

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Optical fibre cables –
Part 2-50: Indoor cables – Family specification for simplex and duplex cables for use in terminated cable assemblies

Câbles à fibres optiques –
Partie 2-50: Câbles intérieurs – Spécification de famille pour les câbles simplex et duplex utilisés dans les câbles assemblés équipés





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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL FIBRE CABLES –

Part 2-50: Indoor cables – Family specification for simplex and duplex cables for use in terminated cable assemblies

FOREWORD

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IEC 60794-2-50 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2020. This edition constitutes a technical revision.

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

- a) added IEC 60793-1-46 and IEC 60794-1-211 to the normative references;
- b) changed the load duration for the tensile test from 5 min to 10 min;
- c) clarified the distance between the clamps for torsion test to 125 times cable diameter, but not less than 0,3 m;

- d) recommended the temperatures -10 °C and $+60\text{ °C}$ for indoor simplex and duplex cables and included the low and high temperatures for category C, C^{HD}, OP and OP^{HD} according to the operating service environments in IEC 61753-1 for temperature cycling and shrinkage testing;
- e) updated the shrinkage test standard to IEC 60794-1-211, F11A, and changed the requirement to maximum 20 mm;
- f) replaced the text for the fire performance with an improved description.

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

| Draft | Report on voting |
|---------------|------------------|
| 86A/2284/FDIS | 86A/2316/RVD |

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 the parts in the IEC 60794 series, published under the general title *Optical fibre cables*, 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.

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INTRODUCTION

This document includes test methods according to IEC 60794-1-21, IEC 60794-1-22 and IEC 60794-1-23 that will be split into single documents and individually renumbered in the IEC 60794-1-1xx series, IEC 60794-1-2xx series and IEC 60794-1-3xx series. Full cross-reference details are given in IEC 60794-1-2.

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OPTICAL FIBRE CABLES –

Part 2-50: Indoor cables – Family specification for simplex and duplex cables for use in terminated cable assemblies

1 Scope

This part of IEC 60794 is a family specification that specifies requirements for simplex and duplex optical fibre cables for use in terminated cable assemblies or as used for termination of passive components.

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

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

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

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

IEC 60794-1-1, *Optical fibre cables – Part 1-1: Generic specification – General*

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

IEC 60794-1-211, *Optical fibre cables – Part 1-211: Generic specification – Basic optical cable test procedures – Environmental test methods – Sheath shrinkage, method F11*

IEC 60794-1-21, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical tests methods*

IEC 60794-1-22, *Optical fibre cables – Part 1-22: Generic specification – Basic optical cable test procedures – Environmental tests methods*

IEC 60794-1-23, *Optical fibre cables – Part 1-23: Generic specification – Basic optical cable test procedures – Cable element test methods*

IEC 60794-2, *Optical fibre cables – Part 2: Indoor cables – Sectional specification*

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*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60794-1-1 and the following 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>

3.1

terminated cable assembly

cable terminated with connectors

Note 1 to entry: Examples from the ISO/IEC 11801 series are optical fibre cords used to establish connections on patch panels, equipment and at work areas or to connect outlets to the terminal equipment.

Note 2 to entry: A so called patch cord or jumper is one type of a terminated cable assembly.

4 Construction

4.1 General

In addition to the constructional requirements in IEC 60794-2, the following considerations apply to simplex and duplex indoor cables for use in terminated cable assemblies.

It is not the intention of this document to specify the finished terminated cable assembly complete with terminations.

There shall be no fibre splice in a delivery length. It shall be possible to identify each individual fibre throughout the length of the cable.

4.2 Optical fibres and primary coating

Multimode or single-mode optical fibres meeting the requirements of IEC 60793-2-10 sub-categories A1-OM1 or A1-OM2 to A1-OM5 or IEC 60793-2-50 class B shall be used.

4.3 Buffer

If a tight or semi-tight (loosely applied) buffer is required, it shall consist of one or more layers of inert material. Unless otherwise specified, the tight buffer shall be removed in one operation together with fibre coating over the specified length. Semi-tight tubes may be filled. For semi-tight and loose buffer, the buffer material is removed for a specified length leaving the primary coating of the fibre intact.

Specified buffer strippability minimum lengths:

- tight: 15 mm;
- semi tight: 300 mm;
- loose: 1,0 m.

Strip force shall comply to the values stated in the relevant specification and the evaluation shall be carried out according to IEC 60793-1-32.

Buffer dimensions are shown in Table 1.

Table 1 – Outer dimensions of buffered fibres

| Nominal outer diameter mm | Tolerance mm |
|------------------------------|-----------------|
| 0,3 to 0,9 | ±0,05 |

Lower tolerance levels can be a requirement for buffered fibres having a low nominal diameter within the specified range. In such cases, tolerance values shall be agreed between supplier and customer.

