

INTERNATIONAL STANDARD



Fibre optic interconnecting devices and passive components – Performance standard –

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

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INTERNATIONAL STANDARD



**Fibre optic interconnecting devices and passive components – Performance
standard –**

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

INTERNATIONAL
ELECTROTECHNICAL
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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

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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 MaIbCcEd 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.

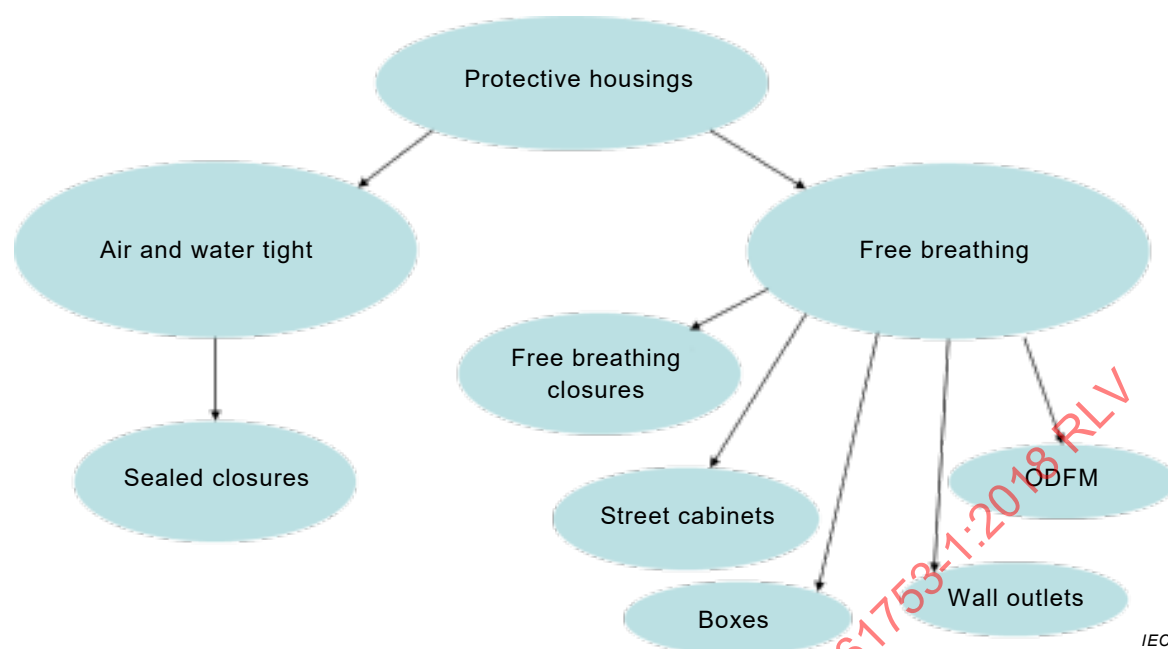


Figure 1 – Relationship between various protective housing types

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

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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 61300-2-4	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	$-10\text{ °C} \pm 2\text{ °C}$ 96 h duration	
Dry heat — High temperature endurance IEC 61300-2-18	$+60\text{ °C} \pm 2\text{ °C}$ 96 h duration	
Damp heat (steady state) IEC 61300-2-19	$+40\text{ °C} \pm 2\text{ °C}$ 93 % RH $\pm 2\text{ %}$ to 3 % RH 96 h duration	
Change of temperature IEC 61300-2-22 Test Nb	$-10\text{ °C} \pm 2\text{ °C}$ to $+60\text{ °C} \pm 2\text{ °C}$ 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: $\pm 90^\circ$ Number of cycles: 100	2 N for reinforced cable Cycle: $\pm 90^\circ$ Number of cycles: 30
Fibre/cable retention ^a IEC 61300-2-4	50 N $\pm 2\text{ N}$ at 5 N/s for reinforced cables 5,0 N $\pm 0,5\text{ N}$ at 0,5 N/s for secondary coated fibres 2,0 N $\pm 0,2\text{ N}$ 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 $\pm 1\text{ N}$ at 5 N/s for reinforced cables 5,0 N $\pm 0,5\text{ N}$ at 0,5 N/s for secondary coated fibres 2,0 N $\pm 0,2\text{ N}$ 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 $\pm 1\text{ N}$ 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 $\leq$ module mass $\leq$ 0,225 kg: 200 g _n • 0,225 kg $\leq$ module mass $\leq$ 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 61300-2-4	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 $d \leq 150 \mu\text{m}$ 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 61300-2-42	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.		

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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 °C ± 2 °C for 168 h or Temperature/duration: Var. B +75 °C ± 2 °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 °C ± 2 °C to +75 °C ± 2 °C, dwell at +23 °C ± 2 °C 1 h duration at dwell temperatures ≥1 °C/min rate of change 21 cycles
Damp heat (steady state) IEC 61300-2-19	+75 °C ± 2 °C 90 % RH ± 5 % RH 168 h
Temperature-humidity cycling IEC 61300-2-48 Method B	Cycle profile: +23 °C to -10 °C to +65 °C to -10 °C to +23 °C. Temperature tolerance: ± 2 °C 90 % RH to 100 % RH ± 2 % RH during dwells at +23 °C and +65 °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 °C must occur faster (20 min max.) to maximize condensation. Dwell time: 2 h at 23 °C and -10 °C. At +65 °C, the dwell time is 3 h minus the ramp time.
Dry Heat – high temperature endurance IEC 61300-2-18	Temperature: +75 °C ± 2 °C Duration: 24 h
Change of temperature IEC 61300-2-22 Test Nb	-40 °C ± 2 °C to +75 °C ± 2 °C, dwell at +23 °C ± 2 °C 1 h duration at dwell temperatures ≥1 °C/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: ± 90° Number of cycles: 100 Load applied 25 cm ± 3 cm from cable entrance to plug
Torsion/twist IEC 61300-2-5	<u>Reinforced jacketed cables:</u> Load: 13,3 N Cycle: ± 900° Number of cycles: 10 <u>900-micron secondary coated fibres:</u> Load: 7,4 N Cycle: ± 540° Number of cycles: 10 <u>250-micron primary coated fibres:</u> Load: 4,9 N Cycle: ± 540° Number of cycles: 10 Load applied 25 cm ± 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 61300-2-4	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/s² (~ 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/s² (~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° ^a ; 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 ≥ 25 mm the clamping distance may be increased to 1 000 mm.	

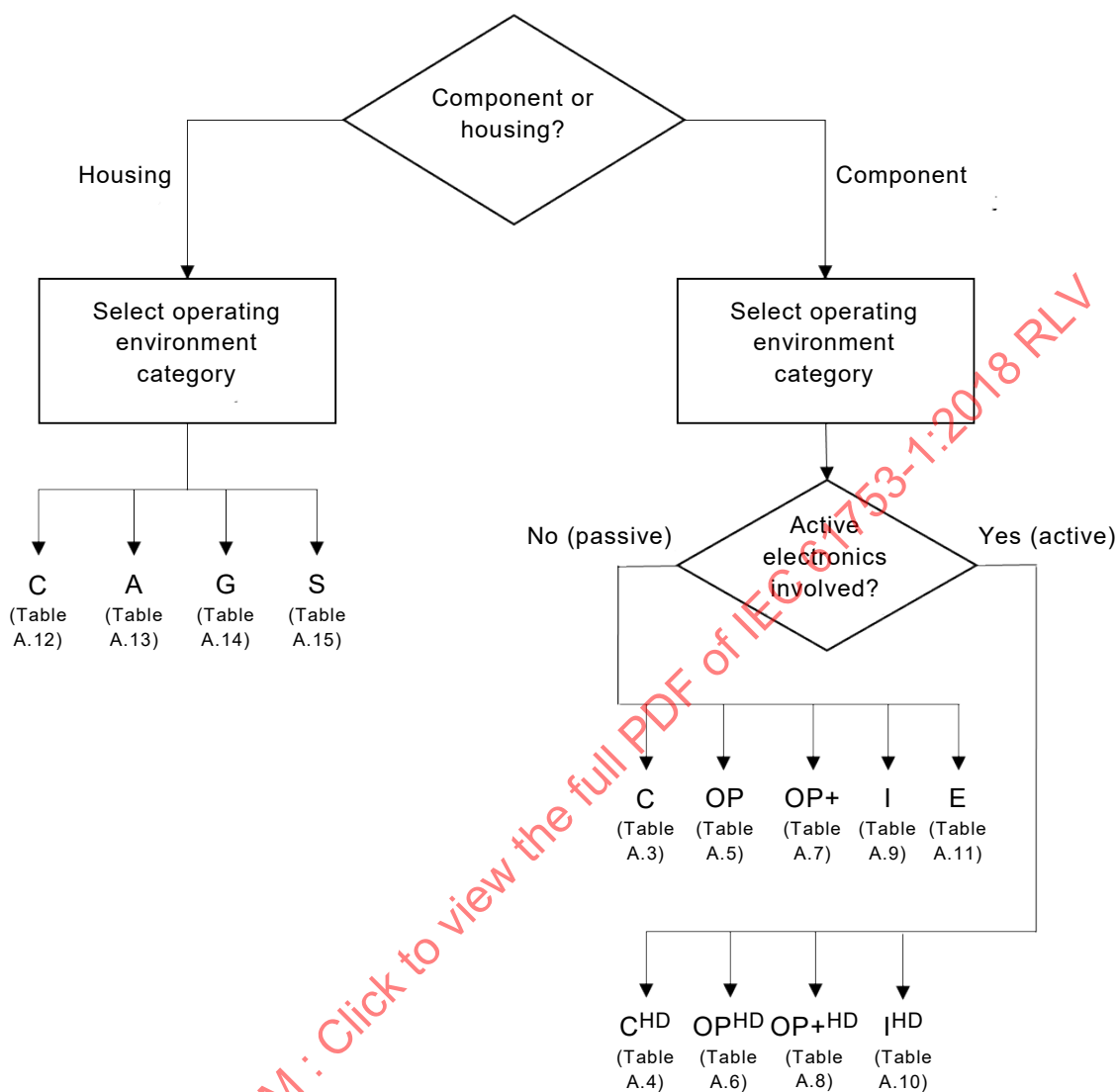
Table A.11 – Closures – Category S – Subterranean environment

Test	Severity
	Closures
Change of temperature IEC 61300-2-22 Test Nb	$-30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ 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 $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$
Water immersion IEC 61300-2-23 Method 2	Depth of water: 5 m (or an equivalent water pressure of 50 kPa) Test conducted at $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ 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 $50\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) 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 $-15\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and $+45\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ 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 $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ 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 $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ 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 $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ 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 $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ 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 $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ 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

[illegible]

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	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

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.

Test	Severity	Connectors	Passive components
Torsion IEC 61300-2-5	Load: 10 N for cables clamping distance: 300 mm 25 cycles $\pm 180^\circ$	O,V	(O _a ,V)
Bending moment IEC 61300-2-7	Load: 10 N for 30 s 2 perpendicular axes Duration: minimum 10 s	O,V	(O _b ,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 _b ,V)
Fibre/cable retention ^a IEC 61300-2-4	Load: 100 N for 120 s on cable	O,V	(O _a ,V)
Nutation IEC 61300-2-35	Load: 10 N Point of application: 0,2 m from rear of body plug 100 cycles of 360°	O,V	(O _a ,V)
Impact (method A) IEC 61300-2-12	Drop height: 1,5 m Drop locations at 0° , 90° , 180° and 270° around longitudinal axis of housing 5 impacts per location	O,V	O,V
Shock ^c IEC 61300-2-9	Acceleration: 250 m/s^2 Pulse shape: half sine pulse Duration pulse: 6 ms Axes: 3 mutually perpendicular axes Number of shocks: 5 shocks per axis and per direction of axis, 30 shocks in total	O,V	O,V
Crush resistance IEC 61300-2-10	Load: 2 200 N Application area: 25 cm^2 (circular shape) Location: centre of housing at 0° and 90° around longitudinal axis of housing Duration: 60 s per location	O,V	O,V
^a These tests shall be applicable to passive optical components which incorporate fibre or fibre cable pigtails in their product design. ^b Applicable only if the component contains a receptacle. ^c If the product is normally mounted in a shock resistant mounting, then it shall be tested in this configuration. ^d Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.			

Table A.10 – Connectors, passive optical components – Category I^{HD} – Industrial environment with additional heat dissipation

Test	Severity	Connectors	Passive components
Change of temperature IEC 61300-2-22	Temperature range: –40 °C to +85 °C Duration at extreme temperatures: 4 h duration 3 °C/min rate of change 12 cycles	O,V	O,V
NOTE 1 Category I^{HD} contains the tests from category I with the replacement of the following more severe test: Change of temperature (–40 °C/+85 °C). NOTE 2 When a product is immediately qualified for category I^{HD}, there is no need to perform the following less severe tests from category I: change of temperature (–40 °C/+70 °C). NOTE 3 When the tests are performed for category I^{HD}, the product will be automatically qualified for category I.			

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**Table A.11 – Connectors and passive optical components –
Category E – Extreme environment**

Test	Severity	Connectors	Passive components
Vibration (sinusoidal) IEC 61300-2-1	Frequency range: 10 Hz to 55 Hz Sweep: 15 sweeps (10 – 55 – 10) Hz Change in frequency: 1 octave/min Axes: 3 mutually perpendicular axes Amplitude: 0,75 mm	O,V	O,V
Cold IEC 61300-2-17	Temperature: –40 °C Duration: 96 h	O,V	O,V
Dry heat IEC 61300-2-18	Temperature: +85 °C Duration: 96 h	O,V	O,V
Change of temperature IEC 61300-2-22 Test Nb	Temperature range: –40 °C to +85 °C Duration at extreme temperatures: 1 h 1 °C/min rate of change 12 cycles	O,V	O,V
Dust IEC 61300-2-27	Particle size: $d < 150 \mu\text{m}$ Dust type: talc Duration: 10 min Dust concentration: $(10,6 \pm 7,1) \text{ g/m}^3$	O,V	O,V
Composite temperature humidity cyclic test IEC 61300-2-21	Z/AD profile with exposure to cold Temperature range: –10 °C to +65 °C 93 % RH $\pm$ 3 % RH at the maximum temperature 3 h dwells at the temperature extremes 10 cycles	O,V	O,V
Corrosive atmosphere IEC 61300-2-28	Sulphur dioxide SO ₂ : 25 ppm Duration: 96 h	O,V ^e	O,V ^e
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH 6,5 to 7,2) Temperature: +35 °C Duration: 96 h	O,V ^e	O,V ^e
Durability by water immersion IEC 61300-2-45	Depth of water: sample shall be 5 cm below the surface of the water Test temperature: +25 °C $\pm$ 2 °C Duration: 1 h Immersion cycles: 1 cycle	O,V	O,V
Optical fibre cable flexing IEC 61300-2-44	Load: 5 N for cable Cycle: +90° and –90° Number of cycles: 100	O,V	
Optical fibre cable flexing IEC 61300-2-44	Load: 5 N for cable Cycle: +90° and –90° Number of cycles: 30		(O _a ,V)
Fibre/cable retention IEC 61300-2-4	Load: 100 N for 60 s for cables with diameter $> 2 \text{ mm}$ 70 N for 60 s for cables with diameter $\leq 2 \text{ mm}$ 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres	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 _a ,V)

Test	Severity	Connectors	Passive components
Impact (method A) IEC 61300-2-12	5 drops 1,5 m drop height	O,V	
Shock ^b IEC 61300-2-9	Acceleration of component or module mass: ≤ 0,125 kg: 5 000 m/s² 0,125 kg < module mass ≤ 0,225 kg: 2 000 m/s² 0,225 kg < module mass ≤ 1 kg: 500 m/s² 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 in total.		O,V ^b
Torsion IEC 61300-2-5	Load: 15 N for cables 2,0 N for primary coated and buffered fibres 25 cycles ± 180°	O,V	
Torsion IEC 61300-2-5	Load: 5,0 N for cables 2,0 N for primary coated and buffered fibres 10 cycles ± 180°		(O _a V)
Tensile strength of coupling mechanism IEC 61300-2-6	Load: 40 N Duration: 120 s	O,V	(O _d V)
Static side load ^c IEC 61300-2-42	Load: 1 N for 1 h for cable 0,2 N for 5 min for buffered fibres Two mutually perpendicular directions	O,V	(O _a V)
Mating durability IEC 61300-2-2	500 cycles at not less than 3 s between engagements	O,V	(O _d V)
Bending moment IEC 61300-2-7	Load: 10 N Duration: minimum 10 s	O,V	(O _d V)
^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. ^d Applicable only if the component contains a receptacle. ^e Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.			

Table A.12 – Wall outlets, boxes, optical distribution frame modules and closures – Category C – Indoor controlled environment

Test	Severity	Wall outlets	Boxes	ODFM	Closures
Vibration (sinusoidal) IEC 61300-2-1	Frequency: 10 Hz Amplitude: 3 mm Cables clamped at 500 mm from connector or closure Number of cycles: 1 000 000 (about 28 h) Test conducted at +23°C ± 3°C	S,V	S,V		S,V
Vibration (sinusoidal) ^c IEC 61300-2-1	Frequency range: 5 Hz to 500 Hz Number of sweeps per axis: 10 sweeps (5 – 500 – 5) Hz Change of frequency: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 1,5 mm at frequencies below 9 Hz Acceleration: 5 m/s ² at frequencies above 9 Hz Test conducted at +23°C ± 3°C	O,V	O,V	O,V	O,V
Shock IEC 61300-2-9	Wave form: Half sine Duration: 11 ms Acceleration: 150 m/s ² (~15 g) Axes: 3 mutually perpendicular axes Number of shocks: 3 shocks per axis and per direction of axis, 18 shocks in total Test conducted at +23 °C ± 3 °C	O,V	O,V	O,V	O,V
Change of temperature ^c IEC 61300-2-22 Test Nb	Temperature range: –10 °C to +60 °C Duration at extreme temperatures: 4 h duration 1 °C/min rate of temperature change 5 cycles	S,O,V	S,O,V	O,V	S,O,V
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	5 disassembly/assembly cycles At least one "Change of temperature" cycle between each disassembly/assembly cycle Test conducted at +23 °C ± 3 °C		S,V		S,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. All movements shall include the most extreme position allowed by the fibre management system. Rearrange splices and/or connectors. Add splice trays/splice modules when applicable. Add fibre/cable. Test conducted at +23 °C ± 3 °C.	O,V	O,V	O,V	O,V
Fibre/cable retention ^c IEC 61300-2-4	Load: 25 N on cables or cords 60 s load duration per cable/cord Test conducted at +23 °C ± 3 °C	S,O,V	S,O,V	O,V	
Fibre/cable retention ^c IEC 61300-2-4	Load on cable (N): 10 × cable diameter (mm) 1 h load duration per cable Test conducted at +23 °C ± 3 °C				S,O,V
Axial compression IEC 61300-2-11	Axial load: 450 N on rigid strength member cable 30 min duration per central strength member Test conducted at +23 °C ± 3 °C				V

Test	Severity	Wall outlets	Boxes	ODFM	Closures
Torsion ^c IEC 61300-2-5	Torque angle: +90° and –90° in 2 directions Point of application: 400 mm from end of seal ^a 5 min in each extreme position 5 cycles per cable Test ^c conducted at +23 °C ± 3 °C	(S,O, V) ^b	(S,O ,V) ^b	(O, V) ^b	S,O, V
Cable bending ^c IEC 61300-2-37	Bending angle: +30° and –30° Point of application: 400 mm from end of seal ^a 5 min in each extreme position 5 cycles per cable Duration at extreme position: 5 min Tests ^c conducted at +23 °C ± 3 °C	(S,O, V) ^b	(S,O ,V) ^b	(O, V) ^b	S,O, V
Impact (method B) IEC 61300-2-12	Impact tool: 1 kg mass steel ball Drop height: 0,5 m Impact locations: centre of closure at 0°, 90°, 180° and 270° around longitudinal axis of closure 1 impact per location Sealing test conducted at +23 °C ± 3 °C				S,V
Impact (method B) IEC 61300-2-12	Impact tool: 1 kg mass steel ball Drop height: 0,2 m Impact locations: top (in centre) and front (in centre) 1 impact per location Sealing test conducted at +23 °C ± 3 °C	S,V	S,V		
^a For rigid cables with diameter Ø > 25 mm, the clamping distance may be increased to 1 000 mm. ^b Test only required when product is pre-cabled and cable handling is expected when unpacking and installing the product. ^c Separate test samples for sealing performance and optical performance evaluation may be used.					

