INTERNATIONAL STANDARD

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Second edition
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**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**

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION
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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

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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International Standard IEC 61300-3-3 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 1997. It constitutes a technical revision.

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

FDIS	Report on voting
86B/1781/FDIS	86B/1835/RVD

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

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

IEC 61300 consists of the following parts, under the general title *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*:

– Part 1: General and guidance

– Part 2: Tests

– Part 3: Examinations and measurements

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

• reconfirmed;
• withdrawn;
• replaced by a revised edition, or
• amended.

A bilingual version of this publication may be issued at a later date.

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

1 Scope

This part of IEC 61300 describes the procedure to monitor changes in attenuation and/or return loss of a component or an interconnecting device, when subjected to an environmental or mechanical test. Such a procedure is commonly referred to as active monitoring. In many instances, it is more efficient to monitor attenuation and return loss at the same time.

The procedure may be applied to measurements on single samples or to simultaneous measurements on multiple samples, both at single wavelengths and multiple wavelengths, by using branching devices and/or switches as appropriate.

2 Normative references

The following referenced documents are indispensable for the application 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 61300-1, *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 61300-3-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

IEC/PAS 61300-3-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Fibre optic cylindrical connector endface visual inspection*

3 General description

The procedure describes a number of active monitoring measurement methods. Method 1 describes the situation where a single sample is subject to mechanical or environmental stress testing. Methods 2 and 3 describe methods for monitoring changes in the optical performance of multiple samples. Methods 4 and 5 measure changes in the optical perform-ance of samples using an OTDR. Methods 4 and 5 may be used only when the OTDR averaging time is much less than the variation time of the test conditions. Where there is any form of uncertainty over the measurement method used, method 1 shall be considered to be the reference method.

All methods are capable of being configured to monitor changes in attenuation and return loss at the same time. The required optical test parameters shall be defined in the relevant specification.

Where a group of samples are being monitored over a period of time, say several days or weeks, it is usual to employ some form of automated data acquisition. Also, since the changes in optical performance can be very small, it is important to ensure high measurement stability over time.

3.1 Precautions

The following requirements shall be met.

3.1.1 Precautions shall be taken to ensure that cladding modes do not affect the measurement. Cladding modes shall be stripped as a function of the fibre coating.

3.1.2 Precautions shall be taken to prevent movement in the position of the fibre cables between the sample(s) and the test apparatus, to avoid changes in optical performance caused by bending losses.

3.1.3 The stability performance of the test equipment shall be ≤0,05 dB or 10 % of the attenuation to be measured, whichever is the lower value. The stability shall be maintained over the measurement time. The required measurement resolution shall be 0,01dB for both multimode and single mode.

3.1.4 To achieve consistent results, clean and inspect all samples prior to measurement in accordance with the manufacturer's instructions. Visual examination shall be undertaken in accordance with IEC 61300-3-1 and IEC 61300-3-35.

3.1.5 The power in the fibre shall be at a level that does not generate non-linear scattering effects (typically <3 mW).

3.1.6 It is common to be monitoring changes in optical performance that are small in comparison with the polarization dependence of the components under test (DUT) and of parts of the test apparatus such as branching devices, switches and detectors. Therefore, it is usually necessary to specify light sources with a low degree of polarization or to couple the source to low polarization-inducing optics.

3.1.7 Particularly when measuring wavelength dependent components such as multiplexers or attenuators, it is necessary to use a light source that does not emit light at extraneous wavelengths at levels that can affect the measurement accuracy.

3.1.8 Reflected powers from the test apparatus shall be at a level that does not affect the measurement accuracy.

3.1.9 Care must be taken when using switches or branching devices for multimode measurements. In many cases, these devices will modify the launched mode power distribution or result in modal detection non-uniformity, which will give rise to measurement inaccuracies.

4 Apparatus

4.1 Methods 1, 2 and 3

The apparatus used for methods 1, 2 and 3 of this procedure is shown in Figures 1, 2 and 3. The apparatus consists of the following.

4.1.1 Source (S)

The source consists of an optical emitter, the means to connect to it, and associated drive electronics. In addition to meeting the stability and power level requirements, the source shall have the following characteristics.

Centre wavelength: as detailed in the performance and product standard

Spectral width   :   filtered LED ≤150 nm full width half maximum (FWHM)

Spectral width   :   LD <10 nm FWHM

For multimode fibres, broadband sources such as an LED shall be used.

For single-mode fibres, either an LED or an LD may be used.

NOTE 1   The interference of modes from a coherent source will create speckle patterns in multimode fibre. These speckle patterns give rise to speckle or modal noise and are observed as power fluctuations, since their characteristic times are longer than the resolution time of the detector. As a result, it may be impossible to achieve stable launch conditions using coherent sources for multimode measurements. Consequently, lasers, including OTDR sources, should be avoided in favour of LEDs or other incoherent sources for measuring multimode components.

