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INTERNATIONAL STANDARD

colour inside

Optical fibre cables –
Part 1-1: Generic specification – General

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Email: csc@iec.ch
Tel.: +41 22 919 02 11
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 60794-1-1 has been prepared by subcommittee 86A: Fibres and Cables, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition, published in 2002, and constitutes a technical revision.

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

a) the contents are updated throughout;
b) the informative Annexes A "Guide to the installation of optical fibre cables" and B "Guide to hydrogen effects in optical fibre cables" have been deleted from this standard and will be published as separate Technical Reports;
c) the informative Annex C is renamed Annex A and the informative Annex B "Guide to qualification sample" is added.

This standard shall be used in conjunction with IEC 60794-1-2.

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

CDV	Report on voting
86A/1355/CDV	86A/1399/RVC

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.

A list of all the parts in the IEC 61754 series, under the general title *Optical fibre cables*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. 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- withdrawn,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.

The contents of the corrigendum of January 2012 have been included in this copy.

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.

OPTICAL FIBRE CABLES –

Part 1-1: Generic specification – General

1 Scope

This part of IEC 60794 applies to optical fibre cables for use with communication equipment and devices employing similar techniques and to cables having a combination of both optical fibres and electrical conductors.

The object of this standard is to establish uniform generic requirements for the geometrical, transmission, material, mechanical, ageing (environmental exposure), climatic and electrical properties of optical fibre cables, where 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 60189-1, *Low-frequency cables and wires with PVC insulation and PVC sheath – Part 1: General test and measuring methods*

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

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 60793-1-40, *Optical fibres – Part 1-40: Measurement methods and test procedures – Attenuation*

IEC 60793-1-40, *Optical fibres – Part 1-40: Measurement methods and test procedures – Attenutation*

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

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

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

IEC 60794-1-2, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*

IEC 60794-1-2:2003, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*[1]

IEC 60794-4-20:-[2], *Optical fibre cables – Part 4-20: Aerial optical cables along electrical power lines – Family specification for ADSS (All Dielectric Self Supported) Optical cables*

IEC 60811-201, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 201: General tests – Measurement of insulation thickness*[3]

IEC 60811-202, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath*[4]

IEC 60811-203, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 203: General tests – Measurement of overall dimensions*[5]

ISO 14001, *Environmental management systems – Requirements with guidance for use*

ISO 14064-1, *Greenhouse gases. Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*

3 Definitions

For the purpose of this document, the following definitions apply:

3.1
no change in attenuation
an acceptance criterion for attenuation measurement that includes an allowance for measurement uncertainty arising from measurement errors or calibration errors due to a lack of suitable reference standards

NOTE For a practical interpretation, see IEC 60794-1-20.

3.2
no change in fibre strain
an acceptance criterion for fibre strain measurement that includes an allowance for measurement uncertainty arising from measurement errors or calibration errors due to a lack of suitable reference standards

NOTE For a practical interpretation, see IEC 60794-1-20.

4 Optical fibre cables

Optical fibre cables, containing optical fibres and possibly electrical conductors, consist of the following types:

– indoor cables;
– patchcords;

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1 To be replaced by future IEC 60794-1-22.

2 To be published.

3 To be published.

4 To be published.

5 To be published.

– premises cabling;
– cables for installation in ducts and lashed aerial cables;
– cables for direct burial;
– cables for installation in tunnels;
– aerial cables;
– underwater cables for lakes, river crossings and coastal applications;
– microduct cabling;
– cables for utility rights of way such as sewers, gas pipes and water pipes;
– overhead cables (power lines);
– other optical fibre cable types not listed above.

5 Materials

5.1 Optical fibre

Optical fibres shall meet the requirements of IEC 60793-1-1, IEC 60793-2 and the relevant IEC standards. Annex A gives guidance on system performance standards.

5.2 Electrical conductors

The characteristics of any electrical conductors shall be in accordance with the relevant IEC standards.

5.3 Other materials

Material used in the construction of optical fibre cables shall be compatible with the physical and optical properties of the fibres and shall be in accordance with the relevant IEC standards.

