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REDLINE VERSION

INTERNATIONAL STANDARD

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

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CONTENTS

FOREWORD 3
1 Scope 5
2 Normative references 5
3 Terms and definitions 5
4 General description 5
5 Apparatus 6
5.1 Mandrel 6
5.2 Holding fixture 7
5.3 Force generator 7
5.4 Force gauge 8
5.5 Alternative apparatus 8
5.6 Timer 8
5.7 ~~Other~~ Measurement equipment 8
6 Procedure 8
6.1 Preparation of DUTs 9
6.2 Pre-conditioning 9
6.3 Mounting DUT and visual inspection of the mounted DUT 9
6.4 Initial examination 9
6.5 Conditioning and optical measurement during the conditioning 9
6.6 Removal of the test load 10
6.7 Recovery 10
6.8 Final examination and performance check 10
6.9 Final visual inspection 10
7 Severity 10
8 Details to be specified 14
Bibliography 15

Figure 1 – An example of DUT configuration of retention test 7

Table 1 – Recommended test severities for connectors, FMC, passive components, splices, and FMS 11
Table 2 – Recommended test severities for wall outlets, boxes, OFDM, and closures 12
Table 3 – Recommended test severities for hardened connectors, street cabinets, boxes, and closures 13

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 2-4: Tests – Fibre or cable retention

FOREWORD

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International Standard IEC 61300-2-4 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 1995. This edition includes the following significant technical changes with respect to the previous edition:

a) addition of Clause 2, Normative references;

b) clarification of the test procedures;

c) clarification of the severities;

d) modification of the whole document structure according to the latest ISO/IEC Directives.

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

FDIS	Report on voting
86B/4147/FDIS	86B/4160/RVD

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

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

A list of all parts in the IEC 61300-2 series, published under the general title *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Tests*, 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 2-4: Tests – Fibre or cable retention

~~1 General~~

1 Scope ~~and object~~

The purpose of this part of IEC 61300 is to ensure that the ~~captivation~~ retention or attachment of the fibre, cord or cable ~~to~~ in a fibre optic device or an enclosure will withstand tensile loads likely to be applied during normal service.

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

IEC 61300-2-38, *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, *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*

3 Terms and definitions

No terms and definitions are listed in this document.

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

- IEC Electropedia: available at http://www.electropedia.org/

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- ISO Online browsing platform: available at http://www.iso.org/obp

4 General description

The ~~specimen~~ device under test (DUT) is rigidly clamped to a holding fixture, which is shown in Figure 1, and a tensile load is applied to the fibre, cord or cable. Potential failure modes for this test include, but are not limited to:

a) cable ~~jacket~~ sheath damage;

b) strength member damage;

c) fibre breakage or damage;

d) cable clamp failure;

e) cable pull-out;

f) loss of optical continuity or loss of sealing of enclosures;

g) ~~degradation of~~ change in optical ~~transmission~~ characteristics, such as attenuation or return loss;

h) breaking, excessive movement ~~of the cable/terminus relative to the device~~ or damage to the cable sheath, seals, cable clamps.

5 Apparatus

~~The apparatus consists of the following elements.~~

5.1 Mandrel

The diameter D of the mandrel is equal to the greater of 60 mm or 25 times the diameter d of the fibre, cord or cable. Use an adequate number of turns to prevent slippage. For optical components, the distance A between the rearmost portion of the cable fixing component of the DUT and the mandrel tangent point shall be 200 mm ± 50 mm. For closures, the distance A shall be the greater of 50 times the diameter d of the fibre, cord or cable or 250 mm.

