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Interested committees:

Title: Draft BS EN 60825-2 Safety of laser products. Part 2: Safety of optical fibre communication systems (OFCS).

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
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- iii) requires additional national guidance or information

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Full document details: 18/30352607 DC

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



76/601/CD

COMMITTEE DRAFT (CD)

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IEC TC 76 : OPTICAL RADIATION SAFETY AND LASER EQUIPMENT

SECRETARIAT:

United States of America

SECRETARY:

Mr William Ertle

OF INTEREST TO THE FOLLOWING COMMITTEES:

SC 86B, SC 86C, TC 108

PROPOSED HORIZONTAL STANDARD:

☐

Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☒ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

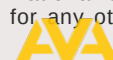
Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY OF LASER PRODUCTS –

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

FOREWORD

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International Standard IEC 60825-2 has been prepared by IEC technical committee 76: Optical radiation safety and laser equipment

This fourth edition cancels and replaces the third edition published in 2004, Amendment 1:2006 and Amendment 2:2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition; with the main affected clauses in this Part 2 edition being as indicated below:

- a) C₇ has been revised in accordance with IEC 60825-1:2014, but with an additional check on the skin MPE; see clause 4.7.2.
- b) Condition 2 has been changed, and a detailed description of the measurement and determination method for hazard level has been added; see clauses 4.1.7 and clause 4.7.2.
- c) Calculation examples of hazard levels have been added.
- d) Clause D.5 Fault analysis – Explanation and guidance has been simplified.
- e) Recommendations for individual components and subassemblies clarified; see clause 1, paragraph 3.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

96

97 Full information on the voting for the approval of this International Standard can be found in the report
98 on voting indicated in the above table.

99 This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

100 The committee has decided that the contents of this document will remain unchanged until the stability
101 date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific
102 document. At this date, the document will be

- 103 – reconfirmed,
- 104 – withdrawn,
- 105 – replaced by a revised edition, or
- 106 – amended.

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SAFETY OF LASER PRODUCTS –

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

1 Scope and object

This document provides requirements and specific guidance for the safe operation and maintenance of optical fibre communication systems (OFCS). In these systems optical power is possibly accessible outside the confinements of transmitting equipment and/or at great distance from the optical source.

This document requires the assessment of hazard levels at each accessible location of the OFCS as a replacement for product classification according to IEC 60825-1. It applies to the installed OFCS as an engineered, end-to-end assembly for the generation, transfer and receipt of optical radiation arising from lasers, light-emitting diodes (LEDs) or optical amplifiers, in which the transference is by means of optical fibre for communication and/or control purposes.

Individual components and subassemblies that fall under the definition of a laser product are subject to the applicable parts of IEC 60825-1. This document is applicable to individual components and subassemblies intended to be installed in OFCSs.

This document 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 possibly gives rise to other hazards, such as fire.

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

Throughout this document, a reference to 'laser' is taken to include LEDs and optical amplifiers.

NOTE The hazard of optical radiation emerging from a fibre is determined by the wavelength and power emerging from the fibre and also by the optical characteristics of the fibre itself (see Annex A).

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

- protect people from optical radiation resulting from OFCS;
- provide requirements for manufacturers, installation organisations, service organisations and operating organisations 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 document.

The safety of an OFCS depends on, to a significant degree, the characteristics of the equipment forming that system. Depending on the characteristics of the equipment, it is 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, this document places the responsibility for the safe deployment and use of these systems on the installer or end-user / operating organisation or both. This document places the responsibility for adherence to safety instructions during installation and service operations on the installation organisation and service organisation as appropriate, and operation and maintenance functions on the end-user or operating organisation. It is recognised that the user of this document possibly falls into one or more of the aforementioned categories of manufacturer, installation organisation, end-user or operating organisation.

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 60825-1:2014, *Safety of laser products – Part 1: Equipment classification and requirements*

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

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

feature of an OFCS by which the accessible power is reliably 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 1 to entry: The term “automatic power reduction” (APR) used in this document 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).

Note 2 to entry: The term automatic laser shut off (ALSO) has been used by some manufacturers in the industry.

3.3

end-user

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

Note 1 to entry: The end-user cannot necessarily control the power generated and transmitted within the system.