Table A.13 – Hardened optical connectors, street cabinets, boxes and closures
Category A – Outdoor aerial environment

Test	Severity	Hardened connectors	Street cabinets	Boxes	Closures
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	5 disassembly/assembly cycles At least one "Change of temperature" cycle between each disassembly/assembly cycle Sealing test conducted at +23 °C ± 3 °C	S ^d , V	S, V	S, V	S, 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	O, V	O, V
Mating durability ^d IEC 61300-2-2	20 cycles Optical test conducted at +23 °C ± 3 °C	O, V ^d			
Fibre optic connector proof test with static load ^c IEC 61300-2-50	Load: 300 N (straight pull 0°) Load: 25 N (side pull 90°) Duration: 5 s Test conducted at +23 °C ± 3 °C	S, O, V			
Fibre/cable retention ^c IEC 61300-2-4	Load (N): 20 × cable diameter (mm) 1 h load duration per cable per test temperature Sealing test ^c conducted at test temperatures –15 °C and +45 °C Optical test ^c conducted at +23 °C ± 3 °C	S, O, V	V ^b		S, O, V
Fibre/cable retention ^c IEC 61300-2-4	Load (N): 10 × cable diameter (mm) for 1 h per feeder cable per test temperature 25 N for 60 s per cord and work area cable and per temperature Sealing test ^c conducted at test temperatures –15 °C and +45 °C Optical test ^c conducted at +23 °C ± 3 °C			S, O, V	
Axial compression IEC 61300-2-11	Axial load: 450 N on (rigid) strength member of cable 30 min duration per central strength member Test conducted at +23 °C ± 3 °C				V
Cable bending ^c IEC 61300-2-37	Cycle with bending angle: +30° and –30° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min at each extreme position Sealing test conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C Optical test conducted at +23 °C ± 3 °C		V ^b	(S, O, V) ^b	S, O, V
Cable bending ^c IEC 61300-2-37	Cycle with bending angle: +90° and –90° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min at each extreme position Sealing test conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C Optical test conducted at +23 °C ± 3 °C	S, O, V			

Test	Severity	Hardened connectors	Street cabinets	Boxes	Closures
Torsion ^c IEC 61300-2-5	Cycle with torque angle: +90° and –90° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min in each extreme position Sealing test ^c conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C Optical test ^c conducted at +23 °C ± 3 °C	S, O, V	V ^b	(S, O, V) ^b	S, O, V
Impact (method A) IEC 61300-2-12	5 drops per test sample 1,5 m drop height per test temperature Sealing test ^c conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C Optical test ^c conducted at +23 °C ± 3 °C	S, O, V			
Impact (method B) 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 enclosure 1 impact per location per test temperature Sealing test conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C				S, V
Impact (method B) IEC 61300-2-12	Impact tool: 1 kg mass steel ball Drop height: 1 m Impact locations: in the centre of top, front and sides (if accessible) 1 impact per location per test temperature Sealing test conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C		S, V	S, V	
Vibration (sinusoidal) IEC 61300-2-1	Frequency: 10 Hz Amplitude: 3 mm Cables clamped at 500 mm from connector or closure Number of cycles: 1 000 000 (about 28 h) Test conducted at +23 °C ± 3 °C	S, V		S, V	S, 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 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 Tests conducted at +23 °C ± 3 °C	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 Change of frequency: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 1,2 mm at frequencies below 9 Hz Acceleration: 4 m/s ² at frequencies above 9 Hz Test conducted at +23 °C ± 3 °C		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 Test conducted at +23 °C ± 3 °C	O, V		O, V	O, V

Test	Severity	Hardened connectors	Street cabinets	Boxes	Closures
Shock IEC 61300-2-9	Wave form: half sine Duration: 11 ms Acceleration: 50 m/s ² (~5 g) Axes: 3 mutually perpendicular axes Number of shocks: 3 shocks per axis and per direction of axis, 18 shocks in total Test conducted at +23 °C ± 3 °C		O,V		
Crush resistance IEC 61300-2-10	Vertical load (N): 1 750 (Pa) × width (m) × cabinet depth (m) Application area: evenly distributed on top surface of cabinet Duration: 10 min per location per test temperature Test conducted at –15 °C and +45 °C		S,V		
Static load on doors IEC 61300-2-10	Vertical load: 200 N Point of application: on top of open door at most extreme point that creates the highest momentum in the hinge of the door Duration: 10 min		S,V		
Change of temperature ^c IEC 61300-2-22	Temperature range: –40 °C to +65 °C Duration at extreme temperatures: 4 h duration Temperature change rate: 1 °C/min 12 cycles	S,O, V	S,O, V	S,O, V	S,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			
Resistance to solvents and contaminating fluids ^g IEC 61300-2-34	Solvents: - HCl at pH 2 - NaOH at pH 12 Duration: 5 days	S ^g , V ^e	V ^e	V ^e	S ^g , V ^e
Salt mist IEC 61300-2-26	Salt solution: 5 % NaCl (pH: between 6,5 and 7,2) Temperature: +35 °C Duration: 5 days	S,V ^e	V ^e	V ^e	S,V ^e
Dust (IP 5x) IEC 60529	Dust type: talcum powder Particle size: < 75 µm Dust density: 2 kg/m ³ Pressure: no pressure difference Duration: 8 h		V	V	
Dust (IP 6x) IEC 60529	Dust type: talcum powder Particle size: < 75 µm Dust density: 2 kg/m ³ Test underpressure: 2 kPa regulated underpressure inside protective housing Duration: 8 h	O,V			

^a For rigid cables with diameter Ø > 25 mm, the clamping distance may be increased to 1 000 mm.

^b Test only required when product is pre-cabled and cable handling is expected when unpacking and installing the product.

^c Separate test samples for hardened connector/closure sealing performance and optical evaluation may be used.

^d Sealing medium may be replaced for sealing test.

^e Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.

^f Test only when the closure is provided with an integrated mounting fixture.

^g Sealing requirement only required for sealed closures and hardened connectors that can be immersed in the fluids. For all other free breathing protective housings (that are not able to hold a permanent overpressure or underpressure), the test shall be carried out on material slabs.

**Table A.14 – Hardened optical connectors and closures –
Category G – Outdoor ground environment**

Test	Severity	Hardened Connector	Closures
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	5 disassembly/assembly cycles. At least one "Change of temperature" cycle between each disassembly/assembly cycle. Test conducted at $+23\text{ °C} \pm 3\text{ °C}$.	S ^d , V	S, 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
Mating durability IEC 61300-2-2	20 cycles Optical test conducted at $+23\text{ °C} \pm 3\text{ °C}$	O, V ^d	
Fibre optic connector proof test with static load ^b IEC 61300-2-50	Load: 300 N (straight pull 0°) Load: 25 N (side pull 90°) Duration: 5 s Tests ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$ Sealing and optical performance checked after test	S, O, V	
Fibre/cable retention ^b IEC 61300-2-4	Load (N): $20 \times$ cable diameter (mm) 1 h load duration per cable per test temperature. Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S, O, V	S, O, V
Axial compression IEC 61300-2-11	Axial load: 450 N on (rigid) strength member of cable Duration: 30 min per central strength member Test conducted at $+23\text{ °C} \pm 3\text{ °C}$		V
Cable bending ^b IEC 61300-2-37	Cycle with bending angle: $+30^\circ$ and -30° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min at each extreme position Sealing test ^b conducted at -15 °C and $+45\text{ °C}$ Optical monitoring test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$		S, O, V
Cable bending ^b IEC 61300-2-37	Cycle with bending angle: $+90^\circ$ and -90° Point of application: 400 mm from end of plug ^a 5 cycles per cable per test temperature 5 min at each extreme position Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S, O, V	
Torsion ^b IEC 61300-2-5	Cycle with torque angle: $+90^\circ$ and -90° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min in each extreme position Sealing test ^b conducted at -15 °C and $+45\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S, O, V	S, O, V
Impact IEC 61300-2-12 (method A)	5 drops per test sample 1,5 m drop height Test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S, O, V	

Test	Severity	Hardened Connector	Closures
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 enclosure 1 impact per location per test temperature Sealing test conducted at $-15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $+45^{\circ}\text{C} \pm 2^{\circ}\text{C}$		S,V
Vibration (sinusoidal) IEC 61300-2-1	Frequency: 10 Hz Amplitude: 3 mm Cables clamped at 500 mm from connector or closure Number of cycles: 1 000 000 (about 28 h) Test conducted at $+23^{\circ}\text{C} \pm 3^{\circ}\text{C}$	S,V	S,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 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 Test conducted at $+23^{\circ}\text{C} \pm 3^{\circ}\text{C}$	O,V	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 Test conducted at $+23^{\circ}\text{C} \pm 3^{\circ}\text{C}$	O,V	O,V
Crush resistance IEC 61300-2-10	Load: 1 000 N Application area: 25 cm^2 (circular shape) Location: centre of closure/connector at 0° and 90° around longitudinal axis of closure/connector Duration: 10 min per location per test temperature Test conducted at -15°C and $+45^{\circ}\text{C}$	S,V	S,V
Change of temperature ^b IEC 61300-2-22 Test Nb	Temperature range: -40°C to $+65^{\circ}\text{C}$ Duration at extreme temperatures: 4 h 1°C/min rate of change 12 cycles 12 cycles	S,O, V	S,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 $+65^{\circ}\text{C}$ Humidity: 93 % RH at the maximum temperature 3 h dwells at the temperature extremes 10 cycles	O,V	
Dust (IP 6x) IEC 60529	Dust type: Talcum powder Particle size: $< 75\text{ }\mu\text{m}$ Dust density: 2 kg/m^3 Pressure: 2 kPa regulated underpressure inside protective housing Duration: 8 h	O,V	

Test	Severity	Hardened Connector	Closures
Resistance to solvents and contaminating fluids IEC 61300-2-34	Solvents: - HCl at pH 2 - NaOH at pH 12 - Cable compound (petroleum jelly), ISO 1998-1:1998, 1.60.132 - Automotive diesel oil ISO 1998-1:1998, 1.20.131, and EN 590 - 10 % Nonyl Phenol Ethoxylate solution (Igepal) (at 50 °C ± 2 °C) Duration: Automotive diesel – 1 hour immersion, 24 hour drying Others: 5 days, no drying	S,V ^c	S,V ^c
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH: between 6,5 and 7,2) Temperature: +35 °C Duration: 5 days	S,V ^c	S,V ^c
Water immersion IEC 61300-2-23 Method 2	Depth of water above highest point of closure: 1 m (or an equivalent water pressure of 10 kPa) Test conducted at +23 °C ± 3 °C Duration: 7 days No wetting agent	V	V
^a For rigid cables with diameter $\varnothing > 25$ mm, the clamping distance may be increased to 1 000 mm. ^b Separate test samples for sealing performance and optical performance evaluation may be used. ^c Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards. ^d Sealing medium may be replaced for sealing test.			

**Table A.15 – Hardened optical connectors and closures – Category S –
Outdoor subterranean environment**

Test	Severity	Hardened connector	Closures
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	5 disassembly/assembly cycles At least one "Change of temperature" cycle between each disassembly/assembly cycle Sealing test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S ^c ,V	S,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
Mating durability ^c IEC 61300-2-2	20 cycles Optical test conducted at $+23\text{ °C} \pm 3\text{ °C}$	O,V	
Fibre optic connector proof test with static load ^b IEC 61300-2-50	Load: 300 N (straight pull 0°) Load: 25 N (side pull 90°) Duration: 5 s Tests conducted at $+23\text{ °C} \pm 3\text{ °C}$ Sealing and optical performance checked after test	S,O,V	
Fibre/cable retention ^b IEC 61300-2-4	Load (N): $20 \times$ cable diameter (mm) Duration: 1 h per cable at test temperature Sealing test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,O,V	S,O,V
Axial compression IEC 61300-2-11	Axial load: 450 N on (rigid) strength member of cable Duration: 30 min per central strength member Test conducted at $+23\text{ °C} \pm 3\text{ °C}$		V
Cable bending ^b IEC 61300-2-37	Cycle with bending angle: $+30^\circ$ and -30° Point of application: 400 mm from end of seal ^a 5 cycles per cable at test temperature 5 min at each extreme position Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$		S,O,V
Cable bending ^b IEC 61300-2-37	Cycle with bending angle: $+90^\circ$ and -90° Point of application: 400 mm from end of plug ^a 5 cycles per cable at test temperature 5 min at each extreme position Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,O,V	
Torsion ^b IEC 61300-2-5	Cycle with torque angle: $+90^\circ$ and -90° Point of application: 400 mm from end of seal ^a 5 cycles per cable at test temperature 5 min in each extreme position Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,O,V	S,O,V

Test	Severity	Hardened connector	Closures
Impact IEC 61300-2-12 (method B)	Impact tool: 1 kg mass steel ball Drop height: 2 m Impact locations: centre of closure at 0°, 90°, 180° and 270° around longitudinal axis of enclosure Number of impacts: 1x per location per test temperature Sealing test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$		S,V
Impact (free fall) IEC 61300-2-12 (method A)	5 drops per test sample 1,5 m drop height Test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,O,V	
Vibration (sinusoidal) IEC 61300-2-1	Frequency: 10 Hz Amplitude: 3 mm Cables clamped at 500 mm from connector or closure Number of cycles: 1 000 000 (about 28 h) Test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,V	S,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 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 Tests conducted at $+23\text{ °C} \pm 3\text{ °C}$	O,V	O,V
Shock IEC 61300-2-9	Wave form: Half sine Duration: 11 milliseconds 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 Test conducted at $+23\text{ °C} \pm 3\text{ °C}$	O,V	O,V
Crush resistance IEC 61300-2-10	Load: 1 000 N Application area: 25 cm^2 (circular shape) Location: centre of closure at 0° and 90° around longitudinal axis of closure Duration: 10 min per location per test temperature Sealing test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$	S,V	S,V
Change of temperature IEC 61300-2-22	Temperature range: -30 °C to $+60\text{ °C}$ Duration at extreme temperatures: 4 h Temperature change rate: 1 °C/min 12 cycles	S,O,V	S,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 $+65\text{ °C}$ Humidity: 93 % RH at the maximum temperature 3 h dwells at the temperature extremes 10 cycles	O,V	
Resistance to solvents and contaminating fluids IEC 61300-2-34	Solvents: - HCl at pH 2 - NaOH at pH 12 - Cable compound (petroleum jelly), ISO1998-1:1998, 1.60.132 - Automotive diesel oil ISO 1998-1:1998, 1.20.131, and EN 590 - 10 % nonylphenol ethoxylate solution (Igepal) - (at $50\text{ °C} \pm 2\text{ °C}$) Duration: Automotive diesel – 1 hour immersion, 24 hour drying at RT Others: 5 days, no drying	S,V ^d	S,V ^d

Test	Severity	Hardened connector	Closures
Dust (IP 6x) IEC 60529	Dust type: talcum powder Particle size: < 75 µm Dust density: 2 kg/m ³ Pressure: 2 kPa underpressure inside enclosure 8 h duration	O,V	
Water immersion IEC 61300-2-23 Method 2	Depth of water above highest point of closure: 5 m (or an equivalent water pressure of 50 kPa) Test conducted at +23 °C ± 3 °C Duration: 7 days No wetting agent	V	V
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH: between 6,5 and 7,2) Temperature: +35 °C Duration: 5 days	S,V ^d	S,V ^d
^a For rigid cables with diameter $\varnothing > 25$ mm, the clamping distance may be increased to 1 000 mm. ^b Separate test samples for sealing performance and optical performance evaluation may be used. ^c Sealing medium may be replaced for sealing test. ^d Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.			

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A.3 Performance requirements criteria

Table A.12 — Connectors

Performance requirements for single mode connectors ^a		
Attenuation grade	Attenuation Random mated IEC 61300-3-34	Monitoring change in attenuation and in return loss (multiple path) IEC 61300-3-3
Grade A	Not defined yet	Not defined yet
Grade B	$\leq 0,12$ dB mean $\leq 0,25$ dB max. for > 97 % of samples	IL $\leq 0,2$ dB during and after test for pigtails IL $\leq 0,5$ dB during and $\leq 0,4$ dB after test for patchcords
Grade C	$\leq 0,25$ dB mean $\leq 0,50$ dB max. for > 97 % of samples	IL $\leq 0,2$ dB during and after test for pigtails IL $\leq 0,5$ dB during and $\leq 0,4$ dB after test for patchcords
Grade D	$\leq 0,50$ dB mean $\leq 1,0$ dB max. for > 97 % of samples	IL $\leq 0,2$ dB during and after test for pigtails IL $\leq 0,5$ dB during and $\leq 0,4$ dB after test for patchcords
Return loss grade	Return loss Random mated IEC 61300-3-6	Monitoring change in attenuation and in return loss (Multiple path) IEC 61300-3-3
Grade 1	≥ 60 dB (mated) and ≥ 55 dB (unmated)	RL ≥ 60 dB (mated) and ≥ 55 dB (unmated) during and after test
Grade 2	≥ 45 dB	RL ≥ 45 dB during and after test
Grade 3	≥ 35 dB	RL ≥ 35 dB during and after test
Grade 4	≥ 26 dB	RL ≥ 26 dB during and after test
^a Multi-mode performance criteria are under consideration.		

Table A.15 – Closures

Performance requirements for single mode closures^a	
Test	Requirement
Monitoring change in attenuation and in return loss (Multiple path) IEC 61300-3-3	During test: $\delta IL \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre during test. $\delta IL \leq 0,5$ dB at 1 625 nm per incoming fibre during test. After test: For circuit with splices only: $\delta IL \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre after test. For circuit containing an optical connector set: $\delta IL \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre after test.
Transient Loss IEC 61300-3-28	During test (transient loss): $\delta IL \leq 0,5$ dB at 1 550 nm per life circuit during test. $\delta IL \leq 1,0$ dB at 1 625 nm per life circuit during test. After test: For circuit with splices only: $\delta IL \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit after test. For circuit containing an optical connector set: $\delta IL \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit after test.
Sealing for pressurised closures of fibre optic devices IEC 61300-2-38	This sealing criterion is mentioned for closures that are able to hold a test pressure of at least 40 kPa over pressure. Method A shall be used after all tests. Method B: for mechanical tests at test temperature. After test ≤ 2 kPa reduction at same atmospheric conditions For products used in pressurised networks, all sealing performance testing should be executed at $98,0 \text{ kPa} \pm 9,8 \text{ kPa}$ over pressure instead of 40 kPa over pressure.
Degrees of protection provided by enclosures IEC 60529	This sealing criterion is mentioned for closures that are not able to hold a test pressure of at least 40 kPa over pressure. Specific degrees of protection shall be specified in the performance standard for each type of closure and the environment required.
^a Multi-mode performance criteria are under consideration.	

