

INTERNATIONAL STANDARD



Fibre optic interconnecting devices and passive components – Performance standard –
Part 1: General and guidance ~~for performance standards~~



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IEC 61753-1

Edition 2.0 2018-08
REDLINE VERSION

INTERNATIONAL STANDARD



Fibre optic interconnecting devices and passive components – Performance standard –
Part 1: General and guidance ~~for performance standards~~

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.180.20

ISBN 978-2-8322-5970-2

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC INTERCONNECTING DEVICES AND
PASSIVE COMPONENTS – PERFORMANCE STANDARD –****Part 1: General and guidance ~~for performance standards~~**

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.
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International Standard IEC 61753-1 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2007. It constitutes a technical revision.

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

- a) definitions updated with new products: wall outlets, wall or pole mounted boxes, splices, ODF modules, street cabinets, hardened connectors and field mountable connectors;
- b) categories U and O are replaced by categories OP and OP+. No mandatory sequence in category OP+. Category OP+ contains the tests from category OP with the addition of only 4 other tests;
- c) addition of Category I (Industrial);
- d) temperature ranges added (with the HD suffix to the categories C, OP, OP+ and I) in case passive optical components are placed in a housing together with active electronics (HD stands for "heat dissipation");
- e) the height of category A changed from 3 m to ground level (0 m);
- f) the lower level height of category G environment changed from ground level (0 m) to –1 m below ground level. Upper level remains at 3 m above ground level;
- g) addition of performance tests, test severities and performance criteria for new products: Wall outlet, wall or pole mounted boxes, mechanical splices, fusion splice protectors, ODF modules, street cabinets, field mountable connectors and hardened optical connectors;
- h) test severity of "Mating durability" test for connectors in categories C, OP, OP+ and I is reduced to 200 cycles for connectors with cylindrical ferrules and 50 cycles for connectors with rectangular ferrules;
- i) test severity of "Change of temperature" test for connectors and passive optical components in category I is reduced from 20 cycles to 12 cycles (harmonized with connectors and components from other categories);
- j) test severity of "Flexing of strain relief" test for connectors in categories C, OP and OP+ is reduced to 50 cycles;
- k) test severities of "Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures" test for all enclosures is reduced to 5 cycles;
- l) test severities of "Change of temperature" test for all protective housings in categories C, A, G and S is reduced from 20 cycles to 12 cycles (harmonized with connectors and components);
- m) test severities of "Resistance to solvents and contaminating fluids" test for closures in categories G and S changed – kerosene is removed, diesel oil exposure reduced to 1 h immersion and 24 h drying at room temperature;
- n) sealing performance criteria of sealed closures for categories G and A are reduced to 20 kPa overpressure.
- o) the change in attenuation criterion for connectors has changed from peak-to-peak into a +/- deviation from the original value of the transmitted power at the start of the test (harmonized with the change in attenuation criterion for components, splices and protective housings).

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

FDIS	Report on voting
86B/4131/FDIS	86B/4137/RVD

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

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

A list of all parts in the IEC 61753 series, published under the general title *Fibre optic interconnecting devices and passive components – Performance standard*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

The contents of the corrigendum of May 2019 have been included in this copy.

INTRODUCTION

The IEC 61753 series is dealing with performance standards for all passive fibre optic products, including connectors, passive optical components, fibre management systems and various protective housings. The standard is published in multiple parts. This part, Part 1, covers general information on performance standards. Subsequent parts are known as performance standards and are numbered according to the classification defined in Annex B. These standards contain the minimum test and measurement severities which are common to all passive fibre optic products, for a particular service environment or performance category, and the test and measurement severities which are considered specific to that particular product in that environment.

Performance Standards define the requirements for standard optical performance under a set of specified conditions. Each standard contains a series or a set of tests and measurements with clearly stated conditions, severities and pass/fail criteria. The series of tests, commonly referred to as an operating service environment or performance category, is intended to be run on a 'one-off' basis to prove the product's ability to satisfy the requirements of a specific application, market sector or user group.

This document define those sets of tests which form each operating service environment or performance category and which have been standardised for international use. A product that has been shown to meet all the requirements of a performance standard ~~may~~ can be declared as complying with that performance standard.

Products having the same classification from one manufacturer that satisfy a performance standard, will operate within the boundaries set by the performance standard. Intermateability or interchangeability of products from different suppliers (having the same classification and conforming to the same performance standard) can only be guaranteed when these products also meet the interface standards. Only in this condition will an equivalent level of performance be provided when they are used together (for example, in the case of optical connectors).

Conformance to a performance standard is not a guarantee of lifetime assured performance or reliability. Reliability testing ~~must be~~ is the subject of a separate test schedule, where the tests and severities selected are truly representative of the requirements of this reliability test programme. Consistency of manufacture ~~should~~ will be maintained using a recognised quality assurance programme whilst the reliability of product ~~should~~ will be evaluated using the procedures recommended in IEC 62005 (all parts).

Tests and measurements are selected from IEC 61300 (all parts). Where this is not possible, the required test method is attached as an annex to the performance standard.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 1: General and guidance ~~for performance standards~~

1 Scope

This part of IEC 61753 ~~deals with~~ provides guidance for the drafting of performance standards for all passive fibre optic products, ~~including connectors, passive optical components, fibre management systems and closures. The IEC 61753 series is published in multiple parts.~~

~~This Part 1 covers general information on performance standards.~~ This document defines the tests and severities which form the performance categories or general operating service environments and identifies those tests which are considered to be product specific. Test and severity details are given in Annex A. ~~Part 1 also includes references, definitions and rules for creating a performance standard, together with informative annexes, such as a description of test sequencing given in Annex B, and other pertinent information.~~

~~Subsequent parts which form IEC 61753 are known as performance standards and are numbered according to the classification defined in Annex C. These standards contain the minimum test and measurement severities which a specific product must satisfy, in order to be categorized as meeting the requirements for use in a particular service environment. A product performance standard will contain a combination of those tests and measurements which are common to all passive fibre optic products, for a particular service environment or performance category, and those which are considered specific to that particular product in that environment.~~

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60529, *Degrees of protection provided by enclosures (IP Code)*

~~IEC 60590, *Determination of the aromatic hydrocarbon content of new mineral insulating oils*~~

IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

IEC 61300-2-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-1: Tests – Vibration (sinusoidal)*

IEC 61300-2-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-2: Tests – Mating durability*

IEC 61300-2-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre/cable retention*

IEC 61300-2-5, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-5: Tests – Torsion/Twist*

IEC 61300-2-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-6: Tests – Tensile strength of coupling mechanism*

IEC 61300-2-7:~~1995~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-7: Tests – Bending moment*

IEC 61300-2-9, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-9: Tests – Shock*

IEC 61300-2-10:~~1995~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-10: Tests – Crush resistance*

IEC 61300-2-11:~~1995~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-11: Tests – Axial compression*

IEC 61300-2-12, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-12: Tests – Impact*

IEC 61300-2-17, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-17: Tests – Cold*

IEC 61300-2-18, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-18: Tests – Dry heat – High temperature endurance*

IEC 61300-2-19, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-19: Tests – Damp heat (steady state)*

IEC 61300-2-21, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-21: Tests – Composite temperature/humidity cyclic test*

IEC 61300-2-22, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*

IEC 61300-2-23, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-23: Tests – Sealing for non-pressurized closures of fibre optic devices*

IEC 61300-2-26, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-26: Tests – Salt mist*

IEC 61300-2-27, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-27: Tests – Dust – Laminar flow*

IEC 61300-2-28, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-28: Tests –~~Industrial~~ Corrosive atmosphere (sulphur dioxide)*

IEC 61300-2-33, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-33: Tests – Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures*

IEC 61300-2-34, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-34: Tests – Resistance to solvents and contaminating fluids of interconnecting components and closures*

IEC 61300-2-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-35: Tests – Cable nutation*

IEC 61300-2-37, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-37: Tests – Cable bending for fibre optic closures*

IEC 61300-2-38, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-38: Tests – Sealing for pressurized ~~closures of~~ fibre optic ~~devices~~ closures*

IEC 61300-2-42, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-42: Tests – Static side load for ~~connectors~~ strain relief*

IEC 61300-2-44, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-44: Tests – Flexing of the strain relief of fibre optic devices*

IEC 61300-2-45, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-45: Tests – Durability test by water immersion*

IEC 61300-2-46, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-46: Tests – Damp heat, cyclic*

~~IEC 61300-2-48, Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-48: Tests – Temperature humidity cycling~~

~~IEC 61300-2-49, Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-49: Tests – Connector Installation test~~

IEC 61300-2-50, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-50: Tests – Fibre optic connector proof test with static load – Singlemode and multimode*

~~IEC 61300-2-51 Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-51: Tests – Fibre optic connector test for transmission with applied tensile load – singlemode and multimode~~

IEC 61300-3-3, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-3: Examinations and measurements – Active monitoring of changes in attenuation and return loss*

IEC 61300-3-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation*

IEC 61300-3-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

IEC 61300-3-7, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-7: Examinations and measurements – Wavelength dependence of attenuation and return loss of single mode components*

IEC 61300-3-28, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-28: Examinations and measurements – Transient loss*

IEC 61300-3-29, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-29: Examinations and measurements – Spectral transfer characteristics of DWDM devices*

IEC 61300-3-34, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-34: Examinations and measurements – Attenuation of random mated connectors*

IEC 61300-3-45, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-45: Examinations and measurements – Attenuation of random mated multi-fibre connectors*

IEC Guide 109, *Environmental aspects – Inclusion in electrotechnical product standards*

~~ISO 1998 (all parts), Petroleum industry – Terminology~~

ISO 1998-1:1998, *Petroleum industry – Terminology – Part 1: Raw materials and products*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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>

NOTE Terms and definitions for various components can be found in IEC TS 62538 and in the relevant IEC 61753 series performance standards ~~or generic specification~~.

3.1

adaptor

component that permits mating between a connector and another optical component

Note 1 to entry: Another optical component is a connector plug, an active device, a passive optical component.

3.2

box

free breathing housing that is permanently fixed to a wall or pole

Note 1 to entry: A box is not specifically designed to allow cable movement (e.g. torsion, bending) at the cable ports during operation.

3.3

connector

component normally attached to a cable or piece of apparatus for the purpose of providing interconnection and disconnection of fibre optic cables

3.4

fibre management system

FMS

system to control, protect and store splices, connectors, passive optical components and fibres from incoming to outgoing cables

Note 1 to entry: Splice trays or organiser trays are parts of a fibre management system.

3.5

fibre splice

permanent or separable joint between optical fibres achieved by either fusion splicing or mechanical splicing

3.6**field mountable connector****FMC**

connector which is mounted directly onto fibre or fibre cable in the field

3.7**free breathing closure**

protective housing that allows a free exchange of air with the environment

Note 1 to entry: A free breathing closure may look like a sealed closure, but it is not designed to hold a varying overpressure or underpressure caused by temperature changes or atmospheric pressure changes. Free breathing closures are used in aerial environments for the interconnection of cables.

Note 2 to entry: Limited water ingress and/or limited dust ingress is possible. Free breathing closures are not intended for use in areas that are subject to flooding or water immersion.

3.8**hardened fibre optic connector**

water and dust tight connector

Note 1 to entry: A hardened fibre optic connector is typically used as connection in outside plant.