Note 2 to entry: If the person or organisation is using the OFCS for a communications application in a manner other than as designed by the manufacturer, then that person/organisation assumes the responsibilities defined in this document applicable to a manufacturer or installation organisation.

3.4

hazard level

potential hazard at any accessible location within an OFCS

Note 1 to entry: 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. The meaning of hazard level is clarified in Annex F.

3.5

hazard level 1

assigned hazard at any accessible location within an OFCS at which, under reasonably foreseeable events, human access to laser radiation measured with the conditions for Class 1 laser products (see IEC 60825-1:2014), but with Condition 2 being as defined in 4.7.2 a) of this document, in excess of

the accessible emission limits of Class 1 for the applicable wavelengths and emission duration will not occur

3.6

hazard level 1M

assigned hazard at any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation measured with the conditions for Class 1M laser products (see IEC 60825-1:2014), but with Condition 2 being as defined in 4.7.2 a) of this document, in excess of the accessible emission limits of Class 1 for the applicable wavelengths and emission duration will not occur

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

3.7

hazard level 2

assigned hazard at any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation measured with the conditions for Class 2 laser products (see IEC 60825-1:2014), but with Condition 2 being as defined in 4.7.2 b) of this document, in excess of the accessible emission limits of Class 2 for the applicable wavelengths and emission duration will not occur

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

3.8

hazard level 2M

assigned hazard at any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation measured with the conditions for Class 2M laser products (see IEC 60825-1:2014), but with Condition 2 being as defined in 4.7.2 b) of this document, in excess of the accessible emission limits of Class 2 for the applicable wavelengths and emission duration will not occur

Note 1 to entry: If the applicable limit of hazard level 2M is larger than the limit of hazard level 3R and less than the limit of hazard level 3B, hazard level 2M is allocated.

3.9

hazard level 3R

assigned hazard at any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation measured with the conditions for Class 3R laser products (see IEC 60825-1:2014), but with Condition 2 being as defined in 4.7.2 c) of this document, in excess of the accessible emission limits of Class 3R for the applicable wavelengths and emission duration will not occur

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

3.10

hazard level 3B

assigned hazard at any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation measured with the conditions for Class 3B laser products (see IEC 60825-1:2014), but with Condition 2 being as defined in 4.7.2 d) of this document, 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

assigned hazard at any accessible location within an OFCS at which, under a reasonably foreseeable event, human access to laser radiation measured with the conditions for Class 3B laser products (see IEC 60825-1:2014), but with Condition 2 being as defined in 4.7.2 e) of this document, in excess of the accessible emission limits of Class 3B for the applicable wavelengths and emission duration may occur

Note 1 to entry: This document 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 document. 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 organisation

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

3.13

location with controlled access

controlled location

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

Note 1 to entry: For examples see D.2.1 a).

3.14

location with restricted access

restricted location

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 1 to entry: For examples see D.2.1 b).

3.15

location with unrestricted access

unrestricted location

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

Note 1 to entry: For examples see D.2.1 c).

3.16

manufacturer

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

Note 1 to entry: Typical system components are shown in D.2.2.

3.17

operating organisation

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

3.18

optical fibre communication system

OFCS

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

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

Note 2 to entry: Any intentional act to create a hazard for oneself is not considered as a reasonably foreseeable event.

3.20**service organisation**

organisation 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

Note 1 to entry The definition of subassembly may be different from optical sub-assembly defined in IEC/TS 62538.

4 Requirements**4.1 General**

This section defines the restrictions that are to be placed on an OFCS and on the location types in which an OFCS can operate, in accordance with the hazard that arises from optical radiation becoming accessible as a result of a reasonably foreseeable event. Whenever one or more alterations are made to an OFCS, the organisation responsible for that alteration shall make a determination of whether each alteration could affect the originally classified hazard level. If the originally classified hazard level has changed, the organisation responsible for the alteration(s) shall re-label those locations in the system that are accessible so as to ensure continued compliance with this document.

