IEC 62005-9-4

Edition 1.0 2018-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – reliability – Part 9-4: High power qualification of passive optical components for environmental category C

Dispositifs d'interconnexion et composants passifs fibroniques – fiabilité – Partie 9-4: Qualification de puissance élevée des composants optiques passifs pour la catégorie environnementale C

IEC 62005-9-4:2018-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 33.180.20

ISBN 978-2-8322-6162-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – RELIABILITY –

Part 9-4: High power qualification of passive optical components for environmental category C

FOREWORD

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International Standard IEC 62005-9-4 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components of IEC technical committee 86: Fibre optics.

This bilingual version (2018-11) corresponds to the monolingual English version, published in 2018-07.

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

FDIS	Report on voting
86B/4130/FDIS	86B/4136/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.

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

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

A list of all parts in the IEC 62005 series, published under the general title *Fibre optic interconnecting devices and passive components – Reliability*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

INTRODUCTION

At present there is no standard for reliability qualification for passive components with respect to high power use. This has led to component manufacturers having to perform different set of tests for various customers leading to higher cost. Additionally such non-standardized testing has led to either over or under testing devices. The aim of this document is to mitigate these issues, by establishing a common framework for reliability assurance at high optical power. While there is no exact number beyond which the optical power is demarcated as high, power exceeding 23 dBm (200 mW) of total input power is considered high.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – RELIABILITY –

Part 9-4: High power qualification of passive optical components for environmental category C

1 Scope

This part of IEC 62005 gives the requirements for the reliability qualification of passive optical components when used in high optical power applications for the environmental category C.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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

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

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

IEC 61300-3-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-1: Examinations and measurements – Visual examination*

IEC 61300-3-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Visual inspection of fibre optic connectors and fibre-stub transceivers*

IEC 62005-9-1, *Fibre optic interconnecting devices and passive components – Reliability – Part 9-1: Qualification of passive optical components*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

3.1
maximum input optical power
$P_{opermax}$
maximum input optical power to which the optical component or device is rated for operation over its lifetime

3.2
maximum operational temperature
$T_{opermax}$
maximum temperature at which the optical component or device is rated for operation over its lifetime

3.3
acceleration factor
k
equivalent acceleration factor that equates expected system life to 2 000 h test duration

4 High power qualification tests

4.1 Tests

Table 1 summarizes the tests for high power qualification test program that shall be performed for passive devices and is intended for use in high optical power conditions.

The damp heat and temperature cycling tests (tests 1(a) and 2(a) in Table 1) are incorporated in the basic qualification program in IEC 62005-9-1 for reliability qualification assurance. When components are intended for use in high power applications,

– high power exposure (tests 1(b) and 2(b) in Table 1) shall be performed on samples that have first undergone damp heat and temperature cycling tests (tests 1(a) and 2(a) respectively in Table 1), and

– an endurance test (test 3 in Table 1) shall also be done to provide reliability qualification assurance for passive components vis-à-vis high optical power.

Table 1 – High power reliability qualification tests for passive optical components and sample size

No	Test	Details	Sample size/no. of allowed failures
1	(a) Damp heat IEC 61300-2-19	Non-hermetic components Temperature: 85 °C Humidity: 85 % RH Duration: 500 h Hermetic components Temperature: 85 °C Humidity: 85 % RH Duration: 100 h The test and measurements shall be performed as outlined in 6.2.	3/0
	(b) Post damp heat high optical power exposure IEC 61300-2-14	Temperature: $T_{opermax}$ Optical power level: $P_{opermax}$ Duration: 100 h Test 1(b) shall be performed on samples that have first undergone test 1(a). The test and measurements shall be performed as outlined in 6.2.	
2	(a) Temperature cycling IEC 61300-2-22	Temperature: –40 °C to 70 °C Dwell time: ≥ 15 min Number of cycles: 100 The test and measurements shall be performed as outlined in 6.3.	3/0
	(b) Post temperature cycling high optical power exposure IEC 61300-2-14	Temperature: $T_{opermax}$ Optical power level: $P_{opermax}$ Duration: 100 h Test 2(b) shall be performed on samples that have first undergone test 2(a). The test and measurements shall be performed as outlined in 6.3.	
3	High power test (endurance) IEC 61300-2-14	Temperature: $T_{opermax}$ Duration: 2 000 h Power level = $k \times P_{opermax}$ k is the acceleration factor that equates expected system life (use) to 2 000 h of operation, if that has been determined by fundamental analysis of all failure modes. In the event k has not been determined, a default value of 1,5 shall be used. The test and measurements shall be performed as outlined in 6.4.	3/0

4.2 Sample size

Sample sizes for the tests are defined in Table 1 of this document.