3.9**MICE**

classification system that describes the environment conditions that are local to a channel based upon the following factors:

- mechanical (M),
- ingress (I),
- climatic and chemical (C),
- electromagnetic (E)

Note 1 to entry: The term MICE is referenced in the generic cabling standards produced by ISO/IEC JTC1 SC25 and relates to the classification of the environment local to the cabling channel.

There are four primary environmental criteria used to classify an environment:

- the M element, defining the mechanical characteristics of the environment;
- the I element, defining the ingress protection characteristics of the environment;
- the C element, defining the climatic and chemical characteristics of the environment;
- the E element, defining the electromagnetic characteristics of the environment.

Each of the four primary environmental criteria is further divided into specific parameters and levels for those parameters. The MICE classification for a given location is therefore defined as MalbCcEd where a, b, c and d are the individual sub-classifications (levels) for the M, I, C and E criteria respectively.

The suffices for the four primary environmental criteria are either 1, 2 or 3. For example, the most benign environment is described as M1I1C1E1 whereas the most harsh environment would be defined as M3I3C3E3.

Note 2 to entry: The E element is considered not relevant to passive optical components.

[SOURCE: ISO/IEC 24702:2006, 3.1.11, modified – The notes have been added.]

3.10**optical distribution frame module****ODF module****ODFM**

housing which is mountable in a supporting structure

Note 1 to entry: An ODFM contains a fibre management system and can provide rearrangeable interconnections between the incoming to the outgoing cables.

Note 2 to entry: The supporting structure that houses the ODFM is often called an equipment rack.

3.11

operating service environment

typical service environment or operating location simulated by a performance category

3.12

performance category

series of tests and measurements ~~(which may or may not be grouped into a specific sequence)~~ with clearly stated conditions and severities, which are chosen to simulate a particular operating service environment

3.13

performance standard

standard which is designed to verify that a product is capable of meeting the requirements of a particular service environment

Note 1 to entry: A performance standard contains a combination of those tests, together with their severities and pass-fail criteria, which ~~shall be~~ are applied to all passive fibre optic products for a particular performance category, together with those which are considered specific to that particular product in that environment.

3.14

performance standard test report

report to be produced on completion of testing to a performance standard

3.15

product specific tests

tests which are considered to be specific to a particular product category or type, ~~e.g. connectors, attenuators, enclosures for aerial applications~~

Note 1 to entry: Where there is a specific IP requirement for a product, this ~~shall be~~ is the subject of a separate test and ~~shall be~~ is included in the relevant product performance standard.

Note 2 to entry: Where there is a specific requirement for a product, this is the subject of a separate test and is included in the relevant product performance standard.

3.16

protective housing

indoor and outdoor housing utilised for the storage, distribution or protection of one or more cable joints or any passive or active telecom equipment

Note 1 to entry: Examples of protective housings: wall boxes, cabinets, cases, optical distribution frame sub racks, closures or pedestals as shown in Figure 1. A closure can be either a "sealed closure" or a "free breathing closure".

Note 2 to entry: The protective housing contains a fibre management system.

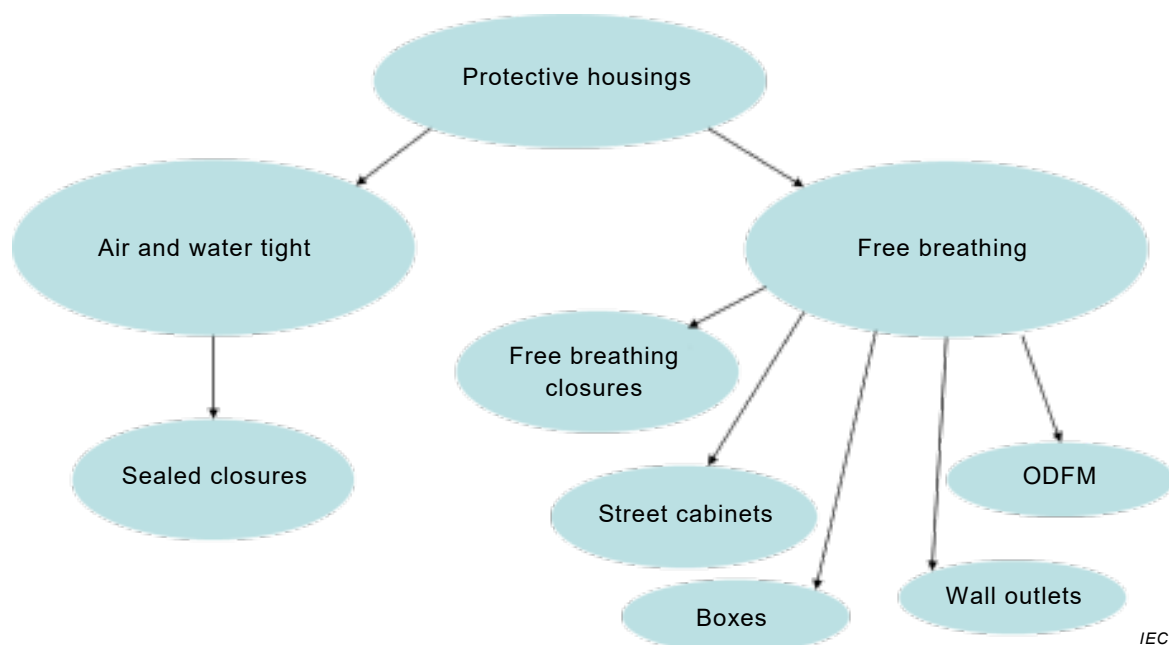


Figure 1 – Relationship between various protective housing types

3.17

sealed closure

watertight and dust-tight housing that can hold a varying overpressure or underpressure caused by temperature changes or atmospheric pressure changes

Note 1 to entry: There is no exchange of air with the outside environment when exposed to temperatures over the specified operating temperature range.

Note 2 to entry: Although often referred to as hermetic sealed closures, humidity can enter the inner closure by diffusion.

Note 3 to entry: Sealed boxes or sealed wall outlets shall be treated as sealed closures.

Note 4 to entry: Complete inner filled housings are also considered to be sealed closures.

3.18

street cabinet

free outdoor breathing above ground-installed housing that is permanently attached to the ground

Note 1 to entry: A street cabinet is permanently fixed to the ground and is not specifically designed to allow cable movement (e.g. torsion, bending) during operation.

3.19

wall outlet

free breathing housing with fixed connecting devices where the horizontal cable terminates

Note 1 to entry: The wall outlet provides the interface to work area cabling.

4 Abbreviations

FMC	field mountable connector
FMS	fibre management system
ODFM	optical distribution frame module

5 Preparation of a performance standard

~~In the preparation of a performance standard, the following items shall be considered and defined, together with any relevant instructions pertaining to them.~~

5.1 Performance standard title

The performance standard title shall be clear. This information shall include

- the product description,
- the appropriate performance category, and
- any other variant or differentiation information to distinguish it from other performance standards.

5.2 Tests

The tests to be carried out on the product in order for it to meet the performance standard shall be clearly defined, including those which are product specific. No ambiguity or options shall be allowed.

The selected tests combined with the severities/durations, groupings/sequencing, method used and pass/fail criteria shall be indicative of a defined operating service environment.

The test method to be used shall be clearly defined for each test. Wherever possible, the test method shall be selected from the IEC 61300 (all parts), but where this is not possible other test methods may be defined. If an undefined test method is used, the test method and details to be specified shall be included in the appropriate annex of the performance standard.

Performance standards may call up additional tests that may be needed to fully characterise a particular connector or component.

~~Impact on the environment shall be carefully considered when specifying the test methods on the products, covered by this standard.~~

5.3 Details

The details to be considered (severities and durations) shall be given for all tests and measurements defined in a performance standard. They shall be directly related to the performance requirements defined by the operating service environment. No ambiguity or options ~~shall be~~ are allowed.

5.4 Requirements

The performance requirements that ~~must~~ shall be satisfied in order for the product to comply with the performance standard shall be specified for each test and/or measurement. No ambiguities ~~shall be~~ are allowed.

5.5 Sample size

The sample size for each test shall be defined in the appropriate annex of the performance standard. No deviations ~~shall be~~ are allowed.

5.6 Sample definition

The sample to be tested shall be defined in the relevant performance standard.

5.7 Groupings/sequences

~~Test groups and test sequences shall be defined in the appropriate annex of the performance standard as required by the user, user group or manufacturer.~~

In general, no sequencing is required and each test is intended to be performed individually. When applicable, test groups and test sequences can be required by the user, user group or manufacturer.

5.8 Pass/fail criteria

Where required by the performance category, the pass/fail criteria shall be unambiguously stated for each test within the performance standard. No deviation or exceptions ~~shall be~~ are allowed.

5.9 Reference product definition

Where a performance standard requires the use of a reference product or component, the reference product shall be clearly defined in the appropriate annex of the performance standard.

5.10 Performance standard test report

Conformance to a performance standard shall be supported by a test report. The test report shall clearly demonstrate that the tests were carried out in accordance with the requirements of the performance standard and provide full details of the tests together with a pass/fail declaration. All test and measurement requirements shall be satisfied before a component may be declared to be in compliance with the performance standard.

The failure of any product to comply with a particular test or sequence of tests shall be reported in the performance standard test report. An analysis of the cause of the failure shall be undertaken and any corrective actions taken shall be described.

If no design changes are made to the product, the test or test sequence where the failure occurred shall be rerun with the results of both tests reported.

If design changes are made, another complete performance standard test programme shall be undertaken. Any tests previously completed successfully shall be repeated with new samples.

6 Environmental aspects

The requirements concerning the reduction of adverse environmental impacts over the whole life cycle of products are not ~~subject to~~ covered in this document. The appropriate environmental aspects shall be implemented according to the guidelines in IEC Guide 109.

Annex A (normative)

Tests, severities and criteria for performance standards

A.1 Introduction General

Annex A defines the tests, the recommended severities, and the recommended performance criteria for the various performance categories, which ~~simulate~~ reflect ~~each of~~ the operating service environments applicable to passive fibre optic products. The list of the operating service environments is given in Table A.1 and Table A.2.

The performance standards of the following components are covered by this document:

- fibre optic connectors and adaptors;
- field mountable connectors (FMC);
- splices (fusion splice protectors and mechanical splices);
- passive optical components;
- fibre management systems (FMS);
- hardened connectors.

The performance standards of the following protective housings are covered by this document:

- wall outlets (indoor applications only);
- boxes (wall mounted and pole mounted);
- street cabinets;
- optical distribution frame modules (ODFM);
- closures (sealed closures and free breathing closures).

The choice of tests and associated severities in each performance category is based upon a harmonized set of requirements determined to be appropriate for that category. The set of tests that form a particular performance category, given in Tables A.3 to A.15, are a combination of common tests, which are applicable to all fibre optic product types, and product specific tests.

Those tests which constitute a performance category form a minimum set of testing requirements. It is recognised that additional tests may often be necessary to fully characterize a particular component or connector.

The outdoor environmental conditions are derived from IEC 60721-2-1. The following climate types are covered for categories E, OP+, A, G and S:

- cold;
- cold temperate;
- warm temperate;
- warm dry;
- mild warm dry;
- extremely warm dry;
- warm damp;
- warm damp, equable.

