

Australian/New Zealand Standard™

Safety of laser products

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



AS/NZS 2211.2:2006

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Australian/New Zealand Standard™

Safety of laser products

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

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-019, Personal Protection Against Laser Radiation to supersede AS/NZS 2211.2:1997, *Laser safety, Part 2: Safety of optical fibre communication systems*.

The Standard is identical with and has been reproduced from IEC 60825-2: Ed.3.0 2005, *Safety of laser products, Part 2: Safety of optical fibre communication systems* (OFCS).

The objective of this Standard is to provide 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 equipments or at greater distance from the optical systems.

The term ‘informative’ has been used in this Standard to define the application of the annex to which it applies. An ‘informative’ annex is only for information and guidance.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number appears on the cover and title page while the International Standard number appears only on the cover.
- (b) In the source text, ‘this Part 2 of IEC 60825’ should read ‘this Australian/New Zealand Standard’.
- (c) A full point should be substituted for a comma when referring to a decimal marker.

References to International Standards should be replaced by references Australian Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
IEC		AS/NZS	
60825	Safety of laser products	2211	Safety of laser products
60825-1	Part 1: Equipment classification, requirements and user’s guide	2211.1	Part 1: Equipment classification, requirements and user’s guide (IEC 60825-1:2001, MOD)

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AUSTRALIAN/NEW ZEALAND STANDARD

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*¹⁾
 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.

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

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

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

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 organization responsible for that alteration shall make a determination of whether each alteration could affect the hazard level. If the hazard level has changed, the organization responsible for the alteration(s) shall re-label those locations in the system that are accessible so as to ensure continued compliance with this standard.

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 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 standard. These actions could for example involve restriction of access to the location, or the implementation of safety features or redesign of the optical communications system to reduce the hazard level.

Suppliers of active components and subassemblies in conformance with this standard that do not comprise an OFCS need to comply only with the applicable portions of Clause 4.

OFCS that also transmit electrical power shall meet the requirements of this standard in addition to any applicable electrical standard.

NOTE When determining the hazard level, two characteristics have to be taken into account.

1) What is the maximum permissible exposure (MPE)? The level of exposure must be determined at a location where it is reasonably foreseeable that a person could be exposed to radiation coming from the OFCS. The time taken for the APR system (if present) to operate must be included when determining the MPE. If the OFCS does not incorporate APR, then meeting the requirements referred to in Note 2 below will be taken as automatically meeting the requirements of this Note 1 without further investigation or tests. Requirements are described in 4.8.2.

2) What is the maximum permitted power at which the OFCS can operate after a reasonable foreseeable event (such as a fibre-break) has caused the radiation to become accessible? This maximum 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 4.8.1.

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 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

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.

4.4.1 Unrestricted locations

In unrestricted locations, if the radiation level exceeds the accessible emission limits of:

- Class 2 within the wavelength range 400 nm to 700 nm, or
- Class 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 4.9.1).

4.4.2 Restricted locations

In restricted locations, if the radiation level exceeds the accessible emission limits of:

- Class 2M within the wavelength range 400 nm to 700 nm, or;
- Class 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 higher (see 4.9.2).

4.4.3 Controlled locations

In controlled locations, if the radiation level exceeds the accessible emission limits of:

- Class 2M within the wavelength range 400 nm to 700 nm, or;
- Class 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 4.9.3).

4.5 Automatic power reduction (APR) and restart pulses

If equipment makes use of an automatic power reduction (APR) system in order to reduce its assigned hazard level, then it shall be restarted with restrictions which are described in the following three scenarios. In addition, the APR shall be designed to have an adequate level of reliability (see Note 1).

NOTE 1 Examples of calculating the reliability of APR systems are given in Clause D.5.

NOTE 2 The restart interval described in the following scenarios is wavelength-dependent as described in IEC 60825-1.

4.5.1 Automatic restart

In the case where the restart is initiated automatically, the timing and power of the restart process shall be restricted such that the hazard level assigned to each accessible location of the system shall not be exceeded.

4.5.2 Manual restart with assured continuity

In the case where the restart is initiated manually and the continuity of the communications path is assured by the use of administrative controls or other means, the timing and power of the restart process is not restricted (see Note 3). The manufacturer's instructions shall specify that administrative controls (or other means) must take account of the fact that the assigned hazard level at any accessible location may be exceeded during this restart procedure.

NOTE 3 Since in this case the timing and power of the restart process is not restricted, the administrative or other controls will need to take into consideration any increased risk of new hazards (such as fire). It is important that these additional controls be documented in the appropriate service instructions.

4.5.3 Manual restart without assured continuity

In the case where the restart is initiated manually and the continuity of the communications path is not assured, the timing and power of the restart process shall be restricted such that the hazard level assigned to each accessible location of the system shall not be exceeded.

4.5.4 Disabling of the APR

If a manual initiated restart of the system temporarily inactivates the APR, the system must indicate that the APR is not operable for the duration of the reboot so that the operating organization can take the appropriate precautions. Unless these conditions are met, the hazard level must be assigned using the transmitting power level before APR.