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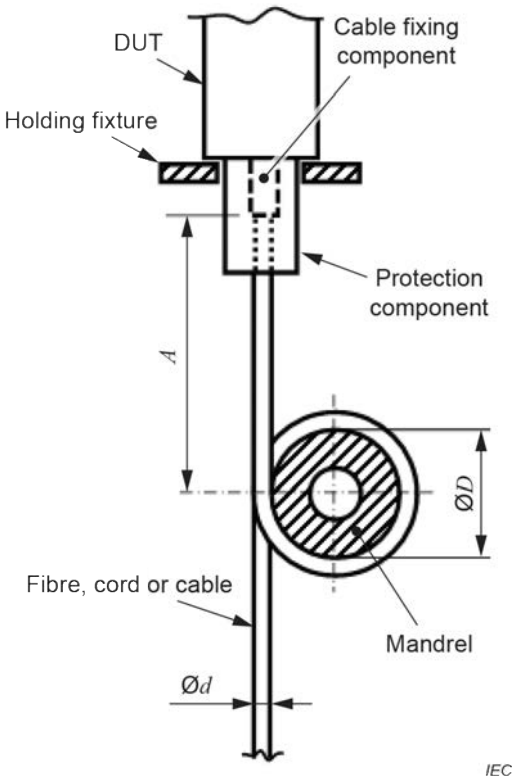

Key

D ≥ 25 d or 60 mm (min.)

Components:

A = 200 mm ± 50 mm

Closures:

A ≥ 50 d or 250 mm (min.)

Figure 1 – An example of DUT configuration of retention test

5.2 Holding fixture

~~A means to hold the fibre/cable and the device(s) in position for the duration of the test. The holding method used shall not distort the device under test. Mount the device in a fixed position using its normal mounting provisions. As an example, wrap the fibre/cable around a mandrel having a diameter which is at least 25 times the diameter of the fibre/cable. Use an adequate number of turns to preclude slippage. The distance between the rearmost portion of the device under test and the mandrel tangent point shall be no less than 50 times the diameter of the fibre/cable.~~

~~NOTE – The fixturing should allow the specimen to be connected to an optical source and detector in order to monitor changes in attenuation (if required by the detail specification).~~

The holding fixture holds the DUT and its mandrel in positions which are shown in Figure 1 for the duration of the test. The holding method used shall not distort the DUT. Mount the DUT in a fixed position. The holding fixture should allow the DUT to be connected to an optical source and detector in order to monitor changes in attenuation if required by the relevant specification.

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5.3 Force generator

~~An appropriate device or apparatus capable of smoothly applying the specified force at the specified rate.~~

The force generator shall smoothly apply the specified force at the specified rate to the DUT.

5.4 Force gauge

~~An appropriate gauge to register the amount of force being exerted between the device under test and the fibre/cable.~~ The force gauge shall register the amount of force being exerted between the DUT and the fibre, cord or cable. This equipment may include a device to record the rate of force application or the total time the force is applied or both.

5.5 Alternative apparatus

~~Unless otherwise specified in the detail specification, other apparatus may be used in lieu of a mechanical separation device or force gauge.~~ Other apparatus may be used in lieu of a tensile test machine and a force indicator. For example, the required force may be achieved by applying controlled increments of mass to~~ one of the holding devices while the other holding device remains fixed~~ the mandrel.

5.6 Timer

A device to measure the total time while the force is applied~~, if the apparatus mentioned in 2.3 is not used~~.

5.7 ~~Other~~ Measurement equipment

Optical, sealing and other examination and measuring equipment shall be available as required by IEC 61300-2-38, IEC 61300-3-1~~ and IEC 1300-3-5~~, IEC 61300-3-3 , IEC 61300-3-4, IEC 61300-3-6 or IEC 61300-3-28 as appropriate. Refer to the required procedure for details.

6 Procedure

~~3.1 Visually examine each specimen in accordance with IEC 1300-3-1 to ensure that the specimens have not been damaged.~~

~~3.2 Unless otherwise specified, precondition each prepared specimen for 4 h at the standard test conditions specified in IEC 1300-1.~~

~~3.3 Securely mount the device under test on the holding fixture and place in the test apparatus.~~

~~3.4 Perform any initial optical measurement and make any other measurements as required by the detail specification. Unless otherwise specified in the detail specification, measure the attenuation in accordance with IEC 1300-3-5.~~

~~3.5 Activate the test apparatus so that an axial force is gradually exerted between the fibre/cable and the device under test. Apply the load gradually so as to eliminate any impulse or impact loading effect. If automatic equipment is used, it is recommended that the rate of separation of the holding devices be approximately 25 mm/min. Continue loading until the tensile load specified in the detail specification has been reached.~~

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~~3.6 Maintain the specified load for the specified time period required by the detail specification. While the specimen is under load, make observations and perform measurements as required by the detail specification.~~

~~3.7 Remove the test load and perform any final optical measurement required by the detail specification. Unless otherwise specified in the detail specification, measure the attenuation in accordance with IEC 1300-3-5.~~

~~3.8 Remove the specimen from the test apparatus and visually examine each specimen in accordance with IEC 1300-3-1.~~

6.1 Preparation of DUTs

Prepare the DUTs in accordance with the manufacturer's instructions or as specified in the relevant specification. DUTs shall be terminated with a sufficient length of fibre cable to facilitate interfacing with the optical source and detector.