For category OP, the following climate types are covered (the "cold" environments are excluded):

- cold temperate;
- warm temperate;
- warm dry;
- mild warm dry;
- extremely warm dry;
- warm damp;
- warm damp, equable.

All of the performance categories contained in this Annex A are applicable to single mode and multi mode fibre optic transmission. The minimum performance acceptance criteria and requirements for connectors, mechanical splices, passive optical components, fibre management systems and various types of enclosures are given in Tables A.16 to A.28. The choice of which values to include in the performance standard test schedules will depend on the system type and the required performance level.

~~Category O is a sequential series of tests. The tests in Tables A.4a and A.4b are shown in the order in which the tests shall be run. An explanation of the test sequencing for category O is given in Annex B.~~

The indicated minimum and maximum temperature limits include the thermal effects caused by solar radiation or surface radiation during cloudless nights. There is a possibility that in environmental categories C, I, OP and OP+ the products are situated in a site or location together with active electronics which generate heat. In this document, such situations are called "sites with heat dissipation". In these circumstances, the maximum upper temperature limit is extended as listed in Table A.2. For category C^{HD}, the temperature is increased from +60 °C to +70 °C. For the outdoor categories, it is increased to +85 °C. This means that a product in category OP shall withstand an upper temperature of +70 °C and in category OP^{HD} +85 °C (HD indicates an extended upper temperature necessary due to additional heat dissipation by active electronics).

For all ~~other~~ categories, there is no defined sequence in which the tests shall be run. All tests are intended to be performed individually. If a certain test sequence is required, it shall be defined in the relevant performance standard.

Table A.1 – ~~General~~ Operating service environments and performance categories

Performance category	Description	~~Operating service environment~~
Connectors and passive components		
C	Controlled environment	Operating temperature: – 10 °C to +60 °C Relative humidity: 5 % to 93 % Typically within an office, equipment room, telecommunication centre or building. Not subjected to condensed water.
U	Uncontrolled environment	Operating temperature: – 25 °C to +70 °C Relative humidity: 0 % to 95 % Typically outdoors but enclosed or covered. Locations: shacks, lofts, telephone booths, street cabinets. Subject to condensed water and limited wind-driven precipitation. In close proximity of sand or dust.
O	Uncontrolled environment (Prescribes a sequential series of tests. See Annex B)	Operating temperature: – 40 °C to +75 °C Relative humidity: 0 % to 95 % Typically outdoors but enclosed or covered. Locations: garages, cellars, entrances of buildings and unattended equipment stations. Subject to condensed water.
E	Extreme environment	Operating temperature – 40 °C to +85 °C Relative humidity 0 % to 95 % Typically outdoors, not enclosed. Locations: direct exposed to open air climat, subject to industrial sources of chemical emission.
Fibre management systems		
C	Controlled environment	Operating temperature – 10 °C to +60 °C Relative humidity 5 % to 93 % Typically within office or building.
U	Uncontrolled environment	Operating temperature – 40 °C to +70 °C Relative humidity 0 % to 95 % Typically outdoors but enclosed or covered in enclosures of categories A, G and S.
Closures		
C	Controlled environment	Operating temperature – 10 °C to +60 °C Relative humidity 5 % to 93 % Typically within office or building.
A	Aerial environment	Operating temperature – 40 °C to +65 °C Relative humidity 0 % to 95 % Typically outdoors, fully exposed environment, aerial-mounted >3 m height
G	Ground-level environment	Ground level (base/wall) Operating temperature – 40 °C to +65 °C Relative humidity 0 % to 95 % Typically outdoor, fully exposed environment, mounted at ground level <3 m height
S	Subterranean or sub-surface environment	Operating temperature – 30 °C to +60 °C Relative humidity 5 % to 100 % Typically outdoors, either direct buried or stored below ground.

Fibre optic connectors, FMC, mechanical splices, fusion splice protectors, passive optical components and fibre management systems		
Performance category	Description	Operating service environment
C	Indoor controlled environment	Operating temperature: –10 °C to +60 °C Relative humidity: 5 % RH to 93 % RH Weather protected, partly temperature-controlled locations. Typically within an office, home, building, indoor garage, cellar, equipment room, telecommunication centre or enclosed in an indoor protective housing of category C. Not subjected to condensed water.
OP	Outdoor protected environment	Operating temperature: –25 °C to +70 °C Relative humidity: 0 % RH to 95 % RH Weather protected, locations with uncontrolled temperature. Typically outdoors but enclosed or covered. Locations: shacks, lofts, telephone booths, entrances of buildings, open garage, unattended equipment stations, street cabinets or enclosed in protective housings of categories A, G or S. Subject to salt mist, condensed water and limited wind driven precipitation. In close proximity to sand or dust.
OP+	Outdoor protected environment Same as OP with wider operational temperature range for cold, dry heat and change of temperature to cover both cold and extremely warm climates. Additional condensation test	Operating temperature: –40 °C to +75 °C Relative humidity: 0 % RH to 95 % RH Weather protected, locations with uncontrolled temperature. Typically outdoors but enclosed or covered. Locations: shacks, lofts, telephone booths, entrances of buildings, open garages, unattended equipment stations, street cabinets or enclosed in protective housings of categories A, G or S. Subject to salt mist, condensed water and limited wind driven precipitation. In close proximity to sand or dust.
I	Industrial environment derived from MICE	Operating temperature: –40 °C to +70 °C Relative humidity: 0 % RH to 95 % RH Locations: typically automation islands. Subject to severe vibrations, industrial sources of corrosive gasses, splashes of liquid solvents, not subjected to immersion.
E	Extreme environment	Operating temperature –40 °C to +85 °C Relative humidity 0 % RH to 100 % RH Non-weather protected, locations with uncontrolled temperature. Locations: typically outdoors, not enclosed. Direct exposed to open air climate, subject to industrial sources of chemical emission.

Hardened connectors and protective housings (wall outlets, boxes, ODFM, street cabinets and closures)		
Performance category	Description	Operating service environment
C	Indoor controlled environment	Operating temperature –10 °C to +60 °C Relative humidity 5 % RH to 93 % RH Weather protected, partly temperature-controlled locations. Typically within an office, home, building, indoor garage, cellar, equipment room or telecommunication centre. Not subjected to condensed water.
A	Outdoor aerial environment	Operating temperature –40 °C to +65 °C Relative humidity 0 % RH to 100 % RH Outdoor, fully exposed environment, above ground level aerial mounted. No flooding requirements.
G	Outdoor ground level environment	Operating temperature –40 °C to +65 °C Relative humidity 0 % RH to 100 % RH Outdoor, fully exposed environment, mounted just above or at ground level with possibility of flooding, or below ground level inside footway boxes or hand holes continuously immersed in water. –1 m ≤ height ≤ +3 m (–: below ground level, +: above ground level)
S	Outdoor subterranean or sub-surface environment	Operating temperature –30 °C to +60 °C Relative humidity 5 % RH to 100 % RH Outdoor, either direct buried or stored below ground level in hand holes or manholes continuously immersed in water. 0 m ≤ depth ≤ 5 m

Table A.2 – Operating service environments and performance categories for components in locations with additional heat dissipation by active electronics

Fibre optic connectors, mechanical splices, fusion splice protectors, passive optical components and fibre management systems		
Performance category	Description	Operating service environment
C ^{HD}	Indoor controlled environment with additional heat dissipation. Same as category C with higher operational upper temperature limit for dry heat and change of temperature.	Operating temperature: –10 °C to +70 °C Relative humidity: 5 % RH to 93 % RH Weather protected, partly temperature-controlled locations. Typically within an office, home, building, indoor garage, cellar, equipment room, telecommunication centre or enclosed in a protective housing of category C. Not subjected to condensed water.
OP ^{HD}	Outdoor protected environment with additional heat dissipation. Same as category OP with higher operational upper temperature limit for dry heat and change of temperature.	Operating temperature: –25 °C to +85 °C Relative humidity: 0 % RH to 95 % RH Weather protected, locations with uncontrolled temperature. Typically outdoors but enclosed or covered. Locations: shacks, lofts, telephone booths, entrances of buildings, open garage, unattended equipment stations, street cabinets or enclosed in a protective housing of categories A, G and S. Subject to salt mist, condensed water and limited wind driven precipitation. In close proximity to sand or dust.
OP+ ^{HD}	Outdoor protected environment with additional heat dissipation. Same as category OP+ with higher operational upper temperature limit for dry heat and change of temperature.	Operating temperature: –40 °C to +85 °C Relative humidity: 0 % RH to 95 % RH Weather protected, locations with uncontrolled temperature. Typically outdoors but enclosed or covered. Locations: shacks, lofts, telephone booths, entrances of buildings, open garages, unattended equipment stations, street cabinets or enclosed in a protective housing of categories A, G and S. Subject to salt mist, condensed water and limited wind driven precipitation. In close proximity to sand or dust.
I ^{HD}	Industrial environment with additional heat dissipation. Same as category I with higher operational upper temperature limit for dry heat and change of temperature.	Operating temperature: –40 °C to +85 °C Relative humidity: 0 % RH to 95 % RH Locations: typically automation islands. Subject to severe vibrations, industrial sources of corrosive gasses, splashes of liquid solvents, not subjected to immersion.

Fire performance is outside the scope of this document and covered by other standards and regulations.

Resistance of polymer materials to ozone and UV radiation should be considered for categories E, A or G, or in other environments with long-term UV light exposure. These material related requirements shall be given in the relevant IEC 61753-series standard.

A.2 How to find the performance tests for each the desired category?

**Table A.2 – Connectors and passive components –
Category C – Controlled environment**

Test	Severity	
	Connectors	Passive components
Vibration (sinusoidal) IEC 61300-2-14	10 Hz – 55 Hz 15 sweeps (10 Hz – 55 Hz – 10 Hz) 1 octave/minute 3 axes 0,75 mm amplitude	
Cold IEC 61300-2-17	–10 °C ± 2 °C 96 h duration	
Dry heat – High temperature endurance IEC 61300-2-18	+60 °C ± 2 °C 96 h duration	
Damp heat (steady state) IEC 61300-2-19	+40 °C ± 2 °C 93 % RH ± 2 % to 3 % RH 96 h duration	
Change of temperature IEC 61300-2-22 Test Nb	–10 °C ± 2 °C to +60 °C ± 2 °C 60 min duration at extremes 1°C/min rate of change 5 cycles	
Optical fibre cable flexing ^a IEC 61300-2-44	2 N for reinforced cable Cycle: ± 90° Number of cycles: 100	2 N for reinforced cable Cycle: ± 90° Number of cycles: 30
Fibre/cable retention ^a IEC 61300-2-4	50 N ± 2 N at 5 N/s for reinforced cables 5,0 N ± 0,5 N at 0,5 N/s for secondary coated fibres 2,0 N ± 0,2 N at 0,5 N/s for primary coated fibres 120 s duration at 50 N 60 s duration at 2N or 5 N	40 N ± 1 N at 5 N/s for reinforced cables 5,0 N ± 0,5 N at 0,5 N/s for secondary coated fibres 2,0 N ± 0,2 N at 0,5 N/s for primary coated fibres 120 s duration at 10 N 60 s duration at 2 N or 5 N
Impact (method A) IEC 61300-2-12	5 drops 1,5 m drop height	Not specified
Tensile strength of coupling mechanism IEC 61300-2-6	40 N ± 1 N at 2 N/s 60 s duration	Not specified
Static side load ^{a, c} IEC 61300-2-42	1 N for 1 h for reinforced cable 0,2 N for 5 min for secondary coated fibres Two mutually perpendicular directions	
Mating durability IEC 61300-2-2	500 cycles at not less than 3 s between engagements	Not specified
Shock ^b IEC 61300-2-9	Not specified	Acceleration forces: Components: 500 g _n • Modules: • 0,125 kg ≤ module mass ≤ 0,225 kg: 200 g _n • 0,225 kg ≤ module mass ≤ 1 kg: 50 g _n • Nominal 1 ms duration, half sine pulse 3 axes in 2 directions, 2 shocks per axis, 12 shocks total.