Table A.16 – Single mode connectors

Optical performance criteria for single mode connectors		
Test	Requirement	
Attenuation of random mated connector IEC 61300-3-34 for single-fibre connector and IEC 61300-3-45 for multi-fibre connector ^{a, c}	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Grade A	Not specified at this time
	Grade B	$\leq 0,12$ dB mean $\leq 0,25$ dB max. for ≥ 97 % of the connections
	Grade C	$\leq 0,25$ dB mean $\leq 0,50$ dB max. for ≥ 97 % of the connections
	Grade D	$\leq 0,50$ dB mean $\leq 1,0$ dB max. for ≥ 97 % of the connections
Random mated return loss: IEC 61300-3-6 ^c	Return loss grades	Return loss at 1 310 nm, 1 550 nm and 1625 nm
	Grade 1	≥ 60 dB (mated) and ≥ 55 dB (unmated)
	Grade 2	≥ 45 dB
	Grade 3	≥ 35 dB
	Grade 4	≥ 26 dB
Active monitoring of changes in attenuation and in return loss (multiple path): IEC 61300-3-3 ^{b, c}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm and $\delta \leq 0,3$ at 1 625 nm for pigtailed (1 connection) $\delta \leq 0,5$ dB at 1 310 nm, $\delta \leq 0,6$ dB at 1 550 nm and $\delta \leq 0,8$ dB at 1 625 nm for patch cords (= 2 connections) Change in attenuation after test: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm for pigtailed (1 connection) $\delta \leq 0,4$ dB at 1 310 nm, 1 550 nm and 1 625 nm for patch cords (= 2 connections) The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss: IEC 61300-3-28 ^{b, c}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per connection $\delta \leq 1,0$ dB at 1 625 nm per connection Change in attenuation after test: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per connection	

^a For MT ferrule based connectors with more than 12 fibres, the random mating attenuation method is under consideration.

^b The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.

^c Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.

Table A.17 – Single mode field mountable connectors

Optical performance criteria for single mode FMC		
Acceptance criteria	Requirement	
Attenuation of random mated connectors IEC 61300-3-34 for single – fibre connector ^a	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Performance criteria are under consideration.	
Wavelength dependence of attenuation for connection with 2 field mountable connectors IEC 61300-3-7 for single-fibre connector ^a	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Performance criteria are under consideration.	
Random mated return loss: IEC 61300-3-6 ^a	Return loss grades	Return loss at 1 310 nm, 1 550 nm and 1625 nm
	Grade 1	≥ 60 dB (mated) and ≥ 55 dB (unmated)
	Grade 2	≥ 45 dB
	Grade 3	≥ 35 dB
	Grade 4	≥ 26 dB
Active monitoring of changes in attenuation and in return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm and $\delta \leq 0,3$ dB at 1 625 nm for pigtailed (1 connection) $\delta \leq 0,5$ dB at 1 310 nm, $\delta \leq 0,7$ dB at 1 550 nm and $\delta \leq 1,0$ dB at 1 625 nm for patch cords (= 2 connections) Change in attenuation after test: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm for pigtailed (1 connection) $\delta \leq 0,4$ dB at 1 310 nm, 1 550 nm and 1 625 nm for patch cords (= 2 connections) The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per connection $\delta \leq 1,0$ dB at 1 625 nm per connection Change in attenuation after test: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per connection	

^a Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.

^b The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.

Table A.18 – Multi mode connectors

Optical performance criteria for multi mode connectors		
Test	Requirement	
Attenuation of random mated connectors IEC 61300-3-34 for single-fibre connector and IEC 61300-3-45 for multi-fibre connector (Note 1)	Attenuation grades	Attenuation at 850 nm
	Grade A _m	Not specified at this time
	Grade B _m	≤ 0,3 dB mean ≤ 0,6 dB max. for ≥ 97 % of the connections
	Grade C _m	≤ 0,5 dB mean ≤ 1,0 dB max. for ≥ 97 % of the connections
	Grade D _m	Not specified at this moment
Random mated return loss: IEC 61300-3-6	Return loss grades	Return loss at 850 nm
	Grade 1 _m	Not specified at this time
	Grade 2 _m	≥ 20 dB (mated)
Active monitoring of changes in attenuation and in return loss IEC 61300-3-3 (Note 2)	Change in attenuation at 850 nm: see relevant performance specification. The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss IEC 61300-3-28 (Note 2)	Change in attenuation at 850 nm: δ ≤ 0,5 dB per connection during test. δ ≤ 0,2 dB per connection after test.	
NOTE 1 For MT ferule based connectors with more than 12 fibres, the random mating attenuation method is under consideration.		
NOTE 2 The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.		

Table A.19 – Single mode mechanical splices

Optical performance criteria for single mode mechanical splices		
Test	Requirement	
Attenuation for mechanical splices IEC 61300-3-4 ^b	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Grade A	Not specified at this time
	Grade B	≤ 0,12 dB mean ≤ 0,25 dB max. for ≥ 97 % of the connections
	Grade C	≤ 0,25 dB mean ≤ 0,50 dB max. for ≥ 97 % of the connections
	Grade D	≤ 0,50 dB mean ≤ 1,0 dB max. for ≥ 97 % of the connections
Return loss IEC 61300-3-6 ^b	Return loss grades	Return loss at 1 310 nm, 1 550 nm and 1 625 nm
	Grade 1	≥ 60 dB (mated)
	Grade 2	≥ 45 dB
	Grade 3	≥ 35 dB
	Grade 4	≥ 26 dB
Active monitoring changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during and after test: δ ≤ 0,2 dB at 1 310 nm, 1 550 nm and 1 625 nm The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss: IEC 61300-3-28 ^{a, b}	Change in attenuation during test: δ ≤ 0,5 dB per splice at 1 550 nm δ ≤ 1,0 dB per splice at 1 625 nm Change in attenuation after test: δ ≤ 0,2 dB per splice at 1 550 nm and 1 625 nm	

^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.

^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.

Table A.20 – Multi mode mechanical splices

Optical performance criteria for multi mode mechanical splices		
Test	Requirement	
Attenuation of mechanical splices IEC 61300-3-4	Attenuation grades	Attenuation at 850 nm
	Grade A _m	Not specified at this time
	Grade B _m	≤ 0,3 dB mean ≤ 0,6 dB max. for ≥ 97 % of the connections
	Grade C _m	≤ 0,5 dB mean ≤ 1.0 dB max. for ≥ 97 % of the connections
	Grade D _m	Not specified at this moment
Random mated return loss: IEC 61300-3-6	Return loss grades	Return loss at 850 nm
	Grade 1 _m	Not specified at this time
	Grade 2 _m	≥ 20 dB (mated)
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 (Note 1)	Change in attenuation at 850 nm: see relevant performance specification. The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss IEC 61300-3-28 (Note 1)	Change in attenuation at 850 nm: δ ≤ 0,5 dB per splice during test. δ ≤ 0,2 dB per splice after test.	
NOTE 1 The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.		

Table A.21 – Single mode fusion splice protectors

Optical performance requirements for single mode fusion splice protectors	
Acceptance criteria	Requirement
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation for 5 splice protectors: δ ≤ 0,2 dB at 1 310 nm, 1 550 nm and 1 625 nm during test. δ ≤ 0,1 dB at 1 310 nm, 1 550 nm and 1 625 nm after test.
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.	
^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.22 – Passive optical components

Performance requirements for single mode passive optical components ^a		
Attenuation grade	Attenuation IEC 61300-3-4	Monitoring change in attenuation and in return loss (Multiple path) IEC 61300-3-3
Refer to the relevant performance standard. ^b		
Return loss grade	Return Loss Random-mated IEC 61300-3-6 ^c	Monitoring change in attenuation and in return loss (Multiple path) IEC 61300-3-3
Grade T	≥ 35 dB	RL ≥ 35 dB during and after test
Grade R	≥ 40 dB	RL ≥ 40 dB during and after test
Grade U	≥ 50 dB	RL ≥ 50 dB during and after test
Grade V	≥ 60 dB	RL ≥ 60 dB during and after test
^a Multi-mode performance criteria are under consideration. ^b Other optical parameters e.g. isolation, directivity, PDL, ... need to be considered. Refer to the relevant performance standard. ^c Specific optical values shall be specified in the performance standard for each type of passive optical component and the environment required.		

Optical performance criteria for single mode passive optical components ^a		
Test	Requirement	
Attenuation: IEC 61300-3-4 IEC 61300-3-7 IEC 61300-3-29	Refer to the relevant performance standard ^b	
Return loss: IEC 61300-3-6	Return loss grades	Return loss
	Grade T	≥ 35 dB
	Grade R	≥ 40 dB
	Grade U	≥ 50 dB
	Grade V	≥ 60 dB
Active monitoring of changes in attenuation and return loss IEC 61300-3-3	Change in attenuation: refer to the relevant performance standard ^{c, d} The return loss requirement of the specified return loss grade shall be met during and after the test.	
^a Multimode performance criteria are under consideration.		
^b Other optical parameters, for example isolation, directivity, polarization dependent loss and wavelengths for measurements, can be found in the relevant performance standard.		
^c The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.		
^d Specific optical values shall be specified in the relevant performance standard for each type of passive optical component and the environment required.		

Table A.23 – Fibre management systems

Performance requirements for single mode fibre management systems^a	
Test	Requirement
Monitoring change in attenuation and in return loss (Multiple path) IEC 61300-3-3	During test: $\delta IL \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre during test. $\delta IL \leq 0,5$ dB at 1 625 nm per incoming fibre during test. After test: For circuit with splices only: $\delta IL \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre after test. For circuit containing an optical connector set: $\delta IL \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre after test.
Transient loss IEC 61300-3-28	During test (Transient loss): $\delta IL \leq 0,5$ dB at 1 550 nm per life circuit during test. $\delta IL \leq 1,0$ dB at 1 625 nm per life circuit during test. After test: For circuit with splices only: $\delta IL \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit after test. For circuit containing an optical connector set: $\delta IL \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit after test.
^a Multi-mode performance criteria are under consideration.	

Optical performance requirements for single mode fibre management systems	
Test	Requirement
Active monitoring of change in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.	
^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.24 – Category C – Wall outlets and boxes

Performance requirements for single mode category C – Wall outlets and boxes	
Test	Requirement
Optical performance criteria	
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
Sealing performance criteria	
Degrees of protection provided by enclosures IEC 60529	Category C wall outlets and boxes shall meet at minimum IP 30 after the tests. (IP 30 = After installation protected against ingress of objects with size larger than 2,5 mm. No protection against water)
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test. ^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.25 – Category C – Optical distribution frame modules (OFDM)

Performance requirements for category C single mode ODFM	
Test	Requirement
Optical performance criteria	
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test. ^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.26 – Category A, single mode boxes, street cabinets and free breathing closures

Performance requirements for category A, single mode boxes, street cabinets and free breathing closures	
Test	Requirement
Optical performance criteria	
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
Sealing performance criteria	
Degrees of protection provided by enclosures IEC 60529	The IEC 60529 IP 54 sealing criterion is used for boxes, street cabinets and free breathing closures. Category A boxes, street cabinets and free breathing enclosures shall meet at minimum IP 54 after the tests. IP 54 means that after installation the product is protected against ingress of dust and water sprayed from all possible directions.
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.	
^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.27 – Category C, A, G and S single mode sealed closures

Performance requirements for single mode sealed closures	
Test	Requirement
Optical performance criteria	
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
Sealing performance criteria	
Sealing for pressurized closures of fibre optic devices IEC 61300-2-38	This sealing criterion is mentioned for sealed closures that are able to hold a test over pressure of 20 kPa (categories C, A and G) or 40 kPa (category S). Method A shall be used after completion of the test. Method B is used for all mechanical tests at the specified test temperature. After the test, the internal test pressure shall not be reduced by more than 2 kPa (measured at the same atmospheric conditions as at the start of the test).
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.	
^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.28 – Category A, G and S single mode hardened fibre optic connectors

Performance requirements for single mode hardened fibre optic connectors ^a		
Test	Requirement	
Optical performance criteria		
Attenuation of random mated connectors IEC 61300-3-34 for single – fibre connector and IEC 61300-3-45 for multi-fibre connector a, c	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Grade A:	Not specified at this time
	Grade B:	≤ 0,12 dB mean ≤ 0,25 dB max. for ≥ 97 % of the connections
	Grade C:	≤ 0,25 dB mean ≤ 0,50 dB max. for ≥ 97 % of the connections
	Grade D:	≤ 0,50 dB mean ≤ 1,0 dB max. for ≥ 97 % of the connections
Return loss of random mated connectors IEC 61300-3-6 ^c	Return Loss grades	Return loss at 1 310 nm, 1 550 nm and 1 625 nm
	Grade 1:	≥ 60 dB (mated) and ≥ 55 dB (unmated)
	Grade 2:	≥ 45 dB
	Grade 3:	≥ 35 dB
	Grade 4:	≥ 26 dB
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{b, c}	Change in attenuation during test: δ ≤ 0,2 dB at 1 310 nm and 1 550 nm per connection δ ≤ 0,5 dB at 1 625 nm per connection Change in attenuation after test: δ ≤ 0,2 dB at 1 310 nm, 1 550 and 1 625 nm per connection Change in return loss: The return loss for the specified grade shall be met during and after the tests	
Transient loss IEC 61300-3-28 ^{b, c}	Change in attenuation during test: δ ≤ 0,5 dB at 1 550 nm per connection δ ≤ 1,0 dB at 1 625 nm per connection Change in attenuation after test: δ ≤ 0,2 dB at 1 550 nm and 1 625 nm per connection	
Sealing performance criteria		
Sealing for pressurised closures IEC 61300-2-38	This sealing criterion is for hardened connectors that are used on sealed closures that are capable to hold a test over pressure of 20 kPa (categories A and G) or 40 kPa (category S). Method A shall be used after all tests. Method B is used for all mechanical tests at the specified test temperature. After the test, the internal test pressure shall not be reduced by more than 2 kPa (measured at the same atmospheric conditions as at the start of the test).	

Performance requirements for single mode hardened fibre optic connectors ^a	
Test	Requirement
Degrees of protection provided by enclosures IEC 60529	This sealing criterion is for hardened connectors of Category A used on boxes or street cabinets (free breathing enclosures). They shall meet at minimum IP 65 and IP 67 after the tests. IP 65/IP 67 means that after installation the hardened connector is completely protected against ingress of dust, protected against jets of water from all directions and that temporary immersion in water up to 1 m depth is allowed.
NOTE 1 For MT ferrule based connectors with more than 12 fibres, the random mating attenuation method is under consideration. ^a Multimode performance criteria are under consideration. ^b The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test. ^c Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

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Annex B (informative)

Test sequencing for category O

IEC 60068-1 (*Environmental testing — Part 1: General and guidance*) describes the background for test sequencing. Test sequencing is based on the premise that the effect one test parameter has on a specimen will depend on the previous test conditions to which the specimen has been exposed. Therefore, it is necessary to conduct the tests in a specific order.

The choice of the sequence of tests is a function of the intended objectives and depends upon a number of considerations. It is recognised that it is difficult to provide a standardised type approval test sequence for all types of passive optical components, however, category O attempts to overcome this issue.

The intention is to use certain tests which will reveal damage caused by previous tests and to design a test sequence which would induce significant effects in passive optical components intended for applications in an uncontrolled environment.

The test sequence for category O components is as given in Table B.1 below.

Table B.1 – Test sequence for passive optical components category O

Test Nbr.	Test description	Sample source
1	Damp heat (steady state)	New
2	Vibration	Test 1
3	Shock	Test 2
4	Change of temperature	Test 3
5	Temperature humidity cycling	Test 4
6	Optical fibre cable flexing	Test 5
7	Torsion/twist	Test 6
8	Static side load	Test 7
9	Fibre/cable retention	Test 8

In general terms, a damp heat (steady state) test comes at the start of the sequence. This provides a high temperature to induce potential failures due to softening and expansion and a high humidity to encourage moisture absorption and swelling.

This is followed by two mechanical tests, vibration and shock, so as to accentuate any faults, such as cracks or failure of adhesives, likely to have been produced by the temperature and humidity changes or to provoke new faults.

A change of temperature test is then applied. This is intended to highlight potential mechanical failures or cracking due to thermal effects and differential heating.

This is followed by a second temperature humidity cycling test. In this case, a low temperature/high humidity component is added to the cycle to facilitate condensation, ice formation, embrittlement and contraction.

The sequence is completed by a number of fibre integrity tests (where the specimen has fibre or fibre cable pigtails). These tests are designed to examine the robustness of the fibre cable and component interface, having undergone tests designed to cause significant thermal and mechanical stress.

The test sequence for category O connectors is as given in Table B.2 below.

Table B.2 – Test sequence connectors category O

Test Nbr.	Test description	Sample source
1	High temperature endurance	New
2	Change of temperature	Test 1
3	Damp heat (steady state)	Test 2
4	Humidity condensation cycle test (IEC: Temperature humidity cycling)	Test 3
5	High temperature endurance	Test 4
6	Change of temperature	Test 5
7	Vibration (sinusoidal)	Test 6
8	Flex	Test 7
9	Torsion	Test 8
10	0° Proof (IEC: Fibre/Cable retention)	Test 9
11	90° Proof	Test 10
12	Transmission with applied tensile load (IEC: Static side load)	Test 11
13	Impact (IEC: Shock)	Test 12
14	Mating durability	Test 13
15	Connector installation	Test 14
16	Salt mist (optional)	Test 15

The test sequence consists of environmental tests that involve exposure to high temperature, humidity and condensation, and mechanical tests that impose mechanical stress to test the product's robustness and long term performance. The environmental test sequence consists of tests of increasing severity to apply stress by virtue of differences in mechanical properties and thermal expansivity. Humidity and condensation provide additional physical stress by penetration into the product structure followed by physico-chemical changes due to freezing.

The high temperature endurance test is of the lowest severity in the sequence of environmental tests; it is designed to simulate thermo-mechanical stresses during product storage and shipping.

The change of temperature test is intended to generate stresses due to differential thermal expansion/contraction of materials and to test interfaces in products of typically composite structure.

The damp heat (steady state) test is aimed at adding humidity as an agent of additional stress to test the structural integrity of the product that is already under thermomechanical stress due to earlier steps in the test sequence.

~~The humidity/condensation cycling test is designed to increase the severity of thermomechanical stress on the physical structure of the product and to test the integrity of all material interfaces that include the fiber connector (or component) interface.~~

~~The high temperature endurance test followed by the change of temperature test is added to drive the humidity out of the product structure at the end of the humidity/condensation cycling test in preparation for the mechanical tests in the sequence. It also serves to test the structural integrity of the product after the withdrawal of condensed water from the product structure.~~

~~The seven step mechanical test sequence is intended to add service life mechanical stresses of increasing severity to simulate product service life/deployment conditions. This sequence consists of: vibration test to simulate cyclic stresses of storage, transportation and service environments and their potential impact on the transmission performance of the product; flex test to verify the integrity of connector assemblies with reinforced jacketed cable under service life stresses; twist test to verify the structural integrity under torsional loads about the fiber axis and the potential impact of torsional loads on transmission performance; proof test to verify the structural integrity at mechanical interfaces (plug adapter and connector booth) of the connector assembly with reinforced jacketed cable and transmission performance; transmission with applied tensile load test to verify transmission performance under combined tensile and bending stresses that are likely to be encountered in service environments, particularly, with high termination densities.~~

~~The impact test is designed to simulate conditions where products are dropped and to verify product structural integrity and transmission performance under impact conditions.~~

~~Mating durability and connector installation tests are designed to simulate installation and use conditions in the service environment and to verify transmission performance during and after exposure to such conditions. The durability test is to verify satisfactory transmission performance with repeated removal/insertion activity by field installation personnel. The connector installation test is to verify installability and transmission performance within limited space such as in a cabinet or closure.~~

~~The salt mist test (optional) is added to check the resistance for corrosion of products when installed near roads (salt spray during winter) and in coastal areas. It will verify whether the connectors are still able to be reconnected after exposure to this corrosive medium.~~

~~It is recognised that the test sequences given above may not be appropriate for all applications and other test sequences may be applied to category O. Where this occurs, the test sequence shall be defined in the relevant specification and recorded as a deviation from the test procedure in the performance standard test report.~~

~~NOTE When conducting a test sequence, it is important to consider the time interval between exposure to different test conditions to ensure this has no significant effect on the specimens. The maximum and minimum time between tests shall be defined in the relevant specification.~~

Annex C **(informative)**

Mixing of products with different performance category

~~This document defines the performance categories for connectors, passive components, fibre management systems and closures.~~

~~In practice the connectors and/or passive components are placed in a fibre management system, which in turn might be located in a closure.~~

~~Each of these three different product groups might be specified for a different environmental category; e.g. connectors for category U are placed in a fibre management system for category C and housed in a closure for category S. The effect of mixing of these grades should be understood in order to achieve the required overall environmental resistance of the combination.~~

~~The resulting temperature range of the combination of products is the lowest of the maximum temperatures and the highest of the minimum temperatures. Neither the temperature range nor the resistance against humidity of components can be improved by placing components in a closure. However, placing the components in a closure of the required IP grade will provide protection against ingress of water or dust.~~

~~For example:~~

~~A closure with the combination of a category C fibre management system and category U connectors is only qualified to a temperature range of –10 °C to +60 °C with a maximum relative humidity of 93 % RH.~~

~~For a combination of components of category E and a free breathing closure (IP 43) from category A, the components are designed and tested to meet the most extreme environmental conditions including water immersion, corrosive atmosphere and dust. The combination of the closure and components would then be able to operate in a service environment with a temp range of –40 °C to +65 °C with water immersion and a maximum relative humidity of 95 % RH.~~

Annex B

(~~informative~~ normative)

Performance standard numbering

The numbering of performance standards shall take the form IEC 61753-xxx-y where ~~the first xxx defines the component type. The third x is used to define the interconnections or fibre type used with the component; e.g. “plug style fixed attenuators — 051”, “pigtailed style fixed attenuators — 052”~~ categorize the variants of the component (e.g. pigtailed version, wavelength ranges or other). And y defines the environmental category.