4.4 Tube

One or two primary coated or buffered fibres are packaged in a tube construction which may be filled. A tube is a cable element that is not covered in 4.3 and typically has a larger outer diameter than what is specified in 4.3. The tube may be reinforced with a composite wall.

If required, the suitability of the tube shall be determined by an evaluation of its kink resistance in accordance with IEC 60794-1-23, method G7.

4.5 Strength and anti-buckling members

The cable shall be designed with sufficient strength members to meet the requirements of this document.

The strength and/or anti-buckling member may be either metallic or non-metallic and may be located in the cable core and/or under the sheath and/or in the sheath.

4.6 Sheath

The cable shall have a uniform overall protective sheath. The cable diameter shall be specified in the relevant specification. Sheath removal is an important feature of these cables. Sheath pull-off force shall be determined in accordance with IEC 60794-1-21, method E21.

4.7 Sheath marking

If required, the cable shall be marked as agreed between the customer and supplier.

4.8 Examples of cable constructions

Examples of cable constructions are shown in Annex A.

Other configurations are not excluded if they meet the mechanical, environmental, transmission and termination requirements given in this document.

5 Tests

5.1 General

Compliance with the specification requirements shall be verified by carrying out tests selected from Clause 5. It is not intended that all tests be carried out in all cases, and Annex B provides guidance on the selection of applicable tests. The tests to be applied and the frequency of testing need to be agreed between the customer and supplier.

Some of the following tests can be performed on a short sample length of cable which is still an integral part of a longer length, thus making it possible to detect permanent changes in attenuation. As a general requirement for the tests specified in this document, the goal is to keep "no change in attenuation" criteria at the end of each evaluation, although the parameters specified in this document may be affected by measurement uncertainty arising either from measurement errors or calibration errors. The optical total uncertainty of measurement for this document shall be $\pm 0,05$ dB for single-mode fibres and $\pm 0,2$ dB for multimode fibres. Any measured value within this range shall be considered as "no change in attenuation".

Single-mode fibre cables are measured at 1 550 nm or 1 625 nm and the measuring wavelength shall be agreed between the customer and supplier. Multimode fibre cables are measured at 850 nm or 1 300 nm and the measuring wavelength shall be agreed between the customer and supplier. Measurements of attenuation shall be carried out according to IEC 60793-1-40. Change in attenuation measurements shall be carried out according to IEC 60793-1-46.

NOTE The optimized wavelength for multimode fibres A1-OM3 and A1-OM4 is 850 nm and for A1-OM5 fibre, the targeted operational wavelength range is in the vicinity of 850 nm to 950 nm.

If loops are used within a test to fix the ends of a cable, the loop diameter shall be equal or greater than the specified minimum cable bend diameter to avoid cable damage and excessive mode filtering in multimode fibre.

Unless otherwise specified, all tests shall be carried out at expanded test conditions as specified in IEC 60794-1-2.

5.2 Dimensions

The fibre dimensions and tolerances shall be checked in accordance with test method IEC 60793-1-20 or IEC 60793-1-21. The diameter of the buffer and of the cable, as well as the thickness of the sheath, shall be measured in accordance with the methods of IEC 60811-202 and IEC 60811-203.

The nominal outer cable diameter is abbreviated as " d " in this document. " d " for the different cable constructions is defined as follows:

- for simplex cable, " d " is the outer diameter;
- for zip cord cable, " d " is the outer diameter of the simplex cable which is used to be combined with another simplex cable to form a zip cord;
- for duplex flat cable, " d " is the outer diameter of the inner cables which include the optical fibre, the buffer, the strength members and the sheath;
- for duplex round cable, " d " is the outer diameter of the inner cables which include the optical fibre, the buffer, the strength members and the sheath.

The cable diameter tolerance shall be $\pm 0,2$ mm.

The deviation of the average sheath thickness shall be within the tolerance of $\pm 0,1$ mm for 100 % of the cable length.

5.3 Mechanical requirements

5.3.1 Tensile performance

Method: IEC 60794-1-21, E1

Diameter of chuck drums and transfer devices: not less than the minimum loaded bending diameter specified for the cable, at least 250 mm diameter.

Load for 10 min:

- simplex cables $d < 1,2$ mm at 50 N; simplex cables $1,2 \text{ mm} \leq d \leq 2,0$ mm at 70 N; simplex cables $d > 2,0$ mm at 100 N;
- duplex round cables at 100 N;
- zipcord and duplex flat cables $d \leq 2,0$ mm at 140 N; zipcord and duplex flat cables $d > 2,0$ mm at 200 N.

Length of sample: sufficient to achieve the desired accuracy of measurement of attenuation change shall be agreed between the customer and supplier.

