IEC 61753-111-7

Edition 1.0 2009-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive component performance standard –
Part 111-7: Sealed closures for category A – Aerial

Dispositifs d'interconnexion et composants passifs à fibres optiques norme de qualité de fonctionnement –
Partie 111-7: Boîtiers scellés pour catégorie A – Aériens

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS PERFORMANCE STANDARD –

Part 111-7: Sealed closures for category A – Aerial

FOREWORD

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International Standard IEC 61753-111-7 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

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

FDIS	Report on voting
86B/2904/FDIS	86B/2934/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.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 61753 series, published under the general title *Fibre optic interconnecting devices and passive components – Performance standard,* can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Performance standards for sealed closures define the requirements for standard optical performance under a set of specified conditions. This part of IEC 61753 contains a series or a set of tests and measurements with clearly stated conditions, severities and pass/fail criteria. The set of tests 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.

A product that has been shown to meet all the requirements of this performance standard may be declared as complying with 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 IEC environmental policy according to IEC Guide 109 and concerning the need to reduce the impact on the natural environment of fibre optic closures during all phases of their life – from acquiring materials to manufacturing, distribution, use, and end-of-life treatment (i.e. re-use, recycling (recovery and disposal)) are not part of this standard, but will be covered in the generic 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 must 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 the product should be evaluated using the procedures recommended in IEC 62005 series.

Tests and measurements are selected from the IEC 61300 series.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS PERFORMANCE STANDARD –

Part 111-7: Sealed closures for category A – Aerial

1 Scope

This part of IEC 61753 contains the minimum test and measurement requirements and severities which a sealed fibre optic closure must satisfy in order to be categorised as meeting the IEC standard for category A – aerial, as defined in Annex A of IEC 61753-1. Free breathing closures are not covered in this standard.

2 Normative references

The following referenced documents are indispensable for the application 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 60068-2-10, *Environmental testing – Part 2-10: Tests – Test J and guidance: Mould growth*

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

IEC 60793-2-50:2008, *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/cable retention*

IEC 61300-2-5, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-5: Tests – Torsion* (available in English only)

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

IEC 61300-2-11, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-11: Tests – Axial compression*[1]

IEC 61300-2-12:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-12: Tests – Impact*

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1 This publication was withdrawn in 2002. A project is currently under consideration.

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 61300-2-33, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-33: Tests – Assembly and disassembly of fibre optic closures*

IEC 61300-2-37, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-37: Tests – Cable bending for fibre optic closures*

IEC 61300-2-38:2006, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-38: Tests – Sealing for pressurized fibre optic closures*

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 61300-3-3:2009, *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* (available in English only)

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

IEC 62134-1, *Fibre optic interconnecting devices and passive components – Fibre optic closures – Part 1: Generic specification*

ISO 4892-3:2006, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1
distribution joint
splice closure that allows easy fibre access, maintenance, re-arrangement and addition of fibre circuits or passive optical components

NOTE Accessing fibre circuits must not cause any transmission degradation or disruption in other operational fibre circuits. Storage of continuous fibres and fibre cable elements is allowed, for example loose tubes passing through the closure. This closure is typically used in access and distribution networks.

3.1.2
excursion loss
change in optical loss during slow variations of environmental parameters

3.1.3
fibre management system
system to control, protect and store fibres from the incoming to the outgoing fibres

3.1.4
free breathing closure
closure that cannot hold an overpressure. Water ingress and/or limited dust ingress is allowed

3.1.5
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 closure

3.1.6
installation
establishment and installation of a closure, by adding new circuits, splices, connectors and other components, including the incoming and outgoing cables

3.1.7
installation conditions
circumstances that must be fulfilled for an installation, which includes; environmental conditions, size interface between the closure or enclosure and the fibre management system, optical performance, additional/special conditions and safety requirements

3.1.8
residual loss
change in optical loss of between initial and final measurements

3.1.9
sealed closure
watertight and dust tight closure that can hold an overpressure of at least 40 kPa

NOTE Since humidity can enter the closure by diffusion, it is not considered to be a hermetic sealed closure.

3.1.10
sealed pressurised closure
watertight and dust tight closure that can hold an overpressure of at least 98 kPa

3.1.11
track joint
splice closure that allows the splicing of at least two cables. It acts as a reinstatement of the cable length

NOTE It will not be re-entered except for repair or reinstatement of damaged cables. This closure configuration is typically used in trunk and junction networks.