6.2 Pre-conditioning

Pre-condition each DUT for 2 h for connectors, splices, passive components and fibre management systems, or for 4 h for closures at the standard atmospheric condition defined in IEC 61300-1.

6.3 Mounting DUT and visual inspection of the mounted DUT

Securely mount the DUT and its mandrel on the holding fixtures and place in the test apparatus.

Visually examine each DUT in accordance with IEC 61300-3-1 to ensure that the DUT has not been damaged by inserting it into the test equipment.

6.4 Initial examination

Visually examine each DUT in accordance with IEC 61300-3-1. Complete the initial examinations and measurements on the DUT as required by the relevant specification.

For the sealing performance of category S closures, the closure shall be pressurized at the test temperature. The pressure will be measured at the test temperature in accordance with test method B of IEC 61300-2-38.

For the optical evaluation, the variation of the attenuation shall be measured in accordance with IEC 61300-3-3 or IEC 61300-3-28. If required, the attenuation will be measured in accordance with IEC 61300-3-4.

6.5 Conditioning and optical measurement during the conditioning

Activate the test apparatus so that an axial force is gradually exerted between the DUT and the mandrel. Apply the load smoothly so as to eliminate any impulse or impact loading effect. If automatic equipment is used, it is recommended that the load change of the DUT be 5 N/s for reinforced cable and 0,5 N/s for secondary and primary coated fibre, unless otherwise specified in the relevant specification. Continue loading until the tensile load specified in the relevant specification has been reached.

Maintain the specified load for the specified time period required by the relevant performance specification.

While the DUT is under load, make observations and perform optical measurements when required by the relevant performance specification.

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If required by the relevant specification, measure the change of attenuation in accordance with IEC 61300-3-3 before, during and after the load is applied.

6.6 Removal of the test load

Remove the test load from the DUT.

For a category S closure, the pressure will be measured at the test temperature in accordance with test method B of IEC 61300-2-38 before and after applying the load.

6.7 Recovery

Remove the DUT from the test apparatus and allow the DUT to recover under standard atmospheric condition for 2 h for connectors, splices, passive components and fibre management systems or for 4 h for closures, as defined in IEC 61300-1, unless otherwise specified in the relevant specification.

6.8 Final examination and performance check

On completion of the test, perform the final measurements, as defined in the relevant specification. The results of the final measurement shall be within the limit established in the relevant specification.

For the sealing test of the DUTs, such as closures, the final sealing performance shall be checked in accordance with test method A of IEC 61300-2-38.

For the optical evaluation of DUTs, the variation of the attenuation shall be measured in accordance with IEC 61300-3-3 or IEC 61300-3-28. If required, the attenuation will be measured in accordance with IEC 61300-3-4.

6.9 Final visual inspection

Visually examine the DUT in accordance with IEC 61300-3-1. Check for evidence of any degradation in the DUT. This may include, for example:

- broken, loose or damaged parts or accessories, and
- excessive movement of, damage to, or broken cable sheath, seals, or cable clamps.

Repeat the procedure at another test temperature if required.

7 Severity

~~The severity consists of the magnitude of the tensile load and the time duration it is applied. The severity shall be given in the detail specification.~~

The severity consists of the test temperature, the magnitude of the tensile load and the time for which it is applied. Recommended severities for connectors, FMCs (Field Mountable Connector), passive components, splices and FMS (Fibre Management Systems) are given in Table 1. Recommended severities for wall outlets, boxes, OFDM and closures of category C are listed in Table 2. Recommended severities for hardened connectors, street cabinets, boxes and closures of category S, G and A are shown in Table 3.