Each accessible location within an OFCS shall be separately assessed to determine the hazard level at that location. Where multiple communications systems are present at a location, the hazard level for the location shall be the highest, with the consideration of the worst cumulative effects, of the levels arising from each of those systems. Based on the hazard level determined, appropriate actions shall be taken to ensure compliance with this document. These actions could for example involve restriction of access to the location, or the implementation of additional safety features or redesign of the optical communications system to reduce the hazard level.

Whenever possible, visual observation of fibre tips with a magnification optics should be avoided when their optical emission is possible.

Electrical power transmitting cables that comprising OFCSs with optical fibre cables shall meet the requirements of any applicable electrical standard besides this document.

NOTE 1 When determining the hazard level, two characteristics are generally taken into account.

1) Maximum permitted power

OFCSs can operate at the maximum permitted power after a reasonable foreseeable event (such as a fibre-break) has caused the radiation to become accessible. This maximum permitted power value could be lower than the normal operating power in the fibre as a result of activation of the APR system. Requirements are described in 4.7.3;

2) Maximum permissible exposure (MPE)

The level of exposure is determined at a location where it is reasonably foreseeable that a person could be exposed to radiation coming from the OFCS. If the OFCS incorporates APR system, the exposure level is kept not to exceed the MPE value which in this case is determined by considering the full period to complete the APR system as specified in 4.7.4, i.e. the MPE value under the APR period is usually larger than that without APR. If the OFCS does not incorporate APR, then meeting the requirements referred to in the above characteristic 1) will be taken as automatically meeting the requirements in 4.7.4 without further investigation or tests.

NOTE 2 In this document, MPEs for the eye and the skin of employees in the workplace and the general public are in many countries specified in national laws. These legally-binding national exposure limits might differ from and override the MPEs given in the informative Annex A of IEC 60825-1.

4.2 Protective housing of OFCS

Each OFCS shall have a protective housing which, when in place, prevents human access to laser radiation in excess of hazard level 1 limits under normal operating conditions.

4.3 Fibre cables

If the potential hazard at any accessible location within an OFCS is hazard level 1, 1M, 2M, 3R or 3B, then the fibre optic cable shall have mechanical properties appropriate to its physical location. Cables

for various physical locations are described in the IEC 60794 series. Where necessary, additional protection, for example ducting, conduit or raceway, may be required for locations where the fibre would otherwise be susceptible to damage.

4.4 Cable connectors

4.4.1 General

The following requirements for cable connectors may be achieved by the mechanical design of the connectors, or by the positioning of the connector, or by any other suitable means. Whichever means is chosen, human access to radiation above that permitted for connectors in a particular location type shall be prevented.

NOTE The use of a tool for disconnection is one example of a mechanical solution.

4.4.2 Unrestricted locations

In unrestricted locations, if the accessible radiation level exceeds:

- hazard level 2 within the wavelength range 400 nm to 700 nm, or
- hazard level 1 in all other cases,

then suitable means shall limit access to the radiation from the connector.

NOTE In an unrestricted location the highest hazard levels permitted are hazard level 2M for the wavelength range 400 nm to 700 nm and hazard level 1M in all other cases (see 4.9.2).

4.4.3 Restricted locations

In restricted locations, if the accessible radiation level exceeds:

- hazard level 2M within the wavelength range 400 nm to 700 nm, or
- hazard level 1M in all other cases,

then suitable means shall limit access to the radiation from the connector.

NOTE In a restricted location the highest hazard level permitted is hazard level 1M, 2M or 3R, whichever is the higher (see 4.9.3).

4.4.4 Controlled locations

In controlled locations, if the accessible radiation level exceeds:

- hazard level 2M within the wavelength range 400 nm to 700 nm, or
- hazard level 1M in all other cases,

then suitable means shall limit access to the radiation from the connector.

NOTE In a controlled location the highest hazard level permitted is hazard level 3B (see 4.9.4).

4.5 Labelling or marking

4.5.1 General requirements

Where required by this subclause, each optical connector, splice box or other part emitting radiation when opened shall be marked (e.g. with a label, sleeve, tag, tape etc.), if the hazard level at the location is in excess of hazard level 1. The information shall consist of the information identified in Tables 1, 2 or 3 as applicable.

Where the accessible radiation at points of disconnection is hazard level 1 or hazard level 1M, it is permitted for the above information to be provided in information for the user instead of as a marking on the product.

