

# INTERNATIONAL STANDARD



Fibre optic interconnecting devices and passive components – Performance standard –

Part 061-2: ~~Non-connectorized~~ Single-mode fibre optic pigtailed style polarization independent isolators for category C – Controlled environments



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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 33.180.10

ISBN 978-2-8322-8188-8

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

#### Part 061-2: ~~Non-connectorized~~ Single-mode fibre optic pigtailed **polarization independent** isolators for category C – Controlled environments

#### FOREWORD

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International Standard IEC 61753-061-2 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 2012 and constitutes a technical revision.

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

- a) addition of the detail high optical power test procedures and the condition in Annex B;
- b) change of test conditions harmonizing with IEC 61753-1:2018;
- c) addition of category C<sup>HD</sup>;
- d) addition of the detailed measurements conditions in Annex C;
- e) change of clause structure accordance with the latest ISO/IEC Directives, Part 2.

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

| FDIS          | Report on voting |
|---------------|------------------|
| 86B/4270/FDIS | 86B/4284/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 of 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 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 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

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- withdrawn,
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## FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

### Part 061-2: ~~Non-connectorized~~ Single-mode fibre optic pigtailed **style polarization independent** isolators for category C – Controlled environments

## 1 Scope

This part of IEC 61753 contains the minimum test and measurement requirements and severities which a fibre optic isolator as specified by IEC 61202-1 ~~should satisfy~~ **satisfies** in order to be categorized as meeting the requirements of isolators used in controlled environments as specified in IEC 61753-1. The requirements cover ~~non-connectorized~~ single-mode ~~fibre optic~~ pigtailed **style polarization independent** isolators for category C used in controlled environments.

## 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 60793-2-50:~~2008~~, *Optical fibres – Part 2-50: Product specifications – Sectional specification 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 61202-1, *Fibre optic interconnecting devices and passive components – Fibre optic isolators – Part 1: Generic specification*

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 61300-2-5, *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<sup>1</sup>, *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*

<sup>1</sup> ~~A new third edition is due 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 61300-2-42, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-42: Tests – Static side load for ~~connectors~~ 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 61300-3-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-2: Examinations and measurements – Polarization dependence 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*

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 TS 62627-09, *Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61202-1 and IEC TS 62627-09 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>

### 4 Test

All test methods are in accordance with a specific standard of the IEC 61300 series, of which parts applicable to this document are mentioned in 6.2 (see Table 2 and Table 3).

The samples shall be terminated onto single-mode fibres as per IEC 60793-2-50:2008 category ~~B1.1, B1.3 or B6~~ B-652.B, B-652.D or B-657 in either coated fibres (primary and secondary) or reinforced cable format as per IEC 60794-2-50.

Table 1 is intended to provide guidance on the wavelength ranges of the various spectral bands. It is not intended for specification. Values of operating wavelength used in performance verification shall be specified between the customer and supplier or shall be as defined in the manufacturer's specification.

**Table 1 – Single-mode spectral bands**

| Band                                                        | Descriptor           | Range<br>nm    |
|-------------------------------------------------------------|----------------------|----------------|
| O-band                                                      | Original             | 1 260 to 1 360 |
| E-band                                                      | Extended             | 1 360 to 1 460 |
| S-band                                                      | Short wavelength     | 1 460 to 1 530 |
| C-band                                                      | Conventional         | 1 530 to 1 565 |
| L-band                                                      | Long wavelength      | 1 565 to 1 625 |
| U-band                                                      | Ultralong wavelength | 1 625 to 1 675 |
| Source: ITU-T G.Supplement 39- <del>14</del> <sup>2</sup> . |                      |                |

## 5 Test report

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

## 6 Performance requirements

### 6.1 Sample size

Sample sizes for the tests are defined in Annex A.

### 6.2 Test details and requirements

A minimum length of fibre or cable of 2,0 m per port shall be ~~included in~~ prepared for all ~~climatic and environmental~~ tests.

Test details and requirements for category C and C<sup>HD</sup> are shown in Table 2 and Table 3, respectively. An example of test details and requirements including detailed measurements conditions is shown in Annex C (informative).

<sup>2</sup>—Numbers in square brackets refer to the Bibliography

**Table 2 – Test details and requirements**

| No | Tests                                          | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Details                                                                                                             |                                                                                                                                                                                                                                                                                                                                          |
|----|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Attenuation (insertion loss)<br>IEC 61300-3-7  | $\leq 0,7$ dB (single stage)<br>$\leq 0,8$ dB (double stage)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Launch fibre length:<br>Polarization state<br>Measurement uncertainty                                               | $\geq 2,0$ m<br>Any polarization<br>$\pm 0,1$ dB                                                                                                                                                                                                                                                                                         |
| 2  | Isolation<br>IEC 61300-3-7                     | $\geq 20$ dB (single stage)<br>$\geq 40$ dB (double stage)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Launch fibre length:<br>Polarization state<br>Measurement uncertainty<br>Note                                       | $\geq 2,0$ m<br>Any polarization<br>$\pm 0,3$ dB (single stage)<br>$\pm 0,5$ dB (double stage)<br>IEC 61300-3-7 defines the method to measure insertion loss. However it can apply to the measurement of isolation, because in the case of an isolator, isolation is the insertion loss measured in the opposite direction to test no. 1 |
| 3  | Return loss<br>IEC 61300-3-7                   | $\geq 55$ dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Launch fibre length:<br>Polarization state<br>Measurement uncertainty<br>Note                                       | $\geq 2,0$ m<br>Any polarization<br>$\pm 1$ dB<br>All ports not under test shall be optically terminated to avoid unwanted reflections contributing to the measurement                                                                                                                                                                   |
| 4  | Polarization dependent loss<br>IEC 61300-3-2   | $\leq 0,10$ dB (single stage)<br>$\leq 0,15$ dB (double stage)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Launch fibre length:<br>Measurement uncertainty                                                                     | $\geq 2,0$ m<br>$\pm 0,02$ dB                                                                                                                                                                                                                                                                                                            |
| 5  | Polarization mode dispersion<br>IEC 61300-3-32 | $\leq 0,20$ ps (single stage)<br>$\leq 0,10$ ps (double stage)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Launch fibre length:<br>Measurement uncertainty                                                                     | $\geq 2,0$ m<br>$\pm 0,05$ ps                                                                                                                                                                                                                                                                                                            |
| 6  | High optical power<br>IEC 61300-2-14           | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br><br>During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within $\pm 0,3$ dB of the initial value.<br><br>During the test, the isolation change is monitored. The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2.<br><br>During the test, the return loss change is monitored. The sum of the initial value and the change of the return loss shall be within the value defined at test no. 3 | Optical power<br>Wavelength<br>Duration of the optical power exposure<br>Temperature:<br>Relative humidity:<br>Note | 300 mW<br>1 550 nm<br>30 min<br>$60^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>$93\% \pm 2\text{RH}$<br>$-3$<br>A different wavelength is acceptable when there is a negotiation between customer and supplier                                                                                                                            |
| 7  | Cold<br>IEC 61300-2-17                         | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Temperature:<br>Duration of exposure:                                                                               | $-10^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>96 h                                                                                                                                                                                                                                                                                      |

|    |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                   |                                                                                                                         |
|----|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
|    |                                              | shall be met.<br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                   |                                                                                                                         |
| 8  | High temperature endurance<br>IEC 61300-2-18 | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value                                                                                                                                                                                                                                           | Temperature:<br>Duration of exposure:                                                                             | $+60^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>96 h                                                                     |
| 9  | Damp heat (steady state)<br>IEC 61300-2-19   | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br>During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within $\pm 0,3$ dB of the initial value.<br>During the test, the isolation change is monitored. The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2 | Temperature:<br>Relative humidity:<br>Duration of exposure:                                                       | $+40 \pm 2^{\circ}\text{C}$<br>$93\% \pm \frac{2}{-3}\text{RH}$<br>96 h                                                 |
| 10 | Change of temperature<br>IEC 61300-2-22      | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br>During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within $\pm 0,3$ dB of the initial value.<br>During the test, the isolation change is monitored. The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2 | High temperature:<br>Low temperature:<br>Number of cycles:<br>Duration at extreme temperature:<br>Rate of change: | $+60 \pm 2^{\circ}\text{C}$<br>$-10 \pm 2^{\circ}\text{C}$<br>Cycles 5<br>60 min<br>$1^{\circ}\text{C/min}$             |
| 11 | Vibration<br>IEC 61300-2-1<br>IEC 61300-3-28 | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br>During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within $\pm 0,3$ dB of the initial value.<br>During the test, the isolation change is monitored. The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2 | Frequency range:<br>Number of axes:<br>Number of sweeps:<br>Sweep rate:<br>Amplitude:                             | 10 Hz – 55 Hz<br>3 orthogonal axes<br>15 /axis<br>1 octave/min<br>0,75 mm                                               |
| 12 |                                              | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value                                                                                                                                                                                                                                           | Acceleration:<br>Duration:<br>Number of axis:<br>Number of shocks:                                                | $5\text{--}000\text{ m/s}^2$<br>1 ms, half sine pulse<br>3 axes in 2 directions<br>2 shocks per axis, 12 shock in total |
| 13 | Optical fibre                                | Before and after the test, the limits                                                                                                                                                                                                                                                                                                                                                                                                                           | Tensile force:                                                                                                    | 2 N for reinforced cable                                                                                                |

|    |                                        |                                                                                                                                                                                                                           |                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | cable flexing<br>IEC 61300-2-44        | of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value                                       | Number of cycles:                                                                                                                      | 30 cycles $\pm 90^\circ$                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 14 | Fibre/cable retention<br>IEC 61300-2-4 | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value | Magnitude and rate of application:<br><br><br>Duration of the test<br><br>Point of application of tensile load:<br>Method of mounting: | ( $10 \pm 1$ ) N at 5 N/s for reinforced cables.<br><br>( $5,0 \pm 0,5$ ) N at 0,5 N/s for secondary-coated fibres.<br><br>( $2,0 \pm 0,2$ ) N at 0,5 N/s for primary-coated fibres.<br><br>120 s duration at 10 N.<br><br>60 s duration at 2 N or 5 N.<br><br>0,3 m from the exit point of the fibre / cable from the specimen.<br><br>The sample shall be rigidly mounted such that the load is only applied to the fibre/cable retention mechanism |
| 15 | Static side load<br>IEC 61300-2-42     | Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value | Magnitude and duration of the tensile load:<br><br>Direction of application:                                                           | 1 N for 1 h for reinforced cable<br>0,2 N for 5 min for secondary coated fibres<br><br>Two mutually perpendicular directions                                                                                                                                                                                                                                                                                                                          |

