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Fibre optic interconnecting devices and passive components – Performance standard –

Part 057-2: Single mode fibre plug-receptacle style optical fuse for category C – Controlled environment

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Dispositifs d'interconnexion et composants passifs fibroniques – Norme de performance

Partie 057-2: Fusible optique du type fiche-embase à fibre unimodale pour catégorie C – Environnement contrôlé





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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC INTERCONNECTING DEVICES
AND PASSIVE COMPONENTS –
PERFORMANCE STANDARD –**

**Part 057-2: Single mode fibre plug-receptacle
style optical fuse for category C –
Controlled environment**

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International Standard IEC 61753-057-2 has been prepared by subcommittee SC86B: Fibre optic interconnecting devices and passive components, of IEC technical committee TC86: Fibre optics.

This bilingual version (2019-07) corresponds to the monolingual English version, published in 2012-12.

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

FDIS	Report on voting
86B/3501/FDIS	86B/3545/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.

The French version of this standard has not been voted upon.

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.

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INTRODUCTION

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IEC takes no position concerning the evidence, validity and scope of this patent right.

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US patent US-7162,114 B2 "Optical Energy switching device and method", granted January 9,2007.

Japan patent 4376632 "Optical Energy switching device and method", granted September 18, 2009

The optical fuse is a passive device, designed to protect equipment and fibre cables from damage due to optical overpower, spikes and surges. The optical fuse produces a controlled, permanent, signal blocking at a predetermined power threshold in an optical fibre transmission line. The optical fuse is wavelength independent over its entire specified spectral range. IEC 60869-1 contains the generic information of the optical fuse. The optical fuse has a maximum allowed power input $P_{in\ max}$ that is allowed. Beyond this power it is dysfunctional and can let light through. Numerical values for $P_{in\ max}$ are given in Annex B.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 057-2: Single mode fibre plug-receptacle style optical fuse for category C – Controlled environment

1 Scope

This part of IEC 61753 contains the minimum initial test and measurement requirements and severities which a fibre optical fuse satisfies in order to be categorised as meeting the requirements of single mode fibre plug-receptacle style optical fuse used in controlled environments. Optical performance specified in this document relate to plug-receptacle style configuration fuses only.

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 specification for class B single-mode fibres* standards.iteh.ai/catalog/standards/sist/33ecef3-dae9-4b0e-b280-8491a654003b/iec-61753-057-2-2012

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

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 61300-2-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-6: Tests – Tensile strength of coupling mechanism*

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*¹

IEC 61300-2-17, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-17: Tests – Cold*

¹ To be published.

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 61300-2-19, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-19: Tests – Damp heat (steady state)*

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

IEC 61300-3-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-2: Examinations 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 61300-3-4, *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 61300-3-7, *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*

IEC 61300-3-32, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-32: Examinations and measurements – Polarization mode dispersion measurement for passive optical components*

IEC 61754 series, *Fibre optic connector interfaces*

IEC 61755 series, *Fibre optic connector optical interfaces*

IEC/TR 62627-02:2010, *Fibre optic interconnecting devices and passive components – Part 02: Report of round robin test results on SC plug style fixed attenuators*

3 Tests

All test methods are in accordance with the IEC 61300 series.

Some tests require the use of reference connector plugs and reference connector adaptors. These are specified in Annex C. It is essential and recommended that all connector, plugs and reference connector adaptors be inspected and cleaned if dirty and checked again, according to manufacturers' instructions, prior to every mating in all tests.

All tests are to be carried out to validate performance over the required operating wavelength and power range. As a result, single or multiple spectral bands may be chosen for the qualification in addition to threshold power.

4 Test reports

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

Sample sizes for the tests are defined in Annex A.

5.2 Dimensions

Dimensions of mechanical interface for mating, plug and receptacle size, shall comply with IEC optical connector interface standard IEC 61754 series and IEC optical interface standard IEC 61755 series. Other dimensions shall comply with those given in appropriate manufacturer's drawings.

