BS EN 61753-1-3:2014

BSI Standards Publication

Fibre optic interconnecting devices and passive components — Performance standard

Part 1-3: General and guidance for single-mode fibre optic connector and cable assembly for industrial environment, Category I

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National foreword

This British Standard is the UK implementation of EN 61753-1-3:2014. It is identical to IEC 61753-1-3:2014. It supersedes DD IEC/PAS 61753-1-3:2009 which is withdrawn.

BSI, as a member of CEN, is obliged to publish EN 61753-1-3:2014 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK committee voted against its approval as a European Standard as they considered that some of the values in the performance tests were not sufficiently different to standard connectors (described in BS EN 61753-1:2007) to warrant the description 'industrial' and the correlation with the $M_3I_3C_3E_3$ requirements unsatisfactory (described in PD ISO/IEC TR 29106:2007+A1:2012).

The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/2, Fibre optic interconnecting devices and passive components.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Fibre optic interconnecting devices and passive components - Performance standard - Part 1-3: General and guidance for single-mode fibre optic connector and cable assembly for industrial environment, Category I (IEC 61753-1-3:2014)

Dispositifs d'interconnexion et composants passifs à fibres optiques - Norme de performance - Partie 1-3 : Généralités et lignes directrices relatives aux connecteurs à fibres optiques unimodales et aux cordons en environnement industriel, Catégorie I (CEI 61753-1-3:2014)

Lichtwellenleiter - Verbindungselemente und passive Bauteile - Betriebsverhalten - Teil 1-3: Allgemeines und Leitfaden für Einmoden-Lichtwellenleiter-Steckverbinder und konfektionierte LWL-Kabel in rauer industrieller Umgebung der Kategorie I (IEC 61753-1-3:2014)

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Foreword

The text of document 86B/3752/FDIS, future edition 1 of IEC 61753-1-3, prepared by SC 86B "Fibre optic interconnecting devices and passive components" of IEC/TC 86 "Fibre optics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61753-1-3:2014.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2015-03-27
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2017-06-27

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61753-1-3:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61300-2-35	NOTE	Harmonised as EN 61300-2-35.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60068-2-60	-	Environmental testing -- Part 2-60: Tests - Test Ke: Flowing mixed gas corrosion test	EN 60068-2-60	-
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529	1991
IEC 60793-2-50	-	Optical fibres -- Part 2-50: Product specifications - Sectional specification for class B single-mode fibres	EN 60793-2-50	-
IEC 61300 (series)	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures	EN 61300 (series)	-
IEC 61300-2-1	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-1: Tests - Vibration (sinusoidal)	EN 61300-2-1	-
IEC 61300-2-2	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-2: Tests - Mating durability	EN 61300-2-2	-
IEC 61300-2-4	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-4: Tests - Fibre/cable retention	EN 61300-2-4	-
IEC 61300-2-5	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-5: Tests - Torsion	EN 61300-2-5	-
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	EN 61300-2-6	-
IEC 61300-2-7	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-7: Tests - Bending moment	EN 61300-2-7	-
IEC 61300-2-9	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-9: Tests - Shock	EN 61300-2-9	-

IEC 61300-2-10	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-10: Tests - Crush resistance	EN 61300-2-10	-
IEC 61300-2-12	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-12: Tests - Impact	EN 61300-2-12	-
IEC 61300-2-22	-	Basic test and measurement procedures - Part 2-22: Tests - Change of temperature	-	-
IEC 61300-2-26	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-26: Tests - Salt mist	EN 61300-2-26	-
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	EN 61300-2-34	-
IEC 61300-2-46	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-46: Tests - Damp heat cyclic	EN 61300-2-46	-
IEC 61300-3-1	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 3-1: Examinations and measurements - Visual examination	EN 61300-3-1	-
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	EN 61300-3-3	-
IEC 61300-3-4	2012	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 3-4: Examinations and measurements - Attenuation	EN 61300-3-4	2013
IEC 61300-3-6	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 3-6: Examinations and measurements - Return loss	EN 61300-3-6	-
IEC 61300-3-11	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 3-11: Examinations and measurements - Engagement and separation forces	EN 61300-3-11	-
IEC 61300-3-28	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 3-28: Examinations and measurements - Transient loss	EN 61300-3-28	-