Requirements:

- in all cases, fibre strain shall not exceed 60 % of the proof strain (equals to absolute 0,6 % strain for 1 % proof-tested fibres);
- the maximum allowable increase in attenuation during the test shall be specified in the relevant specification;
- there shall be no change in attenuation after the test.

5.3.2 Crush

Method: IEC 60794-1-21, E3A

Force short-term:

- 300 N for simplex/duplex cables with $d \leq 2,0$ mm;
- 500 N for simplex/duplex cables with $d > 2,0$ mm.

Duration short-term: 1 min

Number of crushes short-term: 1

Force long-term:

- 100 N for simplex/duplex cables with $d \leq 2,0$ mm;
- 200 N for simplex/duplex cables with $d > 2,0$ mm.

Duration long-term: 10 min

Number of crushes long-term: 1, separated at least 500 mm to any other loaded position.

Requirements:

- the maximum increase in attenuation during the test with a long-term force shall be specified in the relevant specification;
- there shall be no change in attenuation after the test with short-term and long-term force;
- there shall be no damage to the cable elements; any flattening of cable elements is not considered as damage.

For cables having a non-circular cross section, the force shall be applied in the direction of the minor axis (perpendicular to the major axis), as shown in Figure A.6 as an example.

5.3.3 Impact

Method: IEC 60794-1-21, E4

- impact energy: 0,5 J for simplex/duplex cables with $d \leq 2,0$ mm; 1,0 J for simplex/duplex cables with $d > 2,0$ mm;
- number of impacts: 3, each separated at least 500 mm.

Requirements:

- there shall be no change in attenuation after the test;
- there shall be no damage to the cable elements; any flattening of cable elements is not considered as damage.

For cables having a non-circular cross section, the force shall be applied in the direction of the minor axis (perpendicular to the major axis), as shown in Figure A.5 and Figure A.6.

5.3.4 Repeated bending

Method: IEC 60794-1-21, E6

Bending diameter:

- 60 mm for simplex and non-circular duplex cables (consider the cable diameter is the minor dimension);
- 40 times cable diameter for round duplex cables but not less than 60 mm.

Number of cycles: 200

Mass of weights: sufficient to contour the apparatus, for example 1 kg to 2 kg.

Requirements:

- the maximum increase in attenuation during the test shall be specified in the relevant specification;
- there shall be no change in attenuation after the test;
- there shall be no damage to the cable elements; any flattening of cable elements is not considered as damage.

NOTE For cables having a non-circular cross section, the bend requirements are determined using the minor axis as the cable diameter with bending in the direction of the preferential bend, as shown in Figure A.5 and Figure A.6.

5.3.5 Bend

Method: IEC 60794-1-21, E11A

Bending diameter: 20 times cable diameter, but not less than 60 mm (for non-circular cables see note below).

NOTE A cable with smaller bend diameter than specified above can be required for an application. Such a cable can contain bending loss insensitive (enhanced macrobend loss) fibre(s). A smaller bending diameter can be agreed between customer and supplier.

Number of turns: 6

Number of cycles: 3

Length of sample: sufficient to carry out the test.

Prior to bending: at both ends of the sample, all the cable components shall be fixed together, for example by clamps or glue.

Requirements:

- the maximum increase in attenuation during the test shall be specified in the relevant specification;
- there shall be no change in attenuation after the test;
- there shall be no damage to the cable elements; any flattening of cable elements is not considered as damage.

NOTE For cables having a non-circular cross section, the bend requirements are determined using the minor axis as the cable diameter with bending in the direction of the preferential bend, as shown in Figure A.5 and Figure A.6.

5.3.6 Torsion

Method: IEC 60794-1-21, E7

Number of cycles: 10

Distance between fixed and rotating clamps: 125 times cable diameter (for non-circular cables, the cable diameter is the minor dimension) but not less than 0,3 m.

Length of sample: sufficient to carry out the test.

Unless otherwise specified in the relevant specification, sample sag or bend may be minimized by applying tension sufficient to keep the sample straight.

Requirements:

- the maximum increase in attenuation during the test shall be specified in the relevant specification;
- there shall be no change in attenuation after the test;
- there shall be no damage to the cable elements.

5.3.7 Bend at low temperature

Method: IEC 60794-1-21, E11A

Bending diameter: 20 times cable diameter (for non-circular cables, the cable diameter is the minor dimension) but not less than 60 mm.

NOTE A cable with smaller bend diameter than specified above can be required for an application. Such a cable can contain bending loss insensitive (enhanced macrobend loss) fibre(s). A smaller bending diameter can be agreed between customer and supplier.

Number of cycles: 2

Number of turns: 4

Test temperature: 0 °C