

# INTERNATIONAL STANDARD

**Fibre optic interconnecting devices and passive components – Performance standard –**

**Part 052-3: Single-mode fibre non-connectorized fixed attenuator – Category U in uncontrolled environment**



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INTERNATIONAL  
ELECTROTECHNICAL  
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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**FIBRE OPTIC INTERCONNECTING DEVICES  
AND PASSIVE COMPONENTS –  
PERFORMANCE STANDARD –****Part 052-3: Single-mode fibre non-connectorized fixed  
attenuator – Category U in uncontrolled environment**

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International Standard IEC 61753-052-3 has been prepared by subcommittee SC86B: 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 2001. This edition constitutes a technical revision.

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

- reconsideration of performance requirements.

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

FDIS	Report on voting
86B/3994/FDIS	86B/4009/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 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.

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.

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- replaced by a revised edition, or
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## **FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –**

### **Part 052-3: Single-mode fibre non-connectorized fixed attenuator – Category U in uncontrolled environment**

#### **1 Scope**

This part of IEC 61753 contains the minimum initial test and measurement requirements and severities which a fibre optic attenuator satisfies in order to be categorised as meeting the requirements of single-mode fibre non-connectorized fixed attenuator devices used in uncontrolled environments. IEC 60869-1 contains the generic specification of the optical attenuator.

Optical performances specified in this document relate only to non-connectorized configurations optical attenuators.

#### **2 Normative references**

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60793-2-50, *Optical fibres – Part 2.50: Product specifications – Sectional specifications 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 61300-2-1, *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*

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

IEC 61300-2-14, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-14: Tests – High optical power*

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 – High temperature endurance*

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

IEC 61300-2-44, *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 61300-2-46, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-46: Tests – Damp heat, cyclic*

IEC 61300-3-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-2: Examination and measurements – Polarization dependent loss in a single-mode fibre optic device*

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 61300-3-7, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-7: Examinations and measurements – Wavelength dependence of attenuation and return loss of single mode components*

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 Test**

All test methods are in accordance with the IEC 61300 series. Tests validate performance over the required operating wavelength and power range. The samples shall be terminated onto single-mode fibres as per IEC 60793-2-50, type B1.1 or B1.3 or B6 in either coated fibres (primary and secondary) or reinforced cable format as per IEC 60794-2-50.

### **4 Test report**

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

### **5 Performance requirements**

#### **5.1 Sample size, sequencing and grouping**

The sample size to be used for the tests shall be as defined in Annex A.

#### **5.2 Dimensions**

Dimensions shall comply with those given in appropriate manufacturer's drawings.



### 5.3 Test details and requirements

Table 1 defines the performance requirements and test details for single-mode non-connectorized fixed attenuators, category U.

**Table 1 – Test details and requirements**

No.	Tests	Requirements	Details	
1	Attenuation IEC 61300-3-7	Operating wavelength range: 1 260 nm to 1 360 nm and/or 1 460 nm to 1 625 nm.  For nominal values $\leq 5$ dB, the tolerance shall be $\leq \pm 0,5$ dB around the nominal insertion loss value.  For nominal values $> 5$ dB, the tolerance shall be $\leq \pm 10$ % around the nominal insertion loss value.	Method:  Launch patchcord length:  Launch conditions:  Optical source wavelength:  Source power stability:  Total uncertainty:	Method B2.1  $\geq 2$ m. Only the fundamental mode shall propagate at the limiter interface and at the detector.  The wavelength of the source shall be longer than cut-off wavelength of the fibre.  Tunable narrowband non polarized source. 1 260 nm to 1 360 nm and 1 460 to 1 660 nm.  Within $\pm 0,05$ dB over the measuring period or at least 1 h.  $\leq \pm 0,1$ dB
2	Return loss IEC 61300-3-7	$\geq 50$ dB Grade U	Method:  Optical source wavelength:  Other requirements:  Total uncertainty:	Measurement method 1 OCWR  1 310 nm $\pm 10$ nm, 1 550 nm $\pm 10$ nm and/or 1 625 nm $\pm 10$ nm  Test every sample with the three wavelengths.  This test shall be performed twice, reversing the sample. Both measurements shall be within the specified limits.  $\leq \pm 1$ dB
3	Polarization dependent loss IEC 61300-3-2	$\leq 0,3$ dB at 1 550 nm  The samples shall be terminated onto single-mode fibres as per IEC 60793-2-50,	Optical source Wavelength:  Total uncertainty:	1 310 nm $\pm 10$ nm, 1 550 nm $\pm 10$ nm and/or 1 625 nm $\pm 10$ nm  $\leq \pm 0,05$ dB over the dynamic range to be measured
4	High optical power IEC 61300-2-14	Before, during and after the test, the insertion loss shall meet the requirements of test No. 1.  Before, during and after the test, the return loss shall meet the requirements of test No. 2.  During the test, the change in insertion loss and return loss shall be measured by test method IEC 61300-3-3	Test temperature:  Optical source wavelength:  Test duration:  Power increments:	60 °C $\pm 2$ °C  1 310 nm $\pm 10$ nm, 1 550 nm $\pm 10$ nm and/or 1 625 nm $\pm 10$ nm  1 h at each power level  For nominal insertion loss $\leq 5$ dB: start at 0 dBm and go up to maximum allowed power input in 100 mW increments of CW source input  For nominal insertion loss $> 5$ dB: 10 mW continuous power increments  The above increments are applied up to the maximum allowed power input of 100 mW