Disabling of the APR mechanism shall not be permitted for Class 3B and 4 transmitting powers, unless all of the following conditions are met:

- 1) that such disabling is necessary only for the infrequent incidences of system installation and service;
- 2) that such disabling can only be done via software commands or a manual lockout key system;
- 3) if disabling is done via software commands, incorporated in such software shall be a security system that prevents inadvertent disabling of the APR mechanism;
- 4) that such software incorporate a warning indicator that the APR will be disabled if the procedure is continued;
- 5) continuous operation of the traffic-carrying OFCS with APR disabled shall be prevented by suitable engineering means;
- 6) proper instructions on the safe use of the equipment with the disabled APR are included in the documentation.

NOTE 1 Except where otherwise explicitly stated, this standard does not permit end-to-end OFCS to operate if accessible locations within that system are hazard level 4. If the transmitting power of a transmitter, amplifier, etc. is Class 4 and the APR has been disabled, then the result would be accessible locations operating at hazard level 4. Nevertheless, it is recognised that it may be necessary to disable the APR in certain conditions, but these conditions need to be well controlled and time-limited so that the probability of exposure to a Class 4 radiation is very low.

NOTE 2 Regarding condition 5), an example of a 'suitable engineering means' is a control system that automatically re-enables the APR as soon as practicable after a time interval that is long enough to complete whatever task that caused the APR to be initially deactivated.

4.6 Labelling or marking

4.6.1 General requirements

Except as identified below, 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 marking shall be coloured yellow with the imprint of the warning label according to IEC 60825-1 and the explanatory label in IEC 60825-1. If XX is the hazard level assigned to the location, then the explanatory text shall bear the words "hazard level XX". It is permitted to reduce the marking in size, provided that the result is legible. For network elements containing laser or optical amplifiers, it is the responsibility of the manufacturer of the network element to provide such labelling; all other labelling is the responsibility of the operating organization.

Labelling or marking is not required in:

- unrestricted locations for hazard level 1M or 2M;
- restricted locations for hazard level 1M or 2M, if the requirements for cable connectors in unrestricted locations are met (see 4.4.1);
- controlled locations for hazard level 1M or 2M.

NOTE 1 Unlike the labelling requirements of IEC 60825-1, marking in restricted locations is mandatory for locations with hazard level 1M, except as identified above.

NOTE 2 In unrestricted locations, hazard level 1M or 2M is exempt from this requirement, because access to radiation from a connector is limited to hazard level 1 by suitable means (see 4.4.1) and the mechanical design of the fibre cables must be consistent with the relevant standard within the IEC 60794 series (see 4.3).

NOTE 3 In controlled locations, hazard level 1M or 2M is exempt from this requirement, because accessibility is limited to personnel with appropriate laser safety training (see definition 3.13).

4.6.2 Marking of connectors of optical transmitters and optical amplifiers

For connectors of optical transmitters and optical amplifiers, the requirements of 4.6.1 apply. Additionally the explanatory text shall bear a statement of the maximum output of laser radiation (after operation of the APR function, where applicable) and the associated wavelength or wavelength range.

4.6.3 Markings for groups of connectors

Groups of connectors such as patch panels may be marked as a group, with just a single clearly visible location hazard level marking, rather than having each connector individually marked. If a group of connectors is housed within an enclosure and it is a foreseeable event that exposure to optical radiation above hazard level 1M could result from accessing the enclosure, then a marking shall be clearly visible both before and after the access panel is removed. This may require the use of more than one marking.

4.6.4 Indelibility requirements for safety markings

Any marking required by this standard shall be durable and legible. In considering the durability of the marking, the effect of normal use shall be taken into account.

Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit. After this test, the marking shall be legible; it shall not be possible to remove marking labels easily and they shall show no curling.

The petroleum spirit to be used for the test is aliphatic solvent hexane having a maximum aromatic content of 0,1 % by volume, a kauributanol value of 29, an initial boiling point of approximately 65 °C, a dry point of approximately 69 °C and a mass per unit volume of approximately 0,7 kg/l.

NOTE The above requirement and test is identical to that contained in 1.7.13 of IEC 60950-1 [13]².

4.7 Organizational requirements

4.7.1 Manufacturers of ready-to-use OFCS, turn key systems or subassemblies

Manufacturers of OFCS, turnkey end-to-end systems or subassemblies shall:

- 1) ensure that the equipment satisfies the applicable requirements of this standard;
- 2) provide the following information:
 - a) adequate description of the engineering design features incorporated into the product to prevent exposure to radiation above the MPE levels;
 - b) adequate instructions for proper assembly, maintenance and safe use including clear warnings concerning precautions to avoid possible exposure to radiation above the MPE levels;

² Figures in square brackets refer to the Bibliography.