5 Apparatus

5.1 Source (S)

The source unit consists of an optical emitter, the means to connect to it, and the associated drive electronics. A tunable light source (TLS), in which a specific output wavelength can be tuned, may be chosen as the optical emitter. A TLS may consist of a tunable laser diode (LD) and an optical amplifier, or be a fibre ring laser in order to get an efficient power to test. Generally, the power and stability requirements of a test will necessitate that the means to connect to the optical emitter be a fibre pigtail. The source shall be stable in output power and wavelength/frequency over the measurement period. For dense wavelength division multiplexing (DWDM) devices, the frequency uncertainty (instead of the wavelength uncertainty) shall be less than half of the channel bandwidth. Unless otherwise stated in the relevant specification, the source shall have the following characteristics:

– wavelength uncertainty: ≤ ±5 nm (not DWDM devices);
– frequency uncertainty: ≤ ±6,3 GHz (DWDM devices of 25 GHz channel bandwidth);
  ≤ ±12,5 GHz (DWDM devices of 50 GHz channel bandwidth);
  ≤ ±25 GHz (DWDM devices of 100 GHz channel bandwidth);
– stability of responsivity: ≤ ±0,1 dB

5.2 Detector unit (D)

The detector unit consists of an optical detector, the means to connect to it, and the associated electronics. The detectors shall have sufficient dynamic range to make the necessary measurements and shall be linear over this range. The detectors shall be stable over the measurement period and shall have an operational range consistent with the device under test. The detectors can either use an adapter for the connection or accept bare fibre properly cleaved. The detectors shall be capable of capturing all light emitted by the fibre tip and/or connector plug. The detectors shall have the following characteristics:

– linearity: ≤ ±0,1 dB
– stability: ≤ 0,05 dB

5.3 Environmental chamber

The test setup shall include an environmental chamber capable of producing and maintaining the specified temperature and/or humidity.

5.4 Data acquisition system (DAS)

Recording of the optical power readings at the optical detector may be done either manually or automatically. Appropriate DAS shall be used where measurements are performed automatically.

5.5 Temporary joints (TJ)

These are typically used in connecting the device under test to the test apparatus. Generally, the optical power and stability requirements of a test will necessitate that the temporary joints be fusion splices.

5.6 Safety devices

All necessary safety devices, including laser safety glasses, signs and other safety materials shall be provided, in order to protect individuals from possible hazards during testing

6 Test procedure

6.1 Preconditioning

The chosen test samples shall be representative of a standard product. The passive components (devices under test) shall be prepared and cleaned according to the manufacturer's instructions. Visual examination shall be undertaken in accordance with IEC 61300-3-1 and IEC 61300-3-35. The passive components shall be preconditioned for 2 h at the standard atmospheric conditions as defined in IEC 61300-1, unless otherwise specified.

6.2 Damp heat and post damp heat high optical power exposure

6.2.1 Initial optical measurements

Optical measurements at low optical power shall be made on devices under test before the damp heat test, using the applicable part from IEC 61300 (all parts).

6.2.2 Damp heat test

Damp heat reliability test (test 1(a) in Table 1) shall be done in accordance with IEC 62005-9-1 at the conditions specified in Table 1.

6.2.3 Optical measurements following damp heat test

Optical measurements at low optical power shall be made on devices under test after the damp heat test, using the applicable part from IEC 61300 (all parts), in a manner identical to the measurements in 6.2.1.

6.2.4 Post damp heat exposure to high optical power

After 6.2.3, exposure to high optical power (test 1(b) in Table 1) shall be carried out at the conditions mentioned in Table 1 on the devices under test in accordance with IEC 61300-2-14, at the intended wavelength(s) of the operation of the device for the duration of 100 h.

6.2.5 Optical measurements following damp heat and high power exposure

Following 6.2.4, optical measurements at low optical power shall be made on devices under test, using the applicable part from IEC 61300 (all parts), in a manner identical to the measurements in 6.2.1.

6.3 Temperature cycling and post temperature cycling high optical power exposure

6.3.1 Initial optical measurements

Optical measurements at low optical power shall be made on devices under test before the temperature cycling test, using the applicable part from IEC 61300 (all parts).

6.3.2 Temperature cycling test

Temperature cycling reliability test (test 2(a) in Table 1) shall be done in accordance with IEC 62005-9-1 at the conditions specified in Table 1.