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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components performance standard –
Part 101-03: Fibre management systems for category OP – Outdoor protected environment

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Norme de performance pour les dispositifs d'interconnexion et composants passifs fibroniques –
Partie 101-03: Systèmes de gestion de fibres pour la catégorie OP – Environnement extérieur protégé

IEC 61753-101-03:2021-09(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS PERFORMANCE STANDARD –

Part 101-03: Fibre management systems for category OP – Outdoor protected environment

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IEC 61753-101-03 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 IEC 61753-101-3 the first edition published in 2006. This edition constitutes a technical revision.

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

a) the terms and definitions have been updated according to IEC 61753-1:2018 and IEC 61756-1:2019;

b) the test severities have been updated according to IEC 61753-1:2018;

c) detailed material tests for mould growth (IEC 60068-2-10) and UV light exposure (ISO 4892-3) have been added;

d) the detailed transport performance requirements have been removed;

e) IEC 60793-2-50 subcategory B-657 fibres for test samples in Annex A has been added.

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

Draft	Report on voting
86B/4497/FDIS	86B/4522/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/standardsdev/publications.

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.

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS PERFORMANCE STANDARD –

Part 101-03: Fibre management systems for category OP – Outdoor protected environment

1 Scope

This part of IEC 61753 contains the minimum tests, test severities and measurement requirements which a fibre management system need to meet in order to be categorised as meeting the IEC standard, category OP – Outdoor Protected environment, as defined in IEC 61753-1.

This performance standard for fibre management systems defines the requirements for standard optical performance under a set of specified conditions. It 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 a basis to prove the product's ability to satisfy the requirements of a specific application, market sector or user group.

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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.

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IEC 60068-2-10, *Environmental testing – Part 2-10: Tests – Test J and guidance: Mould growth*

IEC 60721-3-1, *Classification of environmental conditions – Part 3-1: Classification of groups of environmental parameters and their severities – Storage*

IEC 60721-3-2, *Classification of environmental conditions – Part 3-2: Classification of groups of environmental parameters and their severities – Transportation and handling*

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

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

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

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

IEC 61300-2-33, *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 61300-2-42, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-42: Tests – Static side load for strain relief*

IEC 61300-2-46, *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 61300-3-28, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-28: Examinations and measurements – Transient loss*

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

IEC 61756-1, *Fibre optic interconnecting devices and passive components – Interface standard for fibre management systems – Part 1: General and guidance*

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ISO 4892-3, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

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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

3.1
excursion loss
change in optical attenuation during the slow variations of environmental parameters

Note 1 to entry: Excursion loss is the ± deviation from the original value of the transmitted power at the start of the test.

3.2
fibre management system
system to control, protect and store splices, connectors, passive optical components and fibres from incoming to outgoing cables

Note 1 to entry: A fibre management system is intended for installation within a protective housing.

Note 2 to entry: A fibre management system is often called an "organiser".

[SOURCE: IEC 61756-1:2019, 3.1.2]

3.3
intervention
gain access to modify, add, remove or repair fibre circuits, splices, connectors or other components between the incoming and outgoing cables of an existing fibre management system

3.4
installation
activities and handling operations to establish and install a protective housing including the cables or by adding new circuits, splices, connectors and other components

3.5
installation conditions
circumstances that are fulfilled for an installation, including environmental conditions, size interface between the protective housing and the fibre management system, optical performance, additional/special conditions and safety requirements

3.6
multiple element
physical fibre separation level consisting of more than one single element

Note 1 to entry: This separation level has fibres from multiple cable elements on one splice tray and is also called mass storage. It is the lowest (worst) degree of physical circuit separation.

[SOURCE: IEC 61756-1:2019, 3.1.3]

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3.7
multiple ribbon
multiple element consisting of multiple optical fibres (circuits) arranged in ribbons (fibres in parallel) which are also arranged (for example, in stacks)

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[SOURCE: IEC 61756-1:2019, 3.1.5]

3.8
single circuit
physical fibre separation level where the optical circuit consists of one fibre (single fibre), or more than one fibre, providing all services for one subscriber

Note 1 to entry: This fibre separation level has the fibre(s) of only one customer on one splice tray. It is the highest (best) degree of physical circuit separation.