**Table 2 – Test details and requirements for category C**

| No | Tests                                                                                    | Requirements                                                   | Details                  |                                                                                                                                                                                                                                                                                                                                                               |
|----|------------------------------------------------------------------------------------------|----------------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                          |                                                                |                          |                                                                                                                                                                                                                                                                                                                                                               |
| 1  | Insertion loss (attenuation)<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Refer Table C.1, No.1. | $\leq 0,7$ dB (single stage)<br>$\leq 0,8$ dB (double stage)   | Launch fibre length:     | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                                  |
|    |                                                                                          |                                                                | Condition:               | Insertion loss (attenuation) shall be met over operating wavelength range and all state of polarization (SOP).                                                                                                                                                                                                                                                |
|    |                                                                                          |                                                                | Measurement uncertainty: | $\leq 0,1$ dB                                                                                                                                                                                                                                                                                                                                                 |
| 2  | Isolation<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Refer Table C.1, No.2.                    | $\geq 20$ dB (single stage)<br>$\geq 40$ dB (double stage)     | Launch fibre length:     | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                                  |
|    |                                                                                          |                                                                | Condition:               | Isolation shall be met over operating wavelength range and all SOP.                                                                                                                                                                                                                                                                                           |
|    |                                                                                          |                                                                | Measurement uncertainty: | $\leq 0,3$ dB (single stage)<br>$\leq 0,5$ dB (double stage)<br><br>NOTE IEC 61300-3-7 is the test method to measure the wavelength dependence of attenuation. However, it can apply to the measurement of isolation, because in the case of an isolator, isolation is the wavelength dependent attenuation measured in the opposite direction to test no. 1. |
| 3  | Return loss<br>IEC 61300-3-7<br>Refer Table C.1, No.3.                                   | $\geq 55$ dB                                                   | Launch fibre length:     | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                                  |
|    |                                                                                          |                                                                | Condition:               | Return loss shall be met over operating wavelength range.                                                                                                                                                                                                                                                                                                     |
|    |                                                                                          |                                                                | Measurement uncertainty: | $\leq 1$ dB<br><br>The port not under test shall be optically terminated to avoid unwanted reflections contributing to the measurement.                                                                                                                                                                                                                       |
| 4  | Polarization dependent loss<br>PDL<br>IEC 61300-3-2                                      | $\leq 0,10$ dB (single stage)<br>$\leq 0,15$ dB (double stage) | Launch fibre length:     | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                                  |
|    |                                                                                          |                                                                | Condition:               | PDL shall be met over operating wavelength range.                                                                                                                                                                                                                                                                                                             |
|    |                                                                                          |                                                                | Measurement uncertainty: | $\leq 0,02$ dB                                                                                                                                                                                                                                                                                                                                                |
| 5  | Polarization mode dispersion<br>PMD<br>IEC 61300-3-32                                    | $\leq 0,20$ ps (single stage)<br>$\leq 0,10$ ps (double stage) | Launch fibre length:     | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                                  |
|    |                                                                                          |                                                                | Measurement uncertainty: | $\leq 0,05$ ps                                                                                                                                                                                                                                                                                                                                                |
|    |                                                                                          |                                                                |                          |                                                                                                                                                                                                                                                                                                                                                               |

| No | Tests                                                                        | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                 |
|----|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| 6  | High optical power<br>IEC 61300-2-14<br>IEC 61300-3-3<br>Refer Annex B.      | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>During the forward input test, the insertion loss (attenuation) change is monitored. During and after the test, the insertion loss change shall be within <math>\pm 0,3</math> dB of the initial value.</p> <p>During the backward input test, the isolation change is monitored. The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2.</p> <p>During the forward input test, the return loss change is monitored. The sum of the initial value and the change of the return loss shall be within the value defined at test no. 3.</p> <p>The insertion loss (attenuation), isolation and return loss shall be measured after launching an optical power of 300 mW simultaneously in both forward and backward directions. After the test, the insertion loss change shall be within <math>\pm 0,3</math> dB of the initial value. After the test, the sum of the initial value and the change of the isolation shall be within the value defined at test no. 2. After the test, the sum of the initial value and the change of the return loss shall be within the value defined at test no. 3.</p> | <p>Test set-up and procedure:</p> <p>Optical power: 300 mW</p> <p>SOP of the light source: Average SOP (depolarized)</p> <p>Wavelength: 1 550 nm for C-band<br/>1 580 nm for L-band</p> <p>NOTE A different wavelength is acceptable when there is a negotiation between customer and supplier.</p> <p>Duration of the optical power exposure: 30 min</p> <p>Temperature: <math>60^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></p> <p>Relative humidity: <math>93\% \pm 2\text{RH}</math><sub>-3</sub></p> | Annex B                                                         |
|    |                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | NOTE This test condition focuses to standard optical isolators. |
| 7  | Cold<br>IEC 61300-2-17                                                       | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>The insertion loss change after the test shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p>Temperature: <math>-10^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></p> <p>Duration of exposure: 96 h</p>                                                                                                                                                                                                                                                                                                                                                                                                |                                                                 |
| 8  | Dry heat – High temperature endurance<br>IEC 61300-2-18                      | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>The insertion loss (attenuation) change after the test shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>Temperature: <math>+60^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></p> <p>Duration of exposure: 96 h</p>                                                                                                                                                                                                                                                                                                                                                                                                |                                                                 |
| 9  | Damp heat (steady state)<br>IEC 61300-2-19<br>IEC 61300-3-3<br>Refer Annex C | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>During and after the test, the insertion loss (attenuation) change shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>Temperature: <math>+40^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></p> <p>Relative humidity: <math>93\% \pm 2\text{RH}</math><sub>-3</sub></p> <p>Duration of exposure: 96 h</p>                                                                                                                                                                                                                                                                                                                        |                                                                 |

| No | Tests                                                                     | Requirements                                                                                                                                                                                                                                                                                                                                                                                    | Details                                                                                                           |                                                                                                                                                                             |
|----|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 | Change of temperature<br>IEC 61300-2-22<br>IEC 61300-3-3<br>Refer Annex C | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.<br><br>The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2. | High temperature:<br>Low temperature:<br>Number of cycles:<br>Duration at extreme temperature:<br>Rate of change: | $+60^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>$-10^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>Cycles 5<br>60 min<br>$1^{\circ}\text{C} / \text{min}$                        |
| 11 | Vibration<br>IEC 61300-2-1<br>IEC 61300-3-28<br>Refer Annex C             | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                      | Frequency range:<br>Number of axes:<br>Number of sweeps:<br>Sweep rate:<br>Amplitude:                             | 10 Hz to 55 Hz<br>3 orthogonal axes<br>15 /axis<br>1 octave/min<br>0,75 mm                                                                                                  |
| 12 | Shock<br>IEC 61300-2-9                                                    | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value.                                                                                                                                                | Acceleration:<br>Duration:<br>Number of axis:<br>Number of shocks:                                                | $5\,000\text{ m/s}^2$<br>1 ms, half sine pulse<br>3 axes in 2 directions<br>2 shocks per axis, 12 shocks in total                                                           |
| 13 | Flexing of the strain relief of fibre optic devices<br>IEC 61300-2-44     | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value                                                                                                                                   | Tensile force:<br>Number of cycles:<br>Angle:                                                                     | 2 N for reinforced cable<br>50 cycles<br>$\pm 90^{\circ}$                                                                                                                   |
| 14 | Fibre/cable retention<br>IEC 61300-2-4                                    | Before and after the test, the limits of insertion loss (attenuation), isolation and return loss of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                               | Magnitude and rate of application:<br><br><br>Duration of the test:                                               | 10 N $\pm$ 1 N at 5 N/s for reinforced cables<br>5,0 N $\pm$ 0,5 N at 0,5 N/s for secondary coated fibres<br>2,0 N $\pm$ 0,2 N at 0,5 N/s for primary coated fibres<br>60 s |
| 15 | Static side load<br>IEC 61300-2-42                                        | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value.                                                                                                                                                | Magnitude and duration of the tensile load:<br><br>Direction of application:                                      | 1 N for 1 h for reinforced cable<br>0,2 N for 5 min for secondary coated fibres<br>Two mutually perpendicular directions                                                    |
| 16 | Torsion<br>IEC 61300-2-5                                                  | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value.                                                                                                                                  | Magnitude of the torsion/twist:<br><br>Angle and cycles:<br><br>Test condition:                                   | Load: 5 N for cables<br>2,0 N for primary coated and buffered fibres<br>Angle: $\pm 180^{\circ}$<br>Number of cycles: 10<br>Fibre/cable clamping distance: 25 cm $\pm$ 5 cm |

**Table 3 – Test details and requirements for category C<sup>HD</sup>**

| No | Tests                                                                                          | Requirements                                         | Details                                                           |                                                                                                                                                                                                                                                                                                                                                                                       |
|----|------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Insertion loss<br>(attenuation)<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Refer Table C.1,<br>No.1. | ≤ 0,7 dB (single stage)<br>≤ 0,8 dB (double stage)   | Launch fibre length:<br>Condition:<br>Measurement<br>uncertainty: | ≥ 2,0 m<br>Attenuation (insertion loss) shall be met over operating wavelength range and all state of polarization (SOP).<br>≤ 0,1 dB                                                                                                                                                                                                                                                 |
| 2  | Isolation<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Refer Table C.1,<br>No.2.                       | ≥ 20 dB (single stage)<br>≥ 40 dB (double stage)     | Launch fibre length:<br>Condition:<br>Measurement<br>uncertainty: | ≥ 2,0 m<br>Isolation shall be met over operating wavelength range and all SOP.<br>≤ 0,3 dB (single stage)<br>≤ 0,5 dB (double stage)<br>NOTE IEC 61300-3-7 defines the method to measure insertion loss. However, it can apply to the measurement of isolation, because in the case of an isolator, isolation is the insertion loss measured in the opposite direction to test no. 1. |
| 3  | Return loss<br>IEC 61300-3-7<br>Refer Table C.1,<br>No.3.                                      | ≥ 55 dB                                              | Launch fibre length:<br>Condition:<br>Measurement<br>uncertainty: | ≥ 2,0 m<br>Return loss shall be met over operating wavelength range.<br>≤ 1 dB<br>The port not under test shall be optically terminated to avoid unwanted reflections contributing to the measurement                                                                                                                                                                                 |
| 4  | Polarization<br>dependent loss<br>IEC 61300-3-2                                                | ≤ 0,10 dB (single stage)<br>≤ 0,15 dB (double stage) | Launch fibre length:<br>Condition:<br>Measurement<br>uncertainty: | ≥ 2,0 m<br>PDL shall be met over operating wavelength range.<br>≤ 0,02 dB                                                                                                                                                                                                                                                                                                             |
| 5  | Polarization<br>mode dispersion<br>IEC 61300-3-32                                              | ≤ 0,20 ps (single stage)<br>≤ 0,10 ps (double stage) | Launch fibre length:<br>Measurement<br>uncertainty:               | ≥ 2,0 m<br>≤ 0,05 ps                                                                                                                                                                                                                                                                                                                                                                  |