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	EN 61300-3-34	-
IEC 61300-3-35	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 3-35: Examinations and measurements - Visual inspection of fibre optic connectors and fibre-stub transceivers	EN 61300-3-35	-
IEC 61753-1	2007	Fibre optic interconnecting devices and passive components performance standard -- Part 1: General and guidance for performance standards	EN 61753-1	2007
IEC 61754-(series)		Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces	EN 61754 (series)	-
IEC 61755-(series)		Fibre optic interconnecting devices and passive components -Fibre optic connector optical interfaces	EN 61755 (series)	-
IEC 61755-1	-	Fibre optic interconnecting devices and passive components -Fibre optic connector optical interfaces -- Part 1: Optical interfaces for single mode non-dispersion shifted fibres - General and guidance	EN 61755-1	-
ISO/IEC 24702	-	Information technology - Generic cabling - Industrial premises	-	-
ISO/IEC/TR 29106	-	Information technology - Generic cabling - Introduction to the MICE environmental classification	-	-

CONTENTS

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 1-3: General and guidance for single-mode fibre optic connector and cable assembly for industrial environment, Category I

1 Scope

This part of IEC 61753 defines the minimum initial performance, test and measurement requirements and severities which a connector or cable assembly with single-mode fibres needs to satisfy in order to be categorized as meeting IEC Category I (industrial environment). Category I is an additional environmental category to C, U, O and E already described in IEC 61753-1. Category I is based on the MICE Table described in ISO/IEC 24702.

The performance tests evaluate the product for two basic acceptance criteria: mechanical integrity and optical transmission requirements, by simulating the effects of exposure to the environment in which it will be installed, simulating installation and intervention conditions, and evaluating specified features of the product.

The defined performance test procedures simulate the situation in a mated condition under use in an industrial environment. It is not the intention to simulate the situation:

when being mated or demated;

during the assembling of the connector;

during transportation and storage of the connector.

Reliability tests for life time expectations are not covered by this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-60, *Environmental testing – Part 2: Tests – Test Ke: Flowing mixed gas corrosion test*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

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

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

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

IEC 61300-2-34, *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 61300-2-46, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-46: Tests – Damp heat, cyclic*

IEC 61300-3-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-1: Examinations and measurements – Visual examination*

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 61300-3-4:2012, *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 61300-3-11, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-11: Examinations and measurements – Engagement and separation forces*

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

IEC 61300-3-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Fibre optic connector endface visual and automated inspection*

IEC 61753-1:2007, *Fibre optic interconnecting devices and passive components – Part 1: General and guidance for performance standards*

IEC 61754 (all parts), *Fibre optic connector interfaces*

IEC 61755 (all parts), *Fibre optic connector optical interfaces*

IEC 61755-1, *Fibre optic connector optical interfaces – Part 1: Optical interfaces for single mode non-dispersion shifted fibres – General and guidance*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

ISO/IEC 24702, *Information technology – Generic cabling – Industrial premises*

ISO/IEC TR 29106, *Information technology – Generic cabling – Introduction to the MICE environmental classification*

3 Abbreviations

For the purposes of this document, the following abbreviations are used.

IL Insertion loss

MICE Mechanical, ingress, climatic and chemical and electromagnetic classification of the environment

OTDR Optical time domain reflectometry

RL Return loss

4 Industrial environment

4.1 General

Fibre optic components are frequently used in industrial environments like control stations, power rooms or inside switch cabinets. The environmental conditions such as temperature, dust, moisture, vibration, chemicals, impact etc. found in industrial deployment, may require robust and sealed components to protect the optical interfaces from the effects of the environment.