No.	Tests	Requirements	Details	
5	Vibration (sinusoidal) IEC 61300-2-1	<p>Before and after the test, the insertion loss shall meet the requirements of test No. 1.</p> <p>Before and after the test, the return loss shall meet the requirements of test No. 2.</p> <p>During the test, the change in insertion loss shall be <math>\leq \pm 0,5</math> dB.</p>	<p>Method:</p> <p>Frequency range:</p> <p>Constant vibration amplitude:</p> <p>Number of cycles:</p> <p>Number of axes:</p> <p>Sweep rate:</p> <p>Optical source wavelength:</p> <p>Specimen optically functioning:</p>	<p>During the test, the change in insertion loss shall be measured by transient loss test method IEC 61300-3-28.</p> <p>10 Hz to 55 Hz</p> <p>0,75 mm</p> <p>15</p> <p>3 orthogonal</p> <p>1 octave/min</p> <p>1 310 nm <math>\pm</math> 10 nm, 1 550 nm <math>\pm</math> 10 nm and/or 1 625 nm <math>\pm</math> 10 nm</p> <p>Yes</p>
6	Cold IEC 61300-2-17	<p>During the test, the maximum allowed change in insertion loss is:</p> <p><math>\leq \pm 0,5</math> dB for attenuator <math>\leq 5</math> dB.</p> <p><math>\leq \pm 10</math> % for attenuators <math>&gt; 5</math> dB.</p> <p>Before and after the test, the insertion loss requirements of test No. 1 shall be met.</p> <p>Before and after the test, the return loss requirement of test No. 2 shall be met.</p>	<p>Method:</p> <p>Temperature:</p> <p>Duration of the exposure:</p> <p>Optical source wavelength:</p> <p>Maximum sampling interval during the test:</p> <p>Specimen optically functioning:</p>	<p>During the test, the change in insertion loss shall be measured by test method IEC 61300-3-3.</p> <p><math>-25</math> °C <math>\pm</math> 2 °C</p> <p>96 h</p> <p>1 310 nm <math>\pm</math> 10 nm, 1 550 nm <math>\pm</math> 10 nm and/or 1 625 nm <math>\pm</math> 10 nm</p> <p>Before and after the test, the samples will be measured with three wavelengths. During the test, the samples will be measured with one wavelength.</p> <p>1 h</p> <p>Yes</p>
7	Dry heat – High temperature endurance IEC 61300-2-18	<p>During the test, the maximum allowed change in insertion loss is:</p> <p><math>\leq \pm 0,5</math> dB for attenuator <math>\leq 5</math> dB</p> <p><math>\leq \pm 10</math>% for attenuators <math>&gt; 5</math> dB</p> <p>Before and after the test, the insertion loss requirements of test No. 1 shall be met</p> <p>Before and after the test, the return loss requirement of test No. 2 shall be met</p>	<p>Method:</p> <p>Temperature:</p> <p>Duration of the exposure:</p> <p>Optical source wavelength:</p> <p>Maximum sampling interval during the test:</p> <p>Specimen optically functioning:</p>	<p>During the test, the change in insertion loss shall be measured by test method IEC 61300-3-3.</p> <p><math>+ 70</math> °C <math>\pm</math> 2 °C</p> <p>96 h</p> <p>1 310 nm <math>\pm</math> 10 nm, 1 550 nm <math>\pm</math> 10 nm and/or 1 625 nm <math>\pm</math> 10 nm</p> <p>Before and after the test, the samples will be measured with three wavelengths. During the test, the samples will be measured with one wavelength.</p> <p>1 h</p> <p>Yes</p>