- c) adequate instructions to installation organizations and service organizations to ensure the product can be installed and serviced in a manner that the radiation accessible under reasonably foreseeable events meets the requirements of Clause 4;
- d) the hazard levels at accessible locations within the system or subassembly and the parameters upon which those hazard levels are based;
- e) for systems with APR:
 - the reaction time and operating parameters of the APR;
 - where installation or service requires overriding an APR, information shall be included to enable the operating organization to specify safe work practices while the APR is overridden and safe procedures reinstating and testing such systems;
 - if a manual initiated restart temporarily inactivates the APR, the timing of the restart shall be stated clearly in the user manual;
 - all scenarios (e.g. removal or failure of a controller or other element) where the APR would not be operable including appropriate precautions that need to be taken under such conditions.
- f) any other information relevant to the safe use of the OFCS;
- g) a statement that the equipment must be installed according to the manufacturer's instructions, including the warning "CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure."

4.7.2 Installation and service organization

The organization responsible for the installation and servicing of OFCS shall follow the manufacturer's instructions for installation of equipment in a manner that will ensure that the accessible radiation under reasonably foreseeable events satisfies the requirements of Clause 4.

Before placing an OFCS into service, the installation organization or service organization, as applicable, shall ensure that APR, if used, is in appropriate working condition as designated in 4.5 and 4.8.

For systems with accessible locations other than hazard level 1 or 2, the installation organization and/or the service organization shall:

- a) provide adequate laser safety training of personnel responsible for carrying out installation and service activities;
- b) ensure that suitable access controls and warning labels are employed on controlled and restricted locations.

4.7.3 Operating organization

The operating organization has the ultimate responsibility for the safety of the end-to-end system. This includes, especially:

- a) identification of the location type at all accessible locations of the entire OFCS;
- b) ensuring that the hazard levels are not exceeded for those location types under reasonably foreseeable events;

- c) ensuring that installation and service is performed only by organizations with the capability of satisfying the requirements of 4.2 to 4.9;
- d) ensuring that access to restricted and controlled locations is appropriately addressed with respect to laser safety;
- e) ensuring continuous compliance with system manufacturing, operating, installation, service and safety requirements.

4.8 Assessment of hazard level

4.8.1 Determination of hazard level

The hazard level is determined by the measurement of the optical radiation that could become accessible following any reasonably foreseeable event (e.g. fibre break) during operation and maintenance. The methods for the determination of compliance with the specified radiation limit values are the same as those described for classification in IEC 60825-1. Measurements need to be taken under the appropriate conditions, e.g. simulated fibre cable break, and shall be based on the relevant clauses in IEC 60825-1.

The assessment of the hazard level with and without automatic power reduction shall take place:

- 1 s after the reasonably foreseeable event for unrestricted locations, unless measurement at a later time would result in a larger exposure;
- 3 s after the reasonably foreseeable event for restricted and controlled locations, unless measurement at a later time would result in a larger exposure.

In circumstances where it is difficult to carry out direct measurements, an assessment of hazard level based on calculations is acceptable. For example, the knowledge of the laser or amplifier power and fibre attenuation may allow an assessment of the hazard at any particular location.

For OFCS with automatic power reduction, the hazard level will be determined by the accessible emission (pulse or continuous wave) after the time interval given above (1 s for unrestricted locations, 3 s for restricted locations or controlled locations). Additionally, the MPE requirement in 4.8.2 shall be satisfied.

4.8.2 Impact of using automatic power reduction features

Where the OFCS uses an automatic power reduction feature to meet the limits of a hazard level that is lower than that which would have to be assigned if no automatic power reduction feature would be present, the irradiance or radiant exposure during the maximum time to reach the lower hazard level specified in 4.8.1 (1 s for unrestricted, 3 s for restricted or controlled locations) shall not exceed the irradiance or radiant exposure limits (MPE). For controlled locations the measurement distance is 250 mm for this subclause only.

4.8.3 Conditions for tests and assessment

Tests and assessments shall be carried out under reasonably foreseeable fault conditions.

In some complex systems (e.g. where the optical output is dependent on the integrity of other components and the performance of circuit design and software), it may be necessary to use other recognised methods for hazard/safety assessment (see Annex C).

However, faults which result in the emission of radiation in excess of the hazard level need not be considered if:

- they are for a limited duration only; and
- it is not reasonably foreseeable that human access to the radiation will occur before the product is taken out of service.

4.9 Hazard level requirements by location type

The required hazard level shall be determined for each accessible location within an OFCS.

NOTE 1 This includes access to optical fibres that can become broken.

NOTE 2 This standard is applicable for the operation and maintenance of OFCS. For the safety of the user, hazard level 4 is not allowed throughout the standard. Where systems employ normal transmitting power levels exceeding the acceptable hazard level for the particular location type, protection systems such as automatic power reduction may be used to determine the actual hazard level.

4.9.1 Unrestricted access locations

At a location with unrestricted access the hazard level shall be 1, 1M, 2 or 2M.

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.

4.9.2 Restricted access locations

At a location with restricted access the hazard level shall be 1, 1M, 2, 2M or 3R.

NOTE 1 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 respectively.

NOTE 2 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.

4.9.3 Controlled access locations

At a location with controlled access the hazard level shall be 1, 1M, 2, 2M, 3R or 3B.