^a These tests shall be applicable to passive optical components which incorporate fibre or fibre cable pigtails in their product design.

^b If the product is normally mounted in a shock resistant mounting, then it shall be tested in this configuration.

^c Static side load shall be applied in two mutually perpendicular directions as permitted by the product design. For example, a product with a base plate extending beyond the fibre exit may prohibit loading in that direction.

**Table A.3 – Connectors and passive components –
Category U – Uncontrolled environment**

Test	Severity	
	Connectors	Passive Components
Vibration (sinusoidal) IEC 61300-2-14	10 Hz – 55 Hz 15 sweeps (10 Hz – 55 Hz – 10 Hz) 1 octave/minute 3 axes 0,75 mm amplitude	
Cold IEC 61300-2-17	–25 °C ± 2 °C 96 h duration	
Dry heat – High temperature endurance IEC 61300-2-18	+70 °C ± 2 °C 96 h duration	
Change of temperature IEC 61300-2-22 Test Nb	–25 °C ± 2 °C to +70 °C ± 2 °C 60 min duration at extremes 1 °C/min rate of change 12 cycles	
Dust IEC 61300-2-27	Particle size $d < 150 \mu\text{m}$ Dust type talc 10 min duration 10,6 g/m ³ ± 7,1 g/m ³	
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH 6,5 – 7,2) 96 h duration	
Damp heat (cyclic) IEC 61300-2-46	+25 °C ± 2 °C to +55 °C ± 2 °C RH > 95 % RH [Variant 1] 96 h duration	
Optical fibre cable flexing ^a IEC 61300-2-44	5 N for reinforced cable Cycle: ± 90° Number of cycles: 100	5 N for reinforced cable Cycle: ± 90° Number of cycles: 30
Fibre/cable retention ^a IEC 61300-2-4	100 N ± 2 N at 5 N/s for reinforced cables with diameter > 2 mm 70 N ± 2 N at 5 N/s for reinforced cables with diameter ≤ 2 mm 5,0 N ± 0,5 N at 0,5 N/s for secondary coated fibres 2,0 N ± 0,2 N at 0,5 N/s for primary coated fibres 120 s duration at 70 N or 100 N 60 s duration at 2 N or 5 N	10 N ± 1 N at 5 N/s for reinforced cables 5,0 N ± 0,5 N at 0,5 N/s for secondary coated fibres 2,0 N ± 0,2 N at 0,5 N/s for primary coated fibres 120 s duration at 10 N 60 s duration at 2 N or 5 N
Impact (method A) IEC 61300-2-12	5 drops 1,5 m drop height	Not specified
Torsion/twist ^a IEC 61300-2-5	15 N at 1 N/s for reinforced cables 2,0 N at 0,1 N/s for primary and secondary coated fibres 25 cycles ± 180°	5,0 N at 0,1 N/s for reinforced cables 2,0 N at 0,1 N/s for primary and secondary coated fibres 10 cycles ± 180°
Tensile strength of coupling mechanism IEC 61300-2-6	40 N at 2 N/s 120 s duration	Not specified
Static side load ^{a, c} IEC 61300-2-42	1 N for 1 h for reinforced cable 0,2 N for 5 min for secondary coated fibres Two mutually perpendicular directions	
Mating durability IEC 61300-2-2	500 cycles at not less than 3 s between engagements	Not specified
Bending moment IEC 61300-2-7	10 N	Not specified

Shock ^b IEC 61300-2-9	Not specified	Acceleration forces: Components: 500 g_n • Modules: • 0,125 kg ≤ module mass ≤ 0,225 kg: 200 g_n • 0,225 kg ≤ module mass ≤ 1 kg: 50 g_n • Nominal 1 ms duration, half sine pulse. 3 axes in 2 directions, 2 shocks per axis, 12 shocks total.
^a—These tests shall be applicable to passive optical components which incorporate fibre or fibre cable pigtails in their product design. ^b—If the product is normally mounted in a shock resistant mounting, then it shall be tested in this configuration. ^c—Static side load shall be applied in two mutually perpendicular directions as permitted by the product design. For example, a product with a base plate extending beyond the fibre exit may prohibit loading in that direction.		

Table A.4a – Passive components – Category O – Uncontrolled environment
(Category O is a sequential series of tests, see Annex B and Table B.2.)

Test	Severity
	Passive Components
Damp heat (steady state) IEC 61300-2-19	+75 °C ± 2 °C 90 % RH ± 5 % RH 168 h
Vibration (sinusoidal) IEC 61300-2-1	10 Hz – 55 Hz 2 h per axis 1 octave/minute 3 axes 1,52 mm amplitude
Shock ^b IEC 61300-2-9	Acceleration forces: Components: 500 g _n • Modules: 0,125 kg ≤ module mass ≤ 0,225 kg: 200 g _n • 0,225 kg ≤ module mass ≤ 1 kg: 50 g _n • Nominal 1 ms duration, half sine pulse. • 3 axes in 2 directions, 2 shocks per axis, 12 shocks total.
Change of temperature IEC 61300-2-22 Test Nb	-40 °C ± 2 °C to +75 °C ± 2 °C 1 h duration at extremes ≥ 1 °C /min rate of change 10 cycles Dwell at +23 °C allowed between temperature extremes
Temperature-humidity cycling IEC 61300-2-48, method A	-40 °C ± 2 °C to +85 °C ± 2 °C for primary, secondary coated fibre and reinforced cables, but limited to: -40 °C ± 2 °C to +75 °C ± 2 °C for LSZH cables 85 % RH ± 5 % RH at the maximum temperature 1 h minimum duration at extremes ≥ 1 °C /min rate of change 42 cycles
Flexing of the strain relief of fibre optic devices ^a IEC 61300-2-44	5 N for reinforced cables 2 N for primary and secondary coated fibres 30 cycles ± 90°
Torsion/twist ^a IEC 61300-2-5	5,0 N at 0,1 N/s for reinforced cables 2,0 N at 0,1 N/s for primary and secondary coated fibres 10 cycles ± 180°
Static side load ^{a, c} IEC 61300-2-42	5 N for 5 s for reinforced cables 2,3 N for 5 s for primary and secondary coated fibres Two mutually perpendicular directions
Fibre/cable retention ^a IEC 61300-2-4	10 N ± 1 N at 0,5 N/s for reinforced cables 5,0 N ± 0,5 N at 0,5 N/s for primary and secondary fibres 120 s duration at 10 N 60 s duration at 5 N
^a —These tests shall be applicable to passive optical components which incorporate fibre or fibre cable pigtails in their product design. ^b —If the product is normally mounted in a shock resistant mounting, then it shall be tested in this configuration. ^c —Static side load shall be applied in two mutually perpendicular directions as permitted by the product design. For example, a product with a base plate extending beyond the fibre exit may prohibit loading in that direction.	

Table A.4b – Connectors – Category O – Uncontrolled environment
(Category O is a sequential series of tests, see Annex B and Table B.2)

Test	Severity
	Connectors
Dry Heat – high temperature endurance IEC 61300-2-18	Temperature/duration: Var. A $+85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 168 h or Temperature/duration: Var. B $+75^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 336 h Var. B shall be used for products with LSZH cables with temperature limitation of 75°C , the longer duration ensures the same aging as in Var. A
Change of temperature IEC 61300-2-22 Test Nb	$-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ to $+75^{\circ}\text{C} \pm 2^{\circ}\text{C}$, dwell at $+23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 1 h duration at dwell temperatures $\geq 1^{\circ}\text{C}/\text{min}$ rate of change 21 cycles
Damp heat (steady state) IEC 61300-2-19	$+75^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 90 % RH ± 5 % RH 168 h
Temperature-humidity cycling IEC 61300-2-48 Method B	Cycle profile: $+23^{\circ}\text{C}$ to -10°C to $+65^{\circ}\text{C}$ to -10°C to $+23^{\circ}\text{C}$. Temperature tolerance: $\pm 2^{\circ}\text{C}$ 90 % RH to 100 % RH ± 2 % RH during dwells at $+23^{\circ}\text{C}$ and $+65^{\circ}\text{C}$. Uncontrolled but not dehumidified during ramps and at -10°C . Number of cycles: 14 Ramp time = 1 h, except change from -10°C to $+65^{\circ}\text{C}$ must occur faster (20 min max.) to maximize condensation. Dwell time: 2 h at 23°C and -10°C . At $+65^{\circ}\text{C}$, the dwell time is 3 h minus the ramp time.
Dry Heat – high temperature endurance IEC 61300-2-18	Temperature: $+75^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Duration: 24 h
Change of temperature IEC 61300-2-22 Test Nb	$-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ to $+75^{\circ}\text{C} \pm 2^{\circ}\text{C}$, dwell at $+23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 1 h duration at dwell temperatures $\geq 1^{\circ}\text{C}/\text{min}$ rate of change 21 cycles
Vibration (sinusoidal) IEC 61300-2-1	10 Hz – 55 Hz 2 h per axis 45 Hz/min sweep rate 3 axes 0,75 mm amplitude
Flexing of strain relief of fibre optic connectors IEC 61300-2-44	<u>Reinforced jacketed cables:</u> Load: 8,9 N for connectors 5,9 N for SFF connectors ^a Cycle: $\pm 90^{\circ}$ Number of cycles: 100 Load applied 25 cm $\pm$ 3 cm from cable entrance to plug
Torsion/twist IEC 61300-2-5	<u>Reinforced jacketed cables:</u> Load: 13,3 N Cycle: $\pm 900^{\circ}$ Number of cycles: 10 <u>900-micron secondary coated fibres:</u> Load: 7,4 N Cycle: $\pm 540^{\circ}$ Number of cycles: 10 <u>250-micron primary coated fibres:</u> Load: 4,9 N Cycle: $\pm 540^{\circ}$ Number of cycles: 10 Load applied 25 cm $\pm$ 3 cm from cable entrance to plug

Table A.4b (continued)
(Category O is a sequential series of tests, see Annex B and Table B.2)

Test	Severity
	Connectors
Fibre optic connector proof test 0° IEC 61300-2-50	<u>Reinforced jacketed cables:</u> Load: 44,5 N Duration under load: 5 min minimum Load applied 25 cm ± 3 cm from cable entrance to plug
Fibre optic connector proof test 90° IEC 61300-2-50	<u>Reinforced jacketed cables:</u> Load: — 22,6 N for connectors —— 14,7 N for SFF connectors ^a Duration under load: 5 s minimum Load applied 25 cm ± 3 cm from cable entrance to plug
Transmission with applied tensile load IEC 61300-2-51	<u>Reinforced jacketed cables:</u> Loads: 2,5 N; 6,9 N; 14,7 N; and 19,6 N <u>900-micron buffered fibres:</u> Loads: 2,5 N and 6,9 N <u>250-micron coated fibres:</u> Loads: 2,5 N and 4,9 N Orientation: 0° and 90° to the axis of the connector For small form factor (SFF) connectors ^a , the 90° loads are reduced to 2/3 of the values listed above. Duration under load: Until optical stability is reached Load applied 25 cm ± 3 cm from cable entrance to plug
Impact (method A) IEC 61300-2-12	8 drops 1,5 m drop height
Mating durability IEC 61300-2-2	Number of cycles: 200
Connector installation IEC 61300-2-49	Distance = 70 mm
Salt mist (optional) ^b IEC 61300-2-26	Salt solution 5 % NaCl (pH 6,5 – 7,2) 7 days duration
^a SFF connectors are optical fibre connectors designed to accommodate two or more optical fibres with at least the same mounting density as the RJ45 connector used for balanced cabling (reference: IS-11801). ^b Salt mist test is required in case connectors or components are deployed in a street cabinet or location where connections can be exposed to salt spray (like seaside, road salts during winter).	