4.2 Cross reference with MICE

ISO/IEC TR 29106 classifies the environment local to a cabling system in terms of MICE characteristics. The tests and severities in Clause 9 of this standard are intended to reflect the M_3 and I_3 environment. The climatic conditions and chemical substances used are selected from the C_3 environment. The defined tests and severities are according to IEC 60068-2-60.

NOTE Only a small subset of the chemical substances from the C_3 environment are used, and these are at different concentrations.

5 Tests

5.1 General

All test methods are in accordance with the IEC 61300 series as defined in Table A.1.

Each test defines the number of samples to be evaluated as described in Annex A. The samples used for each test should be composed of randomly selected and previously unstressed new samples but may also be selected from previously used samples if desired.

The connectors under test shall be terminated onto single-mode fibre per IEC 60793-2-50, type B1.1, B1.3 or B6, depending upon the design of connector. The connector interface standard shall meet the dimensions of the IEC 61754 series and the connector optical interface standard shall meet the relevant requirements of the IEC 61755 series.

Unless otherwise specified, tests should be carried out under standard atmospheric conditions according to IEC 61300-1. The optical criteria for each test shall be as defined in Clause 9 (see also notes to Table 1).

5.2 Sample definition

For the purposes of this standard, a sample is a complete set of passive connector components consisting of a free plug and a socket, as shown in Figure 1, or a plug coupler plug, as shown in Figure 2. The socket may be mounted in an enclosure. This allows demountable coupling between pairs of optical fibres.

Products under test shall be mounted and cleaned according to the manufacturer's instructions.

Each of the non terminated leads from the socket should be at least 3 m long so that the splices may be located outside of the environmental test chamber.

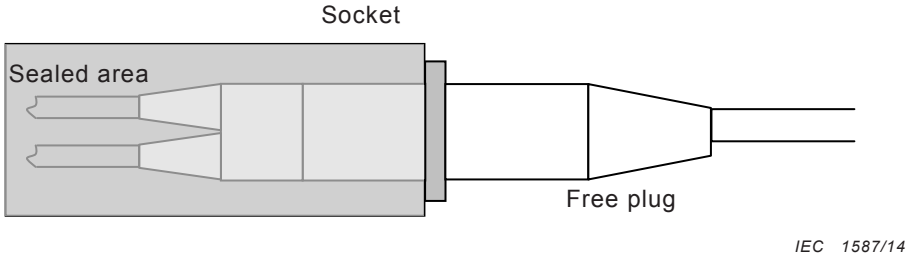

Figure 1 – Example of a free plug and a socket

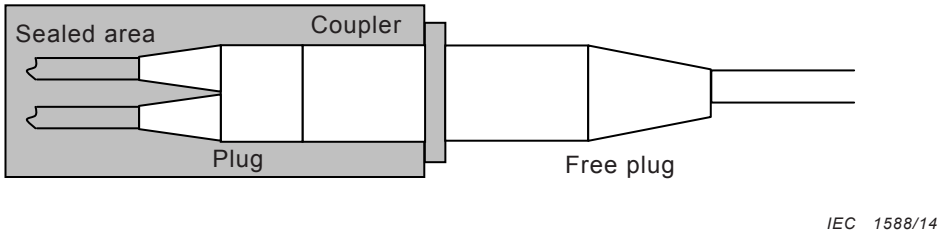

Figure 2 – Example of a plug coupler plug

5.3 Sample size

Default sample sizes for the tests are defined in Annex A.

As a minimum requirement and if not otherwise mentioned, the tests can be run individually as defined in Annex A.

Samples for the attenuation test shall be randomly selected and randomly mated as new products. Samples for the return loss test are the same plugs as those selected and mated for the attenuation test. Samples for subsequent tests may be randomly selected and randomly mated as new products or they may be the same plugs. However, samples are reused at the manufacturer's own risk. In the event that this re-use causes a failure, the test may be re-run with new samples.

6 Test report

Fully documented test reports and supporting evidence shall be prepared and available for inspection to show that the tests have been carried out and the results are satisfactory; the requested performance (see Table 1 for the grades) should be defined before starting the tests.

