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INTERNATIONAL STANDARD

Optical fibres –
Part 1-1: Measurement methods and test procedures – General and guidance

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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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IEC 60793-1-1 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2017. This edition constitutes a technical revision.

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

a) changes in normative references;
b) renamed Clause 10 and added documentation-related requirements in a new subclause 10.2.

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

Draft	Report on voting
86A/2166/CDV	86A/2203/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60793 series, published under the general title *Optical fibres*, 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 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

Publications in the IEC 60793-1 series concern measurement methods and test procedures as they apply to optical fibres.

The documents are categorized as follows:

- Measurement methods and test procedures for dimensions
- Measurement methods and test procedures for mechanical characteristics
- Measurement methods and test procedures for transmission and optical characteristics
- Measurement methods and test procedures for environmental characteristics
- Measurement methods and test procedures for polarization-maintaining fibres

OPTICAL FIBRES –

Part 1-1: Measurement methods and test procedures – General and guidance

1 Scope

This part of IEC 60793 lists and gives guidance on the use of documents giving uniform requirements for measuring and testing optical fibres, thereby assisting in the inspection of fibres and cables for commercial (mostly telecommunications) purposes.

The individual measurement and test methods are contained in the different parts of the IEC 60793 series. They are identified as IEC 60793-1-X, where "X" is an assigned sub-part number, indicating its affiliation to the IEC 60793-1 series.

In general, measurements and tests methods apply to all class A multimode fibres and class B and class C single-mode optical fibres covered by the IEC 60793-2 series relating to product specifications, although there can be exceptions. Clause 1 of each part of the IEC 60793 series contains the scope for each particular attribute.

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 60793-1-20, *Optical fibres – Part 1-20: Measurement methods and test procedures – Fibre geometry*

IEC 60793-1-21, *Optical fibres – Part 1-21: Measurement methods and test procedures – Coating geometry*

IEC 60793-1-22, *Optical fibres – Part 1-22: Measurement methods and test procedures – Length measurement*

IEC 60793-1-30, *Optical fibres – Part 1-30: Measurement methods and test procedures – Fibre proof test*

IEC 60793-1-31, *Optical fibres – Part 1-31: Measurement methods and test procedures – Tensile strength*

IEC 60793-1-32, *Optical fibres – Part 1-32: Measurement methods and test procedures – Coating strippability*

IEC 60793-1-33, *Optical fibres – Part 1-33: Measurement methods and test procedures – Stress corrosion susceptibility*

IEC 60793-1-34, *Optical fibres – Part 1-34: Measurement methods and test procedures – Fibre curl*

IEC 60793-1-40, *Optical fibres – Part 1-40: Attenuation measurement methods*

IEC 60793-1-41, *Optical fibres – Part 1-41: Measurement methods and test procedures – Bandwidth*

IEC 60793-1-42, *Optical fibres – Part 1-42: Measurement methods and test procedures – Chromatic dispersion*

IEC 60793-1-43, *Optical fibres – Part 1-43: Measurement methods and test procedures – Numerical aperture measurement*

IEC 60793-1-44, *Optical fibres – Part 1-44: Measurement methods and test procedures – Cut-off wavelength*

IEC 60793-1-45, *Optical fibres – Part 1-45: Measurement methods and test procedures – Mode field diameter*

IEC 60793-1-46, *Optical fibres – Part 1-46: Measurement methods and test procedures – Monitoring of changes in optical transmittance*

IEC 60793-1-47, *Optical fibres – Part 1-47: Measurement methods and test procedures – Macrobending loss*

IEC 60793-1-48, *Optical fibres – Part 1-48: Measurement methods and test procedures – Polarization mode dispersion*

IEC 60793-1-49, *Optical fibres – Part 1-49: Measurement methods and test procedures – Differential mode delay*

IEC 60793-1-50, *Optical fibres – Part 1-50: Measurement methods and test procedures – Damp heat (steady state) tests*

IEC 60793-1-51, *Optical fibres – Part 1-51: Measurement methods and test procedures – Dry heat (steady state) tests*

IEC 60793-1-52, *Optical fibres – Part 1-52: Measurement methods and test procedures – Change of temperature tests*

IEC 60793-1-53, *Optical fibres – Part 1-53: Measurement methods and test procedures – Water immersion tests*

IEC 60793-1-54 *Optical fibres – Part 1-54: Measurement methods and test procedures – Gamma irradiation*

IEC 60793-1-60, *Optical fibres – Part 1-60: Measurement methods and test procedures – Beat length*

IEC 60793-1-61, *Optical fibres – Part 1-61: Measurement methods and test procedures – Polarization crosstalk*

IEC 60793-2, *Optical fibres – Product specifications – General*

3 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

4 Rounding rules

All reported test results shall follow the conventional rounding rule[1] of "rounding half away from zero" when the results recorded display more than the number of significant digits required in the acceptance criteria. Only the first digit beyond the number of significant digits is used in determining the rounding.