**Table A.5 – Connectors and passive components –
Category E – Extreme environment**

Test	Severity	
	Connectors	Passive Components
Vibration (sinusoidal) IEC 61300-2-1	10 Hz – 55 Hz 15 sweeps (10 Hz – 55 Hz – 10 Hz) 1 octave/minute 3 axes 0,75 mm amplitude	
Cold IEC 61300-2-17	-40 °C ± 2 °C 96 h duration	
Dry heat – High temperature endurance IEC 61300-2-18	+85 °C ± 2 °C 96 h duration	
Change of temperature IEC 61300-2-22 Test Nb	-40 °C ± 2 °C to +85 °C ± 2 °C 1 h duration at extremes 1 °C/min rate of change 12 cycles	
Dust IEC 61300-2-27	Particle size $d < 150 \mu\text{m}$ Dust type tale 10 min duration $10,6 \pm 7,1 \text{g/m}^3$	
Composite temperature humidity cyclic test IEC 61300-2-21	Z/AD profile with exposure to cold -10 °C ± 2 °C to +65 °C ± 2 °C 93 % RH ± 3 % RH at the maximum temperature 3 h dwells at the temperature extremes 4 cycles	
Industrial atmosphere IEC 61300-2-28	Sulphur dioxide SO_2 25×10^{-6} 96 h duration	
Salt mist IEC 61300-2-26	Salt solution 5% NaCl (pH 6,5 – 7,2) 96 h duration	
Durability by water immersion IEC 61300-2-45	Depth of water: sample shall be 5 cm below the surface of the water +25 °C ± 2 °C 1 h duration Immersion: 1 cycle	
Optical fibre cable flexing ^a IEC 61300-2-44	5 N for reinforced cable Cycle: ± 90° Number of cycles: 100	5 N for reinforced cable Cycle: ± 90° Number of cycles: 30
Fibre/cable retention ^a IEC 61300-2-4	100 N ± 2 N at 5 N/s for reinforced cables with diameter > 2 mm 70 N ± 2 N at 5 N/s for reinforced cables with diameter ≤ 2 mm 5,0 N ± 0,5 N at 0,5 N/s for secondary coated fibres 2,0 N ± 0,2 N at 0,5 N/s for primary coated fibres 120 s duration at 70 N or 100 N 60 s duration at 2 N or 5 N	10 N ± 1 N at 5 N/s for reinforced cables 5,0 N ± 0,5 N at 0,5 N/s for secondary coated fibres 2,0 N ± 0,2 N at 0,5 N/s for primary coated fibres 120 s duration at 10 N 60 s duration at 2 N or 5 N
Impact (method A) IEC 61300-2-12	5 drops 1,5 m drop height	Not specified
Torsion/twist ^a IEC 61300-2-5	15 N at 1 N/s for reinforced cables 2,0 N at 0,1 N/s for primary and secondary coated fibres 25 cycles ± 180°	5,0 N at 0,1 N/s for reinforced cables 2,0 N at 0,1 N/s for primary and secondary coated fibres 10 cycles ± 180°

Table A.5 (continued)

Test	Severity	
	Connectors	Passive components
Tensile strength of coupling mechanism IEC 61300-2-6	40 N at 2 N/s 120 s duration	Not specified
Static side load ^{a, c} IEC 61300-2-42	1 N for 1 h for reinforced cable 0,2 N for 5 min for secondary coated fibres Two mutually perpendicular directions	
Mating durability IEC 61300-2-2	500 cycles at not less than 3 s between engagements	Not specified
Bending moment IEC 61300-2-7	10 N	Not specified
Shock ^b IEC 61300-2-9	Not applicable	Acceleration forces: Components: 500 g _n - Modules: 0,125 kg ≤ module mass ≤ 0,225 kg: 200 g_n 0,225 kg ≤ module mass ≤ 1 kg: 50 g_n - Nominal 1 ms duration, half sine pulse. 3 axes in 2 directions, 2 shocks per axis, 12 shocks total.
^a —These tests shall be applicable to passive optical components which incorporate fibre or fibre cable pigtails in their product design. ^b —If the product is normally mounted in a shock resistant mounting, then it shall be tested in this configuration. ^c —Static side load shall be applied in two mutually perpendicular directions as permitted by the product design. For example, a product with a base plate extending beyond the fibre exit may prohibit loading in that direction.		

**Table A.6 – Fibre management systems –
Category C – Controlled environment**

Test	Severity
	Fibre management systems
Vibration (sinusoidal) IEC 61300-2-1	5 Hz to 500 Hz 10 sweeps (5 Hz – 500 Hz – 5 Hz) 1 octave/minute 3 axes 3,5 mm amplitude below 9 Hz 10 m/s ² (~ 1 g _n) above 9 Hz Test optically monitored (transient loss)
Shock IEC 61300-2-9	Wave form: Half sine; Duration: 11 ms; Acceleration: 150 m/s ² (~15 g _n); Direction: 3 mutually perpendicular axes; Number of shocks: 3 up and 3 down per axis Test optically monitored (transient loss)
Fibre/cable retention ^a IEC 61300-2-4	Reinforced cables: 10 N ± 1 N for 120 s Cable elements (tubes): 5,0 N ± 0,5 N for 60 s Test optically monitored (Transient loss)
Static side load ^a IEC 61300-2-42	Reinforced cables: 1,0 N ± 0,1 N for 60 min Cable elements: 0,5 N ± 0,1 N for 5 min Two mutually perpendicular directions Test optically monitored (Transient loss)
Assembly and disassembly of closures and enclosures IEC 61300-2-33	Move splice trays to get access to splices and fibres Rearrange splices and/or connectors Add splice trays/ splice modules when applicable Add fibre/cable Test optically monitored (Transient loss) in adjacent fibre circuits (depending on the circuit separation level SC, SE, SR, ME, or MR)
Damp heat (steady state) IEC 61300-2-19	+40 °C ± 2 °C 93 % RH $\pm \frac{3}{2}$ % RH Duration: 96 h Test optically monitored
Change of temperature IEC 61300-2-22 Test Nb	–10 °C ± 2 °C to +60 °C ± 2 °C 60 min duration at extremes 1 °C/min rate of change 5 cycles Test optically monitored
^a — If cables or cable elements (loose tubes) are not fixed to the entry ports of the fibre management system, the test shall not be performed.	

**Table A.7 – Fibre management systems –
Category U – Uncontrolled environment**

Test	Severity
	Fibre management systems
Vibration (sinusoidal) IEC 61300-2-1	5 Hz to 500 Hz 10 sweeps (5 Hz – 500 Hz – 5 Hz) 1 octave/minute 3 axes 3,5 mm amplitude below 9 Hz 10 m/s ² (~ 1 g _n) above 9 Hz Test optically monitored (transient loss)
Shock IEC 61300-2-9	Wave form: Half sine; Duration: 11 ms; Acceleration: 150 m/s ² (~15 g _n); Direction: 3 mutually perpendicular axes; Number of shocks: 3 up and 3 down per axis Test optically monitored (transient loss)
Fibre/cable retention ^a IEC 61300-2-4	Reinforced cables: 10 N ± 1 N for 120 s Cable elements (tubes): 5,0 N ± 0,5 N for 60 s Test optically monitored (Transient loss)
Static side load ^a IEC 61300-2-42	Reinforced cables: 1,0 N ± 0,1 N for 60 min Cable elements: 0,5 N ± 0,1 N for 5 min Two mutually perpendicular directions Test optically monitored (Transient loss)
Assembly and disassembly of closures and enclosures IEC 61300-2-33	Move splice trays to get access to splices and fibres Rearrange splices and/or connectors Add splice trays/ splice modules when applicable Add fibre/cable Test optically monitored (Transient loss) in adjacent fibre circuits (depending the circuit separation level SC, SE, SR, ME, or MR)
Damp heat (cyclic) IEC 61300-2-46	+25 °C ± 2 °C to +55 °C ± 2 °C Humidity: >95 % RH [Variant 1] 6 cycles (24 h/cycle) Test optically monitored
Change of temperature IEC 61300-2-22 Test Nb	-40 °C ± 2 °C to +70 °C ± 2 °C 60 min duration at extremes 1 °C/min rate of change 12 cycles Test optically monitored
^a — If cables or cable elements (loose tubes) are not fixed to the entry ports of the fibre management system, the test shall not be performed.	

Table A.8 – Closures – Category C – Controlled environment

Test	Severity
	Closures
Vibration (sinusoidal) IEC 61300-2-1	5 Hz to 500 Hz 10 sweeps (5 Hz – 500 Hz – 5 Hz) 1 octave/minute 3 axes 3,5 mm amplitude below 9 Hz 1 g _r above 9 Hz Test optically monitored (transient loss) Test pressure: 0 kPa over-pressure
Change of temperature IEC 61300-2-22 Test Nb	–10 °C ± 2 °C to +60 °C ± 2 °C 4 h duration at extremes 1 °C/min rate of change 5 cycles Test optically monitored Test pressure: 0 kPa over-pressure
Assembly and disassembly of closures IEC 61300-2-33	10 disassembly/assembly cycles At least one “Change of temperature” cycle between each disassembly/assembly cycle Test conducted at +23 °C ± 3 °C
Fibre/cable retention IEC 61300-2-4	Load: 1 000 N x cable diameter(mm)/45 (1 000 N max.) 1 h load duration per cable per test temperature Test conducted at –5 °C ± 2 °C and +45 °C ± 2 °C Test pressure: 0 kPa over-pressure
Axial compression IEC 61300-2-11	Axial load: 450 N on strength member cable 30 min duration per central strength member
Torsion/twist IEC 61300-2-5	Torque: maximum rotation 90°/maximum 50 Nm ^a Point of application: 400 mm from end of seal 5 cycles per cable per test temperature Test conducted at –5 °C ± 2 °C and +45 °C ± 2 °C Test optically monitored Test pressure: 0 kPa over-pressure
Cable bending for closures IEC 61300-2-37	Bending: 30° or maximum 500 N ^a Point of application: 400 mm from end of seal 5 cycles per cable per test temperature Test conducted at –5 °C ± 2 °C and +45 °C ± 2 °C Test optically monitored Test pressure: 0 kPa over-pressure
Impact (free fall) IEC 61300-2-12	1 drop per test sample, random location 0,75 m drop height per test temperature Test conducted at –5 °C ± 2 °C and +45 °C ± 2 °C Test over-pressure: 0 kPa over-pressure
Impact IEC 61300-2-12	Impact tool: 1 kg mass steel ball Drop height: 1 m Impact locations: centre of closure at 0°, 90°, 180° and 270° around longitudinal axis of closure 1 impact per location per test temperature Test conducted at –5 °C ± 2 °C and +45 °C ± 2 °C Test pressure: 0 kPa over-pressure
NOTE – General: separate test samples for closure sealing performance and optical evaluation may be used.	
^a – For rigid cables with diameter Ø > 25 mm the clamping distance may be increased to 1 000 mm.	