7 Reference component

No reference components are required to perform the tests in this standard.

8 Performance requirements

8.1 General

The minimum protection level shall be IP x5 and /or IP x7 for immersion and IP 6x for dust, so the resulting level will be IP 65 and /or IP 67. The protection level of the connector according to IEC 60529 shall be determined before performing the tests.

8.2 Dimensions

Dimensions shall comply with the appropriate IEC interface standard as defined in the IEC 61754 series.

8.3 Test preparation and accomplishment

Before the tests are made, the sample shall be preconditioned under standard atmospheric conditions for testing as specified in IEC 61300-1 for a period of 2 h.

When mounting is required in a test, the adaptors shall be rigidly mounted on a specified accessory using the specified connection methods, fixing devices and panel cut-outs.

The combination of connectors shall be maintained during the complete test sequence, normally without un-mating the sample. When un-mating is required in a test, the end faces of the sample shall be cleaned according to the manufacturer's instructions.

8.4 Performance criteria

Before starting the test the following criteria shall be defined:

a) all performed tests according to the chosen performance category and performance requirements shall be passed with all tested samples;

b) the connector end face shall comply with the end face geometry requirements of the applicable optical interface standard as defined in the IEC 61755-3 series;

c) the optical performance levels shall meet the requirements of the designated grade as defined in Table 1;

d) the mechanical performance shall meet the requirements of the defined protection level according to IEC 60529;

e) a visual examination of the unmated connectors which would impair its operation shall show no mechanical damage.

9 Performance tests

The following tests shall be performed:

a) Optical performance requirements as described in Table 1 (see also IEC 61755-1)

Table 1 – Single mode attenuation and return loss grades at 1 310 nm and 1 550 nm

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	≤ 0,12 dB mean ≤ 0,25 dB max. for > 97 % of samples	Δ Attenuation ≤ 0,2 dB during and after test for pigtails. Δ Attenuation ≤ 0,5 dB during and ≤ 0,4 dB after test for patchcords
Grade C	≤ 0,25 dB mean ≤ 0,50 dB max. for > 97 % of samples	Δ Attenuation ≤ 0,2 dB during and after test for pigtails. Δ Attenuation ≤ 0,5 dB during and ≤ 0,4 dB after test for patchcords
Grade D	≤ 0,50 dB mean ≤ 1,0 dB max. for > 97 % of samples	Δ Attenuation ≤ 0,2 dB during and after test for pigtails. Δ Attenuation ≤ 0,5 dB during and ≤ 0,4 dB after test for patchcords
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
NOTE 1 Table 1 is taken from Table A.12 of IEC 61753-1:2007. NOTE 2 For Grade 1 performance level (APC-version), the RL values depend upon the connecting situation: Minimum ≥ 60 dB (mated) and ≥ 55 dB (unmated), during and after test.		

b) Required tests and severities, reflecting an industrial environment, as described in Table 2.

Table 2 – Test description *(1 of 8)*

Test No.	Test	Requirements	Details
1	Visual inspection	The connector plugs and adaptors or sockts shall be inspected for damage that might impair the performance. Distortion of any mechanical part or damage to the end faces or service-affecting damage constitutes a failure	IEC 61300-3-1, IEC 61300-3-11 and IEC 61300-3-35