When implementing this standard be aware that there have been problems when using a rigid interface component with SC plug style adaptors and plugs. See Clause 6 of IEC/TR 62627-02:2010.

5.3 Test details and requirements

Table 1 specifies the optical, environment and mechanical performance requirements and related test methods for optical fuses.

Compliance to this standard requires demonstration of the ability to meet the performance requirement in Table 1.

Table 1 – Performance requirements for optical fuses (1 of 8)

No.	Test	Requirement	Details	
1	Insertion loss	Operating wavelength range: 1 520 nm to 1 625 nm Insertion loss $\leq 1,5$ dB Insertion loss is measured with input power ≤ -5 dBm	Method: Launch patchcord length: Other requirements: Launch conditions: Source power stability: Wavelength range: Total uncertainty	IEC 61300-3-7, Method B2.1, test sample configuration according to IEC 61300-3-4 substitution method ≥ 2 m. Only the fundamental mode shall propagate at the fuse interface and at the detector. This test shall be performed against a reference plug ^{1,2} and reference adaptor. The wavelength of the source shall be longer than cut-off wavelength of the fibre. $\leq \pm 0,05$ dB over the measuring period or at least 1 h 1 520 nm to 1 625 nm $\leq \pm 0,05$ dB

Table 1 (2 of 8)

No.	Test	Requirement	Details	
2	Return loss Below power threshold	≥ 35 dB Grade T ≥ 40 dB Grade R ≥ 50 dB Grade U ≥ 60 dB Grade V Return loss is measured with input power ≤ -5 dBm	Method: Optical source Wavelength: Total uncertainty	IEC 61300-3-6 (Against 2 reference plugs ¹) measurement method 1, OCWR for grades T,R, U IEC 61300-3-6 (Against 2 reference plugs ¹) measurement method 1, OFDR for grade V 1 520 nm and 1 625 nm Test every sample with the two wavelengths. $\leq \pm 2$ dB
3	Return loss Above power threshold, after fuse response	≥ 30 dB Return loss is measured with input power ≤ -5 dBm	Method: Optical source Wavelength: Total uncertainty	IEC 61300-3-6 (Against 2 reference plugs ¹) measurement method 1, OCWR 1 520 nm and 1 625 nm Test every sample with the two wavelengths. $\leq \pm 2$ dB
4	Polarization Dependent Loss	$\leq 0,2$ dB Over the specified operating wavelength The samples shall be terminated onto single-mode fibres as per IEC 60793-2-50, Type B 1.1, in either coated fibres (primary and secondary) or reinforced cable format	Method: Optical source Wavelength: Total uncertainty	IEC 61300-3-2, all polarization method 1 550 nm \pm 10 nm $\leq \pm 0,05$ dB over the dynamic range to be measured
5	Polarization mode dispersion	$\leq 0,2$ ps (Max value) Over the specified operating wavelength range	Method: Optical source Wavelength: Detector linearity:	IEC 61300-3-32, MPS method 1 550 nm \pm 10 nm $\pm 0,05$ dB over the dynamic range to be measured
6	High optical power Below power threshold	The fuse will not change its insertion and return loss up to power threshold Before and after the test the Insertion loss shall meet the requirements of test 1 Before and after the test the return loss shall meet the requirements of test 2 The insertion loss change during the test shall be within $\pm 0,5$ dB of the initial value.	Method: Optical source Wavelength: Test power: Test temperature: Test duration:	IEC 61300-2-14 1 550 nm \pm 10 nm 3 dB below power threshold 25 °C \pm 2 °C Duration of long-term test: 96 h at test power

Table 1 (3 of 8)