3.1.12
transient loss
sudden variations in a circuit's loss characteristics during:

a) manipulation of the entire closure or enclosure and its fibre management system;

b) access to adjacent circuits stored in the same closure or enclosure;

c) sudden effects induced by the external environment (e.g. vibration, shock)

3.2 Abbreviations

FMS Fibre Management System

SC Single Circuit

SE Single Element

ME Multiple Element

MR Multiple Ribbon

4 General requirements

4.1 Storage, transportation and packaging

The classes of environmental conditions and their severities to which closures may be exposed during transportation from one place to another after being made ready for dispatch from the manufacturer's works are defined in 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.

4.2 Marking and identification

Marking of the closure and its package shall be according to IEC 62134-1.

Product marking and identification shall survive the storage and transportation.

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

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

4.3 Materials

For all applied materials, a Material Safety Data Sheet shall be made available upon request.

The materials of the closure and fibre management 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.

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

The effect of UV light on all polymeric materials that are directly exposed to the environment, shall not adversely affect the product's performance. UV test shall be according to ISO 4892-3 Mode 1 lamp type 2. The effect of UV light shall be determined by measuring a suitable property (e.g. tensile strength) both before and after exposure of the material slabs.

Polymeric materials shall not support mould growth causing mechanical degradation of the materials. Mould growth shall be tested according to IEC 60068-2-10. The effect of mould growth shall be determined by measuring a suitable property (e.g. tensile strength) both before and after exposure of the material slabs.

Metallic elements shall be corrosion resistant. Dissimilar metals should not be used in contact with each other unless they are suitably finished to prevent electrolytic corrosion.

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

4.4 Closure overpressure safety

Special attention should be taken when opening sealed closures that are carrying an overpressure. Overpressure can build up in sealed closures due to temperature differentials, atmospheric pressure changes over a period of time, flash testing of the seals after installation or incorrect installation techniques. Care should be taken when opening a sealed closure. Provisions shall be made that overpressure is exhausted when opening the closure prior to complete removal of the cover.

4.5 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.

5 Test

5.1 General

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

The performance test procedure of a closure shall:

- evaluate the product for 3 basic acceptance criteria: sealing, mechanical integrity 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 specimen to a number of mechanical and environmental conditions and measuring any optical performance deviations at prescribed intervals during and after completion of each test.

5.2 Test specimen preparation

Sealing performance test samples shall be provided with an air pressure test access valve. The length of the cables extending the closure shall be at least 1 m. The free ends of the cables shall be sealed. Each applicable cable type with minimum and maximum cable dimensions shall be represented in the test program. When applicable, open closure ports shall be sealed with a cap.

Optical test samples shall be constructed in such a way that they will cover all allowed functions as specified by the manufacturer, being “track joint “ configuration or “track joint and distribution joint” configuration. This shall be realised by building optical circuits for each fibre separation level (typical SC, SE, or ME 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.

5.3 Test and measurement methods

All tests and measurements have been selected from the IEC 61300 series.

Unless otherwise stated in the individual test details, all attenuation measurements shall be performed at 1 310 nm ± 25 nm, 1 550 nm ± 25 nm and 1 625 nm ± 25 nm for the environmental optical tests, and at 1 550 nm ± 25 nm and 1 625 nm ± 25 nm for the mechanical optical tests.

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.

Effects that are due to the properties of the optical components themselves are not to be taken into account for the evaluation of the closure system itself.

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

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

5.4 Installation or intervention

The minimum and maximum temperatures at which a closure 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 the fibre management system inside the closure is typically done in a more controlled environment. Closures and the fibre management system should be installable in the temperature range between –5 °C and +45 °C for aerial applications (category A). Closure handling alone should be possible at temperatures between –15 °C and +45 °C.

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

- handling of closure;
- opening closure;
- getting access to fibres and splices (e.g. hinging, pivoting, sliding, removal of splice trays, or other organiser 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 organiser elements/components and connecting the fibres;
- closing and sealing the closure.

5.5 Pass/fail criteria

A product will have met the requirements of this standard provided no failures occur in any test.

In the event of a failure occurring on a sealing performance test sample, the test shall be re-run using a sample size double that of the original.