[SOURCE: IEC 61756-1:2019, 3.1.7]

3.9
single element
physical fibre separation level in the cable subassembly comprising one or more optical fibres inside a common covering

Note 1 to entry: A single element provides services to more than one subscriber.

Note 2 to entry: This fibre separation level has all fibres from a cable element (e.g. loose tube) on one splice tray. It is an intermediate degree of physical circuit separation (between single circuit and multiple element).

Note 3 to entry: Optical fibres in a common covering can be in a tube or inside one groove of a grooved cable (slotted core cable).

[SOURCE: IEC 61756-1:2019, 3.1.9, modified – The end of the definition has been moved to a new Note 3 to entry.]

3.10
single ribbon
single element designed to carry all fibres of one ribbon

Note 1 to entry: Depending on the fibres deployment', a single ribbon can contain all the fibres of one circuit (single circuit) or the fibres of more than one circuit (single element).

[SOURCE: IEC 61756-1:2019, 3.1.11]

3.11
splice tray
structure that organises and controls storage of fibre splices in an orderly manner, together with the associated excess uncabled fibre length

Note 1 to entry: It can be a part of a fibre management system.

[SOURCE: IEC 61756-1:2019, 3.1.12]

3.12
transient loss
short term (ms) reversible change of optical transmission characteristics arising from optical discontinuity, physical defects and modifications of the attenuation (e.g. bending loss) normally caused by mechanical stress

4 Abbreviated terms

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FMS fibre management system
ME multiple element
MR multiple ribbons
NA not applicable
SC single circuit
SE single element
SR single ribbon
UV ultraviolet

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5 General requirements

5.1 General

A product that has been shown to meet all the requirements of this performance standard can be declared as conforming to this performance standard. Products having the same classification from one manufacturer that satisfy this performance standard, will operate within the boundaries set by the performance standard. There is no guarantee that products from different manufacturers, having the same classification and which conform to the same performance standard, will provide an equivalent level of performance when they are used together.

Conformance with to IEC environmental policy according to IEC Guide 109 and concerning the need to reduce the impacts on the natural environment of fibre management system products during all phases of their life – from acquiring materials to manufacturing, distribution, use, and end-of-life treatment (i.e. re-use, recycling and disposal) – is indicated within each product specification.

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

5.2 Storage, transportation and packaging

The classes of environmental conditions and their severities to which fibre management products may be exposed during storage and transportation from one place to another after being made ready for dispatch from the manufacturer's works are defined in IEC 60721-3-1 and IEC 60721-3-2. Normal transportation time is considered to be 30 days or less.

The product, in its original packaging, shall be suitable for normal public or commercial transportation and storage in weather-protected non temperature-controlled storage environments and after installation meet the requirements as specified in Table 1 and Table 2.

5.3 Installation and intervention

The minimum and maximum temperatures at which an FMS may be installed (installation conditions) or re-entered (intervention), are not necessarily equal to the maximum temperature excursion of the environment in which it will reside, once installed. Accessing fibres and splices in the fibre management system is typically done in a more controlled environment. Installation and intervention of an FMS shall be possible at temperatures between -5 °C and +45 °C.

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Typically, the following operations are carried out during an intervention:

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– gaining access to fibres and splices (e.g. hinging, pivoting, sliding, removal of splice trays, or other FMS components);
– breaking a splice, rerouting fibres and connecting to another fibre end;
– cutting one or more uncut fibres, rerouting and connecting to another fibre end;
– disconnecting a connector and mating with another connector (when applicable);
– adding FMS elements like splice trays or components and connecting the fibres;
– closing and secure the FMS.

5.4 Marking and identification

Product marking and identification shall survive the storage and transportation.

Each test sample should contain the following information at the minimum:

– manufacturer’s identification mark or logo;
– product designation, model or type;
– any of the following: lot number, batch number, date (at least month and year) of production or serial number;
– expiry date (at least the year) if the product contains components with a limited shelf life.

5.5 Materials

For all applied materials, a material safety data sheet shall be made available upon request.

All materials that are likely to come in contact with personnel shall meet appropriate health and safety regulations.

The materials of the FMS system shall be compatible with the other materials or solvents that can come into contact with it, for example cable filling compounds and degreasing agents. Exposure to these solvents shall not adversely affect the product's performance.