| No | Tests                                                                   | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Details                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                     |
|----|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6  | High optical power<br>IEC 61300-2-14<br>IEC 61300-3-3<br>Refer Annex B. | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>During the forward input test, the insertion loss (attenuation) change is monitored. During and after the test, the insertion loss (attenuation) change shall be within <math>\pm 0,3</math> dB of the initial value.</p> <p>During the backward input test, the isolation change is monitored. The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2.</p> <p>During the forward input test, the return loss change is monitored. The sum of the initial value and the change of the return loss shall be within the value defined at test no. 3.</p> <p>The insertion loss (attenuation), isolation and return loss shall be measured after launching an optical power of 300 mW simultaneously in both forward and backward directions. After the test, the insertion loss (attenuation) change shall be within <math>\pm 0,3</math> dB of the initial value. After the test, the sum of the initial value and the change of the isolation shall be within the value defined at test no. 2. After the test, the sum of the initial value and the change of the return loss shall be within the value defined at test no. 3.</p> | Test set-up and procedure:<br><br>Optical power:<br><br>SOP of the light source:<br><br>Wavelength:<br><br><br><br><br>Duration of the optical power exposure:<br><br>Temperature:<br><br>Relative humidity: | Annex B<br><br>300 mW<br><br>Average SOP (depolarized)<br><br>1 550 nm for C-band<br>1 580 nm for L-band<br><br>NOTE A different wavelength is acceptable when there is a negotiation between customer and supplier<br><br>30 min<br><br>60 °C $\pm$ 2 °C<br>93 % $\pm 2$ RH<br><br>NOTE This test condition focuses to standard optical isolators. |
| 7  | Cold<br>IEC 61300-2-17                                                  | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>The insertion loss (attenuation) change after the test shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Temperature:<br><br>Duration of exposure:                                                                                                                                                                    | -10 °C $\pm$ 2 °C<br><br>96 h                                                                                                                                                                                                                                                                                                                       |
| 8  | High temperature endurance<br>IEC 61300-2-18                            | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>The insertion loss (attenuation) change after the test shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Temperature:<br><br>Duration of exposure:                                                                                                                                                                    | +70 °C $\pm$ 2 °C<br><br>96 h                                                                                                                                                                                                                                                                                                                       |

| No | Tests                                                                        | Requirements                                                                                                                                                                                                                                                                                                                                                                                    | Details                                                                                                           |                                                                                                                                                                                                                           |
|----|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9  | Damp heat (steady state)<br>IEC 61300-2-19<br>IEC 61300-3-3<br>Reger Annex C | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                      | Temperature:<br>Relative humidity:<br><br>Duration of exposure:                                                   | $+40^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>$93\% \pm 2\text{RH}$<br>$-3$<br>96 h                                                                                                                                      |
| 10 | Change of temperature<br>IEC 61300-2-22<br>IEC 61300-3-3<br>Refer Annex C    | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.<br><br>The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2. | High temperature:<br>Low temperature:<br>Number of cycles:<br>Duration at extreme temperature:<br>Rate of change: | $+70^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>$-10^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>Cycles 5<br>60 min<br>$1^{\circ}\text{C/min}$                                                                               |
| 11 | Vibration<br>IEC 61300-2-1<br>IEC 61300-3-28<br>Refer Annex C.               | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                      | Frequency range:<br>Number of axes:<br>Number of sweeps:<br>Sweep rate:<br>Amplitude:                             | 50 Hz to 55 Hz<br>3 orthogonal axes<br>15 /axis<br>1 octave/min<br>0,75 mm                                                                                                                                                |
| 12 | Shock<br>IEC 61300-2-9                                                       | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value.                                                                                                                                  | Acceleration:<br>Duration:<br>Number of axis:<br>Number of shocks:                                                | $5\,000\text{ m/s}^2$<br>1 ms, half sine pulse<br>3 axes in 2 directions<br>2 shocks per axis, 12 shocks in total                                                                                                         |
| 13 | Flexing of the strain relief of fibre optic devices<br>IEC 61300-2-44        | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value                                                                                                                                                 | Tensile force:<br>Number of cycles:<br>Angle:                                                                     | 2 N for reinforced cable<br>50 cycles<br>$\pm 90^{\circ}$                                                                                                                                                                 |
| 14 | Fibre/cable retention<br>IEC 61300-2-4                                       | Before and after the test, the limits of insertion loss (attenuation), isolation and return loss of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                               | Magnitude and rate of application:<br><br><br>Duration of the test:                                               | $10\text{ N} \pm 1\text{ N}$ at 5 N/s for reinforced cables<br><br>$5,0\text{ N} \pm 0,5\text{ N}$ at 0,5 N/s for secondary coated fibres<br>$2,0\text{ N} \pm 0,2\text{ N}$ at 0,5 N/s for primary coated fibres<br>60 s |

| No | Tests                              | Requirements                                                                                                                                                                                                                                                   | Details                                                                         |                                                                                                                                                                           |
|----|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15 | Static side load<br>IEC 61300-2-42 | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value. | Magnitude and duration of the tensile load:<br><br>Direction of application:    | 1 N for 1 h for reinforced cable<br><br>0,2 N for 5 min for secondary coated fibres<br><br>Two mutually perpendicular directions                                          |
| 16 | Torsion<br>IEC 61300-2-5           | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value. | Magnitude of the torsion/twist:<br><br>Angle and cycles:<br><br>Test condition: | Load: 5 N for cables<br>2,0 N for primary coated and buffered fibres<br>Angle: $\pm 180^\circ$<br>Number of cycles: 10<br>Fibre/cable clamping distance: 25 cm $\pm$ 5 cm |

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## Annex A (normative)

### Sample size

The number of samples to be evaluated for each test is defined in the sample size column in Table A.1.

**Table A.1 – Sample size**

| Test number | Test                                   | Sample size |
|-------------|----------------------------------------|-------------|
| 1           | Insertion loss                         | 12          |
| 2           | Isolation                              | 12          |
| 3           | Return loss                            | 12          |
| 4           | Polarization dependent loss            | 12          |
| 5           | Polarization mode dispersion           | 12          |
| 6           | High optical power <del>handling</del> | 6           |
| 7           | Cold                                   | 6           |
| 8           | High temperature endurance             | 6           |
| 9           | Damp heat (steady state)               | 6           |
| 10          | Change of temperature                  | 6           |
| 11          | Vibration                              | 6           |
| 12          | Shock                                  | 6           |
| 13          | Optical fibre cable flexing            | 6           |
| 14          | Fibre/cable retention                  | 6           |
| 15          | Static side load                       | 6           |
| 16          | Torsion                                | 6           |

## Annex B (normative)

### High power test procedure of fibre optic isolators

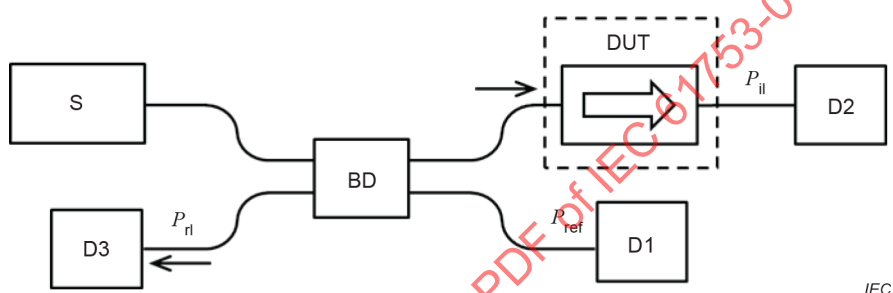
#### B.1 General

Annex B contains a high-power test procedure for fibre optic isolators. The test consists of three steps: 1) forward input, 2) backward input and 3) both directions input.

#### B.2 Forward input test

##### B.2.1 Forward input test set-up

Figure B.1 shows the test set-up of the forward input test.



#### Key

- S light source
- BD branching device
- DUT device under test
- D detector

**Figure B.1 – Test set-up of forward input test**

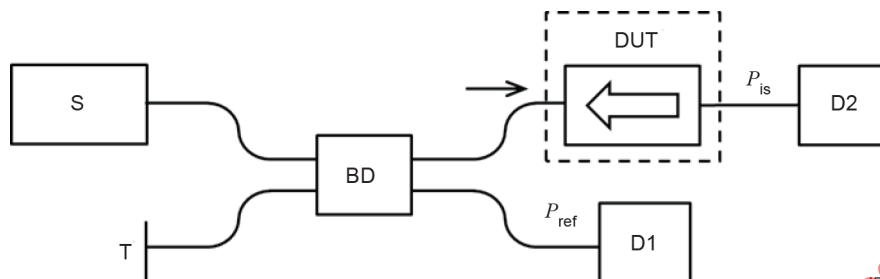
##### B.2.2 Forward input test procedure

- a) Connect light source, S, branching device, BD, device under test, the DUT and detectors, D, shown in Figure B.1. Take care the direction of the DUT when connecting.
- a) Turn on all apparatus.
- b) Monitor the input power change at D1, insertion loss change at D2 and the return loss change at D3.
- c) Turn off all apparatus.

### B.3 Backward input test

#### B.3.1 Backward input test set-up

Figure B.2 shows the test set-up of backward input test.