Markings shall be coloured black on a yellow background. Labels reproduced in the documentation provided by the manufacturer or by the operating organisation are permitted to be black on a white background.

393 It is acceptable to reduce the marking in size, providing that the result is legible. All hazard level
394 labelling is the responsibility of the installer or end-user / operating organisation, including the
395 labelling of subassemblies containing lasers or optical amplifiers. This is because hazard level is a
396 feature of the (end-to-end) OFCS, and depends on system wide features such as APR etc.

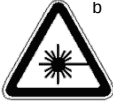
397 Except as permitted below, each optical connector, splice box or other part that is intended to permit
398 access to optical radiation when opened shall be marked (e.g. with a label, sleeve, tag, tape etc.) in
399 accordance with Tables 1, 2 or 3, as applicable.

400 NOTE Subassemblies which provide optical outputs are marked under Part 2 when they are used for OFCSs while under
401 Part 1 of IEC 60825 when they are used for stand-alone applications.

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Table 1 – Marking in unrestricted locations

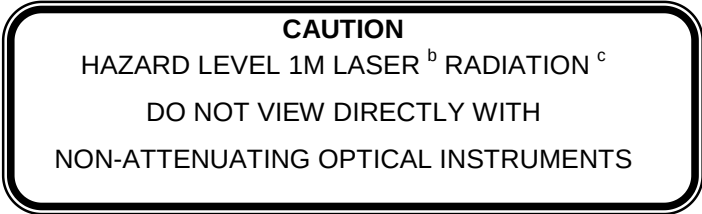
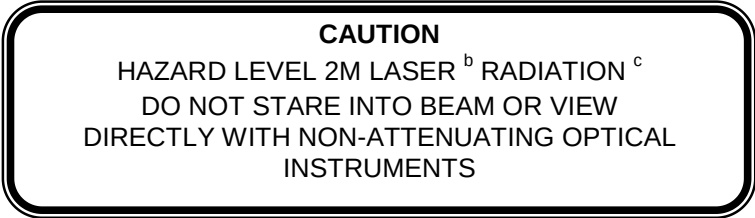
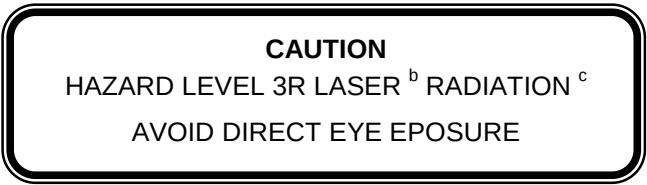
Accessible hazard level	Required marking - Unrestricted location
1	No marking required
1M	No marking required ^a
2	 b e CAUTION HAZARD LEVEL 2 LASER ^c RADIATION ^d DO NOT STARE INTO BEAM
2M	 b e CAUTION HAZARD LEVEL 2M LASER ^c RADIATION ^d DO NOT STARE INTO BEAM OR VIEW DIRECTLY WITH NON-ATTENUATING OPTICAL INSTRUMENTS
3R	Not permitted
3B	Not permitted
NOTE See 4.5.5 regarding invisible laser beam hazards.	
^a 4.4.2 requires access to radiation from a connector to be limited to hazard level 1 by a suitable means and the mechanical design of the fibre cables must be consistent with the relevant standard within the IEC 60794 series (see 4.3). Therefore, hazard level 1M is exempt from marking requirements. ^b Hazard symbol warning label according to Figure 3 of IEC 60825-1:2014. ^c Where the source of the radiation is a light emitting diode, the word “Laser” above shall be replaced by “LED”. ^d Replacing the word “Radiation” with “Light” for radiation in the range 400 nm to 700 nm is optional. ^e Explanatory label (outline) according to IEC 60825-1, Figure 4. It is permitted for this outline to also encompass the hazard symbol according to Figure 3 of IEC 60825-1.	