No.	Tests	Requirements	Details	
8	Damp heat (cyclic) IEC 61300-2-46	<p>Before, during and after the test the insertion loss requirements of test No. 1 shall be met</p> <p>Before and after the test the return loss requirement of test No. 2 shall be met</p> <p>During the test the change in Insertion Loss shall be measured by test method IEC 61300-3-3</p>	<p>Method:</p> <p>High temperature:</p> <p>Low temperature:</p> <p>Humidity:</p> <p>Number of cycles:</p> <p>Duration of each cycle:</p> <p>Optical source wavelength:</p> <p>Maximum sampling interval during the test:</p> <p>Specimen optically functioning:</p>	<p>During the test the change in insertion loss shall be measured by test method IEC 61300-3-3.</p> <p>+ 70 °C ± 2 °C</p> <p>+ 25 °C ± 2 °C</p> <p>&gt; 95 % RH ± 2 % RH</p> <p>4</p> <p>24 h</p> <p>1 310 nm ± 10 nm, 1 550 nm ± 10 nm and/or 1 625 nm ± 10 nm</p> <p>Before and after the test, the samples will be measured with three wavelengths. During the test, the samples will be measured with one wavelength.</p> <p>1 h</p> <p>Yes</p>
9	Change of temperature IEC 61300-2-22	<p>Before, during and after the test, the insertion loss requirements of test No 1 shall be met.</p> <p>Before and after the test, the return loss requirement of test No 2 shall be met.</p>	<p>Method:</p> <p>High temperature:</p> <p>Low temperature:</p> <p>Number of cycles:</p> <p>Rate of temperature change:</p> <p>Duration at extreme temperatures:</p> <p>Optical source wavelength:</p> <p>Maximum sampling interval during the test:</p> <p>Specimen optically functioning:</p>	<p>Test Nb</p> <p>During the test, the change in insertion loss shall be measured by test method IEC 61300-3-3.</p> <p>+ 70 °C ± 2 °C</p> <p>– 25 °C ± 2 °C</p> <p>12</p> <p>1 °C/min</p> <p>1 h</p> <p>1 310 nm ± 10 nm, 1 550 nm ± 10 nm and/or 1 625 nm ± 10 nm</p> <p>Before and after the test, the samples will be measured with three wavelengths. During the test, the samples will be measured with one wavelength.</p> <p>15 min</p> <p>Yes</p>

No.	Tests	Requirements	Details	
10	Dust IEC 61300-2-27	<p>Before and after the test, the insertion loss shall meet the requirements of test No. 1.</p> <p>Before and after the test, the return loss shall meet the requirements of test No. 2.</p> <p>Before and after the test. Specimen tested in mated position.</p> <p>No significant difference either in the visual aspect or in the strength coupling mechanism shall be noticed</p>	<p>Temperature:</p> <p>Relative humidity:</p> <p>Dust type:</p> <p>Dust particle diameter:</p> <p>Dust concentration:</p> <p>Test duration:</p> <p>Particle size</p> <p>Specimen optically functioning:</p>	<p>+ 35 °C ± 2 °C</p> <p>+ 60 % RH ± 2 % RH</p> <p>Talc</p> <p>&lt; 150 µm</p> <p>10,6 g/m<sup>3</sup> ± 7,1 g/m<sup>3</sup></p> <p>10 min</p> <p>d &lt; 150 µm</p> <p>No</p>
11	Salt mist IEC 61300-2-26	<p>Before and after the test, the insertion loss shall meet the requirements of test No. 1.</p> <p>Before and after the test, the return loss shall meet the requirements of test No. 2.</p> <p>Before and after the test. Specimen tested in mated position.</p>	<p>Temperature:</p> <p>Salt solution (NaCl) concentration:</p> <p>pH:</p> <p>Test duration:</p> <p>Specimen optically functioning:</p>	<p>+ 35 °C ± 2 °C</p> <p>5 % ± 1 %</p> <p>Between 6,5 and 7,2</p> <p>96 h</p> <p>No</p>
12	Shock IEC 61300-2-9	<p>Before and after the test, the insertion loss shall meet the requirements of test No. 1.</p> <p>Before and after the test, the return loss shall meet the requirements of test No. 2.</p>	<p>Acceleration force:</p> <p>Time:</p> <p>No. of shocks:</p> <p>Specimen optically functioning:</p> <p>Optical source wavelength:</p>	<p>5 000 m/s<sup>2</sup></p> <p>1ms duration, half sine pulse</p> <p>3 axes in 2 directions, 2 shocks per axis, 12 shocks total</p> <p>No</p> <p>1 310 nm ± 10 nm, 1 550 nm ± 10 nm and/or 1 625 nm ± 10 nm</p>
13	Optical fibre cable flexing IEC 61300-2-44	<p>Before and after the test, the insertion loss shall meet the requirements of test No. 1.</p> <p>Before and after the test, the return loss shall meet the requirements of test No. 2.</p>	<p>Magnitude of the load:</p> <p>Angle of deflection per cycle:</p> <p>Number of cycles:</p> <p>Specimen optically functioning:</p> <p>Method of mounting:</p>	<p>5 000 m/s<sup>2</sup> for reinforced cable</p> <p>± 90°</p> <p>30</p> <p>No</p> <p>The sample shall be rigidly mounted such that the load is only applied to the fibre/cable.</p>