The numbering scheme for fibre optic interconnecting devices and passive components, is as follows:

xxx = 02x Connectors	y = 2 Category C
xxx = 03x Branching devices	y = 3 Category U OP
xxx = 04x Filters	y = 4 Category I
xxx = 05x Passive optical power control devices	y = 5 Category E
~~xxx = 051 Attenuators plug style~~	y = 6 Category OP+
~~xxx = 052 Attenuators pigtailed style~~	y = 7 Category A
xxx = 06x Isolators	y = 8 Category G
xxx = 07x Switches	y = 9 Category S
xxx = 08x WDM	
xxx = 09x Circulators	
xxx = 10x Fibre management systems	
xxx = 11x Closures	
xxx = 12x Simplex and duplex cords	
xxx = 13x Fibre splice	
xxx = 14x Dispersion compensator	
xxx = 32x Connectors	
xxx = 33x Branching devices	
xxx = 34x Filters	
xxx = 35x Passive optical power control devices	
xxx = 36x Isolators	
xxx = 37x Switches	
xxx = 38x WDM	
xxx = 39x Circulators	
xxx = 40x Fibre management systems	
xxx = 41x Closures	
xxx = 42x Patch cords	
xxx = 43x Mechanical fibre splice	
xxx = 44x Dispersion compensator	

Examples:

- ~~• IEC 61753-031-6 refers to a performance standard written for fibre optic branching devices which are designed to operate in an uncontrolled environment.~~
- ~~• IEC 61754-021-2 refers to a performance standard written for connectors terminated onto singlemode fibre which are designed to operate in a controlled environment.~~
- IEC 61753-031-3 refers to a performance standard written for fibre optic branching devices which are designed to operate in an outdoor but protected environment.
- IEC 61753-021-2 refers to a performance standard written for connectors terminated onto single mode fibre which are designed to operate in an indoor controlled environment.

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Annex E
(informative)

Minimum temperature value in Finland

~~The minimum temperature value in performance category (O, E, A and G) of IEC 61753-1 shall be –45 °C in Finland. This temperature range shall be used especially with those fibre optic passive components installed in unheated street cabinets and cable joint closures in manhole, ground or telephone poles.~~

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

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Fibre optic interconnecting devices and passive components – Performance standard –

Part 1: General and guidance

Dispositifs d'interconnexion et composants passifs fibroniques – Norme de performance –

Partie 1: Généralités et recommandations

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC INTERCONNECTING DEVICES AND
PASSIVE COMPONENTS – PERFORMANCE STANDARD –****Part 1: General and guidance****FOREWORD**

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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.

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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 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 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 will be maintained using a recognised quality assurance programme whilst the reliability of product 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

1 Scope

This part of IEC 61753 provides guidance for the drafting of performance standards for all passive fibre optic products.

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.

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 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*

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

IEC 61300-2-11, *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 – 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 fibre optic 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 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 61300-2-50, *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 61300-3-3, *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 1998-1:1998, *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.

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 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 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

Note 1 to entry: Where there is a specific IP requirement for a product, this is the subject of a separate test and 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.

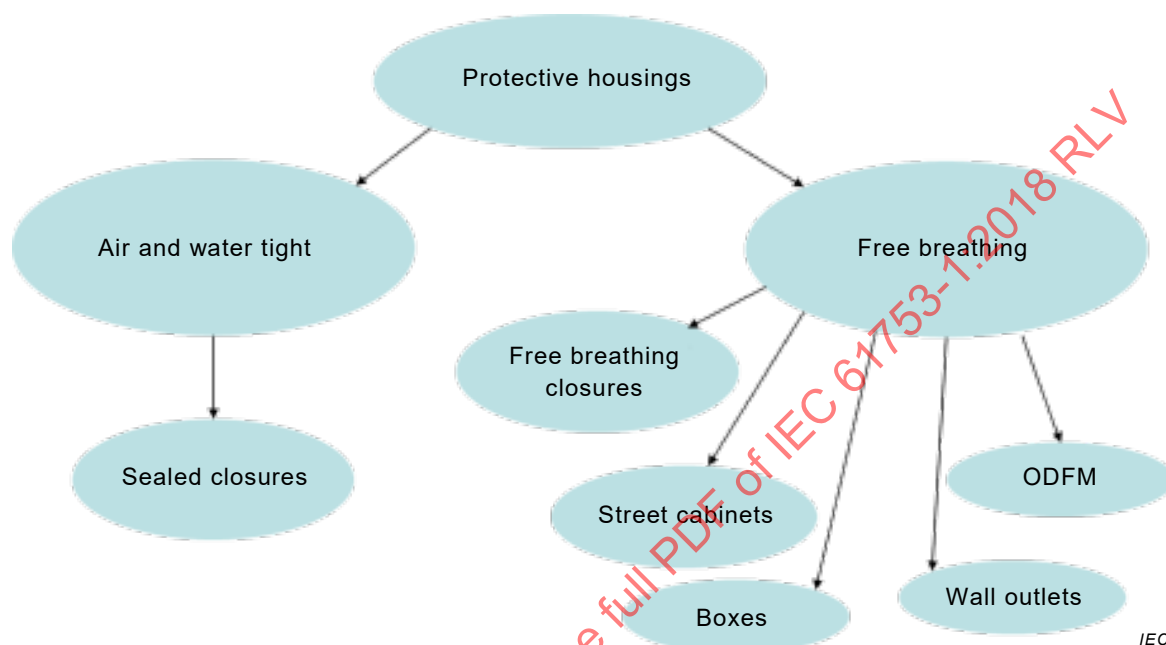


Figure 1 – Relationship between various protective housing types

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

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.

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 are allowed.

5.4 Requirements

The performance requirements that 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 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 are allowed.

5.6 Sample definition

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

5.7 Groupings/sequences

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 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 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 General

Annex A defines the tests, the recommended severities and the recommended performance criteria for the various performance categories, which reflect 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.

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 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 – Operating service environments and performance categories

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

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

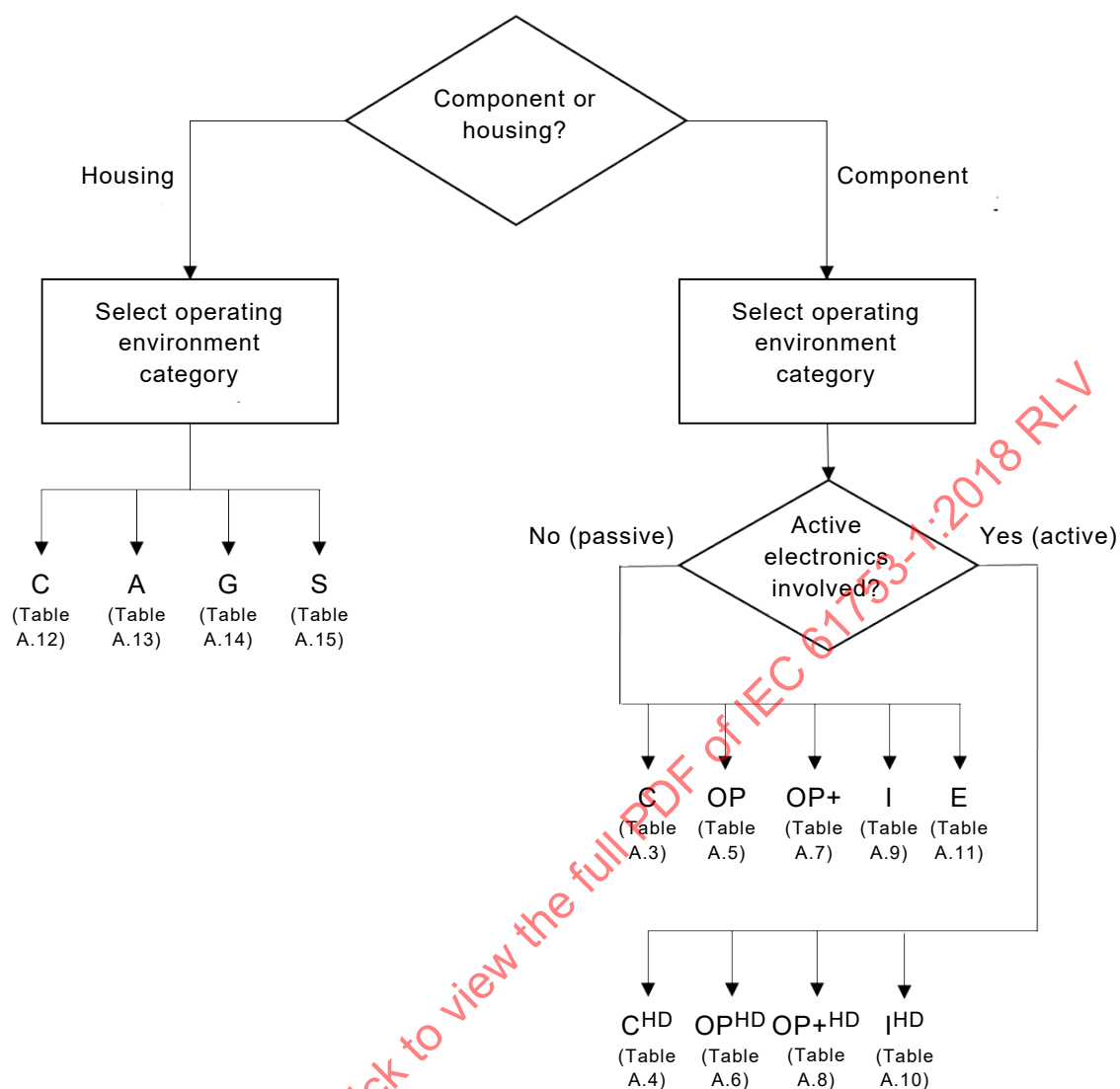
Fibre optic connectors, mechanical splices, fusion splice protectors, passive optical components and fibre management systems		
Performance category	Description	Operating service environment
C ^{HD}	Indoor controlled environment with additional heat dissipation. Same as category C with higher operational 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 the desired category?

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.



IEC

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

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.

Test	Severity	Connectors	Passive components
Torsion IEC 61300-2-5	Load: 10 N for cables clamping distance: 300 mm 25 cycles $\pm 180^\circ$	O,V	(O _a ,V)
Bending moment IEC 61300-2-7	Load: 10 N for 30 s 2 perpendicular axes Duration: minimum 10 s	O,V	(O _b ,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 _b ,V)
Fibre/cable retention ^a IEC 61300-2-4	Load: 100 N for 120 s on cable	O,V	(O _a ,V)
Nutation IEC 61300-2-35	Load: 10 N Point of application: 0,2 m from rear of body plug 100 cycles of 360°	O,V	(O _a ,V)
Impact (method A) IEC 61300-2-12	Drop height: 1,5 m Drop locations at 0° , 90° , 180° and 270° around longitudinal axis of housing 5 impacts per location	O,V	O,V
Shock ^c IEC 61300-2-9	Acceleration: 250 m/s ² Pulse shape: half sine pulse Duration pulse: 6 ms Axes: 3 mutually perpendicular axes Number of shocks: 5 shocks per axis and per direction of axis, 30 shocks in total	O,V	O,V
Crush resistance IEC 61300-2-10	Load: 2 200 N Application area: 25 cm ² (circular shape) Location: centre of housing at 0° and 90° around longitudinal axis of housing Duration: 60 s per location	O,V	O,V
^a These tests shall be applicable to passive optical components which incorporate fibre or fibre cable pigtails in their product design. ^b Applicable only if the component contains a receptacle. ^c If the product is normally mounted in a shock resistant mounting, then it shall be tested in this configuration. ^d Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.			

Table A.10 – Connectors, passive optical components – Category I^{HD} – Industrial environment with additional heat dissipation

Test	Severity	Connectors	Passive components
Change of temperature IEC 61300-2-22	Temperature range: –40 °C to +85 °C Duration at extreme temperatures: 4 h duration 3 °C/min rate of change 12 cycles	O,V	O,V
NOTE 1 Category I^{HD} contains the tests from category I with the replacement of the following more severe test: Change of temperature (–40 °C/+85 °C). NOTE 2 When a product is immediately qualified for category I^{HD}, there is no need to perform the following less severe tests from category I: change of temperature (–40 °C/+70 °C). NOTE 3 When the tests are performed for category I^{HD}, the product will be automatically qualified for category I.			

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**Table A.11 – Connectors and passive optical components –
Category E – Extreme environment**

Test	Severity	Connectors	Passive components
Vibration (sinusoidal) IEC 61300-2-1	Frequency range: 10 Hz to 55 Hz Sweep: 15 sweeps (10 – 55 – 10) Hz Change in frequency: 1 octave/min Axes: 3 mutually perpendicular axes Amplitude: 0,75 mm	O,V	O,V
Cold IEC 61300-2-17	Temperature: –40 °C Duration: 96 h	O,V	O,V
Dry heat IEC 61300-2-18	Temperature: +85 °C Duration: 96 h	O,V	O,V
Change of temperature IEC 61300-2-22 Test Nb	Temperature range: –40 °C to +85 °C Duration at extreme temperatures: 1 h 1 °C/min rate of change 12 cycles	O,V	O,V
Dust IEC 61300-2-27	Particle size: $d < 150 \mu\text{m}$ Dust type: talc Duration: 10 min Dust concentration: $(10,6 \pm 7,1) \text{ g/m}^3$	O,V	O,V
Composite temperature humidity cyclic test IEC 61300-2-21	Z/AD profile with exposure to cold Temperature range: –10 °C to +65 °C 93 % RH $\pm$ 3 % RH at the maximum temperature 3 h dwells at the temperature extremes 10 cycles	O,V	O,V
Corrosive atmosphere IEC 61300-2-28	Sulphur dioxide SO ₂ : 25 ppm Duration: 96 h	O,V ^e	O,V ^e
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH 6,5 to 7,2) Temperature: +35 °C Duration: 96 h	O,V ^e	O,V ^e
Durability by water immersion IEC 61300-2-45	Depth of water: sample shall be 5 cm below the surface of the water Test temperature: +25 °C $\pm$ 2 °C Duration: 1 h Immersion cycles: 1 cycle	O,V	O,V
Optical fibre cable flexing IEC 61300-2-44	Load: 5 N for cable Cycle: +90° and –90° Number of cycles: 100	O,V	
Optical fibre cable flexing IEC 61300-2-44	Load: 5 N for cable Cycle: +90° and –90° Number of cycles: 30		(O _a ,V)
Fibre/cable retention IEC 61300-2-4	Load: 100 N for 60 s for cables with diameter > 2 mm 70 N for 60 s for cables with diameter $\leq$ 2 mm 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres	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 _a ,V)

Test	Severity	Connectors	Passive components
Impact (method A) IEC 61300-2-12	5 drops 1,5 m drop height	O,V	
Shock ^b IEC 61300-2-9	Acceleration of component or module mass: ≤ 0,125 kg: 5 000 m/s² 0,125 kg < module mass ≤ 0,225 kg: 2 000 m/s² 0,225 kg < module mass ≤ 1 kg: 500 m/s² 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 in total.		O,V ^b
Torsion IEC 61300-2-5	Load: 15 N for cables 2,0 N for primary coated and buffered fibres 25 cycles ± 180°	O,V	
Torsion IEC 61300-2-5	Load: 5,0 N for cables 2,0 N for primary coated and buffered fibres 10 cycles ± 180°		(O _a V)
Tensile strength of coupling mechanism IEC 61300-2-6	Load: 40 N Duration: 120 s	O,V	(O _d V)
Static side load ^c IEC 61300-2-42	Load: 1 N for 1 h for cable 0,2 N for 5 min for buffered fibres Two mutually perpendicular directions	O,V	(O _a V)
Mating durability IEC 61300-2-2	500 cycles at not less than 3 s between engagements	O,V	(O _d V)
Bending moment IEC 61300-2-7	Load: 10 N Duration: minimum 10 s	O,V	(O _d V)
^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. ^d Applicable only if the component contains a receptacle. ^e Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.			

Table A.12 – Wall outlets, boxes, optical distribution frame modules and closures – Category C – Indoor controlled environment

Test	Severity	Wall outlets	Boxes	ODFM	Closures
Vibration (sinusoidal) IEC 61300-2-1	Frequency: 10 Hz Amplitude: 3 mm Cables clamped at 500 mm from connector or closure Number of cycles: 1 000 000 (about 28 h) Test conducted at +23°C ± 3°C	S,V	S,V		S,V
Vibration (sinusoidal) ^c IEC 61300-2-1	Frequency range: 5 Hz to 500 Hz Number of sweeps per axis: 10 sweeps (5 – 500 – 5) Hz Change of frequency: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 1,5 mm at frequencies below 9 Hz Acceleration: 5 m/s ² at frequencies above 9 Hz Test conducted at +23°C ± 3°C	O,V	O,V	O,V	O,V
Shock IEC 61300-2-9	Wave form: Half sine Duration: 11 ms Acceleration: 150 m/s ² (~15 g) Axes: 3 mutually perpendicular axes Number of shocks: 3 shocks per axis and per direction of axis, 18 shocks in total Test conducted at +23 °C ± 3 °C	O,V	O,V	O,V	O,V
Change of temperature ^c IEC 61300-2-22 Test Nb	Temperature range: –10 °C to +60 °C Duration at extreme temperatures: 4 h duration 1 °C/min rate of temperature change 5 cycles	S,O,V	S,O,V	O,V	S,O,V
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	5 disassembly/assembly cycles At least one "Change of temperature" cycle between each disassembly/assembly cycle Test conducted at +23 °C ± 3 °C		S,V		S,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. All movements shall include the most extreme position allowed by the fibre management system. Rearrange splices and/or connectors. Add splice trays/splice modules when applicable. Add fibre/cable. Test conducted at +23 °C ± 3 °C.	O,V	O,V	O,V	O,V
Fibre/cable retention ^c IEC 61300-2-4	Load: 25 N on cables or cords 60 s load duration per cable/cord Test conducted at +23 °C ± 3 °C	S,O,V	S,O,V	O,V	
Fibre/cable retention ^c IEC 61300-2-4	Load on cable (N): 10 × cable diameter (mm) 1 h load duration per cable Test conducted at +23 °C ± 3 °C				S,O,V
Axial compression IEC 61300-2-11	Axial load: 450 N on rigid strength member cable 30 min duration per central strength member Test conducted at +23 °C ± 3 °C				V

Test	Severity	Wall outlets	Boxes	ODFM	Closures
Torsion ^c IEC 61300-2-5	Torque angle: +90° and –90° in 2 directions Point of application: 400 mm from end of seal ^a 5 min in each extreme position 5 cycles per cable Test ^c conducted at +23 °C ± 3 °C	(S,O, V) ^b	(S,O, V) ^b	(O, V) ^b	S,O, V
Cable bending ^c IEC 61300-2-37	Bending angle: +30° and –30° Point of application: 400 mm from end of seal ^a 5 min in each extreme position 5 cycles per cable Duration at extreme position: 5 min Tests ^c conducted at +23 °C ± 3 °C	(S,O, V) ^b	(S,O, V) ^b	(O, V) ^b	S,O, V
Impact (method B) IEC 61300-2-12	Impact tool: 1 kg mass steel ball Drop height: 0,5 m Impact locations: centre of closure at 0°, 90°, 180° and 270° around longitudinal axis of closure 1 impact per location Sealing test conducted at +23 °C ± 3 °C				S,V
Impact (method B) IEC 61300-2-12	Impact tool: 1 kg mass steel ball Drop height: 0,2 m Impact locations: top (in centre) and front (in centre) 1 impact per location Sealing test conducted at +23 °C ± 3 °C	S,V	S,V		
^a For rigid cables with diameter Ø > 25 mm, the clamping distance may be increased to 1 000 mm. ^b Test only required when product is pre-cabled and cable handling is expected when unpacking and installing the product. ^c Separate test samples for sealing performance and optical performance evaluation may be used.					