Table A.9 – Closures – Category A – Aerial environment

Test	Severity
	Closures
Change of temperature IEC 61300-2-22 Test Nb	–40 °C ± 2 °C to +65 °C ± 2 °C 4 h duration at extremes 1 °C/min rate of change 20 cycles Test optically monitored Test pressure: 0 kPa over-pressure
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH 6,5 — 7,2) 5 days duration Test pressure: 0 kPa over-pressure
Assembly and disassembly of closures IEC 61300-2-33	10 disassembly/assembly cycles At least one "Change of temperature" cycle between each disassembly/assembly cycle Test conducted at +23 °C ± 3 °C
Vibration (sinusoidal) IEC 61300-2-1	5 Hz to 500 Hz 10 sweeps (5 Hz — 500 Hz — 5 Hz) 1 octave/minute change 3 axes 3,5 mm amplitude below 9 Hz 1 g_r above 9 Hz Test optically monitored (transient loss) Test pressure: 0 kPa over-pressure
Shock IEC 61300-2-9	Wave form: Half sine; Duration: 11 ms; Acceleration: 150 m/s² (~15g); Direction: 3 mutually perpendicular axes; Number of shocks: 3 up and 3 down per axis Test optically monitored (transient loss)
Fibre/cable retention IEC 61300-2-4	1 000 N x cable diameter(mm)/45 (1 000 N max.) 1 h load duration per cable per test temperature Test conducted at –15 °C ± 2 °C and +45 °C ± 2 °C Test over-pressure: 0 kPa over-pressure
Axial compression IEC 61300-2-11	Axial load: 450 N on strength member cable 30 min duration per central strength member
Torsion/twist IEC 61300-2-5	Torque: maximum rotation 90°/maximum 50 Nm Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature Test conducted at –15 °C ± 2 °C and +45 °C ± 2 °C Test optically monitored Test pressure: 0 kPa over-pressure
Cable bending for closures IEC 61300-2-37	Bending: 30° or maximum 500 N Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature Test conducted at –15 °C ± 2 °C and +45 °C ± 2 °C Test optically monitored Test pressure: 0 kPa over-pressure

Table A.9 (continued)

Test	Severity
	Closures
Impact (free fall) IEC 61300-2-12	1 drop per test sample, random location 0,75 m drop height per test temperature Test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Test pressure: 0 kPa over-pressure
Impact IEC 61300-2-12	Impact tool: 1 kg mass steel ball Drop height: 1 m Impact locations: centre of closure at 0°, 90°, 180° and 270° around longitudinal axis of closure 1 impact per location per test temperature Test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Test pressure: 0 kPa over-pressure
NOTE—General: separate test samples for closure sealing performance and optical evaluation may be used.	
^a —For rigid cables with diameter $\varnothing > 25$ mm the clamping distance may be increased to 1 000 mm.	

Table A.10 — Closures — Category G — Ground environment

Test	Severity
	Closures
Change of temperature IEC 61300-2-22 Test Nb	$-40\text{ °C} \pm 2\text{ °C}$ to $+65\text{ °C} \pm 2\text{ °C}$ 2 h duration at extremes 1 °C/min rate of change 20 cycles Test optically monitored Test pressure: 0 kPa over-pressure
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH 6,5 — 7,2) 5 days duration Test pressure 0 kPa over-pressure
Resistance to solvents and contaminating fluids IEC 61300-2-34	HCl at pH 2 NaOH at pH 12 5 days duration Test pressure: 0 kPa over-pressure
Assembly and disassembly of closures IEC 61300-2-33	10 disassembly/assembly cycles At least one “Change of temperature” cycle between each disassembly/assembly cycle Test conducted at $+23\text{ °C} \pm 3\text{ °C}$
Vibration (sinusoidal) IEC 61300-2-1	5 Hz to 500 Hz 10 sweeps (5 Hz — 500 Hz — 5 Hz) 1 octave/minute 3 axes 3,5 mm amplitude below 9 Hz 1 g _r above 9 Hz Test optically monitored (transient loss) Test pressure: 0 kPa over-pressure
Shock IEC 61300-2-9	Wave form: half sine; Duration: 11 ms; Acceleration: 150 m/s ² (~15 g); Direction: 3 mutually perpendicular axes; Number of shocks: 3 up and 3 down per axis Test optically monitored (transient loss)

Table A.10 (continued)

Test	Severity
	Closures
Fibre/cable retention IEC 61300-2-4	Load: 1 000 N x cable diameter (mm)/45 (1 000 N max.) 1 h load duration per cable per test temperature Test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Test pressure: 0 kPa over-pressure
Axial compression IEC 61300-2-11	Axial load: 450 N on strength member cable 30 min duration per central strength member
Torsion/twist IEC 61300-2-5	Torque: maximum rotation 90°/maximum 50 Nm Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature Test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Test optically monitored Test pressure: 0 kPa over-pressure
Cable bending for closures IEC 61300-2-37	Bending: 30° or maximum 500 N Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature Test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Test optically monitored Test pressure: 0 kPa over-pressure
Impact (free fall) IEC 61300-2-12	1 drop per test sample, random location 0,75 m drop height per test temperature Test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Test pressure: 0 kPa over-pressure
Impact IEC 61300-2-12 Method B	Impact tool: 1 kg mass steel ball Drop height: 1 m Impact locations: centre of closure at 0°, 90°, 180° and 270° around longitudinal axis of closure 1 impact per location per test temperature Test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Test pressure: 0 kPa over-pressure
NOTE — Separate test samples for closure sealing performance and optical evaluation may be used:	
^a — For rigid cables with diameter Ø > 25 mm the clamping distance may be increased to 1 000 mm.	

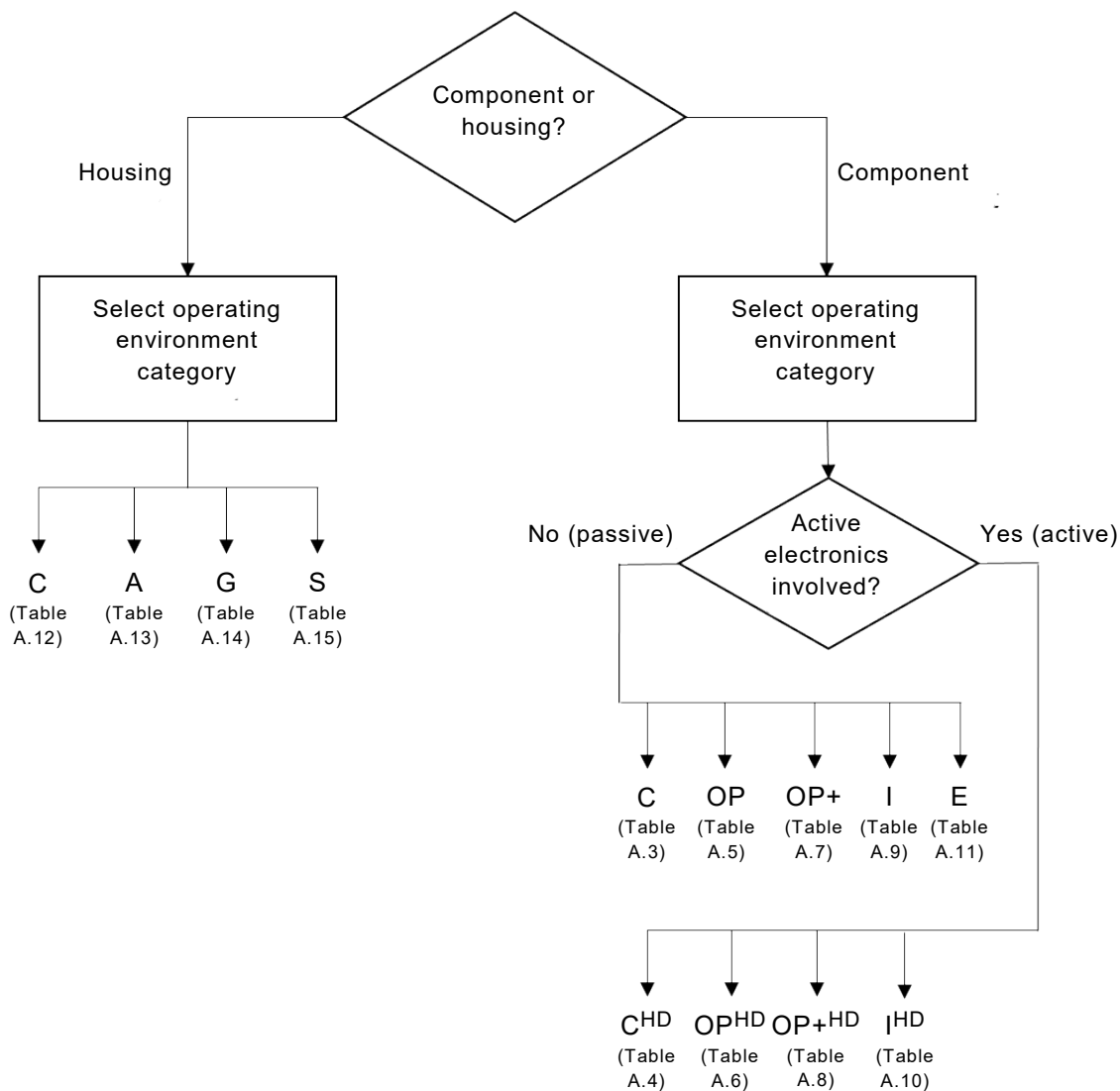
Table A.11 – Closures – Category S – Subterranean environment