Table 2 *(2 of 8)*

Test No.	Test	Requirements	Details
2	Attenuation Random mate, IEC 61300-3-34 See also Annex A	See Table 1 for the requirements for the different performance levels	IEC 61300-3-34, method 1. Test wavelengths: 1 310 nm ± 20 nm and 1 550 nm ± 20 nm (source condition S5 and S6, source condition is in accordance with Table 1 in IEC 61300-3-4:2012). Launch mode conditions: only the fundamental mode shall propagate at the connector interface and at the detector. Sample shall be optically functioning. Preconditioning procedure: clean plug and adapter according to manufacturer's instructions
3	Return loss (IEC 61300-3-6, method 1 or 2) Random mate See also Annex A	See Table 1 for the requirements for the different performance levels	Test wavelengths: 1 310 nm ± 20 nm and 1 550 nm ± 20 nm. Launch fibre length: $L > 2$ m. Source stability: ± 0,20 dB over the measuring period or at least 1 h. Detector linearity: within 5 % of the power levels to be measured. Directivity: > 65 dB. Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. Alternative method: IEC 61300-3-6, Method OTDR Launch fibre length: $L1 \geq 500$ m, $L2 \geq 6$ m, $L3 \geq 6$ m Pulse duration: ≤ 10 ns. Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions
4	Impact	See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-12, method A Test wavelengths: 1 550 nm ± 20 nm. Drop height: 1,5 m Number of drops: 5 per each location. 5 times each rotated 90°. Sampling rate: Initially and after the last drop. Sample shall be unmated during drop cycles. Dust cap fitted. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. Place a dust cap over the ferrule to protect the fibre end face. Recovery procedure: the connector may be cleaned after each drop before measurement

Table 2 *(3 of 8)*

Test No.	Test	Requirements	Details
5	Fibre cable retention	During test Δ Attenuation: ≤ 0,2 dB. See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-4 Test wavelengths: 1 550 nm ± 20 nm Magnitude and rate of application of the load for reinforced cables: 100 N ± 2 N at 5 N/s. The connector shall be rigidly mounted such that the load is applied to the cable retention mechanism and not to the coupling mechanism. Duration for reinforced cables: 120 s. Magnitude and rate of application of the load for secondary coated fibres: 5,0 N ± 0,5 N at 5 N/s. Duration for buffered fibres: 60 s. Magnitude and rate of application of the load for primary coated fibres: 2,0 N ± 0,5 N at 5 N/s. Point of application of tensile load: 0,3 m from the end face of the connector. Sampling rate: Initially and after the load has reached its maximum level and been maintained for a minimum of 30 s. Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions
6	Cable nutation	During test: Δ Attenuation: ≤ 0,5 dB See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-35 [2] Test wavelengths: 1 550 nm ± 20 nm. Number of cycles:100 for each plug. Force: 10 N. Rotation angle: 360°. Sampling rate: continuously according to IEC 61300-3-28 Point of application of the load: 0,2 m from rear of plug body. Sample shall be mated during nutation cycles. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. Recovery procedure: the connector may be cleaned after each cycle before measurement

Table 2 *(4 of 8)*

Test No.	Test	Requirements	Details
7	Mating durability	During test: Δ Attenuation: ≤ 0,2 dB See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-2 Test wavelengths: 1 550 nm ± 20 nm. Coupling mechanism to be cycled: plug-adaptor. Cycling rate: not less than 3 s between each engagement and separation. Number of cycles: 500 minimum (only one industrial plug is subjected to successive engagement and separation). Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. Recovery procedure: the mechanical and optical alignment parts of the sample may be cleaned according to manufacturer's instructions up to 2 times after the final mating cycle. In the event that the attenuation exceeds the allowable limit, the connector may be cleaned as necessary as, but not more than 25 times during the course of the test. (The measurements at which the cleaning takes place shall be discounted from the test results)
8	Durability by water immersion	No water inside the connector. See Table 1 for the requirements for the different performance levels	IEC 60529 IP x7, with 30 min at 1 m, below the surface of water (IP67) and IPx5 intermittent jet, 12,5 l/min, 6,3 mm, > 2,5 mm distance, duration 30 min. 25 °C ± 2 °C Preconditioning procedure: Clean plug and adaptor according to manufacturer's instructions. Recovery procedure: 2 h at normal ambient conditions
9	Strength of coupling mechanism	With IL/RL monitoring: Δ Attenuation: ≤ 0,2 dB. See Table 1 for the requirements for the different performance levels	IEC 61300-2-6 Test wavelengths: 1 550 nm ± 20 nm Magnitude and rate of application of the load: 60 N ± 1 N at 2 N/s (See NOTE 1) Duration: 60 s. Point of application of the load: 0,3 m from rear of plug. Sample shall be optically functioning. Sampling rate: Initially and after the load has reached its maximum level and been maintained for at least 30 s. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. Place a dust cap over the ferrule to protect the fibre end face. Recovery procedure: 5 min recovery period