Table A.13 – Hardened optical connectors, street cabinets, boxes and closures
Category A – Outdoor aerial environment

Test	Severity	Hardened connectors	Street cabinets	Boxes	Closures
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	5 disassembly/assembly cycles At least one "Change of temperature" cycle between each disassembly/assembly cycle Sealing test conducted at +23 °C ± 3 °C	S ^d ,V	S,V	S,V	S,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	O,V	O,V
Mating durability ^d IEC 61300-2-2	20 cycles Optical test conducted at +23 °C ± 3 °C	O,V ^d			
Fibre optic connector proof test with static load ^c IEC 61300-2-50	Load: 300 N (straight pull 0°) Load: 25 N (side pull 90°) Duration: 5 s Test conducted at +23 °C ± 3 °C	S,O, V			
Fibre/cable retention ^c IEC 61300-2-4	Load (N): 20 × cable diameter (mm) 1 h load duration per cable per test temperature Sealing test ^c conducted at test temperatures –15 °C and +45 °C Optical test ^c conducted at +23 °C ± 3 °C	S,O, V	V ^b		S,O, V
Fibre/cable retention ^c IEC 61300-2-4	Load (N): 10 × cable diameter (mm) for 1 h per feeder cable per test temperature 25 N for 60 s per cord and work area cable and per temperature Sealing test ^c conducted at test temperatures –15 °C and +45 °C Optical test ^c conducted at +23 °C ± 3 °C			S, O,V	
Axial compression IEC 61300-2-11	Axial load: 450 N on (rigid) strength member of cable 30 min duration per central strength member Test conducted at +23 °C ± 3 °C				V
Cable bending ^c IEC 61300-2-37	Cycle with bending angle: +30° and –30° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min at each extreme position Sealing test conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C Optical test conducted at +23 °C ± 3 °C		V ^b	(S, O, V) ^b	S,O, V
Cable bending ^c IEC 61300-2-37	Cycle with bending angle: +90° and –90° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min at each extreme position Sealing test conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C Optical test conducted at +23 °C ± 3 °C	S,O, V			

Test	Severity	Hardened connectors	Street cabinets	Boxes	Closures
Torsion ^c IEC 61300-2-5	Cycle with torque angle: +90° and –90° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min in each extreme position Sealing test ^c conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C Optical test ^c conducted at +23 °C ± 3 °C	S, O, V	V ^b	(S, O, V) ^b	S, O, V
Impact (method A) IEC 61300-2-12	5 drops per test sample 1,5 m drop height per test temperature Sealing test ^c conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C Optical test ^c conducted at +23 °C ± 3 °C	S, O, V			
Impact (method B) 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 enclosure 1 impact per location per test temperature Sealing test conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C				S, V
Impact (method B) IEC 61300-2-12	Impact tool: 1 kg mass steel ball Drop height: 1 m Impact locations: in the centre of top, front and sides (if accessible) 1 impact per location per test temperature Sealing test conducted at test temperatures –15 °C ± 2 °C and +45 °C ± 2 °C		S, V	S, V	
Vibration (sinusoidal) IEC 61300-2-1	Frequency: 10 Hz Amplitude: 3 mm Cables clamped at 500 mm from connector or closure Number of cycles: 1 000 000 (about 28 h) Test conducted at +23 °C ± 3 °C	S, V		S, V	S, 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 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 Tests conducted at +23 °C ± 3 °C	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 Change of frequency: 1 octave/min Number of axes: 3 mutually perpendicular axes Amplitude: 1,2 mm at frequencies below 9 Hz Acceleration: 4 m/s ² at frequencies above 9 Hz Test conducted at +23 °C ± 3 °C		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 Test conducted at +23 °C ± 3 °C	O, V		O, V	O, V

Test	Severity	Hardened connectors	Street cabinets	Boxes	Closures
Shock IEC 61300-2-9	Wave form: half sine Duration: 11 ms Acceleration: 50 m/s ² (~5 g) Axes: 3 mutually perpendicular axes Number of shocks: 3 shocks per axis and per direction of axis, 18 shocks in total Test conducted at +23 °C ± 3 °C		O,V		
Crush resistance IEC 61300-2-10	Vertical load (N): 1 750 (Pa) × width (m) × cabinet depth (m) Application area: evenly distributed on top surface of cabinet Duration: 10 min per location per test temperature Test conducted at –15 °C and +45 °C		S,V		
Static load on doors IEC 61300-2-10	Vertical load: 200 N Point of application: on top of open door at most extreme point that creates the highest momentum in the hinge of the door Duration: 10 min		S,V		
Change of temperature ^c IEC 61300-2-22	Temperature range: –40 °C to +65 °C Duration at extreme temperatures: 4 h duration Temperature change rate: 1 °C/min 12 cycles	S,O, V	S,O, V	S,O, V	S,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			
Resistance to solvents and contaminating fluids ^g IEC 61300-2-34	Solvents: - HCl at pH 2 - NaOH at pH 12 Duration: 5 days	S ^g , V ^e	V ^e	V ^e	S ^g , V ^e
Salt mist IEC 61300-2-26	Salt solution: 5 % NaCl (pH: between 6,5 and 7,2) Temperature: +35 °C Duration: 5 days	S,V ^e	V ^e	V ^e	S,V ^e
Dust (IP 5x) IEC 60529	Dust type: talcum powder Particle size: < 75 µm Dust density: 2 kg/m ³ Pressure: no pressure difference Duration: 8 h		V	V	
Dust (IP 6x) IEC 60529	Dust type: talcum powder Particle size: < 75 µm Dust density: 2 kg/m ³ Test underpressure: 2 kPa regulated underpressure inside protective housing Duration: 8 h	O,V			

- ^a For rigid cables with diameter $\varnothing > 25$ mm, the clamping distance may be increased to 1 000 mm.
- ^b Test only required when product is pre-cabled and cable handling is expected when unpacking and installing the product.
- ^c Separate test samples for hardened connector/closure sealing performance and optical evaluation may be used.
- ^d Sealing medium may be replaced for sealing test.
- ^e Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.
- ^f Test only when the closure is provided with an integrated mounting fixture.
- ^g Sealing requirement only required for sealed closures and hardened connectors that can be immersed in the fluids. For all other free breathing protective housings (that are not able to hold a permanent overpressure or underpressure), the test shall be carried out on material slabs.

**Table A.14 – Hardened optical connectors and closures –
Category G – Outdoor ground environment**

Test	Severity	Hardened Connector	Closures
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	5 disassembly/assembly cycles. At least one "Change of temperature" cycle between each disassembly/assembly cycle. Test conducted at $+23\text{ °C} \pm 3\text{ °C}$.	S ^d , V	S, 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
Mating durability IEC 61300-2-2	20 cycles Optical test conducted at $+23\text{ °C} \pm 3\text{ °C}$	O, V ^d	
Fibre optic connector proof test with static load ^b IEC 61300-2-50	Load: 300 N (straight pull 0°) Load: 25 N (side pull 90°) Duration: 5 s Tests ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$ Sealing and optical performance checked after test	S, O, V	
Fibre/cable retention ^b IEC 61300-2-4	Load (N): $20 \times$ cable diameter (mm) 1 h load duration per cable per test temperature. Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S, O, V	S, O, V
Axial compression IEC 61300-2-11	Axial load: 450 N on (rigid) strength member of cable Duration: 30 min per central strength member Test conducted at $+23\text{ °C} \pm 3\text{ °C}$		V
Cable bending ^b IEC 61300-2-37	Cycle with bending angle: $+30^\circ$ and -30° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min at each extreme position Sealing test ^b conducted at -15 °C and $+45\text{ °C}$ Optical monitoring test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$		S, O, V
Cable bending ^b IEC 61300-2-37	Cycle with bending angle: $+90^\circ$ and -90° Point of application: 400 mm from end of plug ^a 5 cycles per cable per test temperature 5 min at each extreme position Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S, O, V	
Torsion ^b IEC 61300-2-5	Cycle with torque angle: $+90^\circ$ and -90° Point of application: 400 mm from end of seal ^a 5 cycles per cable per test temperature 5 min in each extreme position Sealing test ^b conducted at -15 °C and $+45\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S, O, V	S, O, V
Impact IEC 61300-2-12 (method A)	5 drops per test sample 1,5 m drop height Test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S, O, V	

Test	Severity	Hardened Connector	Closures
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 enclosure 1 impact per location per test temperature Sealing test conducted at $-15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $+45^{\circ}\text{C} \pm 2^{\circ}\text{C}$		S,V
Vibration (sinusoidal) IEC 61300-2-1	Frequency: 10 Hz Amplitude: 3 mm Cables clamped at 500 mm from connector or closure Number of cycles: 1 000 000 (about 28 h) Test conducted at $+23^{\circ}\text{C} \pm 3^{\circ}\text{C}$	S,V	S,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 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 Test conducted at $+23^{\circ}\text{C} \pm 3^{\circ}\text{C}$	O,V	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 Test conducted at $+23^{\circ}\text{C} \pm 3^{\circ}\text{C}$	O,V	O,V
Crush resistance IEC 61300-2-10	Load: 1 000 N Application area: 25 cm^2 (circular shape) Location: centre of closure/connector at 0° and 90° around longitudinal axis of closure/connector Duration: 10 min per location per test temperature Test conducted at -15°C and $+45^{\circ}\text{C}$	S,V	S,V
Change of temperature ^b IEC 61300-2-22 Test Nb	Temperature range: -40°C to $+65^{\circ}\text{C}$ Duration at extreme temperatures: 4 h 1°C/min rate of change 12 cycles 12 cycles	S,O, V	S,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 $+65^{\circ}\text{C}$ Humidity: 93 % RH at the maximum temperature 3 h dwells at the temperature extremes 10 cycles	O,V	
Dust (IP 6x) IEC 60529	Dust type: Talcum powder Particle size: $< 75\text{ }\mu\text{m}$ Dust density: 2 kg/m^3 Pressure: 2 kPa regulated underpressure inside protective housing Duration: 8 h	O,V	

Test	Severity	Hardened Connector	Closures
Resistance to solvents and contaminating fluids IEC 61300-2-34	Solvents: - HCl at pH 2 - NaOH at pH 12 - Cable compound (petroleum jelly), ISO 1998-1:1998, 1.60.132 - Automotive diesel oil ISO 1998-1:1998, 1.20.131, and EN 590 - 10 % Nonyl Phenol Ethoxylate solution (Igepal) (at 50 °C ± 2 °C) Duration: Automotive diesel – 1 hour immersion, 24 hour drying Others: 5 days, no drying	S, V ^c	S, V ^c
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH: between 6,5 and 7,2) Temperature: +35 °C Duration: 5 days	S, V ^c	S, V ^c
Water immersion IEC 61300-2-23 Method 2	Depth of water above highest point of closure: 1 m (or an equivalent water pressure of 10 kPa) Test conducted at +23 °C ± 3 °C Duration: 7 days No wetting agent	V	V
^a For rigid cables with diameter $\varnothing > 25$ mm, the clamping distance may be increased to 1 000 mm. ^b Separate test samples for sealing performance and optical performance evaluation may be used. ^c Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards. ^d Sealing medium may be replaced for sealing test.			

**Table A.15 – Hardened optical connectors and closures – Category S –
Outdoor subterranean environment**

Test	Severity	Hardened connector	Closures
Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures IEC 61300-2-33	5 disassembly/assembly cycles At least one "Change of temperature" cycle between each disassembly/assembly cycle Sealing test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S ^c ,V	S,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
Mating durability ^c IEC 61300-2-2	20 cycles Optical test conducted at $+23\text{ °C} \pm 3\text{ °C}$	O,V	
Fibre optic connector proof test with static load ^b IEC 61300-2-50	Load: 300 N (straight pull 0°) Load: 25 N (side pull 90°) Duration: 5 s Tests conducted at $+23\text{ °C} \pm 3\text{ °C}$ Sealing and optical performance checked after test	S,O,V	
Fibre/cable retention ^b IEC 61300-2-4	Load (N): $20 \times$ cable diameter (mm) Duration: 1 h per cable at test temperature Sealing test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,O,V	S,O,V
Axial compression IEC 61300-2-11	Axial load: 450 N on (rigid) strength member of cable Duration: 30 min per central strength member Test conducted at $+23\text{ °C} \pm 3\text{ °C}$		V
Cable bending ^b IEC 61300-2-37	Cycle with bending angle: $+30^\circ$ and -30° Point of application: 400 mm from end of seal ^a 5 cycles per cable at test temperature 5 min at each extreme position Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$		S,O,V
Cable bending ^b IEC 61300-2-37	Cycle with bending angle: $+90^\circ$ and -90° Point of application: 400 mm from end of plug ^a 5 cycles per cable at test temperature 5 min at each extreme position Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,O,V	
Torsion ^b IEC 61300-2-5	Cycle with torque angle: $+90^\circ$ and -90° Point of application: 400 mm from end of seal ^a 5 cycles per cable at test temperature 5 min in each extreme position Sealing test ^b conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$ Optical test ^b conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,O,V	S,O,V

Test	Severity	Hardened connector	Closures
Impact IEC 61300-2-12 (method B)	Impact tool: 1 kg mass steel ball Drop height: 2 m Impact locations: centre of closure at 0°, 90°, 180° and 270° around longitudinal axis of enclosure Number of impacts: 1x per location per test temperature Sealing test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$		S,V
Impact (free fall) IEC 61300-2-12 (method A)	5 drops per test sample 1,5 m drop height Test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,O,V	
Vibration (sinusoidal) IEC 61300-2-1	Frequency: 10 Hz Amplitude: 3 mm Cables clamped at 500 mm from connector or closure Number of cycles: 1 000 000 (about 28 h) Test conducted at $+23\text{ °C} \pm 3\text{ °C}$	S,V	S,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 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 Tests conducted at $+23\text{ °C} \pm 3\text{ °C}$	O,V	O,V
Shock IEC 61300-2-9	Wave form: Half sine Duration: 11 milliseconds 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 Test conducted at $+23\text{ °C} \pm 3\text{ °C}$	O,V	O,V
Crush resistance IEC 61300-2-10	Load: 1 000 N Application area: 25 cm^2 (circular shape) Location: centre of closure at 0° and 90° around longitudinal axis of closure Duration: 10 min per location per test temperature Sealing test conducted at $-15\text{ °C} \pm 2\text{ °C}$ and $+45\text{ °C} \pm 2\text{ °C}$	S,V	S,V
Change of temperature IEC 61300-2-22	Temperature range: -30 °C to $+60\text{ °C}$ Duration at extreme temperatures: 4 h Temperature change rate: 1 °C/min 12 cycles	S,O,V	S,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 $+65\text{ °C}$ Humidity: 93 % RH at the maximum temperature 3 h dwells at the temperature extremes 10 cycles	O,V	
Resistance to solvents and contaminating fluids IEC 61300-2-34	Solvents: - HCl at pH 2 - NaOH at pH 12 - Cable compound (petroleum jelly), ISO1998-1:1998, 1.60.132 - Automotive diesel oil ISO 1998-1:1998, 1.20.131, and EN 590 - 10 % nonylphenol ethoxylate solution (Igepal) - (at $50\text{ °C} \pm 2\text{ °C}$) Duration: Automotive diesel – 1 hour immersion, 24 hour drying at RT Others: 5 days, no drying	S,V ^d	S,V ^d

Test	Severity	Hardened connector	Closures
Dust (IP 6x) IEC 60529	Dust type: talcum powder Particle size: < 75 µm Dust density: 2 kg/m ³ Pressure: 2 kPa underpressure inside enclosure 8 h duration	O,V	
Water immersion IEC 61300-2-23 Method 2	Depth of water above highest point of closure: 5 m (or an equivalent water pressure of 50 kPa) Test conducted at +23 °C ± 3 °C Duration: 7 days No wetting agent	V	V
Salt mist IEC 61300-2-26	Salt solution 5 % NaCl (pH: between 6,5 and 7,2) Temperature: +35 °C Duration: 5 days	S,V ^d	S,V ^d
^a For rigid cables with diameter $\varnothing > 25$ mm, the clamping distance may be increased to 1 000 mm. ^b Separate test samples for sealing performance and optical performance evaluation may be used. ^c Sealing medium may be replaced for sealing test. ^d Suitable material degradation and corrosion acceptance criteria shall be specified in the relevant performance standards.			

A.3 Performance criteria

Table A.16 – Single mode connectors

Optical performance criteria for single mode connectors		
Test	Requirement	
Attenuation of random mated connector IEC 61300-3-34 for single-fibre connector and IEC 61300-3-45 for multi-fibre connector ^{a, c}	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Grade A	Not specified at this time
	Grade B	≤ 0,12 dB mean ≤ 0,25 dB max. for ≥ 97 % of the connections
	Grade C	≤ 0,25 dB mean ≤ 0,50 dB max. for ≥ 97 % of the connections
	Grade D	≤ 0,50 dB mean ≤ 1,0 dB max. for ≥ 97 % of the connections
Random mated return loss: IEC 61300-3-6 ^c	Return loss grades	Return loss at 1 310 nm, 1 550 nm and 1625 nm
	Grade 1	≥ 60 dB (mated) and ≥ 55 dB (unmated)
	Grade 2	≥ 45 dB
	Grade 3	≥ 35 dB
	Grade 4	≥ 26 dB
Active monitoring of changes in attenuation and in return loss (multiple path): IEC 61300-3-3 ^{b, c}	Change in attenuation during test: δ ≤ 0,2 dB at 1 310 nm and 1 550 nm and δ ≤ 0,3 at 1 625 nm for pigtails (1 connection) δ ≤ 0,5 dB at 1 310 nm, δ ≤ 0,6 dB at 1 550 nm and δ ≤ 0,8 dB at 1 625 nm for patch cords (= 2 connections) Change in attenuation after test: δ ≤ 0,2 dB at 1 310 nm, 1 550 nm and 1 625 nm for pigtails (1 connection) δ ≤ 0,4 dB at 1 310 nm, 1 550 nm and 1 625 nm for patch cords (= 2 connections) The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss: IEC 61300-3-28 ^{b, c}	Change in attenuation during test: δ ≤ 0,5 dB at 1 550 nm per connection δ ≤ 1,0 dB at 1 625 nm per connection Change in attenuation after test: δ ≤ 0,2 dB at 1 550 nm and 1 625 nm per connection	
^a For MT ferule based connectors with more than 12 fibres, the random mating attenuation method is under consideration.		
^b The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.		
^c Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.		