#### Key

- S light source
- BD branching device
- DUT device under test
- D detector
- T termination

**Figure B.2 – Test set-up of the backward input test**

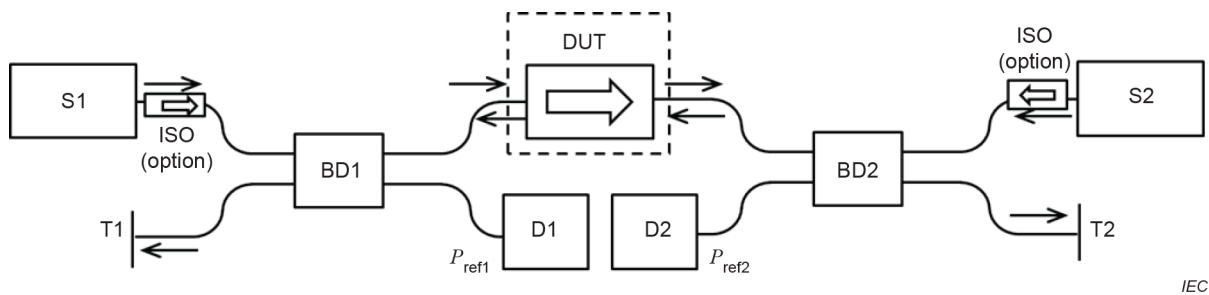
#### B.3.2 Backward input test procedure

- a) Connect light source, S, branching device, BD, device under test, the DUT detectors, D, and termination, T shown in Figure B.2. Take care of the direction of the DUT when connecting.
- b) Turn on all apparatus.
- c) Monitor the input power change at D1 and isolation change at D2.
- d) Turn off all apparatus.

### B.4 Both direction input test

#### B.4.1 Both direction input test set-up

Figure B.3 shows the test set-up of the both-direction input test.



IEC

**Key**

- S light source
- ISO optical Isolator
- BD branching device
- DUT device under test
- D detector
- T termination

**Figure B.3 – Test set-up of both direction input test****B.4.2 Both direction input test procedure**

- a) Measure insertion loss, return loss and isolation of the DUT.
- b) Connect light source, S, branching device, BD, device under test, the DUT detectors, D, and termination, T shown in Figure B.3. Take care of the direction of the DUT when connecting.
- c) Turn on all apparatus.
- d) Monitor the input powers of S1 and S2 at D1 and D2, respectively.
- e) Turn off all apparatus.
- f) Remove DUT from the test set-up. Then measure insertion loss, return loss, isolation and PDL.

## Annex C (informative)

### Example of detailed measurement conditions including test details and requirements

Fibre optic isolators have relatively larger polarization dependent loss (PDL), wavelength dependent loss (WDL), wavelength dependent isolation, and temperature dependent isolation than other passive optical components, such as non-wavelength selective branching devices, spatial switches. Therefore, users generally require optical performances, such as insertion loss, isolation, including over all state of polarization (SOP), over operating wavelength range and operating temperature range.

Table C.1 shows an example of the detailed measurement conditions to clarify the optical performances over all SOP, operating wavelength range and operating temperature range.

**Table C.1 – Example of detailed measurement conditions**

| No | Tests                             | Detailed measurement conditions   |                                                                                                                                                                                                  |
|----|-----------------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Insertion loss (attenuation)      | Launch fibre length:              | $\geq 2,0$ m                                                                                                                                                                                     |
|    |                                   | Polarization state and wavelength | Average state of polarization (SOP) (depolarized) with IEC 61300-3-7 over the operating wavelength range.<br>All SOP with IEC 61300-3-2 at the shortest, the centre and the longest wavelengths. |
|    |                                   | Calculation                       | Insertion loss is calculated by the sum of attenuation with average SOP (depolarized) and the half of PDL by IEC 61300-3-2.                                                                      |
| 2  | Isolation                         | Launch fibre length:              | $\geq 2,0$ m                                                                                                                                                                                     |
|    |                                   | Polarization state and wavelength | Average SOP (depolarized) with IEC 61300-3-7 over the operating wavelength range.<br>All SOP with IEC 61300-3-2 at the shortest, the centre and the longest wavelengths.                         |
|    |                                   | Calculation                       | Isolation is calculated by the sum of isolation with average SOP (depolarized) and the half of polarization dependence of isolation by IEC 61300-3-2.                                            |
| 3  | Return loss                       | Launch fibre length:              | $\geq 2,0$ m                                                                                                                                                                                     |
|    |                                   | Polarization state and wavelength | Average SOP (depolarized) with IEC 61300-3-7 over operating wavelength range.                                                                                                                    |
| 4  | Polarization dependent loss (PDL) | Launch fibre length:              | $\geq 2,0$ m                                                                                                                                                                                     |
|    |                                   | Wavelengths                       | Shortest, centre and longest wavelengths                                                                                                                                                         |

Table C.2 shows an example of the detailed measurement conditions for before, during (if required) and after the environmental tests of high optical power, cold, high temperature endurance, damp heat (steady state), change of temperature, vibration, shock, optical fibre cable flexing, fibre/cable retention, static side load and torsion.

**Table C.2 – Example of detailed measurement conditions for before, during (if required) and after the environmental tests**

| Performance parameters            | Detailed measurements conditions |                           |
|-----------------------------------|----------------------------------|---------------------------|
| Attenuation (Insertion loss)      | Wavelength                       | Centre                    |
|                                   | Polarization state               | Average SOP (depolarized) |
| Isolation                         | Wavelength                       | Centre                    |
|                                   | Polarization state               | Average SOP (depolarized) |
| Return loss                       | Wavelength                       | Centre                    |
|                                   | Polarization state               | Average SOP (depolarized) |
| Polarization dependent loss (PDL) | Wavelength                       | Centre                    |
|                                   | Polarization state               | Average SOP (depolarized) |

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~~IEC 61202-1, Fibre optic interconnecting devices and passive components – Fibre optic isolators – Part 1: Generic specification~~

IEC 61300-3-38, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-38: Examinations and measurements – Group delay and chromatic dispersion and phase ripple*

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

ITU-T G.Supplement 39:2003, *Optical system design and engineering considerations*

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# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

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

**Part 061-2: Single-mode fibre optic pigtailed style polarization independent isolators for category C – Controlled environments**

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

**Partie 061-2: Isolateurs fibroniques à fibres unimodales munis de fibres amorces non connectorisées pour la catégorie C – Environnements contrôlés**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC INTERCONNECTING DEVICES AND  
PASSIVE COMPONENTS – PERFORMANCE STANDARD –****Part 061-2: Single-mode fibre optic pigtailed style  
polarization independent isolators for category C –  
Controlled environments**

## FOREWORD

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International Standard IEC 61753-061-2 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 2012 and constitutes a technical revision.

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

- a) addition of the detail high optical power test procedures and the condition in Annex B;
- b) change of test conditions harmonizing with IEC 61753-1:2018;
- c) addition of category C<sup>HD</sup>;
- d) addition of the detailed measurements conditions in Annex C;
- e) change of clause structure accordance with the latest ISO/IEC Directives, Part 2.

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

| FDIS          | Report on voting |
|---------------|------------------|
| 86B/4270/FDIS | 86B/4284/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 of 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 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 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
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## **FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –**

### **Part 061-2: Single-mode fibre optic pigtailed style polarization independent isolators for category C – Controlled environments**

#### **1 Scope**

This part of IEC 61753 contains the minimum test and measurement requirements and severities which a fibre optic isolator as specified by IEC 61202-1 satisfies in order to be categorized as meeting the requirements of isolators used in controlled environments as specified in IEC 61753-1. The requirements cover single-mode pigtailed style polarization independent isolators for category C used in controlled environments.

#### **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 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification 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 61202-1, *Fibre optic interconnecting devices and passive components – Fibre optic isolators – Part 1: Generic specification*

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 61300-2-5, *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 61300-2-19, *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 61300-2-42, *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 61300-3-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-2: Examinations and measurements – Polarization dependence 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*

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 TS 62627-09, *Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61202-1 and IEC TS 62627-09 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>

### 4 Test

All test methods are in accordance with a specific standard of the IEC 61300 series, of which parts applicable to this document are mentioned in 6.2 (see Table 2 and Table 3).

The samples shall be terminated onto single-mode fibres as per IEC 60793-2-50 category B-652.B, B-652.D or B-657 in either coated fibres (primary and secondary) or reinforced cable format as per IEC 60794-2-50.

Table 1 is intended to provide guidance on the wavelength ranges of the various spectral bands. It is not intended for specification. Values of operating wavelength used in performance verification shall be specified between the customer and supplier or shall be as defined in the manufacturer's specification.

**Table 1 – Single-mode spectral bands**

| Band                           | Descriptor           | Range<br>nm    |
|--------------------------------|----------------------|----------------|
| O-band                         | Original             | 1 260 to 1 360 |
| E-band                         | Extended             | 1 360 to 1 460 |
| S-band                         | Short wavelength     | 1 460 to 1 530 |
| C-band                         | Conventional         | 1 530 to 1 565 |
| L-band                         | Long wavelength      | 1 565 to 1 625 |
| U-band                         | Ultralong wavelength | 1 625 to 1 675 |
| Source: ITU-T G.Supplement 39. |                      |                |

## 5 Test report

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

## 6 Performance requirements

### 6.1 Sample size

Sample sizes for the tests are defined in Annex A.

### 6.2 Test details and requirements

A minimum length of fibre or cable of 2,0 m per port shall be prepared for all tests.

Test details and requirements for category C and C<sup>HD</sup> are shown in Table 2 and Table 3, respectively. An example of test details and requirements including detailed measurements conditions is shown in Annex C (informative).

**Table 2 – Test details and requirements for category C**

| No | Tests                                                                                    | Requirements                                                   | Details                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----|------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Insertion loss (attenuation)<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Refer Table C.1, No.1. | $\leq 0,7$ dB (single stage)<br>$\leq 0,8$ dB (double stage)   | Launch fibre length:                                           | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                                                                                                             |
|    |                                                                                          |                                                                | Condition:<br><br>Measurement uncertainty:                     | Insertion loss (attenuation) shall be met over operating wavelength range and all state of polarization (SOP).<br><br>$\leq 0,1$ dB                                                                                                                                                                                                                                                                                                      |
| 2  | Isolation<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Refer Table C.1, No.2.                    | $\geq 20$ dB (single stage)<br>$\geq 40$ dB (double stage)     | Launch fibre length:                                           | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                                                                                                             |
|    |                                                                                          |                                                                | Condition:<br><br>Measurement uncertainty:                     | Isolation shall be met over operating wavelength range and all SOP.<br><br>$\leq 0,3$ dB (single stage)<br>$\leq 0,5$ dB (double stage)<br><br>NOTE IEC 61300-3-7 is the test method to measure the wavelength dependence of attenuation. However, it can apply to the measurement of isolation, because in the case of an isolator, isolation is the wavelength dependent attenuation measured in the opposite direction to test no. 1. |
| 3  | Return loss<br>IEC 61300-3-7<br>Refer Table C.1, No.3.                                   | $\geq 55$ dB                                                   | Launch fibre length:<br>Condition:<br>Measurement uncertainty: | $\geq 2,0$ m<br>Return loss shall be met over operating wavelength range.<br><br>$\leq 1$ dB<br><br>The port not under test shall be optically terminated to avoid unwanted reflections contributing to the measurement.                                                                                                                                                                                                                 |
| 4  | Polarization dependent loss<br>PDL<br>IEC 61300-3-2                                      | $\leq 0,10$ dB (single stage)<br>$\leq 0,15$ dB (double stage) | Launch fibre length:<br>Condition:<br>Measurement uncertainty: | $\geq 2,0$ m<br>PDL shall be met over operating wavelength range.<br><br>$\leq 0,02$ dB                                                                                                                                                                                                                                                                                                                                                  |
| 5  | Polarization mode dispersion<br>PMD<br>IEC 61300-3-32                                    | $\leq 0,20$ ps (single stage)<br>$\leq 0,10$ ps (double stage) | Launch fibre length:<br>Measurement uncertainty:               | $\geq 2,0$ m<br><br>$\leq 0,05$ ps                                                                                                                                                                                                                                                                                                                                                                                                       |