Polymeric materials shall not support mould growth causing mechanical degradation of the materials. Mould growth shall be tested according to IEC 60068-2-10 Test Variant 1, Severity 1. The effect of mould growth shall be determined first by a visual rating based on examination per IEC 60068-2-10. When a rating 0 is obtained, the material is considered fungus resistant and no further testing is required. When a rating 1 or 2 is obtained, the effect of mould growth shall be evaluated by measuring a suitable property (e.g. tensile strength at yield and elongation at yield for thermoplastic polymers, a compression set, a Shore A hardness for elastic materials, or any other test which checks a relevant property) both before and after exposure of the material slabs. The average change in mechanical characteristics of the tested material slabs shall be less than 20 %. A rating of more than 2 is not allowed.

In case the polymeric materials of the FMS are exposed to ultraviolet (UV) light during operation, the polymeric materials shall be tested according to ISO 4892-3, lamp type 1A (UVA-340), cycle 1, duration 2 160 h. The effect of UV light shall be determined by measuring a suitable property (e.g. tensile strength at yield and elongation at yield) both before and after exposure of the material slabs. The average change in mechanical characteristics of the tested material slabs shall be less than 20 %.

Metallic elements shall be corrosion resistant.

Materials which are not specified or which are not specifically described are left to the discretion of the manufacturer.

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5.6 Safety

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Care should be taken when handling small diameter optical fibre to prevent puncturing the skin, especially in the eye area. Direct viewing of the end of an optical fibre or an optical fibre connector which may be propagating invisible energy is not recommended, unless prior assurance has been obtained as to the safety energy output level.

6 Test

6.1 General

The mechanical and environmental performance of a FMS is vital to the optical cabling system. The purpose of testing is to demonstrate that the FMS can survive under defined environmental conditions, without irreversible or reversible failures and perform according to the requirements.

The performance test procedure of a FMS shall:

– evaluate the product for 2 basic acceptance criteria: mechanical integrity by visual examination and optical transmission requirements;
– simulate the effects of exposure to the environment in which it will be installed;
– simulate installation and intervention conditions.

Optical performance testing is accomplished by subjecting the test sample to a number of mechanical and environmental conditions and measuring any optical performance deviations at prescribed intervals during and after completion of each test.

6.2 Test sample preparation

Optical test samples shall be constructed in such a way that they will cover all allowed functions as specified by the manufacturer. This shall be realised by building optical circuits for each fibre separation level (typical SC, SE, SR, ME and MR splicing and uncut fibre storage). The type of fibre for the optical test samples and the test sample preparation are single-mode fibres as described in Annex A. The minimum bend radius for installed and stored fibres in a FMS depends on the fibre type and is given by IEC 61756-1. Only stable optical fibre fusion splices shall be used in the optical circuits.

6.3 Test and measurement methods

All tests and measurements shall be selected from IEC 61300 (all parts).

All optical losses indicated are referenced to the initial attenuation at the start of the test.

No deviation from the specified test method is allowed.

Since only optical fusion splices are used, the optical effects of other passive optical components are not considered for the evaluation of the fibre management system.

Fibre management system under test shall be mounted and connected in accordance with the manufacturer's guidelines.

Unless otherwise specified, tests shall be carried out under standard atmospheric conditions according to IEC 61300-1.

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6.4 Sample size

The sample size used for each test is intended to be composed of randomly selected and previously unstressed new samples. However, due to the complexity of optical test samples, consecutive testing on the same optical sample is allowed.

The sample size for each test can be found in Table 2.

6.5 Pass/fail criteria

A product meets the requirements of this document provided no failures occur in any test. The pass/fail criteria for fibre management systems are specified in Table 1.

Due to the complexity of the optical test samples, consecutive testing on the same optical sample is allowed. In case of a failure during the consecutive testing, a new sample shall be prepared, and the failed test shall be re-done.

6.6 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. An analysis of the cause of the failure shall be undertaken and any corrective actions taken shall be described.

If design changes are made a risk assessment should be carried out to determine whether full or partial requalification should be done.

7 Performance requirements

7.1 Pass/fail criteria

The pass/fail performance criteria requirements are summarised in Table 1.

