IEC 61753-021-06

Edition 1.0 2023-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – Performance standard –
Part 021-06: Single-mode fibre optic connectors terminated as pigtails and patchcords for category OP+ – Extended outdoor protected environment

Dispositifs d'interconnexion et composants passifs fibroniques – Norme de performance –
Partie 021-06: Connecteurs à fibres optiques unimodales raccordés comme des fibres amorces ou des cordons de brassage pour la catégorie OP+ – Environnement extérieur protégé étendu

IEC 61753-021-06:2023-10(en-fr)

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 021-06: Single-mode fibre optic connectors terminated as pigtails and patchcords for category OP+ – Extended outdoor protected environment

FOREWORD

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IEC 61753-021-06 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics. It is an International Standard.

This first edition cancels and replaces the first edition of IEC 61753-021-6 published in 2007. This edition constitutes a technical revision.

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This edition includes the following significant technical changes with respect to IEC 61753-021-6:2007:

a) updated environmental category (from O to OP+), tests and their severities according to IEC 61753-1:2018;

b) removed the copyright notice as it is no longer needed;

c) changed title and scope to remove restrictions on attenuation and return loss grades;

d) changed the term and definitions of the different types of test samples (pigtail test samples and patchcord test samples) used in the various tests to avoid confusion;

e) removed the term and definition for small form factor (SFF) connectors as it is no longer used in the document;

f) updated fibre naming conventions according to IEC 60793-2-50: and added provisions for B-657 fibres;

g) added all the attenuation and return loss grades defined in IEC 61753-1;

h) removed the static side load test;

i) removed the need to perform all tests sequentially to align with other performance standards;

j) added provisions for rectangular ferrule connectors;

k) added Annex B for visual examination of the outer cable sheath movement of reinforced cables as an additional requirement for change of temperature, cable retention and flexing of the strain relief tests.

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

Draft	Report on voting
86B/4792/FDIS	86B/4813/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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INTRODUCTION

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.

The subsequent parts of this document define those sets of tests which form each operating service environment or performance category, and which have been standardized for international use. A product that has been shown to meet all the requirements of a performance standard may 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 subjected to 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 be maintained using a recognized quality assurance programme whilst the reliability of the product should be evaluated using the procedures recommended in the IEC 62005 series.

Tests and measurements should be selected from the IEC 61300 series. Where this is not possible, the required test method should be attached as an annex to the performance standard.

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 021-06: Single-mode fibre optic connectors terminated as pigtails and patchcords for category OP+ – Extended outdoor protected environment

1 Scope

This part of IEC 61753 defines the minimum initial test and measurement requirements and severities which single-mode fibre optic connectors terminated as a pigtail or a patchcord satisfy in order to be categorised as meeting the IEC standard category OP+ (extended outdoor protected environment), as defined in IEC 61753-1.

If tests were performed on the connectors terminated as pigtails or patchcords for category OP+^{HD} and the product passed, the product will be automatically qualified or categorized as meeting the IEC standard for category OP+. If tests are performed on the connectors terminated as pigtails or patchcords for category OP+, and the product passes, the product will be automatically qualified or categorized as meeting the IEC standard for categories OP and C.

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

IEC 60794-2-50, *Optical fibre cables – Part 2-50: Indoor cables – Family specification for simplex and duplex cables for use in terminated cable assemblies*

IEC 61300-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 1: General and guidance*

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 or 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*

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

IEC 61300-2-12, *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*

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 61300-2-26, *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 61300-2-44, *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 61300-2-50, *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 61300-3-1, *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, *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 61300-3-28, *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 61300-3-45, *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*

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IEC 61753-1, *Fibre optic interconnecting devices and passive components – Performance standard – Part 1: General and guidance*

IEC 61754 (all parts), *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces*

IEC 61755 (all parts), *Fibre optic interconnecting devices and passive components – Connector optical interfaces for single-mode fibres*

IEC 61755-2 (all parts), *Fibre optic interconnecting devices and passive components – Connector optical interfaces for single-mode fibres – Part 2: Connection parameters of dispersion unshifted physically contacting fibres*

IEC 61755-3 (all parts), *Fibre optic interconnecting devices and passive components – Connector optical interfaces for single-mode fibres – Part 3: Connector parameters of dispersion unshifted physically contacting fibres*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61753-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
change in attenuation
δ
large or small deviation from the original value of the transmitted power at the start of the test

3.2
sample
complete set of connector components required to provide demountable coupling between one or more pairs of optical fibres

3.3
pigtail test sample
two pigtails mated with an adaptor

Note 1 to entry: See Figure 1.