| No | Tests                                                                        | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                 |
|----|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| 6  | High optical power<br>IEC 61300-2-14<br>IEC 61300-3-3<br>Refer Annex B.      | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>During the forward input test, the insertion loss (attenuation) change is monitored. During and after the test, the insertion loss change shall be within <math>\pm 0,3</math> dB of the initial value.</p> <p>During the backward input test, the isolation change is monitored. The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2.</p> <p>During the forward input test, the return loss change is monitored. The sum of the initial value and the change of the return loss shall be within the value defined at test no. 3.</p> <p>The insertion loss (attenuation), isolation and return loss shall be measured after launching an optical power of 300 mW simultaneously in both forward and backward directions. After the test, the insertion loss change shall be within <math>\pm 0,3</math> dB of the initial value. After the test, the sum of the initial value and the change of the isolation shall be within the value defined at test no. 2. After the test, the sum of the initial value and the change of the return loss shall be within the value defined at test no. 3.</p> | <p>Test set-up and procedure:</p> <p>Optical power: 300 mW</p> <p>SOP of the light source: Average SOP (depolarized)</p> <p>Wavelength: 1 550 nm for C-band<br/>1 580 nm for L-band</p> <p>NOTE A different wavelength is acceptable when there is a negotiation between customer and supplier.</p> <p>Duration of the optical power exposure: 30 min</p> <p>Temperature: <math>60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}</math></p> <p>Relative humidity: <math>93\text{ }\% \begin{smallmatrix} +2 \\ -3 \end{smallmatrix} \text{RH}</math></p> |                                                                 |
|    |                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | NOTE This test condition focuses to standard optical isolators. |
| 7  | Cold<br>IEC 61300-2-17                                                       | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>The insertion loss change after the test shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p>Temperature: <math>-10\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}</math></p> <p>Duration of exposure: 96 h</p>                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                 |
| 8  | Dry heat – High temperature endurance<br>IEC 61300-2-18                      | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>The insertion loss (attenuation) change after the test shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>Temperature: <math>+60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}</math></p> <p>Duration of exposure: 96 h</p>                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                 |
| 9  | Damp heat (steady state)<br>IEC 61300-2-19<br>IEC 61300-3-3<br>Refer Annex C | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>During and after the test, the insertion loss (attenuation) change shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>Temperature: <math>+40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}</math></p> <p>Relative humidity: <math>93\text{ }\% \begin{smallmatrix} +2 \\ -3 \end{smallmatrix} \text{RH}</math></p> <p>Duration of exposure: 96 h</p>                                                                                                                                                                                                                                                                                                                        |                                                                 |

| No | Tests                                                                     | Requirements                                                                                                                                                                                                                                                                                                                                                                                    | Details                                                                                                           |                                                                                                                                                                             |
|----|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 | Change of temperature<br>IEC 61300-2-22<br>IEC 61300-3-3<br>Refer Annex C | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.<br><br>The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2. | High temperature:<br>Low temperature:<br>Number of cycles:<br>Duration at extreme temperature:<br>Rate of change: | $+60^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>$-10^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>Cycles 5<br>60 min<br>$1^{\circ}\text{C} / \text{min}$                        |
| 11 | Vibration<br>IEC 61300-2-1<br>IEC 61300-3-28<br>Refer Annex C             | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                      | Frequency range:<br>Number of axes:<br>Number of sweeps:<br>Sweep rate:<br>Amplitude:                             | 10 Hz to 55 Hz<br>3 orthogonal axes<br>15 /axis<br>1 octave/min<br>0,75 mm                                                                                                  |
| 12 | Shock<br>IEC 61300-2-9                                                    | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value.                                                                                                                                                | Acceleration:<br>Duration:<br>Number of axis:<br>Number of shocks:                                                | $5\,000\text{ m/s}^2$<br>1 ms, half sine pulse<br>3 axes in 2 directions<br>2 shocks per axis, 12 shocks in total                                                           |
| 13 | Flexing of the strain relief of fibre optic devices<br>IEC 61300-2-44     | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value                                                                                                                                   | Tensile force:<br>Number of cycles:<br>Angle:                                                                     | 2 N for reinforced cable<br>50 cycles<br>$\pm 90^{\circ}$                                                                                                                   |
| 14 | Fibre/cable retention<br>IEC 61300-2-4                                    | Before and after the test, the limits of insertion loss (attenuation), isolation and return loss of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                               | Magnitude and rate of application:<br><br><br>Duration of the test:                                               | 10 N $\pm$ 1 N at 5 N/s for reinforced cables<br>5,0 N $\pm$ 0,5 N at 0,5 N/s for secondary coated fibres<br>2,0 N $\pm$ 0,2 N at 0,5 N/s for primary coated fibres<br>60 s |
| 15 | Static side load<br>IEC 61300-2-42                                        | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value.                                                                                                                                                | Magnitude and duration of the tensile load:<br><br>Direction of application:                                      | 1 N for 1 h for reinforced cable<br>0,2 N for 5 min for secondary coated fibres<br>Two mutually perpendicular directions                                                    |
| 16 | Torsion<br>IEC 61300-2-5                                                  | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value.                                                                                                                                  | Magnitude of the torsion/twist:<br><br>Angle and cycles:<br><br>Test condition:                                   | Load: 5 N for cables<br>2,0 N for primary coated and buffered fibres<br>Angle: $\pm 180^{\circ}$<br>Number of cycles: 10<br>Fibre/cable clamping distance: 25 cm $\pm$ 5 cm |

**Table 3 – Test details and requirements for category C<sup>HD</sup>**

| No | Tests                                                                                          | Requirements                                         | Details                                                           |                                                                                                                                                                                                                                                                                                                                                                                       |
|----|------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Insertion loss<br>(attenuation)<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Refer Table C.1,<br>No.1. | ≤ 0,7 dB (single stage)<br>≤ 0,8 dB (double stage)   | Launch fibre length:<br>Condition:<br>Measurement<br>uncertainty: | ≥ 2,0 m<br>Attenuation (insertion loss) shall be met over operating wavelength range and all state of polarization (SOP).<br>≤ 0,1 dB                                                                                                                                                                                                                                                 |
| 2  | Isolation<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Refer Table C.1,<br>No.2.                       | ≥ 20 dB (single stage)<br>≥ 40 dB (double stage)     | Launch fibre length:<br>Condition:<br>Measurement<br>uncertainty: | ≥ 2,0 m<br>Isolation shall be met over operating wavelength range and all SOP.<br>≤ 0,3 dB (single stage)<br>≤ 0,5 dB (double stage)<br>NOTE IEC 61300-3-7 defines the method to measure insertion loss. However, it can apply to the measurement of isolation, because in the case of an isolator, isolation is the insertion loss measured in the opposite direction to test no. 1. |
| 3  | Return loss<br>IEC 61300-3-7<br>Refer Table C.1,<br>No.3.                                      | ≥ 55 dB                                              | Launch fibre length:<br>Condition:<br>Measurement<br>uncertainty: | ≥ 2,0 m<br>Return loss shall be met over operating wavelength range.<br>≤ 1 dB<br>The port not under test shall be optically terminated to avoid unwanted reflections contributing to the measurement                                                                                                                                                                                 |
| 4  | Polarization<br>dependent loss<br>IEC 61300-3-2                                                | ≤ 0,10 dB (single stage)<br>≤ 0,15 dB (double stage) | Launch fibre length:<br>Condition:<br>Measurement<br>uncertainty: | ≥ 2,0 m<br>PDL shall be met over operating wavelength range.<br>≤ 0,02 dB                                                                                                                                                                                                                                                                                                             |
| 5  | Polarization<br>mode dispersion<br>IEC 61300-3-32                                              | ≤ 0,20 ps (single stage)<br>≤ 0,10 ps (double stage) | Launch fibre length:<br>Measurement<br>uncertainty:               | ≥ 2,0 m<br>≤ 0,05 ps                                                                                                                                                                                                                                                                                                                                                                  |

| No | Tests                                                                                      | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Details                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6  | <p>High optical power</p> <p>IEC 61300-2-14</p> <p>IEC 61300-3-3</p> <p>Refer Annex B.</p> | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>During the forward input test, the insertion loss (attenuation) change is monitored. During and after the test, the insertion loss (attenuation) change shall be within <math>\pm 0,3</math> dB of the initial value.</p> <p>During the backward input test, the isolation change is monitored. The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2.</p> <p>During the forward input test, the return loss change is monitored. The sum of the initial value and the change of the return loss shall be within the value defined at test no. 3.</p> <p>The insertion loss (attenuation), isolation and return loss shall be measured after launching an optical power of 300 mW simultaneously in both forward and backward directions. After the test, the insertion loss (attenuation) change shall be within <math>\pm 0,3</math> dB of the initial value. After the test, the sum of the initial value and the change of the isolation shall be within the value defined at test no. 2. After the test, the sum of the initial value and the change of the return loss shall be within the value defined at test no. 3.</p> | <p>Test set-up and procedure:</p> <p>Optical power:</p> <p>SOP of the light source:</p> <p>Wavelength:</p> <p>Duration of the optical power exposure:</p> <p>Temperature:</p> <p>Relative humidity:</p> | <p>Annex B</p> <p>300 mW</p> <p>Average SOP (depolarized)</p> <p>1 550 nm for C-band<br/>1 580 nm for L-band</p> <p>NOTE A different wavelength is acceptable when there is a negotiation between customer and supplier</p> <p>30 min</p> <p><math>60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}</math></p> <p><math>93\text{ }\% \pm 2\text{ }\% \text{ RH}</math></p> <p>NOTE This test condition focuses to standard optical isolators.</p> |
| 7  | <p>Cold</p> <p>IEC 61300-2-17</p>                                                          | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>The insertion loss (attenuation) change after the test shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Temperature:</p> <p>Duration of exposure:</p>                                                                                                                                                        | <p><math>-10\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}</math></p> <p>96 h</p>                                                                                                                                                                                                                                                                                                                                                                 |
| 8  | <p>High temperature endurance</p> <p>IEC 61300-2-18</p>                                    | <p>Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.</p> <p>The insertion loss (attenuation) change after the test shall be within <math>\pm 0,3</math> dB of the initial value.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Temperature:</p> <p>Duration of exposure:</p>                                                                                                                                                        | <p><math>+70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}</math></p> <p>96 h</p>                                                                                                                                                                                                                                                                                                                                                                 |