EXAMPLE 1 Against a requirement of 0,22 dB/km maximum attenuation, values up to 0,224 dB/km conform, while values of 0,225 dB/km and above are failures.

EXAMPLE 2 Against a requirement of ±0,05 dB, values between –0,054 dB and +0,054 dB are deemed acceptable.

EXAMPLE 3 Against a requirement of 0,6 µm maximum core concentricity error, values up to 0,64 µm are acceptable.

5 Measurement and test categories

The categories include

a) parameter measurements,
b) performance measurements, and
c) compliance tests.

According to several different areas, the tests are grouped as follows:

IEC 60793-1-20 to IEC 60793-1-29:	Measurement methods and test procedures for dimensions
	IEC 60793-1-20
	IEC 60793-1-21
	IEC 60793-1-22
IEC 60793-1-30 to IEC 60793-1-39:	Measurement methods and test procedures for mechanical characteristics
	IEC 60793-1-30
	IEC 60793-1-31
	IEC 60793-1-32
	IEC 60793-1-33
	IEC 60793-1-34

[1] See ISO 80000-1:2009, Annex B, Rule B.

IEC 60793-1-40 to IEC 60793-1-49:	Measurement methods and test procedures for transmission and optical characteristics
	IEC 60793-1-40
	IEC 60793-1-41
	IEC 60793-1-42
	IEC 60793-1-43
	IEC 60793-1-44
	IEC 60793-1-45
	IEC 60793-1-46
	IEC 60793-1-47
	IEC 60793-1-48
	IEC 60793-1-49
IEC 60793-1-50 to IEC 60793-1-59:	Measurement methods and test procedures for environmental characteristics
	IEC 60793-1-50
	IEC 60793-1-51
	IEC 60793-1-52
	IEC 60793-1-53
	IEC 60793-1-54
IEC 60793-1-60 to IEC 60793-1-69:	Measurement methods and test procedures for polarization-maintaining fibres
	IEC 60793-1-60
	IEC 60793-1-61

6 Standard atmospheric measurement and test conditions

It is necessary to control standard atmospheric conditions within a certain range to ensure proper correlation between data obtained from measurements and tests conducted in various facilities. Conduct measurement and test conditions under the following atmospheric conditions (see Table 1), unless otherwise specified. In some cases, special ambient conditions can be necessary and can be specified in the detail specification.

Table 1 gives the standard range of atmospheric conditions for carrying out measurements and tests.

Table 1 – Standard range of atmospheric conditions

Condition	Standard
Temperature	23 °C ± 5 °C
Relative humidity	45 % ± 25 %
Atmospheric pressure (limits are inclusive)	Site ambient

Keep variations in ambient temperature and humidity to a minimum during a series of measurements.

7 Calibration guidance

The process of calibration can be defined as the set of operations which establish, under specified conditions, the relationship between values indicated by a measuring system and the known values of a reference material. Once established, this relationship may be used to adjust the measuring system to correct for measurement bias. Adjustment of the system can, for example, take the form of hardware or a software adjustment.

Follow the instructions given in the test procedure documents as can be necessary for calibration and adjustment of the apparatus to ensure successful application of the documents. If suitable reference materials do not exist, then consideration should be given to an appropriate strategy to minimise measurement uncertainty.

Record relevant information of the calibration process, such as the calibrated value and uncertainty of the reference material or test equipment used.

8 Reference test methods

Several attributes have an agreed-upon reference test method (RTM). This is the method that shall be used to settle disputes.

9 Categories of optical fibres

The measurement methods and test procedures indicated in this document apply to fibre categories described in IEC 60793-2 as appropriate.

10 Packaging and documentation

10.1 Packaging

For handling and shipping of optical fibres, the packaging device shall meet the following requirements:

a) winding techniques shall enable the optical fibre to withstand transport and specified environmental conditions;

b) the possibility of measuring the dimensions, transmission and optical characteristics of the optical fibre without removal of the fibre from the packaging device shall be indicated;

c) reel dimensions shall be provided to the customer.

10.2 Documentation

For handling, shipping and inspection of optical fibres, the information listed below shall be provided on request. The information can be provided either by physical or electronic or digital means (e.g. barcode, quick response code):

a) optical fibre reel handling guidelines;

b) material safety and disposal related information as agreed between the supplier and the customer;

c) the nominal effective group refractive indices at 850 nm for multimode fibres, at 1 550 nm for single-mode fibre and at other wavelengths where data is available;

d) the physical length of the fibre on the shipping reel which shall meet or exceed the stated supplied length.