazard level 1M or 2M is allocated.

### 3.10

#### hazard level 3B

hazard level 3B is assigned to any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation in excess of the accessible emission limits of Class 3B for the applicable wavelengths and emission duration will not occur

### 3.11

#### hazard level 4

hazard level 4 is assigned to any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation in excess of the accessible emission limits of Class 3B for the applicable wavelengths and emission duration may occur

NOTE This standard is applicable for the operation and maintenance of OFCS. In order to achieve an adequate level of safety for persons who may come into contact with the optical transmission path, hazard level 4 is not permitted within this standard. It is permitted to use protection systems, such as automatic power reduction, to achieve the required hazard level where the transmitted power under normal operating conditions (e.g. no fault exists in the fibre path) exceeds that permitted for a particular location type. For instance, it is possible for accessible parts of an OFCS to be hazard level 1 even though the power transmitted down the fibre under normal operating conditions is Class 4.

**3.12****installation organization**

an organization or individual that is responsible for the installation of an OFCS

**3.13****location with controlled access; controlled location**

an accessible location where an engineering or administrative control is present to make it inaccessible, except to authorized personnel with appropriate laser safety training

NOTE For examples see D.2.1 a).

**3.14****location with restricted access; restricted location**

an accessible location that is normally inaccessible by the general public by means of any administrative or engineering control measure but that is accessible to authorized personnel who may not have laser safety training

NOTE For examples see D.2.1 b).

**3.15****location with unrestricted access; unrestricted location**

an accessible location where there are no measures restricting access to members of the general public

NOTE For examples see D.2.1 c).

**3.16****manufacturer**

organization or individual that assembles optical devices and other components in order to construct or modify an OFCS

**3.17****operating organization**

organization or individual that is responsible for the operation of an OFCS

**3.18****optical fibre communication system (OFCS)**

an engineered, end-to-end assembly for the generation, transfer and reception of optical radiation arising from lasers, LEDs or optical amplifiers, in which the transference is by means of optical fibre for communication and/or control purposes

**3.19****reasonably foreseeable event**

an event the occurrence of which under given circumstances can be predicted fairly accurately, and the occurrence probability or frequency of which is not low or very low

NOTE Examples of reasonably foreseeable events might include the following: fibre cable break, optical connector disconnection, operator error or inattention to safe working practices.

Reckless use or use for completely inappropriate purposes is not considered as a reasonably foreseeable event.

**3.20****service organization**

an organization or individual that is responsible for the servicing of an OFCS

**3.21****subassembly**

any discrete unit, subsystem, network element, or module of an OFCS which contains an optical emitter or optical amplifier