| No | Tests                                                                        | Requirements                                                                                                                                                                                                                                                                                                                                                                                    | Details                                                                                                           |                                                                                                                                                                                                                           |
|----|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9  | Damp heat (steady state)<br>IEC 61300-2-19<br>IEC 61300-3-3<br>Reger Annex C | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                      | Temperature:<br>Relative humidity:<br><br>Duration of exposure:                                                   | $+40^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>$93\% \pm 2\text{RH}$<br>$-3$<br>96 h                                                                                                                                      |
| 10 | Change of temperature<br>IEC 61300-2-22<br>IEC 61300-3-3<br>Refer Annex C    | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.<br><br>The sum of the initial value and the change of the isolation shall be within the value defined at test no. 2. | High temperature:<br>Low temperature:<br>Number of cycles:<br>Duration at extreme temperature:<br>Rate of change: | $+70^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>$-10^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br>Cycles 5<br>60 min<br>$1^{\circ}\text{C/min}$                                                                               |
| 11 | Vibration<br>IEC 61300-2-1<br>IEC 61300-3-28<br>Refer Annex C.               | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, the insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                      | Frequency range:<br>Number of axes:<br>Number of sweeps:<br>Sweep rate:<br>Amplitude:                             | 10 Hz to 55 Hz<br>3 orthogonal axes<br>15 /axis<br>1 octave/min<br>0,75 mm                                                                                                                                                |
| 12 | Shock<br>IEC 61300-2-9                                                       | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value.                                                                                                                                  | Acceleration:<br>Duration:<br>Number of axis:<br>Number of shocks:                                                | $5\,000\text{ m/s}^2$<br>1 ms, half sine pulse<br>3 axes in 2 directions<br>2 shocks per axis, 12 shocks in total                                                                                                         |
| 13 | Flexing of the strain relief of fibre optic devices<br>IEC 61300-2-44        | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss change after the test shall be within $\pm 0,3$ dB of the initial value                                                                                                                                                 | Tensile force:<br>Number of cycles:<br>Angle:                                                                     | 2 N for reinforced cable<br>50 cycles<br>$\pm 90^{\circ}$                                                                                                                                                                 |
| 14 | Fibre/cable retention<br>IEC 61300-2-4                                       | Before and after the test, the limits of insertion loss (attenuation), isolation and return loss of test no. 1, 2, 3 and 4 shall be met.<br><br>During and after the test, insertion loss (attenuation) change shall be within $\pm 0,3$ dB of the initial value.                                                                                                                               | Magnitude and rate of application:<br><br><br>Duration of the test:                                               | $10\text{ N} \pm 1\text{ N}$ at 5 N/s for reinforced cables<br><br>$5,0\text{ N} \pm 0,5\text{ N}$ at 0,5 N/s for secondary coated fibres<br>$2,0\text{ N} \pm 0,2\text{ N}$ at 0,5 N/s for primary coated fibres<br>60 s |

| No | Tests                              | Requirements                                                                                                                                                                                                                                                   | Details                                                                         |                                                                                                                                                                           |
|----|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15 | Static side load<br>IEC 61300-2-42 | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value. | Magnitude and duration of the tensile load:<br><br>Direction of application:    | 1 N for 1 h for reinforced cable<br><br>0,2 N for 5 min for secondary coated fibres<br><br>Two mutually perpendicular directions                                          |
| 16 | Torsion<br>IEC 61300-2-5           | Before and after the test, the limits of insertion loss (attenuation), isolation, return loss and PDL of test no. 1, 2, 3 and 4 shall be met.<br><br>The insertion loss (attenuation) change after the test shall be within $\pm 0,3$ dB of the initial value. | Magnitude of the torsion/twist:<br><br>Angle and cycles:<br><br>Test condition: | Load: 5 N for cables<br>2,0 N for primary coated and buffered fibres<br>Angle: $\pm 180^\circ$<br>Number of cycles: 10<br>Fibre/cable clamping distance: 25 cm $\pm$ 5 cm |

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## Annex A (normative)

### Sample size

The number of samples to be evaluated for each test is defined in the sample size column in Table A.1.

**Table A.1 – Sample size**

| Test number | Test                         | Sample size |
|-------------|------------------------------|-------------|
| 1           | Insertion loss               | 12          |
| 2           | Isolation                    | 12          |
| 3           | Return loss                  | 12          |
| 4           | Polarization dependent loss  | 12          |
| 5           | Polarization mode dispersion | 12          |
| 6           | High optical power           | 6           |
| 7           | Cold                         | 6           |
| 8           | High temperature endurance   | 6           |
| 9           | Damp heat (steady state)     | 6           |
| 10          | Change of temperature        | 6           |
| 11          | Vibration                    | 6           |
| 12          | Shock                        | 6           |
| 13          | Optical fibre cable flexing  | 6           |
| 14          | Fibre/cable retention        | 6           |
| 15          | Static side load             | 6           |
| 16          | Torsion                      | 6           |

## Annex B (normative)

### High power test procedure of fibre optic isolators

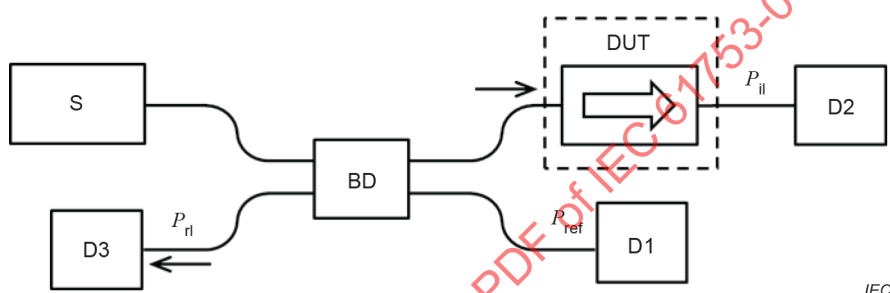
#### B.1 General

Annex B contains a high-power test procedure for fibre optic isolators. The test consists of three steps: 1) forward input, 2) backward input and 3) both directions input.

#### B.2 Forward input test

##### B.2.1 Forward input test set-up

Figure B.1 shows the test set-up of the forward input test.



#### Key

- S light source
- BD branching device
- DUT device under test
- D detector

**Figure B.1 – Test set-up of forward input test**

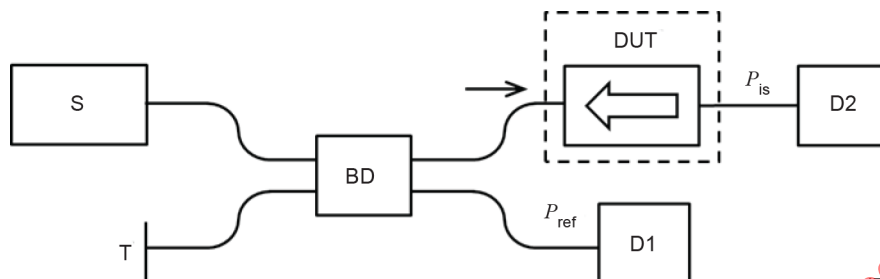
##### B.2.2 Forward input test procedure

- a) Connect light source, S, branching device, BD, device under test, the DUT and detectors, D, shown in Figure B.1. Take care the direction of the DUT when connecting.
- b) Turn on all apparatus.
- c) Monitor the input power change at D1, insertion loss change at D2 and the return loss change at D3.
- d) Turn off all apparatus.

### B.3 Backward input test

#### B.3.1 Backward input test set-up

Figure B.2 shows the test set-up of backward input test.



#### Key

- S light source
- BD branching device
- DUT device under test
- D detector
- T termination

**Figure B.2 – Test set-up of the backward input test**

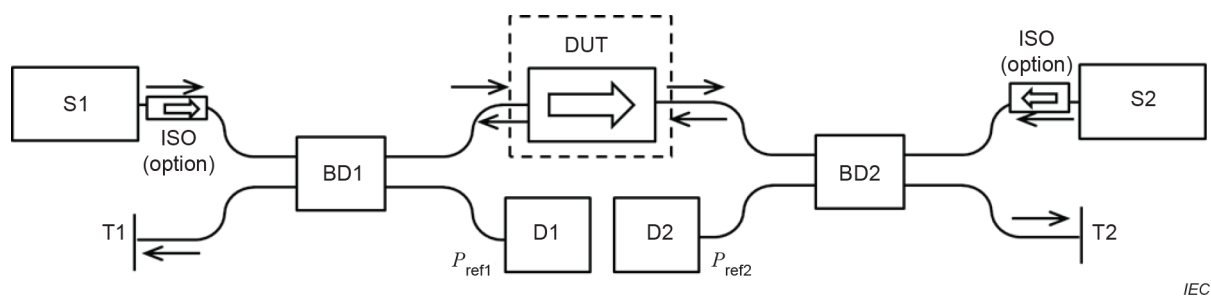
#### B.3.2 Backward input test procedure

- a) Connect light source, S, branching device, BD, device under test, the DUT detectors, D, and termination, T shown in Figure B.2. Take care of the direction of the DUT when connecting.
- b) Turn on all apparatus.
- c) Monitor the input power change at D1 and isolation change at D2.
- d) Turn off all apparatus.

### B.4 Both direction input test

#### B.4.1 Both direction input test set-up

Figure B.3 shows the test set-up of the both-direction input test.



IEC

**Key**

- S light source
- ISO optical Isolator
- BD branching device
- DUT device under test
- D detector
- T termination

**Figure B.3 – Test set-up of both direction input test**

**B.4.2 Both direction input test procedure**

- a) Measure insertion loss, return loss and isolation of the DUT.
- b) Connect light source, S, branching device, BD, device under test, the DUT detectors, D, and termination, T shown in Figure B.3. Take care of the direction of the DUT when connecting.
- c) Turn on all apparatus.
- d) Monitor the input powers of S1 and S2 at D1 and D2, respectively.
- e) Turn off all apparatus.
- f) Remove DUT from the test set-up. Then measure insertion loss, return loss, isolation and PDL.

