# IEC 61300-2-14

Edition 4.0 2021-02

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

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

## Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures – Partie 2-14: Essais – Puissance optique élevée

IEC 61300-2-14:2021-02(en-fr)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.180.20

ISBN 978-2-8322-9267-9

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

## Part 2-14: Tests – High optical power

## FOREWORD

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International Standard IEC 61300-2-14 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This fourth edition cancels and replaces the third edition published in 2012. This edition constitutes a technical revision.

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

a) harmonizing IEC 61300-1:2016 and IEC 61300-3-4:2012;
b) addition of abbreviated terms;
c) addition of Clause A.2 regarding input optical power from both ends.

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

| CDV | Report on voting |
|---|---|
| 86B/4299/CDV | 86B/4362A/RVC |

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

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

A list of all parts in the IEC 61300 series, published under the general title *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures,* 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

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

## Part 2-14: Tests – High optical power

## 1 Scope

This part of IEC 61300 describes a procedure for determining the suitability of a fibre optic interconnecting device or a passive component to withstand exposure to the optical power which occurs during its operation.

## 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 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

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

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

IEC 61300-3-3, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-3: Examinations and measurements – Active monitoring of changes in attenuation and return loss*

IEC 61300-3-35, *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*

## 3 Terms, definitions and abbreviated terms

### 3.1 Terms and definitions

No terms and definitions are listed in this document.

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

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

### 3.2 Abbreviated terms

CWDM course wavelength division multiplexing

DAS data acquisition system

DUT device under test

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| | |
|---|---|
| DWDM | dense wavelength division multiplexing |
| IL | insertion loss |
| ISO | optical isolator |
| LD | laser diode |
| OSA | optical spectrum analyzer |
| PDL | polarization dependent loss |
| RL | return loss |
| TLS | tunable light source |
| WDL | wavelength dependent loss |
| WDM | wavelength division multiplexing |
| WWDM | wide wavelength division multiplexing |

## 4 Apparatus

### 4.1 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 LD and an optical amplifier or a fibre ring laser. Generally, the power and stability requirements of the test will necessitate that the optical emitter has a fibre pigtail. It shall have a stable output power and wavelength/frequency over the measurement period. For DWDM devices, the frequency stability (instead of the wavelength stability) shall be less than half of the channel bandwidth. Unless otherwise stated in the relevant specification, the source shall have the following characteristics:

a) centre wavelength stability:
   – nominal centre wavelength ±5 nm (for WWDM and CWDM devices);
b) centre frequency stability:
   – nominal centre frequency ±6,3 GHz (for DWDM devices of 25 GHz channel bandwidth);
   – nominal centre frequency ±12,5 GHz (for DWDM devices of 50 GHz channel bandwidth);
   – nominal centre frequency ±25 GHz (for DWDM devices of 100 GHz channel bandwidth);
c) output power stability:
   – nominal output power ±0,05 dB.

### 4.2 Optical detector (D)

The optical detector unit consists of an optical detector, the means to connect to it and the associated electronics. The detector shall have sufficient dynamic range to make the necessary measurements and shall be linear over the measurement range. The detector shall be stable over the measurement period and shall have an operational wavelength range consistent with the DUT. The connection to the detector shall be an adaptor that accepts a connector plug of the appropriate design. The detector shall be capable of capturing all light emitted by the connector plug. Unless otherwise stated in the relevant specification, the detector shall have the following characteristics:

– maximum nonlinearity: ≤ ±0,1 dB;
– accuracy including polarization dependency: ≤ ±0,05 dB;
– resolution: ≤ 0,01 dB.

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### 4.3 Environmental chamber

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

### 4.4 Data acquisition system (DAS)

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

### 4.5 Branching device (BD)

The splitting ratio of the branching device shall be stable over the optical powers and wavelengths chosen for the test. It shall also be insensitive to polarization. A splitting ratio of 1:99 is recommended for the branching device in order to input high power to the DUT and low power to the optical detector.

### 4.6 Temporary joints (TJ)

These are typically used in connecting the device under test to the test apparatus. For the test requirements of optical power and stability, the temporary joints shall be fusion splices.

### 4.7 Safety devices

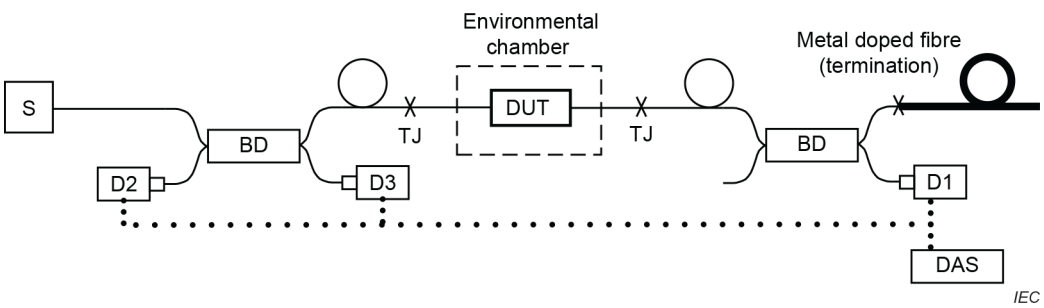
All necessary safety devices, including laser safety glasses, signs and other safety materials, shall be provided in order to protect individuals from possible hazards during testing.

### 4.8 Test set-up

For two-port optical components, a typical layout for the test apparatus is shown in Figure 1.

This test procedure involves the use of optical powers which constitute a potential ocular and skin hazard to test personnel. All necessary safety procedures shall be adopted in accordance with IEC 60825-1. In particular, the DUT shall be unpowered (that is, with no power propagating in the fibre) when conducting a visual examination.