Test	Severity
	Closures
Change of temperature IEC 61300-2-22 Test Nb	$-30^{\circ}\text{C} \pm 2^{\circ}\text{C}$ to $+60^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 2 h duration at extremes 1°C/min rate of change 20 cycles Test optically monitored Test pressure: 40 kPa $\pm$ 2 kPa regulated over-pressure ^a
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH 6,5 – 7,2) 5 days duration Test pressure: 0 kPa over-pressure
Assembly and disassembly of closures IEC 61300-2-33	10 disassembly/assembly cycles At least one "Change of temperature" cycle between each disassembly/assembly cycle Test conducted at $+23^{\circ}\text{C} \pm 3^{\circ}\text{C}$
Water immersion IEC 61300-2-23 Method 2	Depth of water: 5 m (or an equivalent water pressure of 50 kPa) Test conducted at $+23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ Duration: 7 days No wetting agent Test pressure: 0 kPa over-pressure
Resistance to solvents and contaminating fluids IEC 61300-2-34	Solvents: — HCl at pH 2 — NaOH at pH 12 — Kerosene (lamp oil) ISO 1998/I 1.005 — Petroleum jelly — Diesel fuel for cars IEC 60590 — 10 % Igepal CO-630 solution (at $50^{\circ}\text{C} \pm 2^{\circ}\text{C}$) Duration: 5 days No drying at 70°C Test pressure: 40 kPa $\pm$ 2 kPa regulated over-pressure ^a
Vibration (sinusoidal) IEC 61300-2-1	5 Hz to 500 Hz 10 sweeps (5 Hz – 500 Hz – 5 Hz) 1 octave/minute 3 axes 3,5 mm amplitude below 9 Hz 1 g _r above 9 Hz Test optically monitored (transient loss) Test pressure: 40 kPa $\pm$ 2 kPa over-pressure ^a
Shock IEC 61300-2-9	Wave form: Half sine; Duration: 11 ms; Acceleration: 150 m/s ² (~15 g); Direction: 3 mutually perpendicular axes; Number of shocks: 3 up and 3 down per axis Test optically monitored (transient loss)
Fibre/cable retention IEC 61300-2-4	Load: 1 000 N x cable diameter(mm)/45 (1 000 N max.) 1 h load duration per cable per test temperature Test conducted at $-15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $+45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Test pressure 40 kPa $\pm$ 2 kPa over-pressure at test temperature ^a

Table A.11 (continued)

Test	Severity
	Closures
Axial compression IEC 61300-2-11	Axial load: 450 N on strength member cable 30 min duration per central strength member
Torsion/twist IEC 61300-2-5	Torque: maximum rotation 90° maximum 50 Nm Point of application: 400 mm from end of seal ^b 5 cycles per cable per test temperature Test conducted at $-15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $+45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Test optically monitored Test pressure: 40 kPa $\pm$ 2 kPa over-pressure at test temperature ^a
Cable bending for closures IEC 61300-2-37	Bending: 30° or maximum 500 N Point of application: 400 mm from end of seal ^b 5 cycles per cable per test temperature Test conducted at $-15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $+45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Test optically monitored Test pressure: 40 kPa $\pm$ 2 kPa over-pressure at test temperature ^a
Impact (free fall) IEC 61300-2-12	1 drop per test sample, random location 0,75 m drop height per test temperature Test conducted at $-15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $+45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Test pressure 40 kPa $\pm$ 2 kPa over-pressure at test temperature ^a
Impact IEC 61300-2-12 Method B	Impact tool: 1 kg mass steel ball Drop height: 2 m Impact locations: centre of enclosure at 0°, 90°, 180° and 270° around longitudinal axis of closure 1 impact per location per test temperature Test conducted at $-15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $+45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Test pressure 40 kPa $\pm$ 2 kPa over-pressure at test temperature ^a
Crush resistance IEC 61300-2-10	1 000 N $\pm$ 50 N Application area: 25 cm ² Location: centre of closure at 0° and 90° around longitudinal axis of closure Test conducted at $-15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $+45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 10 min duration per location per test temperature Test pressure: 40 kPa $\pm$ 2 kPa over-pressure at test temperature ^a
NOTE—General: separate test samples for closure sealing performance and optical evaluation may be used.	
^a For products used in pressurized networks, all testing should be carried out at 98,0 kPa $\pm$ 9,8 kPa over-pressure instead of 40 kPa over-pressure.	
^b For rigid cables with diameter $\varnothing > 25$ mm the clamping distance may be increased to 1 000 mm.	

The relevant category for the operating service environment of a product can be found by following the flow chart as given in Figure A.1.



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Figure A.1 – Flow chart to identify the relevant category for the operating service environment

Once the category is identified, the following Tables A.3 to A.15 will give the minimum required tests, the test methods and the recommended acceptance criteria for the specific product. The acceptance criteria S, O and/or V are given for the tests that need to be performed for each product listed at the top of the columns.

S: Sealing acceptance criteria

O: Optical acceptance criteria

V: Visual inspection acceptance criteria

The tests with a blank cell are not required for the selected product.

The detailed acceptance criteria for the relevant products are listed in Tables A.16 to A.28.

Table A.3 – Connectors, passive components, mechanical splices, fusion splice protectors and fibre management systems – Category C – Indoor controlled environment

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Fibre/cable retention IEC 61300-2-4	Load: 50 N for 60 s for cables with aramid yarn strength members 10 N for 60 s for tubes or cables without aramid yarn strength members 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres	O,V	O,V		O, V	
Fibre/cable retention IEC 61300-2-4	Load: 10 N for 60 s for cables 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres			O,V		
Fibre/cable retention ^b IEC 61300-2-4	Load: 10 N for 60 s for cables 5,0 N for 60 s for cable elements and tubes					O, V ^b
Tensile strength of coupling mechanism IEC 61300-2-6	Load: 40 N for 60 s	O,V	O,V	O, V ^d		
Static side load ^{a,c} IEC 61300-2-42	Load: 1 N for 1 h for cables 0,2 N for 5 min for buffered fibres Two mutually perpendicular directions	O,V		O,V		
Static side load ^{b,c} IEC 61300-2-42	Load: 1,0 N for 1 h for cables 0,5 N for 5 min for cable elements and tubes Two mutually perpendicular directions					O, V ^b
Flexing of the strain relief of fibre optic devices IEC 61300-2-44	Load: 2 N for cables Cycle: $\pm 90^\circ$ Number of cycles: 50	O,V		O, V ^a		
Torsion IEC 61300-2-5	Load: 10 N for cables 2,0 N for primary coated and buffered fibres 25 cycles $\pm 180^\circ$ Fibre/cable clamping distance: 25 cm $\pm$ 5 cm	O,V	O,V			
Torsion IEC 61300-2-5	Load: 5 N for cables 2,0 N for primary coated and buffered fibres Cycle: $\pm 180^\circ$ Number of cycles: 10 Fibre/cable clamping distance: 25 cm $\pm$ 5 cm			O,V	O, V	
Mating durability IEC 61300-2-2	200 cycles for cylindrical ferrules 50 cycles for rectangular ferrules Not less than 3 s between engagements	O,V	O,V	O, V ^d		

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures ^f IEC 61300-2-33	Open and re-install the mechanical splice ^f 5 cycles				O, V	
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	If applicable, move the fibre management system to gain access to the splice trays. Move the splice trays to gain access to splices and fibres. Rearrange splices and/or connectors. Add splice trays/splice modules when applicable. Add fibre/cable.					O,V
Vibration (sinusoidal) IEC 61300-2-1	Frequency range: 10 Hz to 55 Hz Number of sweeps: 15 sweeps, (10 – 55 – 10) Hz per axis Rate of frequency change: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 0,75 mm	O,V	O,V	O,V	O, V	
Vibration (sinusoidal) IEC 61300-2-1	Frequency range: 5 Hz to 500 Hz Number of sweeps per axis: 10 sweeps, (5 – 500 – 5) Hz Rate of change of frequency: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 3,5 mm at frequencies below 9 Hz Acceleration: 10 m/s ² at frequencies above 9 Hz					O,V
Impact (method A) IEC 61300-2-12	5 drops 1,5 m drop height	O,V	O,V			
Shock IEC 61300-2-9	Acceleration: - Component or module mass ≤ 0,125 kg: 5 000 m/s ² - 0,125 kg < module mass ≤ 0,225 kg: 2 000 m/s ² - 0,225 kg < module mass ≤ 1 kg: 500 m/s ² Wave form: half sine pulse Duration: 1 ms Axes: 3 mutually perpendicular axes Number of shocks: 2 shocks per axis and per direction of axis, 12 shocks total.			O, V ^e	O, V	
Shock IEC 61300-2-9	Wave form: half sine Duration: 11 ms Acceleration: 150 m/s ² Axes: 3 mutually perpendicular axes Number of shocks: 3 shocks per axis and per direction of axis, 18 shocks in total.					O,V
Cold IEC 61300-2-17	Temperature: –10 °C Duration: 96 h	O,V	O,V	O,V	O, V	
Dry heat – High temperature endurance IEC 61300-2-18	Temperature: +60 °C Duration: 96 h	O,V	O,V	O,V	O, V	
Damp heat (steady state) IEC 61300-2-19	Temperature: +40 °C Humidity: 93 % RH Duration: 96 h	O,V	O,V	O,V	O, V	O,V

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Change of temperature IEC 61300-2-22	Temperature: –10 °C to +60 °C Duration: 60 min at extremes Rate of temperature change: 1 °C/min 5 cycles	O,V	O,V	O,V	O, V	O,V
^a These tests shall be applicable to passive optical components with a strain relief boot attached to the component. The test is not applicable for components without a strain relief boot. ^b If cables or cable elements (loose tubes) are not fixed to the entry: ports of the fibre management system, the test shall not be performed. ^c Static side load shall be applied in two mutually perpendicular directions as permitted by the product design. For example, a product with a base plate extending beyond the fibre exit may prohibit loading in that direction. ^d Applicable only if the component contains a receptacle. ^e If the product is normally mounted in a shock resistant mounting, then it shall be tested in this configuration. ^f This test is only applicable for re-installable mechanical splices.						

Table A.4 – Connectors, field mountable connectors, passive components, mechanical splices, fusion splice protectors and fibre management systems – Category C^{HD} – Indoor controlled environment with additional heat dissipation

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Dry heat IEC 61300-2-18	Temperature: +70 °C Duration: 96 h	O,V	O, V	O,V	O, V	
Change of temperature IEC 61300-2-22	Temperature: –10 °C to +70 °C Duration at extreme temperatures: 60 min 1 °C/min rate of change 5 cycles	O,V	O, V	O,V	O, V	O, V
NOTE 1 Category C^{HD} contains the tests from category C with the addition of the following more severe tests: dry heat (+70°C) and change of temperature (–10°C/+70°C). NOTE 2 When a product is immediately qualified for category C^{HD}, there is no need to perform the following less severe tests from category C: dry heat (+60°C) and change of temperature (–10°C/+60°C). NOTE 3 When the tests are performed for category C^{HD}, the product will be automatically qualified for category C.						