5.4 Environmental requirements

When requested, information shall be provided on the overall environmental impact of the cable and cable material. This information should include manufacturing, cable handling and environmental impact during the lifetime of the cable. Examples of relevant information are the minimisation or replacement of harmful materials and improvements in waste disposal. Relevant standards include ISO 14001 and ISO 14064-1.

6 Cable construction

The construction, dimensions, weight, mechanical, optical, electrical and climatic properties of each type of optical fibre cable shall be as stated in the relevant specification.

7 Measuring methods

7.1 General

Not all tests are applicable to all cables.

Intrinsic characteristics of optical fibres are not normally measured by cable manufacturers. The relevant values are provided by optical fibre manufacturers, available as unitary or statistical values. For practical reasons, the core diameter of single-mode fibres is not specified. Mode field diameter is the relevant specification parameter.

Guidance on selecting fibres for testing is given in Annex B.

7.2 Measuring methods for dimensions

The dimensions of the optical fibres, electrical conductors and cables shall be determined by subjecting samples to tests selected from Table 1. The tests applied, acceptance criteria and number of samples shall be as specified in the relevant specification.

Table 1 – Measuring methods for dimensions

Test method	Test	Characteristics covered by test method
IEC 60793-1-21	Coating geometry measurement	Diameter of primary coating Diameter of inked fibre Diameter of secondary or "buffer" coating Non-circularities of secondary or "buffer" coating
IEC 60793-1-22 method A	Delay of transmitted and/or reflected pulse	Length of fibre
IEC 60793-1-22 method B	Backscattering technique	Length of fibre
IEC 60189-1	Mechanical	Diameter of electrical conductor
IEC 60811-201 IEC 60811-202 IEC 60811-203	Mechanical	Thickness of insulation – electrical conductors Thickness of sheaths Overall dimensions

7.3 Measuring methods for mechanical characteristics

The mechanical characteristics of optical fibre cables shall be verified by subjecting samples to tests selected from IEC 60794-1-21. The tests applied and acceptance criteria shall be as specified in the relevant specification.

7.4 Measuring methods for electrical characteristics

When electrical conductors are incorporated in an optical fibre cable, verification of various electrical characteristics may be necessary. Typical tests are shown in Table 2, in addition to those given in IEC 60794-1-24. The tests applied and the acceptance criteria shall be as laid down in the relevant specification.

Table 2 – Measuring methods for electrical characteristics

Test method	Test	Characteristics covered by test method
IEC 60189-1	Conductor resistance	Characteristics of insulated electrical conductors
	Dielectric strength of insulation Insulation resistance	The insulation properties of conductors within optical fibre cables are normally just specified for the incoming material, pre-cabling.

For cables installed along overhead power lines, specialised tests are given in future IEC 60794-1-24 (method H1: Short circuit test and method H2: Lightning test method) and in IEC 60794-4-20 (Annex C: Electrical test (tracking).

7.5 Measuring methods for transmission and optical characteristics

The transmission and optical characteristics of optical fibre in cables shall be verified by carrying out selected tests from those shown in Table 3. The tests applied and acceptance criteria shall be as specified in the relevant specification.

Table 3 – Transmission and optical characteristics of cabled optical fibres

Test method	Test	Characteristics covered by the test method
Test methods for multimode and single-mode fibres		
IEC 60793-1-40 method B	Insertion loss technique	Attenuation
IEC 60793-1-40 method C	Backscattering technique	Attenuation
IEC 60793-1-40 method C	Backscattering technique	Point defects
IEC 60793-1-46 method A IEC 60793-1-46 method B	Transmitted power monitoring Backscattering monitoring	Change of optical transmittance during mechanical and environmental tests
Test methods for single-mode fibres		
IEC 60793-1-48	Polarisation mode dispersion	Polarisation mode dispersion

NOTE Bandwidth, chromatic dispersion and cable cut-off are not measured on cabled optical fibre.

7.6 Measuring methods for environmental characteristics

The environmental characteristics of optical fibre cables shall be verified by subjecting samples to tests selected from IEC 60794-1-2:2003. The tests applied and acceptance criteria shall be as specified in the relevant specification.