## Annex C (informative)

### Example of detailed measurement conditions including test details and requirements

Fibre optic isolators have relatively larger polarization dependent loss (PDL), wavelength dependent loss (WDL), wavelength dependent isolation, and temperature dependent isolation than other passive optical components, such as non-wavelength selective branching devices, spatial switches. Therefore, users generally require optical performances, such as insertion loss, isolation, including over all state of polarization (SOP), over operating wavelength range and operating temperature range.

Table C.1 shows an example of the detailed measurement conditions to clarify the optical performances over all SOP, operating wavelength range and operating temperature range.

**Table C.1 – Example of detailed measurement conditions**

| No | Tests                             | Detailed measurement conditions   |                                                                                                                                                                                                  |
|----|-----------------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Insertion loss (attenuation)      | Launch fibre length:              | $\geq 2,0$ m                                                                                                                                                                                     |
|    |                                   | Polarization state and wavelength | Average state of polarization (SOP) (depolarized) with IEC 61300-3-7 over the operating wavelength range.<br>All SOP with IEC 61300-3-2 at the shortest, the centre and the longest wavelengths. |
|    |                                   | Calculation                       | Insertion loss is calculated by the sum of attenuation with average SOP (depolarized) and the half of PDL by IEC 61300-3-2.                                                                      |
| 2  | Isolation                         | Launch fibre length:              | $\geq 2,0$ m                                                                                                                                                                                     |
|    |                                   | Polarization state and wavelength | Average SOP (depolarized) with IEC 61300-3-7 over the operating wavelength range.<br>All SOP with IEC 61300-3-2 at the shortest, the centre and the longest wavelengths.                         |
|    |                                   | Calculation                       | Isolation is calculated by the sum of isolation with average SOP (depolarized) and the half of polarization dependence of isolation by IEC 61300-3-2.                                            |
| 3  | Return loss                       | Launch fibre length:              | $\geq 2,0$ m                                                                                                                                                                                     |
|    |                                   | Polarization state and wavelength | Average SOP (depolarized) with IEC 61300-3-7 over operating wavelength range.                                                                                                                    |
| 4  | Polarization dependent loss (PDL) | Launch fibre length:              | $\geq 2,0$ m                                                                                                                                                                                     |
|    |                                   | Wavelengths                       | Shortest, centre and longest wavelengths                                                                                                                                                         |

Table C.2 shows an example of the detailed measurement conditions for before, during (if required) and after the environmental tests of high optical power, cold, high temperature endurance, damp heat (steady state), change of temperature, vibration, shock, optical fibre cable flexing, fibre/cable retention, static side load and torsion.

**Table C.2 – Example of detailed measurement conditions for before, during (if required) and after the environmental tests**

| Performance parameters            | Detailed measurements conditions |                           |
|-----------------------------------|----------------------------------|---------------------------|
| Attenuation (Insertion loss)      | Wavelength                       | Centre                    |
|                                   | Polarization state               | Average SOP (depolarized) |
| Isolation                         | Wavelength                       | Centre                    |
|                                   | Polarization state               | Average SOP (depolarized) |
| Return loss                       | Wavelength                       | Centre                    |
|                                   | Polarization state               | Average SOP (depolarized) |
| Polarization dependent loss (PDL) | Wavelength                       | Centre                    |
|                                   | Polarization state               | Average SOP (depolarized) |

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## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**DISPOSITIFS D'INTERCONNEXION ET COMPOSANTS  
PASSIFS FIBRONIQUES – NORME DE PERFORMANCE –****Partie 061-2: Isolateurs fibroniques à fibres unimodales munis  
de fibres amorces non connectorisées pour la catégorie C –  
Environnements contrôlés**

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Cette deuxième édition annule et remplace la première édition parue en 2012 et constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) ajout des détails et des conditions des procédures d'essai à puissance optique élevée dans l'Annexe B;
- b) modification des conditions d'essai en harmonisation avec l'IEC 61753-1:2018;
- c) ajout de la catégorie C<sup>HD</sup>;
- d) ajout des conditions de mesure détaillées dans l'Annexe C;
- e) modification de la structure des articles conformément aux dernières Directives ISO/IEC, Partie 2.

Le texte de cette Norme internationale est issu des documents suivants:

| FDIS          | Rapport de vote |
|---------------|-----------------|
| 86B/4270/FDIS | 86B/4284/RVD    |

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de la présente Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61753, publiées sous le titre général *Dispositifs d'interconnexion et composants passifs fibroniques – Norme de performance*, peut être consultée sur le site web de l'IEC.

Les futures normes porteront dorénavant le nouveau titre général cité ci-dessus. Le titre des normes existant déjà dans cette série sera mis à jour lors de la prochaine édition.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

## **DISPOSITIFS D'INTERCONNEXION ET COMPOSANTS PASSIFS FIBRONIQUES – NORME DE PERFORMANCE –**

### **Partie 061-2: Isolateurs fibroniques à fibres unimodales munis de fibres amorces non connectorisées pour la catégorie C – Environnements contrôlés**

#### **1 Domaine d'application**

La présente partie de l'IEC 61753 contient les sévérités et les exigences minimales de mesure et d'essai auxquelles un isolateur fibronique tel que spécifié dans l'IEC 61202-1 est tenu de satisfaire afin d'être considéré comme conforme aux exigences des isolateurs utilisés dans des environnements contrôlés tel que spécifié dans l'IEC 61753-1. Les exigences couvrent les isolateurs à fibres unimodales munis de fibres amorces non connectorisées pour la catégorie C utilisés dans des environnements contrôlés.

#### **2 Références normatives**

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60793-2-50, *Fibres optiques – Partie 2-50: Spécifications de produits – Spécification intermédiaire pour les fibres unimodales de classe B*

IEC 60794-2-50, *Câbles à fibres optiques – Partie 2-50: Câbles intérieurs – Spécification de famille pour les câbles simplex et duplex utilisés dans les ensembles de câbles équipés*

IEC 61202-1, *Dispositifs d'interconnexion et composants passifs fibroniques – Isolateurs fibroniques – Partie 1: Spécification générique*

IEC 61300-2-1, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-1: Essais – Vibrations (sinusoïdales)*

IEC 61300-2-4, *Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures – Partie 2-4: Essais – Rétention de la fibre ou du câble*

IEC 61300-2-5, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-5: Tests – Torsion (disponible en anglais seulement)*

IEC 61300-2-9, *Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures – Partie 2-9: Essais – Chocs*

IEC 61300-2-14, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-14: Essais – Puissance optique élevée*

IEC 61300-2-17, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-17: Essais – Froid*

IEC 61300-2-18, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-18: Essais – Chaleur sèche – Résistance à haute température*

IEC 61300-2-19, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-19: Essais – Chaleur humide (état continu)*

IEC 61300-2-22, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-22: Essais – Variations de température*

IEC 61300-2-42, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-42: Essais – Charge latérale statique pour serre-câble*

IEC 61300-2-44, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Procédures fondamentales d'essais et de mesures – Partie 2-44: Essais – Flexion du serre-câble des dispositifs à fibres optiques*

IEC 61300-3-2, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-2: Examens et mesures – Pertes en fonction de la polarisation dans un dispositif pour fibres optiques unimodales*

IEC 61300-3-3, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-3: Examens et mesures – Contrôle actif des variations de l'affaiblissement et de l'affaiblissement de réflexion*

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, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-28: Examens et mesures – Perte transitoire*

IEC 61300-3-32, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-32: Examens et mesures – Mesures de la dispersion de mode de polarisation pour composants optiques passifs*

IEC TS 62627-09, *Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices* (disponible en anglais seulement)

### 3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 61202-1 et l'IEC TS 62627-09 s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

## 4 Essai

Toutes les méthodes d'essai sont conformes à une norme spécifique de la série IEC 61300, dont les parties applicables au présent document sont mentionnées en 6.2 (voir Tableau 2 et Tableau 3).

Les échantillons doivent être raccordés à des fibres unimodales conformes à l'IEC 60793-2-50, de catégorie B-652.B, B-652.D ou B-657, soit sous forme de fibres sous revêtement (primaire et secondaire), soit sous forme de câbles renforcés conformes à l'IEC 60794-2-50.

Le Tableau 1 est destiné à fournir des recommandations sur les plages de longueurs d'onde des différentes bandes spectrales. Son but n'est pas de fournir des spécifications. Les valeurs de longueur d'onde de fonctionnement utilisées lors de la vérification des performances doivent être spécifiées entre le client et le fournisseur ou bien elles doivent être telles que définies dans la spécification du fabricant.

**Tableau 1 – Bandes spectrales en unimodal**

| Bande                          | Descripteur                  | Plage<br>nm   |
|--------------------------------|------------------------------|---------------|
| Bande O                        | Original                     | 1 260 à 1 360 |
| Bande E                        | Etendu                       | 1 360 à 1 460 |
| Bande S                        | Longueur d'onde courte       | 1 460 à 1 530 |
| Bande C                        | Conventionnel                | 1 530 à 1 565 |
| Bande L                        | Grande longueur d'onde       | 1 565 à 1 625 |
| Bande U                        | Ultra-grande longueur d'onde | 1 625 à 1 675 |
| Source: ITU-T G.Supplement 39. |                              |               |

## 5 Rapport d'essai

Des rapports d'essai bien documentés et étayés par des preuves doivent être établis et mis à disposition en vue des contrôles, afin de démontrer que les essais ont été réalisés et qu'ils sont satisfaisants.

## 6 Exigences relatives au fonctionnement

### 6.1 Nombre d'échantillons

Les nombres d'échantillons pour les essais sont définis dans l'Annexe A.

### 6.2 Détails et exigences des essais

Une longueur minimale de fibre ou de câble de 2,0 m par port doit être préparée pour tous les essais.

Les détails et exigences des essais pour les catégories C et C<sup>HD</sup> sont indiqués dans le Tableau 2 et le Tableau 3, respectivement. Des exemples de détails et d'exigences des essais, comprenant les conditions de mesure détaillées, sont donnés dans l'Annexe C (informative).