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Table 2 – Marking in restricted locations

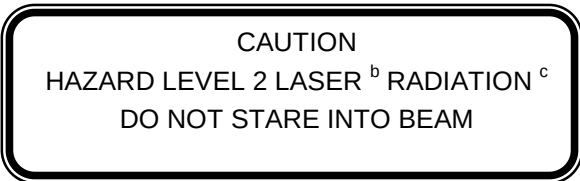
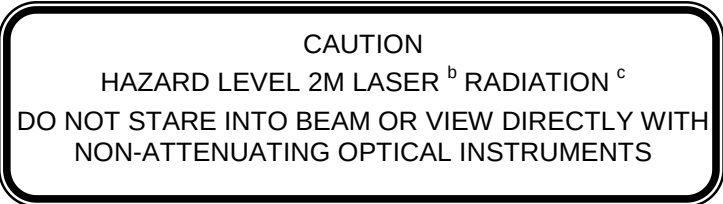
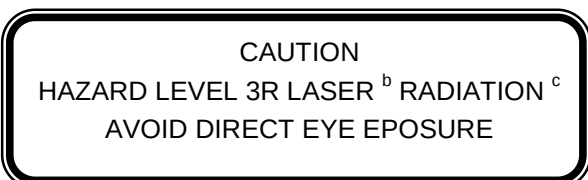
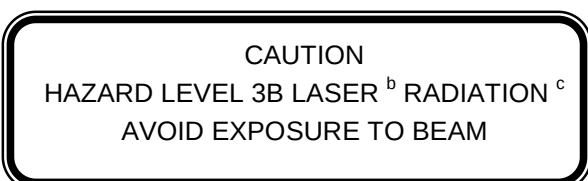
Accessible hazard level	Required Marking - Restricted Location
1	No marking required
1M	Marking required only for those cases where the requirements for cable connectors in unrestricted locations are not met (see 4.4.2), but also see NOTE 2 below:  CAUTION HAZARD LEVEL 1M LASER ^b RADIATION ^c DO NOT VIEW DIRECTLY WITH NON-ATTENUATING OPTICAL INSTRUMENTS 
2	 CAUTION HAZARD LEVEL 2 LASER ^b RADIATION ^c DO NOT STARE INTO BEAM 
2M	 CAUTION HAZARD LEVEL 2M LASER ^b RADIATION ^c DO NOT STARE INTO BEAM OR VIEW DIRECTLY WITH NON-ATTENUATING OPTICAL INSTRUMENTS 
3R	 CAUTION HAZARD LEVEL 3R LASER ^b RADIATION ^c AVOID DIRECT EYE EPOSURE 
3B	Not permitted.
NOTE 1 Where the accessible radiation at points of disconnection is hazard level 1 or hazard level 1M, it is permitted for this to be noted in information for the user instead of as a marking on (e.g.) the product, fibre or connector.	
NOTE 2 See 4.5.5 regarding invisible laser beam hazards.	
^a Warning label according to Figure 3 of IEC 60825-1. ^b Where the source of the radiation is a light emitting diode, the word "Laser" above shall be replaced by "LED". ^c If the radiation is in the range 400 nm to 700 nm it is optional to replace the word "Radiation" with "Light". ^d Explanatory label (outline) according to Figure 4 of IEC 60825-1. It is permitted for this outline to also encompass the hazard symbol according to Figure 3 of IEC 60825-1.	

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Table 3 – Marking in controlled locations

Accessible hazard level	Required Marking - Controlled Location	
1	No marking required	
1M	No marking required ^e	
2		
2M		
3R		
3B		
NOTE See 4.5.5 regarding invisible laser beam hazards.		
^a Warning label according to Figure 3 of IEC 60825-1. ^b Where the source of the radiation is a light emitting diode, the word "Laser" above shall be replaced by "LED". ^c If the radiation is in the range 400 nm to 700 nm it is optional to replace the word "Radiation" with "Light". ^d Explanatory label (outline) according to Figure 4 of IEC 60825-1. It is permitted for this outline to also encompass the Hazard Symbol according to Figure 3 of IEC 60825-1. ^e It is recommended but not required to identify those connectors having an optical output by using the warning label according to Figure 3 of IEC 60825-1.		

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411 4.5.2 Marking of connectors of optical transmitters and optical amplifiers

412 For connectors of optical transmitters and optical amplifiers in each of which optical port, or group of
 413 ports (see 4.5.3) that may be connected to an optical fibre, the requirements of 4.5.1 are modified as
 414 below.

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