

# INTERNATIONAL STANDARD



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



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

INTERNATIONAL  
ELECTROTECHNICAL  
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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## OPTICAL FIBRES –

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

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International Standard IEC 60793-1-1 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This fourth edition cancels and replaces the third edition published in 2008. This edition constitutes a technical revision.

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

- a) addition of rounding rules in Clause 4;
- b) addition of two packaging requirements in Clause 10 d) and e).

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

CDV	Report on voting
86A/1747/CDV	86A/1774/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 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 "<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- withdrawn,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.

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

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

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

Within the same series, several different areas are grouped, as follows:

- Parts 1-10 to 1-19: General
- Parts 1-20 to 1-29: Measurement methods and test procedures for dimensions
- Parts 1-30 to 1-39: Measurement methods and test procedures for mechanical characteristics
- Parts 1-40 to 1-49: Measurement methods and test procedures for transmission and optical characteristics
- Parts 1-50 to 1-59: Measurement methods and test procedures for environmental characteristics.

## 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 the 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 IEC 60793-2 (all parts) 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: Measurement methods and test procedures – Attenuation*

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

IEC TR 61931:1998, *Fibre optic – Terminology*

### **3 Terms and definitions**

For the purposes of this document, the terms and definitions given in IEC TR 61931 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 Rounding rules**

All reported test results shall follow the conventional rounding rule<sup>1</sup> of "rounding half away from zero", when the results recorded display more than the significant number of 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, whilst values of 0,225 dB/km and above are failures.

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<sup>1</sup> Please see Annex B, Rule B of ISO 80000-1:2009.

EXAMPLE 2 Against a requirement of  $\pm 0,05$  dB, values between  $-0,054$  dB and  $+0,054$  dB are deemed acceptable.

EXAMPLE 3 Against a requirement of  $0,6 \mu\text{m}$  maximum core concentricity error, values up to  $0,64 \mu\text{m}$  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:

Parts 1-10 to 1-19:	General
Parts 1-20 to 1-29:	Measurement methods and test procedures for dimensions IEC 60793-1-20 IEC 60793-1-21 IEC 60793-1-22
Parts 1-30 to 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
Parts 1-40 to 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
Parts 1-50 to 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

## 6 Standard atmospheric measurement and test conditions

Standard atmospheric conditions need to be controlled within some range to ensure proper correlation of data obtained from measurements and tests conducted in various facilities. Conduct measurement and test conditions under the following atmospheric conditions, unless otherwise specified. In some cases, special ambient conditions may be needed 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**

<i>Condition</i>	<i>Standard</i>
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 may, 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

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;
- d) on request, optical fibre reel handling guidelines can be provided;

- e) material safety and disposal related information can be provided upon request.

## Bibliography

IEC 60793-2 (all parts), *Optical fibres – Part 2: Product specifications*

ISO 80000-1:2009, *Quantities and units – Part 1; General*

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