**Tableau 2 – Détails et exigences des essais pour la catégorie C**

| N° | Essais                                                                                             | Exigences                                                      | Détails                           |                                                                                                                                                                                                                                                                                                                                                       |
|----|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Perte d'insertion (affaiblissement)<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Voir<br>Tableau C.1, n° 1 | $\leq 0,7$ dB (à un étage)<br>$\leq 0,8$ dB (à double étage)   | Longueur de la fibre d'injection: | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                          |
|    |                                                                                                    |                                                                | Condition:                        | Les exigences relatives à la perte d'insertion (l'affaiblissement) doivent être satisfaites sur la plage de longueurs d'onde de fonctionnement et tous les états de polarisation (SOP).                                                                                                                                                               |
|    |                                                                                                    |                                                                | Incertitude de mesure:            | $\leq 0,1$ dB                                                                                                                                                                                                                                                                                                                                         |
| 2  | Isolation<br>IEC 61300-3-7<br>IEC 61300-3-2<br>Voir<br>Tableau C.1, n° 2                           | $\geq 20$ dB (à un étage)<br>$\geq 40$ dB (à double étage)     | Longueur de la fibre d'injection: | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                          |
|    |                                                                                                    |                                                                | Condition:                        | Les exigences relatives à l'isolation doivent être satisfaites sur la plage de longueurs d'onde de fonctionnement et tous les états de polarisation.                                                                                                                                                                                                  |
|    |                                                                                                    |                                                                | Incertitude de mesure:            | $\leq 0,3$ dB (à un étage)<br>$\leq 0,5$ dB (à double étage)                                                                                                                                                                                                                                                                                          |
|    |                                                                                                    |                                                                |                                   | NOTE L'IEC 61300-3-7 constitue la méthode d'essai pour mesurer la dépendance à la longueur d'onde de l'affaiblissement. Cependant, elle peut être appliquée à la mesure de l'isolation, car dans le cas d'un isolateur, l'isolation correspond à l'affaiblissement en fonction de la longueur d'onde mesuré dans la direction opposée à l'essai n° 1. |
| 3  | Affaiblissement de réflexion<br>IEC 61300-3-7<br>Voir<br>Tableau C.1, n° 3                         | $\geq 55$ dB                                                   | Longueur de la fibre d'injection: | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                          |
|    |                                                                                                    |                                                                | Condition:                        | Les exigences relatives à l'affaiblissement de réflexion doivent être satisfaites sur la plage de longueurs d'onde de fonctionnement.                                                                                                                                                                                                                 |
|    |                                                                                                    |                                                                | Incertitude de mesure:            | $\leq 1$ dB                                                                                                                                                                                                                                                                                                                                           |
|    |                                                                                                    |                                                                |                                   | Le port non soumis à essai doit être optiquement bouclé afin d'éviter que des réflexions indésirables ne perturbent la mesure.                                                                                                                                                                                                                        |
| 4  | Perte dépendant de la polarisation (PDL, polarization dependent loss)<br>IEC 61300-3-2             | $\leq 0,10$ dB (à un étage)<br>$\leq 0,15$ dB (à double étage) | Longueur de la fibre d'injection: | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                          |
|    |                                                                                                    |                                                                | Condition:                        | Les exigences relatives à la perte dépendant de la polarisation doivent être satisfaites sur la plage de longueurs d'onde de fonctionnement.                                                                                                                                                                                                          |
|    |                                                                                                    |                                                                | Incertitude de mesure:            | $\leq 0,02$ dB                                                                                                                                                                                                                                                                                                                                        |
| 5  | Dispersion du mode de polarisation (PMD, polarization mode dispersion)<br>IEC 61300-3-32           | $\leq 0,20$ ps (à un étage)<br>$\leq 0,10$ ps (à double étage) | Longueur de la fibre d'injection: | $\geq 2,0$ m                                                                                                                                                                                                                                                                                                                                          |
|    |                                                                                                    |                                                                | Incertitude de mesure:            | $\leq 0,05$ ps                                                                                                                                                                                                                                                                                                                                        |

| N° | Essais                                                                        | Exigences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Détails                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                            |
|----|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6  | Puissance optique élevée<br>IEC 61300-2-14<br>IEC 61300-3-3<br>Voir Annexe B. | <p>Les limites de la perte d'insertion (affaiblissement), de l'isolation, de l'affaiblissement de réflexion et de la perte dépendant de la polarisation données aux essais 1, 2, 3 et 4 doivent être respectées, avant et après l'essai.</p> <p>Lors de l'essai d'entrée par l'avant, la variation de perte d'insertion (affaiblissement) est surveillée. Pendant et après l'essai, la variation de perte d'insertion doit rester à <math>\pm 0,3</math> dB de la valeur initiale.</p> <p>Lors de l'essai d'entrée en arrière, la variation de l'isolation est surveillée. La somme de la valeur initiale et de la variation de l'isolation doit rester inférieure à la valeur définie à l'essai 2.</p> <p>Pendant l'essai d'entrée par l'avant, la variation de l'affaiblissement de réflexion est surveillée. La somme de la valeur initiale et de la variation de l'affaiblissement de réflexion doit rester inférieure à la valeur définie à l'essai 3.</p> <p>La perte d'insertion (affaiblissement), l'isolation et l'affaiblissement de réflexion doivent être mesurés après l'injection d'une puissance optique de 300 mW dans les directions avant et arrière simultanément. Après l'essai, la variation de perte d'insertion doit rester à <math>\pm 0,3</math> dB de la valeur initiale. Après l'essai, la somme de la valeur initiale et de la variation de l'isolation doit rester inférieure à la valeur définie à l'essai 2. Après l'essai, la somme de la valeur initiale et de la variation de l'affaiblissement de réflexion doit rester inférieure à la valeur définie à l'essai 3.</p> | Montage et procédure d'essai:<br><br>Puissance optique:<br><br>SOP de la source lumineuse:<br><br>Longueur d'onde:<br><br><br><br><br>Durée de l'exposition à la puissance optique:<br><br>Température:<br><br>Humidité relative: | Annexe B<br><br>300 mW<br>SOP moyen (dépolarisé)<br><br>1 550 nm pour la bande C<br>1 580 nm pour la bande L<br>NOTE Une longueur d'onde différente est acceptable en cas de négociation entre le client et le fournisseur.<br><br>30 min<br><br>60 °C $\pm$ 2 °C<br>93 % $^{+2}_{-3}$ d'humidité relative |
| 7  | Froid<br>IEC 61300-2-17                                                       | <p>Les limites de la perte d'insertion (affaiblissement), de l'isolation, de l'affaiblissement de réflexion et de la perte dépendant de la polarisation données aux essais 1, 2, 3 et 4 doivent être respectées, avant et après l'essai.</p> <p>La variation de perte d'insertion après l'essai doit rester à <math>\pm 0,3</math> dB de la valeur initiale.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Température:<br><br>Durée d'exposition:                                                                                                                                                                                           | -10 °C $\pm$ 2 °C<br><br>96 h<br><br>NOTE Cette condition d'essai se focalise sur les isolateurs optiques conventionnels.                                                                                                                                                                                  |

| N° | Essais                                                                                 | Exigences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Détails                                                                                                                           |                                                                                                                             |
|----|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 8  | Chaleur sèche –<br>Résistance à<br>haute<br>température<br>IEC 61300-2-18              | Les limites de la perte d'insertion (affaiblissement), de l'isolation, de l'affaiblissement de réflexion et de la perte dépendant de la polarisation données aux essais 1, 2, 3 et 4 doivent être respectées, avant et après l'essai.<br><br>La variation de perte d'insertion (affaiblissement) après l'essai doit rester à $\pm 0,3$ dB de la valeur initiale.                                                                                                                                             | Température:<br>Durée d'exposition:                                                                                               | $+60\text{ °C} \pm 2\text{ °C}$<br>96 h                                                                                     |
| 9  | Chaleur humide<br>(essai continu)<br>IEC 61300-2-19<br>IEC 61300-3-3<br>Voir Annexe C. | Les limites de la perte d'insertion (affaiblissement), de l'isolation, de l'affaiblissement de réflexion et de la perte dépendant de la polarisation données aux essais 1, 2, 3 et 4 doivent être respectées, avant et après l'essai.<br><br>Pendant et après l'essai, la variation de perte d'insertion (affaiblissement) doit rester à $\pm 0,3$ dB de la valeur initiale.                                                                                                                                 | Température:<br>Humidité relative:<br>Durée d'exposition:                                                                         | $+40\text{ °C} \pm 2\text{ °C}$<br>$93\% \pm \frac{2}{3}$ d'humidité relative<br>96 h                                       |
| 10 | Variations de<br>température<br>IEC 61300-2-22<br>IEC 61300-3-3<br>Voir Annexe C.      | Les limites de la perte d'insertion (affaiblissement), de l'isolation, de l'affaiblissement de réflexion et de la perte dépendant de la polarisation données aux essais 1, 2, 3 et 4 doivent être respectées, avant et après l'essai.<br><br>Pendant et après l'essai, la variation de perte d'insertion (affaiblissement) doit rester à $\pm 0,3$ dB de la valeur initiale.<br><br>La somme de la valeur initiale et de la variation de l'isolation doit rester inférieure à la valeur définie à l'essai 2. | Température élevée:<br>Température basse:<br>Nombre de cycles:<br>Durée d'exposition à température extrême:<br>Taux de variation: | $+60\text{ °C} \pm 2\text{ °C}$<br>$-10\text{ °C} \pm 2\text{ °C}$<br>5 cycles<br>60 min<br>$1\text{ °C/min}$               |
| 11 | Vibrations<br>IEC 61300-2-1<br>IEC 61300-3-28<br>Voir Annexe C.                        | Les limites de la perte d'insertion (affaiblissement), de l'isolation, de l'affaiblissement de réflexion et de la perte dépendant de la polarisation données aux essais 1, 2, 3 et 4 doivent être respectées, avant et après l'essai.<br><br>Pendant et après l'essai, la variation de perte d'insertion (affaiblissement) doit rester à $\pm 0,3$ dB de la valeur initiale.                                                                                                                                 | Plage de fréquences:<br>Nombre d'axes:<br>Nombre de balayages:<br>Vitesse de balayage:<br>Amplitude:                              | 10 Hz à 55 Hz<br>3 axes orthogonaux<br>15 par axe<br>1 octave/min<br>0,75 mm                                                |
| 12 | Chocs<br>IEC 61300-2-9                                                                 | Les limites de la perte d'insertion (affaiblissement), de l'isolation, de l'affaiblissement de réflexion et de la perte dépendant de la polarisation données aux essais 1, 2, 3 et 4 doivent être respectées, avant et après l'essai.<br><br>La variation de perte d'insertion après l'essai doit rester à $\pm 0,3$ dB de la valeur initiale.                                                                                                                                                               | Accélération:<br>Durée:<br>Nombre d'axes:<br>Nombre de chocs:                                                                     | $5\,000\text{ m/s}^2$<br>1 ms, impulsion semi-sinusoïdale<br>3 axes dans 2 directions<br>2 chocs par axe, 12 chocs au total |