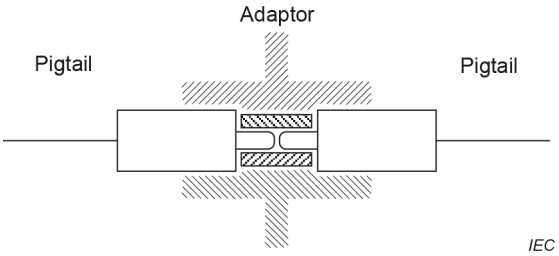

Figure 1 – Pigtail test sample

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3.4
patchcord test sample
patchcord mated to two pigtails using adaptors

Note 1 to entry: See Figure 2.

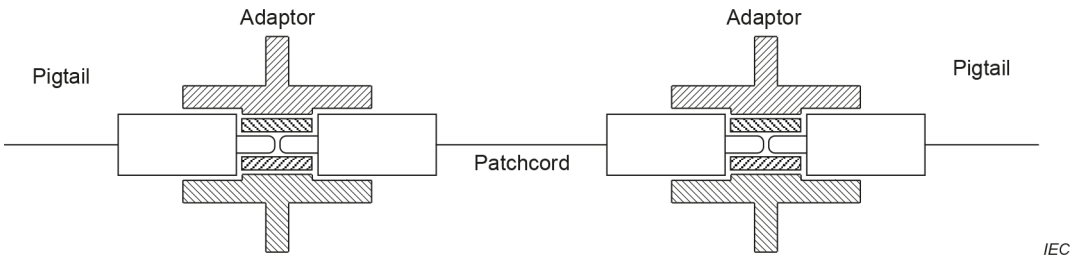

Figure 2 – Patchcord test sample

4 Test

All test and measurement methods have been selected from the IEC 61300 series and the test parameters and requirements from IEC 61753-1 as defined in 7.6 and 7.7. Additional requirements to certain tests are given in Annex B.

The connector plugs under test shall be terminated onto single-mode fibre in accordance with IEC 60793-2-50, type B-652 or B-657, in either buffered or reinforced cable format. The reinforced cable used for the pigtails or patchcords shall conform to the requirements of IEC 60794-2-50. The minimum bend radius of the cable shall be maintained. The connector interface standard shall meet the dimensions of the relevant part of the IEC 61754 series and the connector optical interface standard shall meet the relevant requirements of the IEC 61755 series.

5 Test report

Fully documented test reports and supporting evidence shall be prepared and available for inspection as evidence that the tests have been carried out and the results are satisfactory.

6 Reference components

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

7 Performance requirements

7.1 General

Unless otherwise specified, all tests shall be carried out at standard atmospheric conditions as specified in IEC 61300-1.

7.2 Dimensions

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

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7.3 Sample size and test sequencing

For the purposes of this document, a sample is composed of pigtail test samples or patchcord test samples (see Clause 3). The sample sizes to be used for the tests shall be as defined in Annex A. The tests are not intended to be performed in any particular sequence or grouping, but rather, individually on new samples. Samples for the first test (attenuation) are to be randomly selected and randomly mated new products. Samples for the second test (return loss) are the same plugs selected and mated for the first test. Samples from the previous tests may be used if desired. If a failure occurs on a sample that was tested in a previous test, a new set of samples shall be prepared, and the failed test shall be re-done.

7.4 Endface geometry

The connector endface shall comply with the endface geometry requirements of the applicable IEC optical interface standard as defined in the IEC 61755-3 series. Compliance to the appropriate optical interface standard shall be confirmed on all samples before the start of testing and after each of the tests have been completed. Non-compliance with the endface geometry requirements of the applicable optical interface standard on any connector tested results in a failure of this document.

7.5 Visual examination

A visual examination shall be carried out on all samples before and after each of the mechanical and climatic tests (see Table 2). The outer cable sheath of the samples with reinforced cable shall be marked at the end of the connector boot during the initial visual examination (see Annex B).

The connector endface shall comply with the visual requirements for defects and scratches according to the relevant part of the IEC 61755-2 series.

7.6 Performance criteria

The optical performance levels shall meet the requirements of one specific grade as defined in IEC 61753-1 (see Table 1).

Table 1 – Pass/Fail criteria

Criterion No.	Examinations and measurements	Initial	During or after test, or both
1	Attenuation – random mate IEC 61300-3-34 for cylindrical ferrules IEC 61300-3-45 for rectangular ferrules	Grade B: ≤ 0,12 dB mean ≤ 0,25 dB max. for ≥ 97 % of samples Grade C: ≤ 0,25 dB mean ≤ 0,50 dB max. for ≥ 97 % of samples Grade D: ≤ 0,50 dB mean ≤ 1,00 dB max. for ≥ 97 % of samples At 1 310 nm, 1 550 nm and 1 625 nm[a]	
2	Return loss IEC 61300-3-6	Grade 1: ≥ 60 dB Grade 2: ≥ 45 dB Grade 3: ≥ 35 dB Grade 4: ≥ 26 dB	The initial requirement shall be met.