Table A.17 – Single mode field mountable connectors

Optical performance criteria for single mode FMC		
Acceptance criteria	Requirement	
Attenuation of random mated connectors IEC 61300-3-34 for single – fibre connector ^a	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Performance criteria are under consideration.	
Wavelength dependence of attenuation for connection with 2 field mountable connectors IEC 61300-3-7 for single-fibre connector ^a	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Performance criteria are under consideration.	
Random mated return loss: IEC 61300-3-6 ^a	Return loss grades	Return loss at 1 310 nm, 1 550 nm and 1625 nm
	Grade 1	≥ 60 dB (mated) and ≥ 55 dB (unmated)
	Grade 2	≥ 45 dB
	Grade 3	≥ 35 dB
	Grade 4	≥ 26 dB
Active monitoring of changes in attenuation and in return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm and $\delta \leq 0,3$ dB at 1 625 nm for pigtails (1 connection) $\delta \leq 0,5$ dB at 1 310 nm, $\delta \leq 0,7$ dB at 1 550 nm and $\delta \leq 1,0$ dB at 1 625 nm for patch cords (= 2 connections) Change in attenuation after test: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm for pigtails (1 connection) $\delta \leq 0,4$ dB at 1 310 nm, 1 550 nm and 1 625 nm for patch cords (= 2 connections) The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per connection $\delta \leq 1,0$ dB at 1 625 nm per connection Change in attenuation after test: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per connection	

^a Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.

^b The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.

Table A.18 – Multi mode connectors

Optical performance criteria for multi mode connectors		
Test	Requirement	
Attenuation of random mated connectors IEC 61300-3-34 for single-fibre connector and IEC 61300-3-45 for multi-fibre connector (Note 1)	Attenuation grades	Attenuation at 850 nm
	Grade A _m	Not specified at this time
	Grade B _m	≤ 0,3 dB mean ≤ 0,6 dB max. for ≥ 97 % of the connections
	Grade C _m	≤ 0,5 dB mean ≤ 1,0 dB max. for ≥ 97 % of the connections
	Grade D _m	Not specified at this moment
Random mated return loss: IEC 61300-3-6	Return loss grades	Return loss at 850 nm
	Grade 1 _m	Not specified at this time
	Grade 2 _m	≥ 20 dB (mated)
Active monitoring of changes in attenuation and in return loss IEC 61300-3-3 (Note 2)	Change in attenuation at 850 nm: see relevant performance specification. The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss IEC 61300-3-28 (Note 2)	Change in attenuation at 850 nm: δ ≤ 0,5 dB per connection during test. δ ≤ 0,2 dB per connection after test.	
NOTE 1 For MT ferule based connectors with more than 12 fibres, the random mating attenuation method is under consideration.		
NOTE 2 The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.		

Table A.19 – Single mode mechanical splices

Optical performance criteria for single mode mechanical splices		
Test	Requirement	
Attenuation for mechanical splices IEC 61300-3-4 ^b	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Grade A	Not specified at this time
	Grade B	≤ 0,12 dB mean ≤ 0,25 dB max. for ≥ 97 % of the connections
	Grade C	≤ 0,25 dB mean ≤ 0,50 dB max. for ≥ 97 % of the connections
	Grade D	≤ 0,50 dB mean ≤ 1,0 dB max. for ≥ 97 % of the connections
Return loss IEC 61300-3-6 ^b	Return loss grades	Return loss at 1 310 nm, 1 550 nm and 1 625 nm
	Grade 1	≥ 60 dB (mated)
	Grade 2	≥ 45 dB
	Grade 3	≥ 35 dB
	Grade 4	≥ 26 dB
Active monitoring changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during and after test: δ ≤ 0,2 dB at 1 310 nm, 1 550 nm and 1 625 nm The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss: IEC 61300-3-28 ^{a, b}	Change in attenuation during test: δ ≤ 0,5 dB per splice at 1 550 nm δ ≤ 1,0 dB per splice at 1 625 nm Change in attenuation after test: δ ≤ 0,2 dB per splice at 1 550 nm and 1 625 nm	
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.		
^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.		

Table A.20 – Multi mode mechanical splices

Optical performance criteria for multi mode mechanical splices		
Test	Requirement	
Attenuation of mechanical splices IEC 61300-3-4	Attenuation grades	Attenuation at 850 nm
	Grade A _m	Not specified at this time
	Grade B _m	≤ 0,3 dB mean ≤ 0,6 dB max. for ≥ 97 % of the connections
	Grade C _m	≤ 0,5 dB mean ≤ 1.0 dB max. for ≥ 97 % of the connections
	Grade D _m	Not specified at this moment
Random mated return loss: IEC 61300-3-6	Return loss grades	Return loss at 850 nm
	Grade 1 _m	Not specified at this time
	Grade 2 _m	≥ 20 dB (mated)
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 (Note 1)	Change in attenuation at 850 nm: see relevant performance specification. The return loss requirement of the specified return loss grade shall be met during and after the test.	
Transient loss IEC 61300-3-28 (Note 1)	Change in attenuation at 850 nm: δ ≤ 0,5 dB per splice during test. δ ≤ 0,2 dB per splice after test.	
NOTE 1 The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.		

Table A.21 – Single mode fusion splice protectors

Optical performance requirements for single mode fusion splice protectors	
Acceptance criteria	Requirement
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation for 5 splice protectors: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm during test. $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm after test.
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.	
^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.22 – Passive optical components

Optical performance criteria for single mode passive optical components ^a		
Test	Requirement	
Attenuation: IEC 61300-3-4 IEC 61300-3-7 IEC 61300-3-29	Refer to the relevant performance standard ^b	
Return loss: IEC 61300-3-6	Return loss grades	Return loss
	Grade T	≥ 35 dB
	Grade R	≥ 40 dB
	Grade U	≥ 50 dB
	Grade V	≥ 60 dB
Active monitoring of changes in attenuation and return loss IEC 61300-3-3	Change in attenuation: refer to the relevant performance standard ^{c, d} The return loss requirement of the specified return loss grade shall be met during and after the test.	
^a Multimode performance criteria are under consideration.		
^b Other optical parameters, for example isolation, directivity, polarization dependent loss and wavelengths for measurements, can be found in the relevant performance standard.		
^c The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.		
^d Specific optical values shall be specified in the relevant performance standard for each type of passive optical component and the environment required.		

Table A.23 – Fibre management systems

Optical performance requirements for single mode fibre management systems	
Test	Requirement
Active monitoring of change in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test. ^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.24 – Category C – Wall outlets and boxes

Performance requirements for single mode category C – Wall outlets and boxes	
Test	Requirement
Optical performance criteria	
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
Sealing performance criteria	
Degrees of protection provided by enclosures IEC 60529	Category C wall outlets and boxes shall meet at minimum IP 30 after the tests. (IP 30 = After installation protected against ingress of objects with size larger than 2,5 mm. No protection against water)
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test. ^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.25 – Category C – Optical distribution frame modules (OFDM)

Performance requirements for category C single mode OFDM	
Test	Requirement
Optical performance criteria	
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test. ^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.26 – Category A, single mode boxes, street cabinets and free breathing closures

Performance requirements for category A, single mode boxes, street cabinets and free breathing closures	
Test	Requirement
Optical performance criteria	
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set and splices: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
Sealing performance criteria	
Degrees of protection provided by enclosures IEC 60529	The IEC 60529 IP 54 sealing criterion is used for boxes, street cabinets and free breathing closures. Category A boxes, street cabinets and free breathing enclosures shall meet at minimum IP 54 after the tests. IP 54 means that after installation the product is protected against ingress of dust and water sprayed from all possible directions.
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test. ^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.27 – Category C, A, G and S single mode sealed closures

Performance requirements for single mode sealed closures	
Test	Requirement
Optical performance criteria	
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{a, b}	Change in attenuation during test: $\delta \leq 0,2$ dB at 1 310 nm and 1 550 nm per incoming fibre $\delta \leq 0,5$ dB at 1 625 nm per incoming fibre Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre For circuit containing an optical connector set: $\delta \leq 0,2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre
Transient loss IEC 61300-3-28 ^{a, b}	Change in attenuation during test: $\delta \leq 0,5$ dB at 1 550 nm per life circuit $\delta \leq 1,0$ dB at 1 625 nm per life circuit Change in attenuation after test: For circuit with splices only: $\delta \leq 0,1$ dB at 1 550 nm and 1 625 nm per optical circuit For circuit containing an optical connector set: $\delta \leq 0,2$ dB at 1 550 nm and 1 625 nm per optical circuit
Sealing performance criteria	
Sealing for pressurized closures of fibre optic devices IEC 61300-2-38	This sealing criterion is mentioned for sealed closures that are able to hold a test over pressure of 20 kPa (categories C, A and G) or 40 kPa (category S). Method A shall be used after completion of the test. Method B is used for all mechanical tests at the specified test temperature. After the test, the internal test pressure shall not be reduced by more than 2 kPa (measured at the same atmospheric conditions as at the start of the test).
^a The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test.	
^b Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

Table A.28 – Category A, G and S single mode hardened fibre optic connectors

Performance requirements for single mode hardened fibre optic connectors ^a		
Test	Requirement	
Optical performance criteria		
Attenuation of random mated connectors IEC 61300-3-34 for single – fibre connector and IEC 61300-3-45 for multi-fibre connector a, c	Attenuation grades	Attenuation at 1 310 nm, 1 550 nm and 1 625 nm
	Grade A:	Not specified at this time
	Grade B:	≤ 0,12 dB mean ≤ 0,25 dB max. for ≥ 97 % of the connections
	Grade C:	≤ 0,25 dB mean ≤ 0,50 dB max. for ≥ 97 % of the connections
	Grade D:	≤ 0,50 dB mean ≤ 1,0 dB max. for ≥ 97 % of the connections
Return loss of random mated connectors IEC 61300-3-6 ^c	Return Loss grades	Return loss at 1 310 nm, 1 550 nm and 1 625 nm
	Grade 1:	≥ 60 dB (mated) and ≥ 55 dB (unmated)
	Grade 2:	≥ 45 dB
	Grade 3:	≥ 35 dB
	Grade 4:	≥ 26 dB
Active monitoring of changes in attenuation and return loss IEC 61300-3-3 ^{b, c}	Change in attenuation during test: δ ≤ 0,2 dB at 1 310 nm and 1 550 nm per connection δ ≤ 0,5 dB at 1 625 nm per connection Change in attenuation after test: δ ≤ 0,2 dB at 1 310 nm, 1 550 and 1 625 nm per connection Change in return loss: The return loss for the specified grade shall be met during and after the tests	
Transient loss IEC 61300-3-28 ^{b, c}	Change in attenuation during test: δ ≤ 0,5 dB at 1 550 nm per connection δ ≤ 1,0 dB at 1 625 nm per connection Change in attenuation after test: δ ≤ 0,2 dB at 1 550 nm and 1 625 nm per connection	
Sealing performance criteria		
Sealing for pressurised closures IEC 61300-2-38	This sealing criterion is for hardened connectors that are used on sealed closures that are capable to hold a test over pressure of 20 kPa (categories A and G) or 40 kPa (category S). Method A shall be used after all tests. Method B is used for all mechanical tests at the specified test temperature. After the test, the internal test pressure shall not be reduced by more than 2 kPa (measured at the same atmospheric conditions as at the start of the test).	

Performance requirements for single mode hardened fibre optic connectors ^a	
Test	Requirement
Degrees of protection provided by enclosures IEC 60529	This sealing criterion is for hardened connectors of Category A used on boxes or street cabinets (free breathing enclosures). They shall meet at minimum IP 65 and IP 67 after the tests. IP 65/IP 67 means that after installation the hardened connector is completely protected against ingress of dust, protected against jets of water from all directions and that temporary immersion in water up to 1 m depth is allowed.
NOTE 1 For MT ferrule based connectors with more than 12 fibres, the random mating attenuation method is under consideration. ^a Multimode performance criteria are under consideration. ^b The change in attenuation refers to the +/- deviation from the original value of the transmitted power at the start of the test. ^c Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.	

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Annex B (normative)

Performance standard numbering

The numbering of performance standards shall take the form IEC 61753-xxx-y. Where xxx defines the component type. The third x is used to categorize the variants of the component (e.g. pigtailed version, wavelength ranges or other). And y defines the environmental category.

The numbering scheme for fibre optic interconnecting devices and passive components is as follows:

xxx = 02x Connectors	y = 2 Category C
xxx = 03x Branching devices	y = 3 Category OP
xxx = 04x Filters	y = 4 Category I
xxx = 05x Passive optical power control devices	y = 5 Category E
xxx = 06x Isolators	y = 6 Category OP+
xxx = 07x Switches	y = 7 Category A
xxx = 08x WDM	y = 8 Category G
xxx = 09x Circulators	y = 9 Category S
xxx = 10x Fibre management systems	
xxx = 11x Closures	
xxx = 12x Simplex and duplex cords	
xxx = 13x Fibre splice	
xxx = 14x Dispersion compensator	
xxx = 32x Connectors	
xxx = 33x Branching devices	
xxx = 34x Filters	
xxx = 35x Passive optical power control devices	
xxx = 36x Isolators	
xxx = 37x Switches	
xxx = 38x WDM	
xxx = 39x Circulators	
xxx = 40x Fibre management systems	
xxx = 41x Closures	
xxx = 42x Patch cords	
xxx = 43x Mechanical fibre splice	
xxx = 44x Dispersion compensator	

Examples:

- IEC 61753-031-3 refers to a performance standard written for fibre optic branching devices which are designed to operate in an outdoor but protected environment.
- IEC 61753-021-2 refers to a performance standard written for connectors terminated onto single mode fibre which are designed to operate in an indoor controlled environment.

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

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

DISPOSITIFS D'INTERCONNEXION ET COMPOSANTS PASSIFS FIBRONIQUES – NORME DE PERFORMANCE –

Partie 1: Généralités et recommandations

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La Norme internationale IEC 61753-1 a été établie par le sous-comité 86B: Dispositifs d'interconnexion et composants passifs à fibres optiques, du comité d'études 86 de l'IEC: Fibres optiques.

Cette deuxième édition annule et remplace la première édition parue en 2007. Elle constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) définitions mises à jour avec de nouveaux produits: prises murales, coffrets à montage mural ou sur poteau, épissures, modules ODF, armoires d'environnement urbain, connecteurs renforcés et connexions montables sur le terrain;

- b) les catégories U et O ont été remplacées par les catégories OP et OP+. Pas de séquence obligatoire dans la catégorie OP+. La catégorie OP+ contient les essais de la catégorie OP avec l'ajout de seulement 4 autres essais;
- c) ajout de la catégorie I (industriel);
- d) ajout des plages de température (avec le suffixe HD aux catégories C, OP, OP+ et I) au cas où des composants optiques passifs sont placés dans un boîtier avec des composants électroniques actifs (HD signifie *Heat Dissipation*, dissipation thermique);
- e) la hauteur de la catégorie A a été modifiée de 3 m au niveau du sol (0 m);
- f) la hauteur du niveau inférieur de l'environnement de catégorie G a été modifiée du niveau du sol (0 m) à –1 m en dessous du niveau du sol. Le niveau supérieur reste à 3 m au-dessus du niveau du sol;
- g) ajout d'essais de performance, de sévérités d'essai et de critères de qualité de fonctionnement pour de nouveaux produits: prises murales, coffrets à montage mural ou sur poteau, épissures mécaniques, protecteurs d'épissures par fusion, modules ODF, armoires d'environnement urbain, connexions montables sur le terrain et connecteurs optiques renforcés;
- h) la sévérité de l'essai «Durabilité de l'accouplement» pour les connecteurs des catégories C, OP, OP+ et I a été ramenée à 200 cycles pour les connecteurs avec férules cylindriques et à 50 cycles pour les connecteurs avec férules rectangulaires;
- i) la sévérité de l'essai «Variations de température» pour les connecteurs et les composants optiques passifs de la catégorie I a été ramenée de 20 cycles à 12 cycles (harmonisée avec les connecteurs et les composants d'autres catégories);
- j) la sévérité de l'essai «Flexion du serre-câble» pour les connecteurs des catégories C, OP et OP+ a été ramenée à 50 cycles;
- k) les sévérités de l'essai «Montage et démontage des épissures mécaniques fibroniques, des systèmes de gestion des fibres et des boîtiers» pour tous les boîtiers ont été ramenées à 5 cycles;
- l) les sévérités de l'essai «Variations de température» pour tous les boîtiers de protection des catégories C, A, G et S ont été ramenées de 20 cycles à 12 cycles (harmonisées avec les connecteurs et les composants);
- m) les sévérités de l'essai «Résistance aux solvants et aux fluides contaminants» pour les boîtiers des catégories G et S ont été modifiées: le kérosène a été supprimé, l'exposition au gazoil a été ramenée à 1 h d'immersion et à 24 h de séchage à température ambiante;
- n) les critères de performance d'étanchéité des boîtiers étanches pour les catégories G et A ont été ramenés à une surpression de 20 kPa;
- o) Le critère de variations de l'affaiblissement pour les connecteurs a été modifié de crête-à-crête à une divergence +/- par rapport à la valeur d'origine de la puissance transmise au début de l'essai (harmonisée avec les critères de variations de l'affaiblissement pour les composants, épissures et boîtiers de protection).

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
86B/4131/FDIS	86B/4137/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61753, publiées sous le titre général *Dispositifs d'interconnexion et composants passifs fibroniques – norme de performance*, peut être consultée sur le site web de l'IEC.

Les futures normes de cette série porteront dorénavant le nouveau titre général cité ci-dessus. Le titre des normes existant déjà dans cette série sera mis à jour lors de la prochaine édition.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives au document recherché. A cette date, le document sera

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- supprimé,
- remplacé par une édition révisée, ou
- amendé.

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Le contenu du corrigendum de mai 2019 a été pris en considération dans cet exemplaire.

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INTRODUCTION

La série IEC 61753 traite des normes de qualité de fonctionnement applicables à tous les produits passifs fibroniques, y compris les connecteurs, les composants optiques passifs, les systèmes de gestion de fibres et les différents boîtiers de protection. La norme est publiée en plusieurs parties. La présente partie, la Partie 1, concerne les informations générales sur les normes de qualité de fonctionnement. Les autres parties sont connues en tant que normes de qualité de fonctionnement et elles sont numérotées selon une classification donnée à l'Annexe B. Ces normes contiennent les sévérités minimales d'essai et de mesure qui sont communes à l'ensemble des produits passifs fibroniques pour un environnement de service ou une catégorie de qualité de fonctionnement donné(e), ainsi que les sévérités minimales d'essai et de mesure considérées comme spécifiques au produit concerné dans l'environnement couvert.

Les normes de qualité de fonctionnement définissent les exigences de performance optique normalisées selon un ensemble de conditions spécifiées. Chaque norme contient une série ou un ensemble d'essais et de mesures, assortis de conditions, de sévérités et de critères d'acceptation et de rejet clairement définis. Les séries d'essais, auxquelles il est généralement fait référence en tant qu'environnement de service ou de fonctionnement ou en tant que catégorie de qualité de fonctionnement, sont destinées à être effectuées les unes après les autres, afin de prouver l'aptitude du produit à satisfaire aux exigences d'une application, d'un secteur de marché ou d'un groupe d'utilisateurs spécifiques.

Le présent document définit les séries d'essais qui constituent chaque environnement de service ou de fonctionnement ou catégorie de qualité de fonctionnement, et qui ont été normalisées en vue d'un usage international. Un produit dont on a prouvé qu'il répondait à toutes les exigences d'une norme de qualité de fonctionnement peut être déclaré conforme à cette norme de qualité de fonctionnement.

Les produits qui ont la même classification que ceux d'un fabricant qui satisfont à une norme de qualité de fonctionnement fonctionneront selon les limites établies par cette norme de qualité de fonctionnement. La compatibilité d'accouplement ou l'interchangeabilité de produits provenant de fournisseurs différents (de même classification et conformes à la même norme de qualité de fonctionnement) ne peut être garantie que dans le cas où ces produits satisfont aussi aux normes d'interface. Ce n'est qu'à cette condition qu'un niveau équivalent de qualité de fonctionnement sera assuré lorsque ces produits sont utilisés ensemble (par exemple, dans le cas de connecteurs optiques).