Table 2 *(5 of 8)*

Test No.	Test	Requirements	Details
10	Vibration (sinusoidal)	During Δ Attenuation: ≤ 0,2 dB See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-1 Test wavelength: 1 550 nm ± 20 nm. Displacement 15 mm, 2-9 Hz. Acceleration 5 g, 9 Hz to 200 Hz. Change in frequency: 1 oct/min Number of axes: 3 orthogonal Number of sweeps per axis: 15 Additionally transient monitoring according to IEC 61300-3-28. Method of mounting: an adaptor shall be mounted rigidly to the mounting fixture. Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. The connector samples may not be uncoupled or cleaned anytime during the test
11	Shock	During Δ Attenuation: ≤ 0,2 dB See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-9 Test wavelength: 1 550 nm ± 20 nm. 250 m/s^2, 6ms duration, 5 shocks in each of the 6 directions. Additionally. transient monitoring according to IEC 61300-3-28. Sampling rate: before, during and after shock. Measurements shall be made after the load has been maintained at its maximum level for at least 3 s. Method of mounting: an adaptor shall be mounted rigidly to the mounting fixture. Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. The connector samples may not be uncoupled or cleaned anytime during the test

Table 2 *(6 of 8)*

Test No.	Test	Requirements	Details
12	Torsion	During Δ Attenuation: ≤ 0,2 dB See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-5 Test wavelength: 1 550 nm ± 20 nm. Cycles: 25 (± 180°) Force: 10 N at 300 mm from rear of plug body, at 1 N/s Sampling rate: before, during and after torsion. Method of mounting: an adaptor shall be mounted rigidly to the mounting fixture. Sample shall be optically functioning. Preconditioning procedure: Clean plug and adaptor according to manufacturer's instructions. The connector samples may not be uncoupled or cleaned anytime during the test
13	Bending moment	During Δ Attenuation: ≤ 0,2 dB See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-7 Test wavelengths: 1 550 nm ± 20 nm. Force 10 N. Point of application of bending load: the end of the connector plug with the moment being about the centre of the adaptor. The load shall be applied in 2 perpendicular axes with reference to the connector latching orientation, 55 mm from the outer front surface of the adaptor. 30 s per axis. Sampling rate: initially and after the load has reached its maximum level and been maintained for a minimum of 30 s. Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. Place a dust cap over the ferrule to protect the fibre end face
14	Dust	No dust inside. See Table 1 for the requirements for the different performance levels	IEC 60529:1989 IP 6x, Test 6 (Table VII). Sample not optically functioning. Testing only in a mated condition. Particle size: 150 um, talc powder, 10 min. duration. Concentration: 10,6 g/m^3
15	Industrial atmosphere	After test: As described in test 1, Visual inspection See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 60068-2-60, method 1 Concentration of H2S: 10×10^{-6} Concentration of SO2: 5×10^{-6} Time of exposure: 96 h. Maximum allowed duration of stabilization and adjustment is 24 h before the test