Table 1 – Pass/fail requirements

No	Examinations and measurements	Requirement	Details	
Criterion 1	Active monitoring of change in attenuation and return loss [a]	Excursion losses: $\delta \leq 0{,}2$ dB at 1 310 nm and 1 550 nm per incoming fibre [b] during test. $\delta \leq 0{,}5$ dB at 1 625 nm per incoming fibre during test. Residual losses: For circuit with splices only: $\delta \leq 0{,}1$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre after test. For circuit containing an optical connector set and a splice: $\delta \leq 0{,}2$ dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre after test.	Method: Wavelengths [c]: Source stability: Detector linearity: Measurements required: Sampling rate:	IEC 61300-3-3 method 1 1 310 nm ± 30 nm 1 550 nm ± 30 nm 1 625 nm ± 30 nm Within ± 0,05 dB over the measuring period Within ± 0,05 dB over the dynamic range to be measured Before, during and after the test At least every 10 min
Criterion 2	Transient loss [b]	Transient losses: $\delta \leq 0{,}5$ dB at 1 550 nm per life circuit during test. $\delta \leq 1$ dB at 1 625 nm per life circuit during test. Residual losses: For circuit with splices only: $\delta \leq 0{,}1$ dB at 1 550 nm and 1 625 nm per life circuit after test. For circuit containing optical connector sets and splices: $\delta \leq 0{,}2$ dB at 1 550 nm and 1 625 nm per life circuit after test.	Method: Wavelengths [c]: Source stability: Detector linearity: Measurements required: Life circuit:	IEC 61300-3-28 1 550 nm ± 30 nm 1 625 nm ± 30 nm Within ± 0,05 dB over the measuring period Within ± 0,05 dB over the dynamic range to be measured Before, during and after the test 5 incoming fibres in series
Criterion 3	Visual examination	No defects which would affect functionality of the fibre management system. Limited movement of the parts of FMS is allowed as long as it does not affect the functionality.	Method: Examination:	IEC 61300-3-1 Product shall be checked with naked eye.

[a] The change in attenuation values refer to the ± deviation from the original value of the transmitted power at the start of the test.

[b] An “incoming fibre” is a part of an optical circuit containing the fibre entering the product, spliced to a fibre leaving the product. One optical circuit can contain many “incoming fibres” (see sample description in Annex A). Light will sequentially flow through all “incoming fibres”.

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

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7.2 Performance requirements

The performance requirements are summarised in Table 2.

Table 2 – Performance requirements

No	Test	Requirement	Details	
1	Installation	Residual loss (criterion 1) Visual examination (criterion 3)	Method: Procedure: Measurements required: Sample size:	See Annex B A live optical circuit is built with 5 splices and/or connections. The fibres and splices are kept outside the splice trays. Active monitoring is started and the fibres and splices are installed in the splice trays. After installation of all fibres and splices, the change in attenuation is checked. Before and after test 3
2	Vibration (sinusoidal)	Transient loss (criterion 2) Visual examination (criterion 3)	Method: Frequency sweep range: Amplitude and acceleration: Duration per axis: No. of axes: Measurements required: Sample size:	IEC 61300-2-1 5 Hz to 500 Hz to 5 Hz at 1 octave/min Amplitude 3,5 mm at ≤ 9Hz Acceleration 10 m/s^2 at > 9 Hz 10 cycles (5 Hz to 500 Hz to 5 Hz) 3 mutually perpendicular Before, during and after test 3
3	Shock	Transient loss (criterion 2) Visual examination (criterion 3)	Method: Wave form: Duration: Acceleration: No. of shocks: No. of axes Measurements required: Sample size:	IEC 61300-2-9 half sine 11 ms 150 m/s^2 3 up and 3 down in each axis 3 mutually perpendicular Before, during and after the test 3
4	Fibre/Cable retention [a]	Transient loss (criterion 2) Visual examination (criterion 3)	Method: Tensile force: Rate of application: Duration of maximum load: Point of application of the load: Measurements required: Sample size:	IEC 61300-2-4 Cable elements or tubes: 5 N Cables: 10 N From 0 to maximum load in 15 s 1 min 0,25 m from the fibre management entrance Before, during (continuous) and after the test. (5 min recovery period). 3

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