La conformité à une norme de qualité de fonctionnement ne constitue pas une garantie de qualité de fonctionnement ou de fiabilité assurée pour toute la durée de vie du produit. Les essais de fiabilité font l'objet d'un programme d'essais séparé dans lequel les essais et les sévérités choisis représentent fidèlement les exigences de ce programme d'essais de fiabilité. La cohérence de la fabrication sera conservée en utilisant un programme d'assurance de la qualité reconnu, tandis que la fiabilité du produit sera évaluée au moyen des procédures recommandées dans l'IEC 62005 (toutes les parties).

Les essais et mesures sont choisis à partir de l'IEC 61300 (toutes les parties). Lorsque cela est impossible, la méthode d'essai exigée est jointe comme annexe de la norme de qualité de fonctionnement.

DISPOSITIFS D'INTERCONNEXION ET COMPOSANTS PASSIFS FIBRONIQUES – NORME DE PERFORMANCE –

Partie 1: Généralités et recommandations

1 Domaine d'application

La présente partie de l'IEC 61753 fournit des recommandations pour la rédaction de normes de qualité de fonctionnement applicables à tous les produits passifs fibroniques.

Le présent document définit les essais et les sévérités qui constituent les catégories de qualité de fonctionnement ou les environnements de service ou de fonctionnement général et elle identifie les essais qui sont considérés comme spécifiques à un produit. Les informations détaillées concernant les essais et les sévérités sont données à l'Annexe A.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60529, *Degrés de protection procurés par les enveloppes (Code IP)*

IEC 61300 (toutes les parties), *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures*

IEC 61300-2-1, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-1: Essais – Vibrations (sinusoïdales)*

IEC 61300-2-2, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-2: Essais – Durabilité de l'accouplement*

IEC 61300-2-4, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-4: Essais – Rétention de la fibre ou du câble*

IEC 61300-2-5, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-5: Essais – Torsion*

IEC 61300-2-6, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-6: Essais – Résistance à la traction du mécanisme de couplage*

IEC 61300-2-7, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-7: Essais – Moment de flexion*

IEC 61300-2-9, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-9: Essais – Chocs*

IEC 61300-2-10, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-10: Essais – Résistance à la compression*

IEC 61300-2-11, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-11: Essais – Compression axiale*

IEC 61300-2-12, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-12: Essais – Impact*

IEC 61300-2-17, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-17: Essais – Froid*

IEC 61300-2-18, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-18: Essais – Chaleur sèche – Résistance à haute température*

IEC 61300-2-19, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-19: Essais – Chaleur humide (essai continu)*

IEC 61300-2-21, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-21: Essais – Essai cyclique composite de température/humidité*

IEC 61300-2-22, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-22: Essais – Variations de température*

IEC 61300-2-23, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-23: Essais – Étanchéité pour les boîtiers non pressurisés de dispositifs à fibres optiques*

IEC 61300-2-26, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-26: Essais – Brouillard salin*

IEC 61300-2-27, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-27: Essais – Poussière – Écoulement laminaire*

IEC 61300-2-28, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-28: Essais – Atmosphère corrosive (dioxyde de soufre)*

IEC 61300-2-33, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-33: Essais – Montage et démontage des épissures mécaniques de fibres optiques, des systèmes de gestion des fibres et des boîtiers*

IEC 61300-2-34, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-34: Essais – Résistance des composants d'interconnexion et des boîtiers aux solvants et aux fluides contaminants*

IEC 61300-2-35, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-35: Essais – Nutation du câble*

IEC 61300-2-37, *Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures – Partie 2-37: Essais – Courbure du câble pour les boîtiers pour fibres optiques*

IEC 61300-2-38, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-38: Essais – Etanchéité pour les boîtiers à fibres optiques à surpression interne*

IEC 61300-2-42, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-42: Essais – Charge latérale statique pour serre-câble*

IEC 61300-2-44, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-44: Essais – Flexion du serre-câble des dispositifs à fibres optiques*

IEC 61300-2-45, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-45: Essais – Essai de durabilité par immersion dans l'eau*

IEC 61300-2-46, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-46: Essais – Chaleur humide, essai cyclique*

IEC 61300-2-50, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-50: Essais – Essai de résistance des connecteurs à fibres optiques sous charge statique – Unimodal et multimodal*

IEC 61300-3-3, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-3: Examens et mesures – Contrôle actif des variations de l'affaiblissement et de l'affaiblissement de réflexion*

IEC 61300-3-4, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-4: Examens et mesures – Affaiblissement*

IEC 61300-3-6, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-6: Examens et mesures – Affaiblissement de réflexion*

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 (disponible en anglais seulement)*

IEC 61300-3-28, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-28: Examens et mesures – Perte transitoire*

IEC 61300-3-29, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 3-29: Examens et mesures – Caractéristiques de transfert spectral des dispositifs DWDM*

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 (disponible en anglais seulement)*

IEC 61300-3-45, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-45: Examens et mesures – Affaiblissement dû à l'accouplement de connecteurs quelconques multifibres*

Guide IEC 109, *Aspects liés à l'environnement – Prise en compte dans les normes électrotechniques de produits*

ISO 1998-1:1998, *Industrie pétrolière – Terminologie – Partie 1: Matières premières et produits*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

NOTE Les définitions concernant les différents composants se trouvent dans l'IEC TS 62538 et dans les normes de qualité de fonctionnement de la série IEC 61753 correspondantes.

3.1

raccord

composant qui permet l'accouplement entre un connecteur et un autre composant optique

Note 1 à l'article: Un autre composant optique est une fiche de connecteur, un composant actif, un composant optique passif.

3.2

coffret

boîtier à ventilation libre qui est fixé à demeure sur un mur ou sur un poteau

Note 1 à l'article: Un coffret n'est pas spécifiquement conçu pour permettre le mouvement des câbles (par exemple torsion, flexion) aux orifices de câbles pendant le fonctionnement.

3.3

connecteur

composant normalement fixé à un appareil ou à l'extrémité d'un câble afin de permettre la connexion et la déconnexion de câbles fibroniques

3.4

système de gestion de fibres

FMS

système de contrôle, de protection et de stockage d'épissures, de connecteurs, de composants optiques passifs et de fibres des câbles d'entrée aux câbles de sortie

Note 1 à l'article: Les plateaux d'épissures ou platines d'assemblage font partie d'un système de gestion de fibres.

3.5

épissure de fibre

liaison permanente ou séparable entre fibres optiques réalisée au moyen soit d'une épissure par fusion, soit d'une épissure mécanique

3.6

connexion montable sur le terrain

FMC

connecteur qui est monté directement sur une fibre ou un câble à fibres sur le terrain

3.7

boîtier à ventilation libre

boîtier de protection qui permet librement l'échange d'air avec l'environnement

Note 1 à l'article: Un boîtier à ventilation libre peut ressembler à un boîtier scellé, mais il n'est pas conçu pour supporter une surpression ou une dépression variable causée par des variations de température ou des variations de pression atmosphérique. Les boîtiers à ventilation libre sont utilisés dans les environnements aériens pour l'interconnexion de câbles.

Note 2 à l'article: Une limitation de la pénétration d'eau et/ou une limitation de la pénétration de poussière est possible. Les boîtiers à ventilation libre ne sont pas censés être utilisés dans des zones susceptibles d'être inondées ou immergées dans l'eau.

3.8

connecteur fibronique renforcé

connecteur étanche à l'eau et à la poussière

Note 1 à l'article: Un connecteur fibronique renforcé est généralement utilisé comme connexion en installations extérieures.

3.9

MICE

système de classification qui décrit les conditions de l'environnement local d'un système de câblage selon les facteurs suivants:

- mécanique (M),
- infiltration (I),
- climatique et chimique (C),
- électromagnétique (E)

Note 1 à l'article: Le terme MICE est référencé dans les normes de câblage génériques produites par l'ISO/IEC JTC1 SC25 et a trait à la classification de l'environnement local d'un système de câblage.

Quatre principaux critères environnementaux sont utilisés pour classifier un environnement:

- l'élément M qui définit les caractéristiques mécaniques de l'environnement;
- l'élément I qui définit les caractéristiques de protection contre les infiltrations de l'environnement;
- l'élément C qui définit les caractéristiques climatiques et chimiques de l'environnement;
- l'élément E qui définit les caractéristiques électromagnétiques de l'environnement.

Chacun des quatre principaux critères environnementaux est lui-même divisé en paramètres spécifiques et en niveaux pour ces paramètres. La classification MICE pour un emplacement donné est donc définie comme MaIbCcEd, où a, b, c et d sont respectivement des sous-classifications individuelles (niveaux) pour les critères M, I, C et E.

Les suffixes pour les quatre principaux critères environnementaux sont 1, 2 ou 3. Par exemple, l'environnement le moins sévère est décrit comme M1I1C1E1, tandis que l'environnement le plus sévère est défini comme M3I3C3E3.

Note 2 à l'article: L'élément E n'est pas considéré pertinent pour les composants optiques passifs.

[SOURCE: ISO/IEC 24702:2006, 3.1.11, modifié – les notes ont été ajoutées.]

3.10

module répartiteur optique

module ODF

ODFM

boîtier qui est montable dans une structure support

Note 1 à l'article: Un ODFM contient un système de gestion de fibres et peut fournir des interconnexions réarrangeables entre les câbles d'entrée et les câbles de sortie.

Note 2 à l'article: La structure support qui abrite le module répartiteur optique est souvent appelé châssis d'équipement.

3.11**environnement de service ou de fonctionnement**

environnement de service ou emplacement de fonctionnement typique correspondant à une catégorie de qualité de fonctionnement donnée

3.12**catégorie de qualité de fonctionnement**

série d'essais et de mesures avec des conditions et des sévérités clairement stipulées choisies pour simuler un environnement de service ou de fonctionnement donné

3.13**norme de qualité de fonctionnement**

norme conçue pour vérifier qu'un produit est capable de satisfaire aux exigences d'un environnement de service donné

Note 1 à l'article: Une norme de qualité de fonctionnement contient une combinaison d'essais, avec leurs sévérités et leurs critères d'acceptation et de rejet, qui sont appliqués à l'ensemble des produits passifs fibroniques pour une catégorie de qualité de fonctionnement donnée, ainsi que ceux qui sont considérés comme spécifiques au produit concerné dans l'environnement couvert.

3.14**rapport d'essai de la norme de qualité de fonctionnement**

rapport à produire à l'issue des essais selon une norme de qualité de fonctionnement

3.15**essais spécifiques à un produit**

essais qui sont considérés comme spécifiques à une catégorie ou à un type de produit donné(e)

Note 1 à l'article: Lorsqu'il y a une exigence IP spécifique pour un produit, elle fait l'objet d'un essai séparé et est incluse dans la norme de qualité de fonctionnement de produit correspondante.

Note 2 à l'article: Lorsqu'il y a une exigence spécifique pour un produit, elle fait l'objet d'un essai séparé et est incluse dans la norme de qualité de fonctionnement de produit correspondante.

3.16**boîtier de protection**

boîtier intérieur et extérieur utilisé pour le stockage, la distribution ou la protection d'une ou plusieurs liaisons de câbles ou de tout équipement de télécommunication passif ou actif

Note 1 à l'article: Exemples de boîtiers de protection: coffrets muraux, armoires, enceintes, châssis de répartiteur optique, boîtiers ou armoires de rue comme représentés à la Figure 1. Un boîtier peut être soit un «boîtier étanche» ou un «boîtier à ventilation libre».

Note 2 à l'article: Le boîtier de protection contient un système de gestion de fibres.

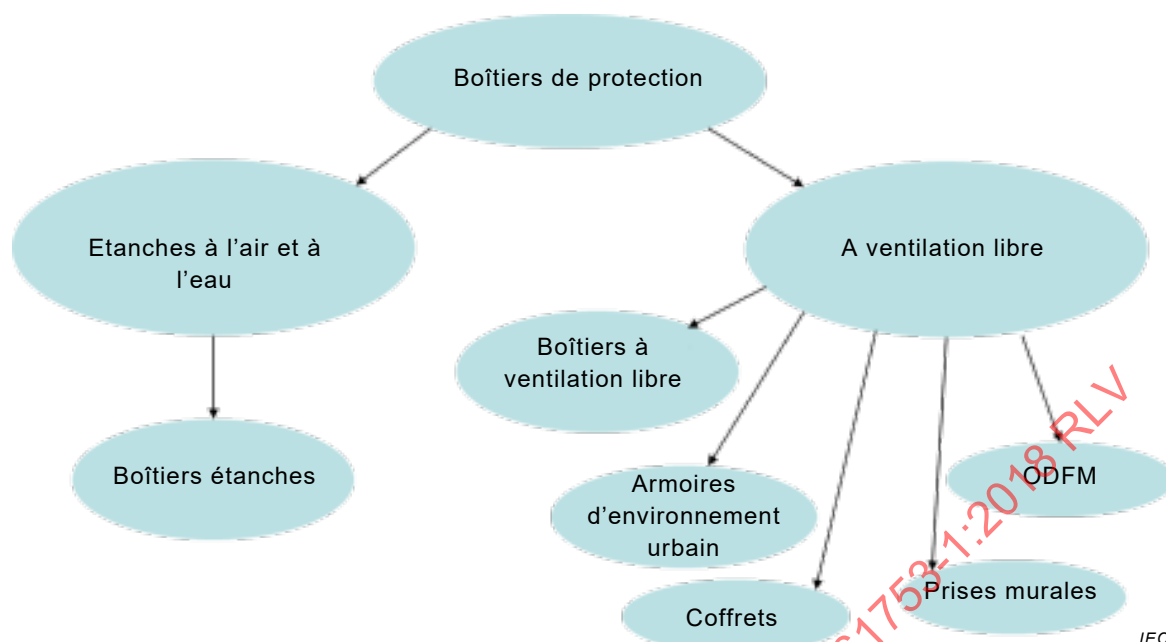


Figure 1 – Relation entre plusieurs types de boîtiers de protection

3.17

boîtier étanche

boîtier étanche à l'eau et à la poussière pouvant supporter une surpression ou une dépression variables causées par des variations de température ou des variations de pression atmosphérique

Note 1 à l'article: Il n'y a pas d'échange d'air avec l'environnement extérieur lorsqu'il est exposé à des températures supérieures à la plage de température de service spécifiée.

Note 2 à l'article: Bien que souvent appelés boîtiers hermétiques, l'humidité peut pénétrer par diffusion à l'intérieur du boîtier.

Note 3 à l'article: Les coffrets étanches ou les prises murales étanches doivent être traités comme des boîtiers étanches.

Note 4 à l'article: Les boîtiers dont l'intérieur est complètement rempli sont également considérés comme des boîtiers étanches.

3.18

armoire d'environnement urbain

boîtier extérieur à ventilation libre installé au-dessus du sol et fixé en permanence au sol

Note 1 à l'article: Une armoire d'environnement urbain est fixée en permanence au sol et n'est pas spécifiquement conçue pour permettre le mouvement des câbles (par exemple torsion, flexion) pendant le fonctionnement.

3.19

prise murale

boîtier à ventilation libre pourvu de dispositifs de connexion fixes dans lequel le câble horizontal est raccordé

Note 1 à l'article: La prise murale constitue l'interface avec le cordon de raccordement.

4 Abréviations

FMC	connexion montable sur le terrain
FMS	système de gestion de fibres
ODFM	module répartiteur optique

5 Préparation d'une norme de qualité de fonctionnement

5.1 Titre de la norme de qualité de fonctionnement

Le titre de la norme de qualité de fonctionnement doit être clair. Ces informations doivent inclure:

- la description du produit,
- la catégorie de qualité de fonctionnement appropriée,
- toute autre variante ou information de différenciation permettant de distinguer la norme des autres normes de qualité de fonctionnement.

5.2 Essais

Pour que le produit satisfasse à la norme de qualité de fonctionnement, les essais à effectuer sur ce produit doivent être clairement définis, y compris ceux qui sont spécifiques au produit. Aucune ambiguïté ou option ne doit être permise.

Les essais choisis combinés avec les sévérités/durées, les groupements/séquences, les méthodes utilisées et les critères d'acceptation/rejet doivent fournir l'indication d'un environnement de service ou de fonctionnement défini.

La méthode d'essai à utiliser doit être clairement définie pour chaque essai. Chaque fois que possible, la méthode d'essai doit être choisie à partir de l'IEC 61300 (toutes les parties); si tel n'est pas le cas, d'autres méthodes d'essais peuvent être définies. Si une méthode d'essai non définie est utilisée, la méthode d'essai et les détails à spécifier doivent être spécifiés dans l'annexe appropriée de la norme de qualité de fonctionnement.

Les normes de qualité de fonctionnement peuvent prévoir des essais supplémentaires éventuellement nécessaires pour donner les caractéristiques complètes d'un connecteur ou d'un composant donné.

5.3 Détails

Les détails à prendre en compte (sévérités et durées) doivent être donnés pour tous les essais et mesures définis dans une norme de qualité de fonctionnement. Ils doivent être directement liés aux exigences de qualité de fonctionnement définies par l'environnement de service ou de fonctionnement. Aucune ambiguïté ou option n'est permise.

5.4 Exigences

Les exigences de qualité de fonctionnement qui doivent être satisfaites afin que le produit soit conforme à la norme de qualité de fonctionnement doivent être spécifiées pour chaque essai et/ou mesure. Aucune ambiguïté n'est permise.

5.5 Nombre d'échantillons

Le nombre d'échantillons pour chaque essai doit être défini dans l'annexe correspondante de la norme de qualité de fonctionnement. Aucune divergence n'est permise.

5.6 Définition de l'échantillon

L'échantillon à soumettre aux essais doit être défini dans la norme de qualité de fonctionnement correspondante.

5.7 Groupements/séquences

En général, aucune séquence n'est nécessaire et chaque essai est destiné à être réalisé individuellement. Le cas échéant, les groupes d'essais et les séquences d'essais peuvent être exigés par l'utilisateur, le groupe d'utilisateurs ou le fabricant.

5.8 Critères d'acceptation/rejet

Les critères d'acceptation/rejet doivent être établis sans ambiguïté pour chaque essai dans le cadre de la norme de qualité de fonctionnement, lorsque la catégorie de qualité de fonctionnement l'exige. Aucune divergence ou exception n'est permise.

5.9 Définition du produit de référence

Lorsqu'une norme de qualité de fonctionnement exige l'utilisation d'un produit ou d'un composant de référence, le produit de référence doit être clairement défini dans l'annexe correspondante de la norme de qualité de fonctionnement.

5.10 Rapport d'essai d'une norme de qualité de fonctionnement

La conformité à une norme de qualité de fonctionnement doit être étayée par un rapport d'essai. Le rapport d'essai doit démontrer clairement que les essais ont été effectués conformément aux exigences de la norme de qualité de fonctionnement et doit fournir les détails complets des essais, ainsi qu'une déclaration d'acceptation/rejet. Toutes les exigences d'essai et de mesure doivent être satisfaites avant qu'un composant puisse être déclaré conforme à la norme de qualité de fonctionnement.

Toute défaillance d'un produit lors d'un essai ou d'une séquence d'essais donnés doit figurer dans le rapport d'essai de la norme de qualité de fonctionnement. Une analyse de la cause de la défaillance doit être menée et toute action corrective subséquente doit être décrite.

Si aucun changement de conception n'est effectué sur le produit, l'essai ou la séquence d'essais ayant fait l'objet d'une défaillance doit être repris(e), en précisant dans un rapport les résultats des deux essais.

Si des changements de conception sont réalisés, un nouveau programme d'essais complet de la norme de qualité de fonctionnement doit être effectué. Tout essai réalisé avec succès auparavant doit être répété avec de nouveaux échantillons.