Table 2 *(7 of 8)*

Test No.	Test	Requirements	Details
16	Change of temperature	During Δ Attenuation: ≤ 0,2 dB See Table 1 for the requirements for the different performance levels	IEC 61300-2-22 (see NOTE 2) Test wavelength: 1 550 nm ± 20 nm. High temperature: +70 °C ± 2 °C. Low temperature: –40 °C ± 2 °C. Duration at each dwell temperature: 4 h. Rate of change: 3 °C/min. Number of cycles: 20. Length of the cable on each side of the connector inside the chamber: 1,5 m minimum. Sample shall be optically functioning. Sampling rate: initially at room ambient, after 30 min during each dwell (measurements to be completed during dwell) and at the end of the test at room ambient. Preconditioning procedure: before test, samples shall be maintained in room temperature condition for 2 h. Recovery procedure: after the test, samples shall be maintained in room temperature condition for 2 h. The connector samples may not be uncoupled or cleaned anytime during the test
17	Damp heat cyclic	During Δ Attenuation: ≤ 0,2dB See Table 1 for the requirements for the different performance levels. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-46 Minimum temperature: 25 °C. Maximum temperature: 55 °C. Humidity: 90 %, no condensing. 6 cycles, 24 h per cycle. Sampling rate: initially at room ambient, after 30 min during each dwell (measurements to be completed during dwell) and at the end of the test at room ambient. Preconditioning procedure: before test, samples shall be maintained in room temperature condition for 2 h. Recovery procedure: after test, samples shall be maintained in room temperature condition for 2 h. The connector samples may not be uncoupled or cleaned anytime during the test

Table 2 *(8 of 8)*

Test No.	Test	Requirements	Details
18	Salt mist	See Table 1 for the requirements for the different performance levels. Δ Attenuation: ≤ 0,2dB Before and after test. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-26 Salt solution 5 % NaCl. pH 6,5 – 7,2. Temperature + 35 °C. 96 h. Sample not optically functioning . Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. The connector samples may not be uncoupled or cleaned anytime during the test
19	Resistance to solvents and contaminating fluids	See Table 1 for the requirements for the different performance levels. Δ Attenuation: ≤ 0,2dB. Before and after. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-34 NaCl 0,3 $\times 10^{-6}$ at 30 °C Mineral oil 0,5 $\times 10^{-6}$ at 70 °C Soap 50 000 $\times 10^{-6}$ at 30 °C 24 h Sample not optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions. The connector samples may not be uncoupled or cleaned anytime during the test
20	Crush resistance	See Table 1 for the requirements for the different performance levels. Δ Attenuation: ≤ 0,2dB. Before and after. The sample shall not have any mechanical damage and shall be inspected as per test 1	IEC 61300-2-10 2 200 N ± 50 N Pad 50 mm by 50 mm Centre of housing at 0° and 90° along the longitudinal axis. 60 s per location. Sample optically functioning. Sampling rate: before, during (continuous) and after the test. Measurements shall be made after the load has been maintained at its maximum level for at least 3 s. Pre-conditioning procedure: clean plug and adaptor according to manufacturer's instructions
NOTE 1 IEC 61300-2-6 to be updated for the required conditions in this standard. NOTE 2 IEC 61300-2-22 to be updated for the required conditions in this standard.			

Annex A
(normative)

Sample size

Table A.1 provides values for the sample sizes and their sourcing.

Table A.1 – Sample size and product sourcing requirements

No.	Test	Sample size plug	Source
1	Visual Inspection	10	New
2	Attenuation (random mate)	10	Test 1
3	Return loss (random mate)	10	Test 2
4	Impact	5	Test 2
5	Fibre/cable retention	5	Test 2
6	Cable nutation	5	Test 2
7	Mating durability	5	Test 2
8	Durability by water immersion	5	Test 2
9	Strength of coupling mechanism	5	Test 2
10	Vibration (sinusoidal)	5	Test 2
11	Shock	5	Test 2
12	Torsion	5	Test 2
13	Bending moment	5	Test 2
14	Dust	5	Test 2
15	Industrial atmosphere	5	Test 2
16	Change of temperature: Connector Patchcord	 8 4	Test 2
17	Damp heat, cyclic	5	Test 2
18	Salt mist	5	Test 2
19	Resistance to solvents and contaminating fluids	5	Test 2
20	Crush	5	Test 2

The tests are intended to be performed individually in any order on product sourced as defined. Products from previous tests may be used.

Bibliography

[1] IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at www.electropedia.org

[2] IEC 61300-2-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-35: Tests – Cable nutation*[1]

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