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Criterion No.	Examinations and measurements	Initial	During or after test, or both
3	Active monitoring of changes in attenuation and return loss (multiple path) IEC 61300-3-3		Change in attenuation during test[a]: $\delta \leq$ 0,2 dB at 1 310 nm and 1 550 nm and $\delta \leq$ 0,3 at 1 625 nm for pigtail test samples (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 patchcord test samples (2 connections) Change in attenuation after test[a]: $\delta \leq$ 0,2 dB at 1 310 nm, 1 550 nm and 1 625 nm for pigtail test samples (1 connection) $\delta \leq$ 0,4 dB at 1 310 nm, 1 550 nm and 1 625 nm for patchcord test samples (2 connections) The initial return loss requirement shall be met.
4	Transient Loss IEC 61300-3-28		Change in attenuation during test[a]: $\delta \leq$ 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[a]: $\delta \leq$ 0,2 dB at 1 550 nm and 1 625 nm per connection
5	Visual inspection IEC 61300-3-1	The connector plugs and adaptors shall be inspected for damage that might impair the performance. This inspection shall include: – distortion of housing parts, as indicated by difficulty in insertion, improper snap-fits, etc.; – distortion of ferrules and sleeves, as indicated by change in mating force, changes in endface geometry, etc.; – housing cracks; – presence of debris, shavings, etc.; – corrosion or residue; – ferrule endface cracks, chips, or scratches; – other potentially service-affecting damage.	After the test, the sample shall be inspected and comply with the initial requirements.
[a] Testing at 1 625 nm is optional for enterprise applications but required for carrier applications.			

7.7 Performance details

Performance details are specified in Table 2.

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Table 2 – Performance test details

No.	Test	Requirements	Details
1	Attenuation (random mate)	Criterion no. 1 (Table 1)	IEC 61300-3-34, method 1 (cylindrical ferrules) IEC 61300-3-45, method 1 (rectangular ferrules) Launch mode conditions: only the fundamental mode shall propagate at the connector interface and at the detector. Source characteristics: reference to IEC 61300-3-4 (attenuation) Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions.
2	Return loss (random mate)	Criterion no. 2 (Table 1)	IEC 61300-3-6, method 1 Mating combinations according to: IEC 61300-3-34, method 1 (cylindrical ferrules) IEC 61300-3-45, method 1 (rectangular ferrules) Launch fibre length: L > 2 m Source stability: ±0,20 dB from the initial value over the measuring period or at least 1 h Detector linearity: ±2,5 % 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 2 Launch fibre length: L_1 ≥ 500 m, L_2 ≥ 6 m, L_3 ≥ 6 m Pulse duration: ≤ 10 ns Sample shall be optically functioning. Preconditioning procedure: clean plug and adaptor according to manufacturer's instructions.
3	Dry heat	During and after: Criterion no. 3 (Table 1) After: Criterion no. 5 (Table 1)	IEC 61300-2-18 Temperature: +75 °C ± 2 °C for 96 h Test sample configuration in the environmental chamber: see IEC 61300-1 Sampling rate: before and after test and at a maximum interval of 1 h during the test. Preconditioning procedure: before test, samples shall be maintained at standard atmospheric conditions for 2 h. Clean plug and adaptor according to manufacturer's instructions. Recovery procedure: after test, samples shall be maintained at standard atmospheric conditions for 2 h. The connector samples shall not be uncoupled or cleaned at any time before, during, or after the test.

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No.	Test	Requirements	Details
4	Change of temperature	During and after: Criterion no. 3 (Table 1) After: Criterion no. 5 (Table 1) Sheath visual examination for test samples with reinforced cable: see Annex B	IEC 61300-2-22 High temperature dwell: +75 °C ± 2 °C Low temperature dwell: -40 °C ± 2 °C Duration at each dwell temperature: 1 h Ramp time: 1 °C/min Number of cycles: 12 Test sample configuration in the environmental chamber: see IEC 61300-1 Sample shall be optically functioning. Sampling rate: initially at room ambient, after 0,5 h during each dwell (measurements to be completed during dwell) and at the end of the test at standard atmospheric conditions. Preconditioning procedure: before test, samples shall be maintained at standard atmospheric conditions for 2 h. Recovery procedure: after test, samples shall be maintained at standard atmospheric conditions for 2 h. The connector samples shall not be uncoupled or cleaned anytime before, during or after the test.
5	Cold	During and after: Criterion no. 3 (Table 1) After: Criterion no. 5 (Table 1)	IEC 61300-2-17 Temperature: -40 °C ± 2 °C Duration of exposure: 96 h Test sample configuration in the environmental chamber: see IEC 61300-1 Sample shall be optically functioning. Sampling rate: before and after test and at a maximum interval of 1 h during the test. Preconditioning procedure: before test, samples shall be maintained at standard atmospheric conditions for 2 h. Recovery procedure: after test, samples shall be maintained at standard atmospheric conditions for 2 h. The connector samples shall not be uncoupled or cleaned any time before, during, or after the test.

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