Table A.5 – Connectors, field mountable connectors, passive components, mechanical splices, fusion splice protectors and fibre management systems – Category OP – Outdoor protected environment

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Fibre/cable retention IEC 61300-2-4	Load: 70 N for 60 s for cables with aramid yarn strength members 10 N for 60 s for tubes or cables without aramid yarn strength members 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres	O,V	O,V		O, V	
Fibre/cable retention IEC 61300-2-4	Load: 10 N for 60 s for cables 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres			O,V		
Fibre/cable retention ^b IEC 61300-2-4	Load: 10 N for 60 s for cables 5,0 N for 60 s for cable elements or tubes					O, V ^b
Tensile strength of coupling mechanism IEC 61300-2-6	Load: 40 N Duration: 60 s	O,V	O,V	O, V ^d		
Static side load ^c IEC 61300-2-42	Load: 0,2 N for 5 min for buffered fibres 1 N for 1 h for cable Two mutually perpendicular directions	O,V		O, V ^a		
Static side load ^{a,b,c} IEC 61300-2-42	Load: 1,0 N for 1 h for cables 0,5 N for 5 min for cable elements or tubes Two mutually perpendicular directions					O, V ^a b,c
Flexing of the strain relief of fibre optic devices ^a IEC 61300-2-44	Load: 5 N for cables Cycle: $\pm 90^\circ$ Number of cycles: 50	O,V		O,V		
Fibre optic connector proof test 90° IEC 61300-2-50	Load: 5 N on buffered fibres 15 N on cables Duration: 5 s Optical performance checked after test	O,V	O,V			
Torsion IEC 61300-2-5	Load: 10 N for cables 2,0 N for primary coated and buffered fibres 25 cycles $\pm 180^\circ$ Fibre/cable clamping distance: 25 cm $\pm$ 5 cm	O,V	O,V			
Torsion IEC 61300-2-5	Load: 5 N for cables 2,0 N for primary coated and buffered fibres 10 cycles $\pm 180^\circ$ Fibre/cable clamping distance: 25 cm $\pm$ 5 cm			O,V	O, V	
Mating durability IEC 61300-2-2	200 cycles for cylindrical ferrules 50 cycles for rectangular ferrules Not less than 3 s between engagements	O,V	O,V	O, V ^d		

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Bending moment IEC 61300-2-7	Load: 2 N for splices 10 N for connectors Duration: minimum 10 s	O,V	O,V	O, V ^d	O, V	
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	If applicable, move the fibre management system to gain access to the splice trays. Move the splice trays to gain access to splices and fibres. Rearrange splices and/or connectors. Add splice trays/splice modules when applicable. Add fibre/cable.					O,V
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures ^f IEC 61300-2-33	Open and re-install the mechanical splice ^f . 5 cycles				O, V	
Vibration (sinusoidal) IEC 61300-2-1	Frequency range: 10 Hz to 55 Hz Number of sweeps: 15 sweeps (10 – 55 – 10) Hz per axis Rate of frequency change: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 0,75 mm	O,V	O,V	O,V	O, V	
Vibration (sinusoidal) IEC 61300-2-1	Frequency range: 5 Hz to 500 Hz Number of sweeps per axis: 10 sweeps (5 – 500 – 5) Hz Rate of frequency change: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 3,5 mm at frequencies below 9 Hz Acceleration: 10 m/s ² at frequencies above 9 Hz					O,V
Impact (method A) IEC 61300-2-12	5 drops 1,5 m drop height	O,V	O,V			
Shock IEC 61300-2-9	Acceleration: Component or module mass - ≤ 0,125 kg: 5 000 m/s ² - 0,125 kg < module mass ≤ 0,225 kg: 2 000 m/s ² - 0,225 kg < module mass ≤ 1 kg: 500 m/s ² Wave form: half sine pulse Duration: 1 ms Axes: 3 mutually perpendicular axes Number of shocks: 2 shocks per axis and per direction of axis, 12 shocks total			O, V ^e	O, V	
Shock IEC 61300-2-9	Wave form: half sine Duration: 11 ms Acceleration: 150 m/s ² Axes: 3 mutually perpendicular axes Number of shocks: 3 shocks per axis and per direction of axis, 18 shocks in total					O,V
Cold IEC 61300-2-17	Temperature: –25 °C Duration: 96 h	O,V	O,V	O,V	O, V	
Dry heat – High temperature endurance IEC 61300-2-18	Temperature: +70 °C Duration: 96 h	O,V	O,V	O,V	O, V	
Damp heat (cyclic) IEC 61300-2-46	Temperature: +25 °C to +55 °C Humidity: > 90 % RH 6 cycles (24 h/cycle)	O,V	O,V	O,V	O, V	O,V

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Change of temperature IEC 61300-2-22	Temperature range: -25 °C to +70 °C Duration at extreme temperatures: 60 min 1 °C/min rate of change 12 cycles	O, V	O, V	O, V	O, V	O, V
Dust IEC 61300-2-27	Dust type: talc Particle size: d <150 µm Duration: 10 min Dust concentration: 10,6 g/m ³ ± 7,1 g/m ³	O, V	O, V	O, V	O, V	
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH: between 6,5 and 7,2) Temperature: 35 °C Duration: 96 h	O, V ^g	O, V ^g	O, V ^g	O, V ^g	
^a These tests shall be applicable to passive optical components with a strain relief boot attached to the component. The test is not applicable for components without strain relief boot. ^b If cables or cable elements (loose tubes) are not fixed to the entry ports of the fibre management system, the test shall not be performed. ^c Static side load shall be applied in two mutually perpendicular directions as permitted by the product design. For example, a product with a base plate extending beyond the fibre exit may prohibit loading in that direction. ^d Applicable only if the component contains a receptacle. ^e If the product is normally mounted in a shock resistant mounting, then it shall be tested in this configuration. ^f This test is only applicable for re-installable mechanical splices. ^g Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.						

Table A.6 – Connectors, field mountable connectors, passive components, mechanical splices, fusion splice protectors and fibre management systems – Category OP^{HD} – Outdoor protected environment with additional heat dissipation

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Dry heat IEC 61300-2-18	Temperature: +85 °C Duration: 96 h	O, V	O, V	O, V	O, V	
Change of temperature IEC 61300-2-22	Temperature range: -25 °C to +85 °C Duration at extreme temperatures: 60 min 1 °C/min rate of change 12 cycles	O, V	O, V	O, V	O, V	O, V
NOTE 1 Category OP^{HD} contains the tests from category OP with the addition of the following more severe tests: dry heat (+85°C) and change of temperature (-25°C/+85°C). NOTE 2 When a product is immediately qualified for category OP^{HD}, there is no need to perform the following less severe tests from category OP: dry heat (+70°C) and change of temperature (-25°C/+70°C). NOTE 3 When the tests are performed for category OP^{HD}, the product will be automatically qualified for categories OP, OP^{HD}, C and C^{HD}.						

Table A.7 – Connectors, field mountable connectors, passive components, mechanical splices, fusion splice protectors and fibre management systems – Category OP+ – Extended outdoor protected environment

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Cold IEC 61300-2-17	Temperature: –40 °C Duration: 96 h	O,V	O,V	O,V	O, V	
Dry heat IEC 61300-2-18	Temperature: +75 °C Duration: 96 h	O,V	O,V	O,V	O, V	
Composite temperature humidity cyclic test IEC 61300-2-21	Z/AD profile with exposure to cold and humidity cycles Temperature range: –10 °C to +65 °C Humidity: 93 % RH at the maximum temperature 3 h dwells at the temperature extremes 10 cycles	O,V	O,V	O,V	O, V	O,V
Change of temperature IEC 61300-2-22	Temperature range: –40 °C to +75 °C Duration: 60 min at extremes 1 °C/min rate of change 12 cycles	O,V	O,V	O,V	O, V	O,V
NOTE 1 Category OP+ contains the tests from category OP with the addition or replacement by the following more severe tests: cold (–40 °C), dry heat (+75 °C), composite temperature humidity cyclic test Z/AD (–10 °C/+65 °C/93 % RH) and change of temperature (–40 °C/+75 °C). NOTE 2 When a product is immediately qualified for category OP+, there is no need to perform the following less severe tests from category OP: cold (–25 °C), dry heat (+70 °C), damp heat (cyclic) (+25 °C/+55 °C/90 % RH) and change of temperature (–25 °C/+70 °C). NOTE 3 When the tests are performed for category OP+, the product will be automatically qualified for category OP and category C.						

Table A.8 – Connectors, field mountable connectors, passive components, mechanical splices, fusion splice protectors and fibre management systems – Category OP+^{HD} – Extended outdoor protected environment with additional heat dissipation

Test	Severity	Connectors	FMC	Passive components	Splices	FMS
Dry heat IEC 61300-2-18	Temperature: 85 °C Duration: 96 h	O,V	O,V	O,V	O, V	
Change of temperature IEC 61300-2-22	Temperature range: –40 °C to +85 °C Duration at extreme temperatures: 60 min 1 °C/min rate of change 12 cycles	O,V	O,V	O,V	O, V	O,V
NOTE 1 Category OP+^{HD} contains the tests from category OP+ with the replacement of the following more severe tests: dry heat (+85 °C) and change of temperature (–40 °C/+85 °C). NOTE 2 When a product is immediately qualified for category OP+^{HD}, there is no need to perform the following less severe tests from category OP+: dry heat (+75 °C) and change of temperature (–40 °C/+75 °C). NOTE 3 When the tests are performed for category OP+^{HD}, the product will be automatically qualified for categories OP+, OP, OP^{HD}, C and C^{HD}.						

Table A.9 – Connectors, passive optical components – Category I – Industrial environment

Test	Severity	Connectors	Passive components
Vibration (sinusoidal) IEC 61300-2-1	Frequency range: 2 Hz to 200 Hz Number of sweeps per axis: 15 sweeps (2 – 200 – 2) Hz Change of frequency: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 15 mm at frequencies below 9 Hz Acceleration: 50 m/s ² at frequencies above 9 Hz	O,V	O,V
Change of temperature IEC 61300-2-22 Test Nb	Temperature range: –40 °C ± 2 °C to +70 °C ± 2 °C Duration: 4 h at extremes 3 °C/min rate of change 12 cycles	O,V	O,V
Damp heat (cyclic) IEC 61300-2-46	Temperature range: +25 °C to +55 °C Humidity: > 90 % RH 6 cycles (24 h/cycle)	O,V	O,V
Dust (IP 6x) IEC 60529	Dust type: talcum powder Particle size < 75 µm Dust density: 2 kg/m ³ Pressure: 2 kPa underpressure inside housing Duration: 8 h	O,V	O,V
Protection against ingress of water (IP x5) IEC 60529	Spray medium: tap water at ambient temperature Internal Ø nozzle: 6,3 mm Flow rate: 12,5 l/min ± 5 % Water pressure adjusted to get specified flow rate Distance nozzle/ sample: between 2,5 m and 3 m Sample position: depending application Duration: 3 min in total	V	V
Protection against ingress of water (IP x7) IEC 60529	Depth of water: lowest point of sample shall be 1 m below the surface of the water, the highest point shall be at minimum 0,15 m below the surface of the water Temperature: +23 °C ± 3 °C Duration: 30 min	V	V
Corrosive atmosphere (mixed gas) IEC 61300-2-54 ¹	Sulphur dioxide SO ₂ : 10 ppm Hydrogen sulphide H ₂ S: 5 ppm Duration: 96 h	O,V ^d	O,V ^d
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH: between 6,5 and 7,2) Temperature: +35 °C Duration: 96 h	O,V ^d	O,V ^d
Resistance to solvents and contaminating fluids IEC 61300-2-34	Solvents: - NaCl 0,3 × 10 ⁻⁶ at 30 °C - Mineral oil 0,5 × 10 ⁻⁶ at 70 °C - Soap 50 000 × 10 ⁻⁶ at 30 °C Duration: 24 h	O,V ^d	O,V ^d
Tensile strength of coupling mechanism IEC 61300-2-6	Load: 60 N smoothly applied at 2 N/s Duration: 60 s	O,V	O,V ^b

¹ Under preparation. Stage at the time of publication: IEC/CDM 61300-2-54:2018.