6 Aspects environnementaux

Les exigences concernant la réduction des effets néfastes à l'environnement pendant toute la durée de vie des produits ne sont pas couvertes dans le présent document. Les aspects environnementaux appropriés doivent être implémentés conformément aux lignes directrices données dans le Guide IEC 109.

Annexe A (normative)

Essais, sévérités et critères pour les normes de qualité de fonctionnement

A.1 Généralités

L'Annexe A définit les essais, les sévérités recommandées et les critères de qualité de fonctionnement pour les différentes catégories de qualité de fonctionnement reflétant les environnements de service ou de fonctionnement applicables aux produits passifs fibroniques. Le Tableau A.1 et le Tableau A.2 offrent une liste des environnements de service ou de fonctionnement.

Les normes de qualité de fonctionnement des composants suivants sont couvertes par le présent document:

- connecteurs et adaptateurs fibroniques,
- connexions montables sur le terrain (FMC),
- épissures (protecteurs d'épissures par fusion et épissures mécaniques),
- composants optiques passifs,
- systèmes de gestion de fibres (FMS),
- connecteurs renforcés.

Les normes de qualité de fonctionnement des boîtiers de protection suivants sont couvertes par le présent document:

- prises murales (utilisation en intérieur uniquement),
- coffrets (à montage mural ou sur poteau),
- armoire d'environnement urbain,
- modules répartiteurs optiques (ODFM),
- boîtiers (boîtiers étanches et boîtiers à ventilation libre).

La sélection des essais et des sévérités associées dans chaque catégorie de qualité de fonctionnement est fondée sur un ensemble harmonisé d'exigences déterminées comme appropriées pour la catégorie concernée. Les séries d'essais qui constituent des catégories de qualité de fonctionnement données, telles qu'indiquées aux Tableaux A.3 à A.15, sont des combinaisons d'essais communs applicables à tous les types de produits fibroniques et d'essais spécifiques à un produit donné.

Les essais qui constituent une catégorie de qualité de fonctionnement forment un ensemble minimal d'exigences d'essai. Il est reconnu que des essais supplémentaires peuvent souvent être nécessaires pour caractériser complètement un composant ou un connecteur particulier.

Les conditions d'environnement extérieur sont extraites de l'IEC 60721-2-1. Les types de climats suivants sont couverts pour les catégories E, OP+, A, G et S:

- froid,
- froid tempéré,
- chaud tempéré,
- chaud sec,
- doux chaud sec,
- extrêmement chaud et sec,

- chaud humide,
- chaud humide, tempéré.

Pour la catégorie OP, les types de climats suivants sont couverts (les environnements «froids» sont exclus):

- froid tempéré,
- chaud tempéré,
- chaud sec,
- doux chaud sec,
- extrêmement chaud et sec,
- chaud humide,
- chaud humide, tempéré.

Toutes les catégories de qualité de fonctionnement contenues dans la présente Annexe A sont applicables aux transmissions fibroniques unimodales et multimodales. Les critères d'acceptation et les exigences de qualité de fonctionnement minimales pour les connecteurs, les épissures mécaniques, les composants optiques passifs, les systèmes de gestion de fibres et les différents types d'enveloppes sont donnés par les Tableaux A.16 à A.28. Le choix des valeurs à inclure dans les programmes d'essais de la norme de qualité de fonctionnement dépend du type de système et du niveau de qualité de fonctionnement exigé.

Les limites de température minimale et maximale indiquées tiennent compte des effets thermiques engendrés par le rayonnement solaire ou le rayonnement de surface pendant les nuits sans nuages. Il est possible que, dans les catégories d'environnement C, I, OP et OP+, les produits soient situés dans un site ou un emplacement conjointement avec des composants électroniques actifs qui génèrent de la chaleur. Dans ce document, de telles situations sont appelées «sites avec dissipation thermique». Dans ces circonstances, la limite de température supérieure maximale est étendue comme indiqué dans le Tableau A.2. Pour la catégorie C^{HD}, la température est relevée de +60 °C à +70 °C. Pour les catégories extérieures, elle est augmentée jusqu'à +85 °C. Cela signifie qu'un produit de la catégorie OP doit résister à une température supérieure de +70 °C et qu'un produit de la catégorie OP^{HD} +85 °C (HD indique une température supérieure étendue nécessaire en raison de la dissipation de chaleur supplémentaire générée par des composants électroniques actifs).

Pour toutes les catégories, il n'existe pas d'ordre défini dans lequel les essais doivent être effectués. Tous les essais sont destinés à être réalisés individuellement. Si une certaine séquence d'essais est exigée, elle doit être définie dans la norme de qualité de fonctionnement pertinente.

Tableau A.1 – Environnements de service ou de fonctionnement et catégories de qualité de fonctionnement

Connecteurs fibroniques, connexions montables sur le terrain, épissures mécaniques, protecteurs d'épissures par fusion, composants optiques passifs et systèmes de gestion de fibres		
Catégorie de qualité de fonctionnement	Description	Environnement de service ou de fonctionnement
C	Environnement intérieur contrôlé	Température de fonctionnement: -10 °C à $+60\text{ °C}$ Humidité relative: 5 % à 93 % Emplacements protégés contre les intempéries, partiellement thermorégulés. Généralement à l'intérieur d'un bureau, d'une maison, d'un bâtiment, d'un garage intérieur, d'une cave, d'un local technique, d'un centre de télécommunication ou enfermé dans un boîtier de protection intérieur de catégorie C. Non soumis à la condensation.
OP	Environnement extérieur protégé	Température de fonctionnement: -25 °C à $+70\text{ °C}$ Humidité relative: 0 % à 95 % Emplacements protégés contre les intempéries, sans thermorégulation. Généralement à l'extérieur, mais enfermé ou couvert. Emplacements: cabanes, greniers, cabines téléphoniques, entrées des bâtiments, garage ouvert, locaux techniques sans surveillance, armoires d'environnement urbain ou enfermé dans des boîtiers de protection de catégories A, G ou S. Soumis au brouillard salin, à la condensation et à des précipitations limitées dues au vent. A proximité immédiate du sable ou de la poussière.
OP+	Environnement extérieur protégé Identique à OP, mais avec une plage de température de fonctionnement étendue pour le froid, la chaleur sèche et les variations de température pour couvrir les climats froids et extrêmement chauds. Essai de condensation supplémentaire	Température de fonctionnement: -40 °C à $+75\text{ °C}$ Humidité relative: 0 % à 95 % Emplacements protégés contre les intempéries, sans thermorégulation. Généralement à l'extérieur, mais enfermé ou couvert. Emplacements: cabanes, greniers, cabines téléphoniques, entrées des bâtiments, garage ouvert, locaux techniques sans surveillance, armoires d'environnement urbain ou enfermé dans des boîtiers de protection de catégories A, G ou S. Soumis au brouillard salin, à la condensation et à des précipitations limitées dues au vent. A proximité immédiate du sable ou de la poussière.
I	Environnement industriel issu de la classification MICE	Température de fonctionnement: -40 °C à $+70\text{ °C}$ Humidité relative: 0 % à 95 % Emplacements: îlots d'automatisation généralement. Soumis à de fortes vibrations, à des sources de gaz corrosifs industrielles, à des éclaboussures de solvants liquides, non soumis à l'immersion.
E	Environnement extrême	Température de fonctionnement: -40 °C à $+85\text{ °C}$ Humidité relative: 0 % à 100 % Emplacements non protégés contre les intempéries, sans thermorégulation. Emplacements: Généralement à l'extérieur, non enfermé. Exposition directe à l'air libre, soumis à des sources d'émissions chimiques industrielles.

Connecteurs renforcés et boîtiers de protection (prises murales, coffrets, modules répartiteurs optiques, armoires d'environnement urbain et boîtiers)		
Catégorie de qualité de fonctionnement	Description	Environnement de service ou de fonctionnement
C	Environnement intérieur contrôlé	Température de fonctionnement: -10 °C à $+60\text{ °C}$ Humidité relative: 5 % à 93 % Emplacements protégés contre les intempéries, partiellement thermorégulés. Généralement à l'intérieur d'un bureau, d'une maison, d'un bâtiment, d'un garage intérieur, d'une cave, d'un local technique ou d'un centre de télécommunication. Non soumis à la condensation.
A	Environnement aérien extérieur	Température de fonctionnement: -40 °C à $+65\text{ °C}$ Humidité relative: 0 % à 100 % Environnement extérieur, très exposé, montage aérien au-dessus du niveau du sol. Pas d'exigences relatives aux inondations.
G	Environnement extérieur au niveau du sol	Température de fonctionnement: -40 °C à $+65\text{ °C}$ Humidité relative: 0 % à 100 % Environnement extérieur, très exposé, montage juste au-dessus du sol ou au niveau de celui-ci avec possibilité d'inondation, ou en dessous du niveau du sol à l'intérieur de coffrets de trottoir ou de boîtes de raccordement immergées d'une manière prolongée dans l'eau. $-1\text{ m} \leq \text{hauteur} \leq +3\text{ m}$ (–: en dessous du niveau du sol, +: au-dessus du niveau du sol)
S	Environnement extérieur souterrain ou enfoui	Température de fonctionnement: -30 °C à $+60\text{ °C}$ Humidité relative: 5 % à 100 % A l'extérieur, soit directement enterré, soit stocké en dessous du niveau du sol en boîtes de raccordement ou en regards immergés d'une manière prolongée dans l'eau. $0\text{ m} \leq \text{profondeur} \leq 5\text{ m}$

Tableau A.2 – Environnements de service ou de fonctionnement et catégories de qualité de fonctionnement avec dissipation de chaleur supplémentaire générée par des composants électroniques actifs

Connecteurs fibroniques, épissures mécaniques, protecteurs d'épissures par fusion, composants optiques passifs et systèmes de gestion de fibres		
Catégorie de qualité de fonctionnement	Description	Environnement de service ou de fonctionnement
C ^{HD}	Environnement intérieur contrôlé avec dissipation de chaleur supplémentaire. Identique à la catégorie C, mais avec une limite de température de fonctionnement supérieure plus élevée pour la chaleur sèche et les variations de température.	Température de fonctionnement: –10 °C à +70 °C Humidité relative: 5 % à 93 % Emplacements protégés contre les intempéries, partiellement thermorégulés. Généralement à l'intérieur d'un bureau, d'une maison, d'un bâtiment, d'un garage intérieur, d'une cave, d'un local technique, d'un centre de télécommunication ou enfermé dans un boîtier de protection de catégorie C. Non soumis à la condensation.
OP ^{HD}	Environnement extérieur protégé avec dissipation de chaleur supplémentaire. Identique à la catégorie OP, mais avec une limite de température de fonctionnement supérieure plus élevée pour la chaleur sèche et les variations de température.	Température de fonctionnement: –25 °C à +85 °C Humidité relative: 0 % à 95 % Emplacements protégés contre les intempéries, sans thermorégulation. Généralement à l'extérieur, mais enfermé ou couvert. Emplacements: cabanes, greniers, cabines téléphoniques, entrées des bâtiments, garage ouvert, locaux techniques sans surveillance, armoires d'environnement urbain ou enfermé dans des boîtiers de protection de catégories A, G et S. Soumis au brouillard salin, à la condensation et à des précipitations limitées dues au vent. A proximité immédiate du sable ou de la poussière.
OP+ ^{HD}	Environnement extérieur protégé avec dissipation de chaleur supplémentaire. Identique à la catégorie OP+, mais avec une limite de température de fonctionnement supérieure plus élevée pour la chaleur sèche et les variations de température.	Température de fonctionnement: –40 °C à +85 °C Humidité relative: 0 % à 95 % Emplacements protégés contre les intempéries, sans thermorégulation. Généralement à l'extérieur, mais enfermé ou couvert. Emplacements: cabanes, greniers, cabines téléphoniques, entrées des bâtiments, garage ouvert, locaux techniques sans surveillance, armoires d'environnement urbain ou enfermé dans des boîtiers de protection de catégories A, G et S. Soumis au brouillard salin, à la condensation et à des précipitations limitées dues au vent. A proximité immédiate du sable ou de la poussière.
I ^{HD}	Environnement industriel avec dissipation de chaleur supplémentaire. Identique à la catégorie I, mais avec une limite de température de fonctionnement supérieure plus élevée pour la chaleur sèche et les variations de température.	Température de fonctionnement: –40 °C à +85 °C Humidité relative: 0 % à 95 % Emplacements: îlots d'automatisation généralement. Soumis à de fortes vibrations, à des sources de gaz corrosifs industrielles, à des éclaboussures de solvants liquides, non soumis à l'immersion.

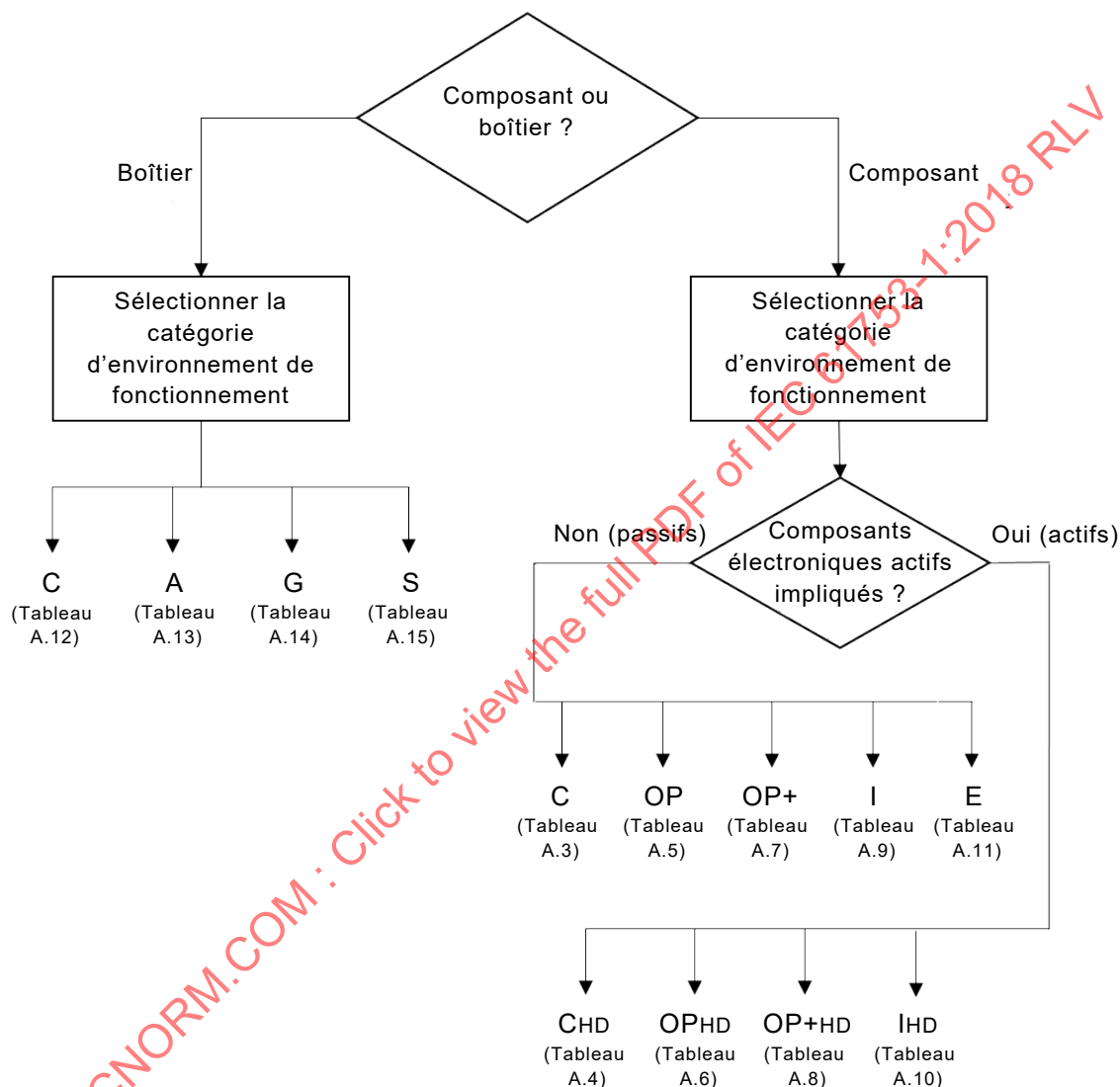
Le comportement au feu ne relève pas du domaine d'application du présent document, il fait l'objet d'autres normes et réglementations.

Il convient de considérer la résistance des matériaux de polymères à l'ozone et au rayonnement UV pour les catégories E, A ou G, ou dans d'autres environnements avec

exposition de longue durée à la lumière UV. Ces exigences liées aux matériaux doivent être données dans la norme pertinente de la série IEC 61753.

A.2 Comment trouver les essais de performance pour la catégorie souhaitée ?

La catégorie pertinente pour l'environnement de service ou de fonctionnement d'un produit peut être trouvée en suivant l'organigramme de la Figure A.1.



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Figure A.1 – Organigramme d'identification de la catégorie pertinente pour l'environnement de service ou de fonctionnement

Une fois la catégorie identifiée, les Tableaux A.3 à A.15 suivants indiquent les essais minimaux exigés, les méthodes d'essai et les critères d'acceptation recommandés pour le produit spécifique. Les critères d'acceptation S, O et/ou V sont indiqués pour les essais qui doivent être effectués sur chaque produit indiqué en haut des colonnes.

S: Critères d'acceptation d'étanchéité

O: Critères d'acceptation optique

V: Critères d'acceptation du contrôle visuel

Les essais avec une cellule vide ne sont pas exigés pour le produit choisi.

Les critères d'acceptation détaillés pour les produits concernés sont énumérés dans les Tableaux A.16 à A.28.

Tableau A.3 – Connecteurs, composants passifs, épissures mécaniques, protecteurs d'épissures par fusion et systèmes de gestion de fibres – Catégorie C – Environnement intérieur contrôlé

Essai	Sévérité	Connecteurs	FMC	Composants passifs	Epissures	FMS
Rétention de la fibre ou du câble IEC 61300-2-4	Charge: 50 N pendant 60 s pour les câbles avec renforts en fils d'aramide 10 N pendant 60 s pour les gaines ou les câbles sans renforts en fils d'aramide 5,0 N pendant 60 s pour les fibres sous revêtement protecteur 2,0 N pendant 60 s pour les fibres sous revêtement primaire	O, V	O, V		O, V	
Rétention de la fibre ou du câble IEC 61300-2-4	Charge: 10 N pendant 60 s pour les câbles 5,0 N pendant 60 s pour les fibres sous revêtement protecteur 2,0 N pendant 60 s pour les fibres sous revêtement primaire			O, V		
Rétention de la fibre ou du câble ^b IEC 61300-2-4	Charge: 10 N pendant 60 s pour les câbles 5,0 N pendant 60 s pour les éléments de câbles et les gaines					O, V ^b
Résistance à la traction du mécanisme de couplage IEC 61300-2-6	Charge: 40 N pendant 60 s	O, V	O, V	O, V ^d		
Charge latérale statique ^{a, c} IEC 61300-2-42	Charge: 1 N pendant 1 h pour les câbles 0,2 N pendant 5 min pour les fibres sous revêtement protecteur Deux directions perpendiculaires l'une par rapport à l'autre	O, V		O, V		
Charge latérale statique ^{b, e} IEC 61300-2-42	Charge: 1,0 N pendant 1 h pour les câbles 0,5 N pendant 5 min pour les éléments de câbles et les gaines Deux directions perpendiculaires l'une par rapport à l'autre					O, V ^b
Flexion du serre-câble des dispositifs à fibres optiques IEC 61300-2-44	Charge: 2 N pour les câbles Cycle: $\pm 90^\circ$ Nombre de cycles: 50	O, V		O, V ^a		
Torsion IEC 61300-2-5	Charge: 10 N pour les câbles 2,0 N pour les fibres sous revêtement primaire et sous revêtement protecteur 25 cycles $\pm 180^\circ$ Distance de fixation fibres/câbles: (25 ± 5) cm	O, V	O, V			