Optical connectors shall not be used. Fusion splices shall be used for all connecting points as described in 4.6.




**Key**

BD branching device

D detector

DAS data acquisition system

DUT device under test

S light source

TJ temporary joint

**Figure 1 – Typical optical power test set-up**

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For multiport devices such as branching devices, all combinations of input and output ports shall be tested, unless otherwise stated in the relevant specification.

For WDM devices, multiple wavelengths shall be input at the same time according to the application. Clause A.1 describes an example of the test set-up for WDM devices.

To minimize test equipment, the DUTs may be connected in series. Clause A.2 describes an example of the test set-up for series-connected DUTs.

# 5 Procedure

## 5.1 Preconditioning

The chosen test samples shall be representative of a standard product.

Prepare and clean the DUTs according to the manufacturer's instructions. Visual examination shall be undertaken in accordance with IEC 61300-3-1 and IEC 61300-3-35. Debris or the presence of contamination is one of the primary causes of failure in high optical power connector applications.

NOTE IEC TR 62627-01 describes fibre optic connector cleaning methods.

Precondition the DUTs for 2 h or more at the standard atmospheric conditions as defined in IEC 61300-1, unless otherwise specified in the relevant specification.

## 5.2 Initial examinations and measurements

Perform initial examinations and measurements on the DUTs as required by the relevant specification. The results of the initial measurements shall be within the limits established in the relevant specification.

## 5.3 Conditioning

a) Set the chamber and the DUT to the standard atmospheric conditions. Place the DUT in the chamber in its normal operating position. The hook-ups of the DUT to the peripheral equipment shall also be placed in their normal operating position, where required.

b) Set the chamber temperature and humidity to the specified severities (see 6.4 and 6.5). The rate of change of temperature shall not exceed 1 °C/min, averaged over a maximum period of 5 min. Allow the DUT to reach the set stable temperature and maintain the temperature for the exposure time.

c) Set the wavelength and optical power to be input to the DUT and turn on the optical source and input optical power to the DUT.

d) Continue to input the optical power to the DUT for the exposure time specified (see 6.6). Monitor the changes in attenuation and return loss of the DUT according to IEC 61300-3-3 during the exposure time. The changes shall be within the pass criteria specified in the relevant specification (see Annexe B).

   NOTE Optical power absorption within the DUT can cause its internal temperature to rise leading to a change in attenuation. The duration of changing attenuation depends on the absorption rate and the thermal capacity of the DUT. Examples of the high power test results are described in IEC TR 62627-03-02 and IEC TR 62627-03-03.

e) At the completion of the exposure time, stop inputting the optical power and change the temperature in the chamber to the standard atmospheric condition. Continue to maintain the DUT in the chamber while the temperature is gradually changed.

## 5.4 Recovery

Allow the DUT to remain under the standard atmospheric condition for 2 h or more, as defined in IEC 61300-1, unless otherwise specified in the relevant specification.

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### 5.5 Final examinations and measurements

On completion of the test, remove all fixtures and make final examinations and measurements on the DUT, as required by the relevant specification, to ensure that there is no permanent damage to the DUT. Clean the DUT according to the manufacturer's instructions. The results of the final measurement shall be within the limit established in the relevant specification.

Unless otherwise specified in the relevant specification, visually examine the DUT in accordance with IEC 61300-3-1. Check for evidence of any degradation in the DUT. These include, for example:

a) broken, loose or damaged parts or accessories;

b) breaking or damage to the cable jacket, seals, strain relief or fibres;

c) displaced, bent, or broken parts.

## 6 Severity

### 6.1 General

Severity is a combination of an optical power, a wavelength, a temperature, humidity and an exposure time. The severity shall be specified in the relevant specification.

NOTE IEC TR 62627-03-04 gives guidelines for high optical power testing.

### 6.2 Optical power

The optical power of the test shall be decided in consideration of the application, unless otherwise stated in the relevant specification. The recommended power levels for testing are:

10 mW, 30 mW, 50 mW, 100 mW, 300 mW and 500 mW.

### 6.3 Wavelengths

The test wavelength shall be the centre or typical wavelength of all operating wavelength ranges specified in the relevant specification. The recommended wavelengths for testing are:

980 nm, 1 310 nm, 1 490 nm, 1 510 nm, 1 550 nm, 1 580 nm, 1 610 nm, 1 625 nm and 1 650 nm.

For WDM devices, the combinations of multi-wavelengths which are input at the same time shall be decided in consideration of the application, unless otherwise stated in the relevant specification.

### 6.4 Temperature

Unless otherwise stated in the relevant specification, the test temperature shall be the maximum temperature of the operating temperature range specified in the relevant specification.

### 6.5 Humidity

Unless otherwise stated in the relevant specification, the test humidity shall be controlled at the maximum humidity of the operating humidity range specified in the relevant specification.

### 6.6 Exposure time

The test exposure time shall be decided in consideration of the thermal capacity of the DUT. For a small component whose weight is less than 0,1 kg, a test exposure time of 30 min is recommended.

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## 7 Details to be specified

The following details, as applicable, shall be specified in the relevant specification:

f) optical power;

g) wavelengths;

h) temperature;

i) humidity;

j) exposure time;

k) initial examinations, initial measurements and initial performance requirements;

l) examinations during test, measurements during test and performance requirements during test;

m) final examinations, final measurements and final performance requirements;

n) deviations from test procedure;

o) additional pass/fail criteria;

p) number of ports and combinations of input and output ports;

q) combinations of multiple wavelengths which are input at the same time for WDM devices.

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