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 Performance requirements

6.1 Sample size

A detailed description of the sample size can be found in Annex B.

6.2 Sealing, optical and appearance performance criteria

Table 1 – Tightness, optical and appearance performance criteria

No.	Test	Requirement	Details	
1	Sealing for pressurised closures of fibre optic devices – sealing performance after test	No emission of air bubbles indicating a leak	Method: Test temperature: Test pressure: Immersion depth: Duration: Pre-conditioning procedure:	IEC 61300-2-38, Method A 23 °C ± 3 °C Internal overpressure 40 kPa ± 2 kPa (Note 1) Just below the surface of the water 15 min Sample should be conditioned to room temperature for at least 2 h
2	Visual examination	No defects which would affect functionality of the closure	Method: Examination:	IEC 61300-3-1 Product shall be checked with the naked eye
3	Active monitoring of change in attenuation and return loss (Note 2)	Excursion losses: δIL ≤ 0,2 dB at 1 310 nm and 1 550 nm per incoming fibre during test. δIL ≤ 0,5 dB at 1 625 nm per incoming fibre during test. Residual losses: δIL ≤ 0,1 dB at 1 310 nm, 1 550 nm and 1 625 nm per incoming fibre after test	Method: Wavelengths: Source stability: Detector linearity: Measurements required: Sampling rate:	IEC 61300-3-3, Method 1 1 310 nm ± 25 nm 1 550 nm ± 25 nm 1 625 nm ± 25 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 Every 10 min
4	Transient loss (Note 2)	Transient losses: δIL ≤ 0,5 dB at 1 550 nm per active circuit during test. δIL ≤ 1 dB at 1 625 nm per active circuit during test. Residual losses: δIL ≤ 0,1 dB at 1 550 nm and 1 625 nm per active circuit after test	Method: Wavelengths: Source stability: Detector linearity: Measurements required: Active circuit:	IEC 61300-3-28 1 550 nm ± 25 nm 1 625 nm ± 25 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 10 incoming fibres in series

NOTE 1 For products used in pressurised networks, all testing should be carried out at 98,0 kPa ± 9,8 kPa over-pressure instead of 40 kPa over-pressure.

NOTE 2 All optical losses indicated are referenced to the initial attenuation at the start of the test.

6.3 Mechanical sealing performance requirements

Table 2 – Mechanical sealing performance requirements

No.	Test	Requirement	Details	
5	Vibration (sinusoidal)	Sealing performance (test 1) Visual examination (test 2)	Method: Frequency range: Amplitude /acceleration force: Cross-over frequency: Number of sweeps Number of axes: Test temperature: Test pressure: Pre-conditioning procedure:	IEC 61300-2-1 5 Hz – 500 Hz at 1 octave/min 3 mm or 10 m/s^2 (~ 1 g_n) maximum 9 Hz 10 sweeps (5-500-5) 3 mutually perpendicular +23 °C ± 3 °C Internal overpressure 0 kPa ± 2 kPa Sample should be conditioned at room temperature for at least 2 h
6	Cable retention	Sealing performance (test 1) Visual examination (test 2)	Method: Test temperatures: Load: Duration: Test pressure: Pre-conditioning procedure:	IEC 61300-2-4 –15 °C ± 2 °C and +45 °C ± 2 °C $\varnothing_{Cable}$ (mm)/45*1 000 N or 1000 N maximum 1 h per cable Internal overpressure 0 kPa ± 2 kPa at room temperature Sample should be conditioned at the specified temperature for at least 4 h
7	Axial compression of central strength member	Visual examination (test 2) No movement of central strength member by more than 5 mm	Method: Test temperature: Load: Duration: Pre-conditioning procedure:	IEC 61300-2-11 +23 °C ± 3 °C 450 N on central strength member 30 min per strength member Sample should be conditioned at room temperature for at least 2 h
8	Cable bending	Sealing performance (test 1) Visual examination (test 2)	Method: Test temperatures: Force: Force application:	IEC 61300-2-37 –15 °C ± 2 °C and +45 °C ± 2 °C 30° or maximum 500 N 400 mm from end of seal (Note)
			Number of cycles: Test pressure: Pre-conditioning procedure:	5 cycles per cable Internal overpressure 0 kPa ± 2 kPa at room temperature Sample should be conditioned at the specified temperature for at least 4 h