No.	Test	Requirement	Details	
7	High optical power Above power threshold (Destructive test)	The fuse will block the power from power threshold to ≥ 30 dBm input power or higher value specified in Annex B Before the test the Insertion loss shall meet the requirements of test 1 After and during the test the Insertion loss shall meet the requirements of test 9 Before and after the test the return loss shall meet the requirements of test 2	Method: Optical source Wavelength: Test power: Test temperature: Test duration:	IEC 61300-2-14 1 550 nm \pm 10 nm 3 dB above power threshold 25 °C \pm 2 °C Duration of long-term test: 96 h at test power
8	Power threshold (Destructive test)	The tolerance is \pm 1 dB from the specified optical fuse power threshold The fuse will meet the power threshold requirements as specified when operated at the 3 specified temperatures	Method: Optical source Wavelength: Test temperature:	See Annex E for detailed test description. The test power input is 1 dB to 3 dB above power threshold and the blocking attenuation is measured accordingly. Samples from every batch will be destructively tested, all will comply. 1 550 nm 10 °C \pm 2 °C 25 °C \pm 2 °C 60 °C \pm 2 °C
9	Blocking attenuation at threshold (destructive test)	> 30 dB The fuse will meet the requirement as specified, when operated at the 3 specified temperatures for the specified duration	Method: Optical source Wavelength: Test duration: Test temperature:	See Annex E for detailed test description. The test power input is 1 dB to 3 dB above power threshold and the blocking attenuation is measured accordingly. Samples from every batch will be destructively tested, all will comply. 1 550 nm 96 h at test power 10 °C \pm 2 °C 25 °C \pm 2 °C 60 °C \pm 2 °C

Table 1 (4 of 8)

No.	Test	Requirement	Details	
10	Response time	< 100 μ s The fuse will meet the requirement as specified, when operated at the 3 specified temperatures	Method: Optical source Wavelength: Test temperature:	See Annex E for detailed test description. The test power input is 1 dB to 3 dB above power threshold and the blocking attenuation is measured accordingly. Samples from every batch will be destructively tested, all will comply. 1 550 nm 10 °C \pm 2 °C 25 °C \pm 2 °C 60 °C \pm 2 °C
11	Damp heat (steady state)	By the end of the test the insertion loss shall meet the requirements of test 1 By the end of the test the return loss shall meet the requirements of test 2 The insertion loss change during the test shall be within \pm 0,5 dB of the initial value. Insertion loss is measured with input power \leq -5 dBm After the test the power threshold shall meet the requirements of test 8	Method: Pre conditioning procedure: Temperature: Relative Humidity: Duration of exposure: Specimen optically functioning: Optical source Wavelength: Optical power: Recovery procedure:	IEC 61300-2-19 During the test the change in Insertion loss shall be measured by test method IEC 61300-3-3. Standard atmospheric conditions as defined in IEC 61300-1 for 2 hours + 40 \pm 2 °C 93 % $\begin{matrix} +2 \\ -3 \end{matrix}$ RH 96 h Yes 1 550 nm 3 dB lower than power threshold, as defined in Annex B Allow specimens to return to standard atmospheric conditions defined in IEC 61300-1 in 2 h.

Table 1 (5 of 8)

