IEC 61753-1-3

Edition 1.0 2014-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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

IEC 61753-1-3:2014-05(en-fr)

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ICS 33.180.20

ISBN 978-2-8322-3144-9

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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

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International Standard IEC 61753-1-3 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This first edition cancels and replaces IEC/PAS 61753-1-3 published in 2009. This edition constitutes a technical revision.

This bilingual version (2016-02) corresponds to the monolingual English version, published in 2014-05.

The text of this standard is based on the following documents:

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FDIS	Report on voting
86B/3752/FDIS	86B/3780/RVD

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

The French version of this standard has not been voted upon.

This publication 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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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

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*

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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*

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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.

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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.

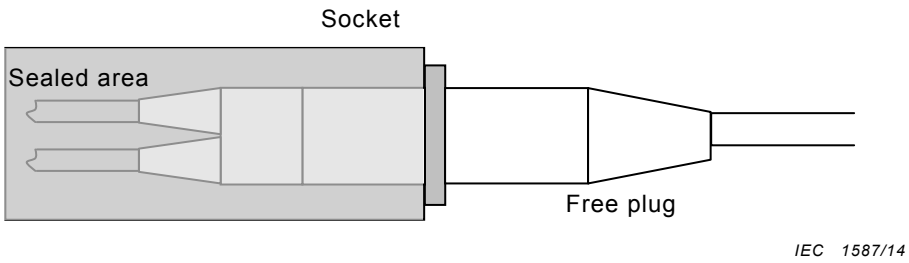

Figure 1 – Example of a free plug and a socket

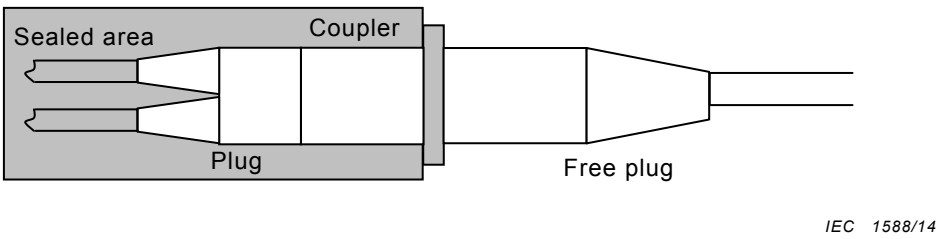

Figure 2 – Example of a plug coupler plug

5.3 Sample size

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

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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;

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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

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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

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