IEC/TR 62222[2][6] gives guidance on tests for assessing the fire performance of communication cables installed in buildings.

IEC/TR 62362 [5] gives guidance on the selection of optical fibre cable specifications relative to mechanical, ingress, climatic or electromagnetic characteristics, as classified in ISO/IEC 24702 [10].

7.7 Measuring methods for cable element characterisation

Tests to characterise the different types of cable elements for handling purposes are given in future IEC 60794-1-23.

8 Related Technical Reports

Guidance to assist the user and installer with regard to the general aspects of the installation of optical fibre cables is covered by IEC/TR 62691 [3].

An evaluation of hydrogen induced effects within optical fibre cables is relevant for certain specialised designs, such as those for lakes, rivers, coastal and OPGW applications and those containing metallic tubes. More details on when detailed consideration may be warranted are given in IEC/TR 62690 [4].

Guidelines on considerations that should be taken into account when testing optical fibres which are exposed to nuclear radiation are given in IEC/TR 62283 [6].

6 Numbers in square brackets refer to the Bibliography.

Guidelines on considerations that should be taken into account when planning to connect different types of singlemode fibre are given in IEC/TR 62000 [7].

Guidance on techniques for the measurement of the Coefficient of Friction between cables and ducts is given in IEC/TR 62470 [8].

Annex A
(informative)

Guide to specific defined applications and cabled fibre performance

Applications of optical fibre cables are defined by many different standards organisations including IEEE, ITU-T and ISO/IEC.

A list of applications for multimode optical cables can be found in IEC 60793-2-10:2011, Annex H, for A1 multimode optical fibre.

ISO/IEC 11801:2008 [9], Annex F, provides an informative list of applications for single-mode and multimode optical cables. It has simplified the requirements for cable attenuation by defining categories of cabled optical fibre. The categories can then be used in channels, defined by distance, which support applications.

Annex B
(informative)

Guide to qualification sampling

B.1 Introduction

Typically, a wide range of fibre counts can be accommodated by a small range of generic optical fibre cables. For example, considering loose tube designs with 12 fibres per tube, a 6 element cable could be produced in 12, 24, 36, 48, 60 or 72 fibre versions just by varying the number of tubes and dummy filler elements, within the same basic design. Similarly, cables with 6, 8, 12 and 24 elements could provide options for 12 cables covering from 12 to 288 fibres, within just 4 generic cable designs. This concept can be applied to different fibre counts. For qualification purposes, it should only be necessary to test a subset of the fibre counts and element counts that represent the product range. In the previous example, it could be considered appropriate to test just one 6 element design and one 24 element design in order to prove a manufacturer's design and manufacturing capability.

This philosophy can equally be applied to other designs of optical cable such as central tube cable designs or buffered optical fibre cable designs.

B.2 Fibre selection for cable testing

The cable being tested may contain a full compliment of working fibres or may contain working and dummy/scrap fibres. The tested fibres shall be dispersed throughout the working units. For cables with multiple tube designs, non-working tubes or filler rods may be deployed but they should be used in such a manner that they do not affect the performance of the test. The manufacturer shall position the working units within a cable such that they will be subjected to the full force of the test.

A minimum of one cable per cable design family shall be tested. When testing cables with different element counts, within a design family, only the tests that are affected by the change need to be performed. When a change in the design occurs, then only the tests that are affected by the design change need to be performed.

Stranded loose tube cable designs with more than one active tube shall be tested as follows:

In a single layer cable design at least 2 tubes shall be tested. In a multi-layer design at least 2 tubes of each layer shall be tested. The selected tubes should not be located next to each other. The tube should be fully populated with fibre although some may be scrap/dummy fibres. It is recommended that a total number of test fibres not less than 10 working fibres or all fibres if the fibre count is less than ten.

Ribbon cables shall contain working fibres in the first, last, and central ribbon position. The working fibre being tested shall be located at both edges and in the middle of each of these ribbons.

If agreed by customer and supplier, optical fibres within a tube may be spliced to each other, for example, in cases where a test requires that no fibres shall break. This is a convenient way to check all fibres under test.