There are a number of methods of monitoring performance at multiple wavelengths. One method, illustrated in Figure 3, shows independent light sources joined by an optical switch SW3.

NOTE 2   It is particularly important to consider the wavelength dependence of the test apparatus when monitoring multiple wavelengths. For example, different switch ports may not have the same wavelength dependence. This can affect comparative measurements made between any channel "i" and the reference channel, since they will be connected to different switch ports. It is therefore necessary, in such circumstances, to complete an accurate spectral characterization of the test set-up prior to use.

4.1.2   Launch condition (E)

Unless otherwise specified the launch conditions shall be in accordance with Annex B of IEC 61300-1. The launch condition must ensure full cladding mode stripping and an equilibrium mode distribution.

4.1.3   Monitoring equipment

Where multiple measurements are made, suitable apparatus is required to permit monitoring of the light through the multiple paths.

In Figure 2, individual monitoring channels are established by dividing the light into N paths using a 1×N branching device (BD). This method is practical for a small number of DUTs, since it requires a multiplicity of branching devices and detectors.

In Figure 3, active switching of the light paths through the DUTs is used. The apparatus consists of a directional branching device and two 1×N computer-controlled optical switches. The channel number of these switches is sufficiently large to accommodate the DUTs under test, one or more reference lines, and a reference reflectance channel.

NOTE   The design of systems to test multiple samples requires the trade-off of a number of factors such as cost and measurement capability. When testing multimode samples, for example, it may be inappropriate to use branching devices and/or optical switches, due to the problems surrounding modal losses and the associated cost of the test apparatus. However, optical switches may be cost-effective for testing single-mode samples, particularly when the cost of suitable sources and detectors and the measurement stability requirements are considered.

Switch parameters which shall be considered for this test include the following.

a) Repeatability

The switches shall be capable of high repeatability in per-channel insertion loss, since this parameter will directly detract from the accuracy of the measurement of attenuation or return loss of the DUT. Furthermore, since environmental tests are generally carried out over extended periods the switch repeatability shall be considered over the full duration of the test.

b) Return loss

The return loss characteristics of the switch shall be such that they do not unduly influence the measurement in methods 2 and 3.

c) Wavelength dependence

When undertaking multiple wavelength measurements, the wavelength dependence characteristics of the switch shall be taken into account, to ensure they do not unduly influence the measurement in methods 2 and 3.

4.1.4 Detector D

The detector consists of an optical detector, the means to connect to it, and associated electronics. The connection to the detector will be an adaptor that accepts a connector plug of the appropriate design. The detector shall capture all light emitted by the connector plug.

In addition to meeting the stability and resolution requirements, the detector shall have the following characteristics.

Linearity: Multimode ±0,25 dB (over –5 dBm to –60 dBm)

Singlemode ±0,1dB (over –5 dBm to –60 dBm)

NOTE   The power meter linearity shall be referenced to a power level of –23 dBm at the operational wavelength.

The detectors shall have a high dynamic range with an operational wavelength range consistent with that of the DUT and the capability to zero the reference level.

4.1.5 Stress fixture

The stress fixture consists of a suitable mechanism for applying the required stress level(s) to the DUTs. In the case of environmental stress testing, the fixture will typically consist of an environmental chamber capable of meeting the required temperature and/or humidity extremes. In the case of mechanical stress testing, a number of different fixtures will often be required depending on the requirements of the relevant specification, for example, impact rigs, tensile testers, vibration beds, etc.

4.1.6 Branching device BD

The splitting ratio of the BD shall be stable. It shall also be insensitive to polarization. The directivity should be at least 10 dB higher than the maximum return loss to be measured.

4.1.7 Temporary joints

Temporary joints are typically used for connecting the DUTs to the test apparatus. Generally, the stability requirements of a test will require that the temporary joints be mechanical or fusion splices.

4.1.8 Data acquisition

Data recording may be done either manually or automatically. Measurements shall be made at intervals as defined in the relevant specification. Appropriate data acquisition apparatus shall be used where measurements are performed automatically.

4.1.9 Monitor sample

A monitor sample provides a direct performance comparison with the sample(s) under test and shall be used for environmental testing of samples. The monitor sample is similar to those under test, except that it does not contain a DUT. For example, where the DUT is a connector, the monitor sample is simply a length of fibre cable of the same type, located in the same environment as the DUT. The monitor sample shall be placed as close as possible to the DUT(s).

4.1.10 Reference fibre

A reference fibre is typically employed for the purpose of monitoring and compensating for source instability. Reference fibres shall be used where there is no monitor sample and the source does not have sufficient stability to give the required measurement accuracy.