No.	Test	Requirement	Details	
12	Change of temperature	<p>By the end of the test the Insertion loss shall meet the requirements of test 1</p> <p>By the end of the test the return loss shall meet the requirements of test 2</p> <p>The insertion loss change during the test shall be within $\pm 0,5$ dB of the initial value. Insertion loss is measured with input power ≤ -5 dBm</p> <p>After the test the power threshold shall meet the requirements of test 8</p>	<p>Method:</p> <p>Pre conditioning procedure:</p> <p>High Temperature:</p> <p>Low temperature:</p> <p>Number of cycles:</p> <p>Temperature rate of change:</p> <p>Duration at extreme temperatures:</p> <p>Specimen optically functioning:</p> <p>Optical source Wavelength:</p> <p>Optical power:</p> <p>Maximum sampling interval during the test:</p> <p>Recovery procedure:</p>	<p>IEC 61300-2-22</p> <p>During the test the change in Insertion loss shall be measured by test method IEC 61300-3-3.</p> <p>Standard atmospheric conditions as defined in IEC 61300-1 for 2 h</p> <p>$+60 \pm 2$ °C</p> <p>-10 ± 2 °C</p> <p>5</p> <p>1 °C/min</p> <p>1 h</p> <p>Yes</p> <p>1 550 nm</p> <p>3 dB lower than power threshold, as defined in Annex B</p> <p>15 min</p> <p>Allow specimen to return to standard atmospheric conditions in IEC 61300-1 for in 2 h.</p>
13	Dry heat-high temperature endurance	<p>By the end of the test the insertion loss requirements of test No. 1 shall be met</p> <p>By the end of the test the return loss requirement of test No. 2 shall be met</p> <p>The insertion loss change during the test shall be within $\pm 0,5$ dB of the initial value. Insertion loss is measured with input power ≤ -5 dBm</p> <p>After the test the power threshold shall meet the requirements of test 8</p>	<p>Method:</p> <p>Pre-conditioning procedure:</p> <p>Specimen optically functioning:</p> <p>Temperature:</p> <p>Duration of the exposure:</p> <p>Optical source Wavelength:</p> <p>Maximum sampling interval during the test:</p> <p>Recovery procedure:</p>	<p>IEC 61300-2-18</p> <p>During the test the change in insertion loss shall be measured. By test method IEC 61300-3-3.</p> <p>Standard atmospheric conditions as defined in IEC 61300-1 for 2 h</p> <p>Yes</p> <p>$+60$ °C ± 2 °C</p> <p>96 h</p> <p>1 550 nm</p> <p>1 h</p> <p>Allow specimen to return to standard atmospheric conditions in IEC 61300-1 for in 2 h.</p>

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Table 1 (6 of 8)

No.	Test	Requirement	Details	
14	Cold	<p>By the end of the test the Insertion loss shall meet the requirements of test 1</p> <p>By the end of the test the return loss shall meet the requirements of test 2</p> <p>The insertion loss change during the test shall be within $\pm 0,5$ dB of the initial value. Insertion loss is measured with input power ≤ -5 dBm</p> <p>After the test the power threshold shall meet the requirements of test 8</p>	<p>Method:</p> <p>Pre-conditioning procedure:</p> <p>Specimen optically functioning:</p> <p>Temperature:</p> <p>Duration of the exposure:</p> <p>Optical source Wavelength:</p> <p>Optical power:</p> <p>Maximum sampling interval during the test:</p> <p>Recovery procedure:</p>	<p>IEC 61300-2-17</p> <p>During the test the change in Insertion loss shall be measured by test method IEC 61300-3-3.</p> <p>Standard atmospheric conditions as defined in IEC 61300-1 for 2 h</p> <p>Yes</p> <p>-10 °C ± 2 °C</p> <p>96 h</p> <p>1 550 nm</p> <p>3 dB lower than power threshold, as defined in Annex B</p> <p>1 h</p> <p>Allow specimen to return to standard atmospheric conditions in IEC 61300-1 for in 2 h.</p>
15	Vibration (sinusoidal)	<p>After the test the insertion loss shall meet the requirements of test 1</p> <p>After the test the return loss shall meet the requirements of test 2</p> <p>The insertion loss change between value before test and value after test shall be within $\pm 0,5$ dB of the initial value. Insertion loss is measured with input power ≤ -5 dBm</p> <p>After the test the power threshold shall meet the requirements of test 8</p>	<p>Method:</p> <p>Frequency range:</p> <p>Vibration amplitude:</p> <p>Number of cycles:</p> <p>Rate of change:</p> <p>Number of axes:</p> <p>Specimen optically functioning:</p> <p>Optical source Wavelength:</p> <p>Optical power:</p>	<p>IEC 61300-2-1</p> <p>During the test the change in Insertion loss shall be measured by test method IEC 61300-3-3.</p> <p>10 Hz to 55 Hz</p> <p>0,75 mm</p> <p>15</p> <p>1 octave/min</p> <p>3 orthogonal axes</p> <p>No</p> <p>1 550 nm</p> <p>3 dB lower than power threshold, as defined in Annex B</p>