No.	Tests	Requirements	Details	
14	Fibre/cable retention IEC 61300-2-4	<p>Before and after the test, the insertion loss shall meet the requirements of test No. 1.</p> <p>Before and after the test, the return loss shall meet the requirements of test No. 2.</p> <p>During the test, the change in insertion loss shall be <math>\pm 0,5</math> dB.</p>	<p>Magnitude of the load:</p> <p>Load application point:</p> <p>Duration of the load:</p> <p>Method of mounting:</p> <p>Specimen optically functioning:</p> <p>Optical source wavelength:</p>	<p>During the test, the change in insertion loss shall be measured by test method IEC 61300-3-3.</p> <p>10 N <math>\pm</math> 1 N at 5 N/s for reinforced cables</p> <p>5,0 N <math>\pm</math> 0,5 N at 0,5 N/s for secondary coated fibres</p> <p>2,0 N <math>\pm</math> 0,2 N at 0,5 N/s for primary coated fibres</p> <p>0,3 m from point where the fibre/cable exits from the specimen.</p> <p>120 s duration at 10 N</p> <p>60 s duration at 2 N or 5 N</p> <p>The sample shall be rigidly mounted such that the load is only applied to the fibre/cable retention mechanism.</p> <p>Yes</p> <p>1 310 nm <math>\pm</math> 10 nm, 1 550 nm <math>\pm</math> 10 nm and/or 1 625 nm <math>\pm</math> 10 nm</p>
15	Torsion/twist IEC 61300-2-5	<p>Before and after the test, the insertion loss shall meet the requirements of testNo. 1.</p> <p>Before and after the test, the return loss shall meet the requirements of test No. 2.</p>	<p>Magnitude of the load:</p> <p>Rate of load application:</p> <p>Number of cycles:</p> <p>Specimen optically functioning:</p>	<p>5,0 N at 0,1 N/s for reinforced cables</p> <p>2,0 N at 0,1 N/s for primary and secondary coated fibres</p> <p>0,1 N/s</p> <p>10 cycles</p> <p><math>\pm 180^\circ</math> angular movement</p> <p>No</p>
16	Static side load <sup>a</sup> IEC 61300-2-42	<p>Before and after the test, the insertion loss shall meet the requirements of test 1.</p> <p>Before and after the test, the return loss shall meet the requirements of test 2.</p>	<p>Magnitude of the load:</p> <p>Load application point:</p> <p>Specimen optically functioning:</p>	<p>1 N for 1 h for reinforced cable</p> <p>0,2 N for 5 min for secondary coated fibres</p> <p>0,3 m from the end of the device and two mutually perpendicular directions as permitted by the product design.</p> <p>No</p>
<sup>a</sup> Static side load shall be applied in two mutually perpendicular directions as permitted by the product design. For example, a product with a base plate extending beyond the fibre exit may prohibit loading in that direction.				

## Annexe A (normative)

### Test sequencing for single-mode non-connectorized fixed attenuators, category U

IEC 60068-1 describes the background for test sequencing. Test sequencing is based on the premise that the effect one test parameter has on a specimen will depend on the previous test conditions to which the specimen has been exposed. Therefore, it is necessary to conduct the tests in a specific order.

The choice of the sequence of tests is a function of the intended objectives and depends upon a number of considerations. It is recognized that it is difficult to provide a standardized type approval test sequence for all types of passive optical components, however, category U attempts to overcome this issue.

The intention is to use certain tests which will reveal damage caused by previous tests and to design a test sequence which would induce significant effects in passive optical components intended for applications in an uncontrolled environment.

The test sequence for passive optical components for category U is given in Table A.1.

**Table A.1 – Test sequence for single-mode non-connectorized  
fixed attenuators, category U**

No.	Test	Sample size	Source
1	Insertion loss	12	New
2	Return Loss	12	Test 1
3	Polarization dependence of insertion loss	12	Test 2
4	High optical power	8	Test 3
5	Vibration (sinusoidal)	4	Test 3
6	Cold	4	Test 5
7	Dry heat – High temperature endurance	4	Test 6
8	Damp heat (cyclic)	4	Test 7
9	Change of temperature	4	Test 8
10	Dust	4	Test 9
11	Salt mist	4	Test 10
12	Shock	4	Test 11
13	Optical fibre cable flexing	4	Test 12
14	Fibre/cable retention	4	Test 13
15	Torsion/twist	4	Test 14
16	Static side load	4	Test 15
NOTE Tests 4 to 16 are performed in order; product is sourced as shown in the table.			

## Bibliography

IEC 60869-1, *Fibre optic interconnecting devices and passive components – Fibre optic passive power control devices – Part 1: Generic specification*

IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

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