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Table 1 – Recommended test severities for connectors, FMC, passive components, splices, and FMS

Categories	Severity	Connectors	FMC	Passive components	Splices	FMS
C, C[HD]	Load: 50 N for 60 s for cables with aramid yarn strength members 10 N for 60 s for tubes or cables without aramid yarn strength members 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres	O,V	O,V		O,V	
	Load: 10 N for 60 s for cables 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres			O,V		
	Load: 10 N for 60 s for cables 5,0 N for 60 s for cable elements and tubes					O,V [a]
OP, OP[HD], OP+, OP+[HD]	Load: 70 N for 60 s for cables with aramid yarn strength members 10 N for 60 s for tubes or cables without aramid yarn strength members 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres	O,V	O,V		O,V	
	Load: 10 N for 60 s for cables 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres			O,V		
	Load: 10 N for 60 s for cables 5,0 N for 60 s for cable elements or tubes					O,V [a]
I, I[HD]	Load: 100 N for 120 s on cable	O,V		(O,V) [b]		
E	Load: 100 N for 60 s for cables with diameter, $d > 2$ mm 70 N for 60 s for cables with diameter, $d \leq 2$ mm 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres	O,V				
	Load: 10 N for 60 s for cables 5,0 N for 60 s for buffered fibres 2,0 N for 60 s for primary coated fibres			(O,V) [b]		

NOTE 1 Categories are defined in IEC 61753-1.

NOTE 2 For ribbon fibres, the severities should be the same as for secondary coated fibres.

NOTE 3 For non-round duplex cords and flat cables, the smaller diameter is used to define the severities.

[a] If cables or cable elements (loose tubes) are not fixed to the entry ports of the fibre management system, the test shall not be performed.

[b] These tests shall be applicable to passive optical components that incorporate fibre or fibre cable pigtails in their product design.

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Table 2 – Recommended test severities for wall outlets, boxes, OFDM, and closures

Categories	Severity	Wall outlet	Boxes	OFDM	Closures
C	Load: 25 N on cables or cords 60 s load duration per cable/cord Test conducted at +23 °C ± 3 °C	S,O,V	S,O,V	O,V	
	Load on cable (N): 10 x cable diameter (mm) 1 h load duration per cable Test conducted at +23 °C ± 3 °C				S,O,
NOTE 1 Categories are defined in IEC 61753-1. NOTE 2 For non-round duplex cords and flat cables, the smaller diameter is used to define the severities. NOTE 3 Separate test samples for sealing performance and optical performance evaluation may be used.					

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Table 3 – Recommended test severities for hardened connectors, street cabinets, boxes, and closures

Categories	Severity	Hardened connectors	Street cabinets	Boxes	Closures
A	Load (N): 20 × cable diameter (mm) 1 h load duration per cable per test temperature Sealing test [a] conducted at test temperatures −15 °C and +45 °C Optical test [a] conducted at +23 °C ± 3 °C	S,O,V	V [b]		S,O,V
	Load (N): 10 × cable diameter (mm) for 1 h per feeder cable per test temperature 25 N for 60 s per cord and work area cable and per temperature Sealing test [a] conducted at test temperatures −15°C and +45°C Optical test [a] conducted at +23°C ± 3°C			S, O, V	
G	Load (N): 20 × cable diameter (mm) 1 h load duration per cable per test temperature. Sealing test [c] conducted at −15 °C ± 2 °C and +.45 °C ± 2 °C Optical test [c] conducted at +23 °C ± 3 °C	S,O,V			S,O, V
S	Load (N): 20 × cable diameter (mm) Duration: 1 h per cable at test temperature Sealing test [c] conducted at −15 °C ± 2 °C and +45 °C ± 2 °C Optical test [c] conducted at +23 °C ± 3 °C	S,O,V			S,O, V

NOTE 1 Categories are defined in IEC 61753-1.

NOTE 2 For non-round duplex cords and flat cables, the smaller diameter is used to define the severities.

[a] Separate test samples for hardened connector/closure sealing performance and optical evaluation may be used.

[b] Test only required when product is pre-cabled and cable handling is expected when unpacking and installing the product.

[c] Separate test samples for sealing performance and optical performance evaluation may be used.

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