IEC 60794-2-50

Edition 3.0 2023-03
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

IEC 60794-2-50:2023-03 RLV(en)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC 60794-2-50

Edition 3.0 2023-03
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.180.10

ISBN 978-2-8322-6746-2

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

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

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60794-2-50:2020. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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 °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.

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

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.

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 ~~with optical fibre~~ 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
~~short length of cable provisioned with a connector at both ends~~

cable terminated with connectors

Note 1 to entry: Examples from the ISO/IEC 11801 series are optical fibre ~~optic~~ 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 ~~and~~ 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 ~~removable~~ 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 ~~stripped off~~ 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 ~~minimum~~.

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 ~~(loosely or not)~~ 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 ~~detail~~ specification ~~(or product 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. ~~The marking shall be resistant to abrasion, which shall be verified in accordance with IEC 60794-1-21, method E2B, method 2.~~

4.8 Examples of cable constructions

Examples of ~~some main types 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 ~~shall~~ 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 ~~spirit~~ 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 ±0,05 dB for single-mode fibres and ±0,2 dB for multimode fibres. Any measured value within this range shall be considered as "no change in attenuation".

~~Cabled~~ Single-mode fibre~~s~~ cables are measured at 1 550 nm or 1 625 nm and the measuring wavelength shall be agreed between the customer and supplier. ~~Cabled~~ Multimode fibre~~s~~ 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~~(s)~~ range is ~~between~~ in the vicinity of 850 nm ~~and~~ 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 ±0,2 mm.

The deviation of the average sheath thickness shall be within the tolerance of ±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 ~~5~~ 10 min:

– simplex cables d < 1,2 mm at 50 N; simplex cables 1,2 mm ≤ d ≤ 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 ≤ 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 ~~be less than 0,6 %~~ 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 ~~product~~ relevant specification;
– there shall be no change in attenuation after the test.

~~– there shall be no damage to the cable elements.~~

5.3.2 Crush

Method: IEC 60794-1-21, E3A

Force short-term:

– 300 N for simplex/duplex cables with d ≤ 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 ≤ 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 ~~product~~ 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 ≤ 2,0 mm; 1,0 J for simplex/duplex cables with d > 2,0 mm;
– number of impacts: ~~at least~~ 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.
~~– any imprint of the striking surface on the cable sheath is not considered mechanical 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 ~~circular~~ 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 ~~product~~ 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 ~~per helix~~: 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 ~~loops~~ clamps or glue.

Requirements:

– the maximum increase in attenuation during the test shall be specified in the ~~product~~ 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: ~~greater than 0,3 m or~~ 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 ~~detail~~ relevant specification, ~~specimen~~ sample sag or bend may be minimized by applying tension sufficient to keep the ~~specimen~~ sample straight.

Requirements:

– the maximum increase in attenuation during the test shall be specified in the ~~product~~ 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 ~~per helix~~: 4

Test temperature: 0 °C ~~for applications at category C and C^{HD} environment;~~

~~The acronyms for the categories are specified in IEC 61753-1. A suitable category should be selected according to the application. See Table 2.~~

Requirements:

– the maximum increase in attenuation during the test shall be specified in the ~~product~~ 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.

5.3.8 Kink

Method: IEC 60794-1-21, E10

Inner loop diameter (for non-circular cables, the cable diameter is the minor dimension): ~~5 times cable diameter.~~

– for cables with outer diameter ≤ 3,0 mm, to be 15 mm;
– for cables with outer diameter > 3,0 mm, to be 5 times the cable outer diameter.

NOTE This is not an operational parameter; this is to address short-term installation/handling performance.

Requirement: no kink on cable shall occur when submitted to the specified loop diameter.

5.3.9 Sheath pull-off force

Method: IEC 60794-1-21, E21

Rate of separation: ≤ 200 mm/min

Strip length: 50 mm

Requirement: the force to strip the sheath shall not be greater than 15 N.

5.3.10 Abrasion resistance of cable marking

Method: IEC 60794-1-21, E2B, method 2

Number of cycles: 50

Requirement: the marking shall be legible on completion of the test, after the number of specified cycles.

5.3.11 Buffered fibre movement under compression

Method: IEC 60794-1-21, E22

Compression distance: 1 mm

Number of movements: 5

Requirements:

– the maximum increase in attenuation during the test shall be specified in the ~~product~~ relevant specification;
– the reaction force shall be less than 1 N at 0,4 mm.

5.4 Environmental requirements

5.4.1 Temperature cycling

~~Method: IEC 60794-1-22, Method F12~~

~~Period t_1 and the number of cycles shall be according Table 2.~~

~~Length of sample: 10 m~~

~~At both ends of the sample, all components of the cable shall be fixed together, for example with loops or glue.~~

~~The temperature cycling range used for the test shall be taken from the intended application environment of the final assembly as described in Table 2.~~

~~Requirements:~~

~~– the maximum change in attenuation during the test shall be specified in the relevant product specification;~~
~~– there shall be no change in attenuation after the test.~~

~~**Table 2 – Temperature cycling ranges according to the application environment**~~

~~Category [a]~~	~~Environment description~~	~~Temperature extreme~~ T_A ~~°C~~	~~Temperature extreme~~ T_B ~~°C~~	~~Soak time~~ t_1 ~~h~~	~~Number of cycles~~
~~C~~	~~Indoor controlled~~	~~–10~~	~~+60~~	~~1~~	~~5~~
~~C^{HD}~~	~~Indoor controlled with heat dissipation~~	~~–10~~	~~+70~~	~~1~~	~~5~~

~~[a] The acronyms for the categories are specified in IEC 61753-1. A suitable category should be selected according the application.~~

Method: IEC 60794-1-22, method F12

Length of device under test (DUT): 10 m

NOTE The length of the DUT is the length between the fixing points of all components of the cable. The cable sample length is longer to allow for connection to the optical measurement device outside the temperature chamber.

At both ends of the length of the DUT, all components of the cable shall be fixed together, for example with clamps or glue.

For indoor simplex and duplex cables, –10 °C and +60 °C are the recommended low and high temperatures. Specific operating temperatures can be agreed between customer and supplier. Table 2 gives the preferred operating temperatures.

Table 2 – Preferred low and high temperatures

Low temperature T_A °C	High temperature T_B °C	Sources of temperatures (informative)		Remark
		Performance categories of connectors, components and protective housings [a]	Environmental classification of customer premises cabling [b]	
–10	+60	C	$M_xI_xC_1E_x$	Recommended
–10	+70	C^{HD}	-	
–25	+70	OP	$M_xI_xC_2E_x$	
–25	+85	OP^{HD}	-	

A suitable operating service environment (performance category) or environmental classification should be selected according to the application. A complete list of operating service environments can be found in IEC 60794-1-1.

[a] Included in IEC 61753-1. The abbreviations represent:

C: indoor controlled environment;

OP: outdoor protected environment;

HD: indicates an extended upper temperature necessary due to additional dissipation by active electronics.

[b] Included in ISO/IEC 11801-1. For an introduction to the MICE environmental classification system, use ISO/IEC TR 29106. The abbreviation MICE represents: mechanical, ingress, climatic, electromagnetic.

Soak time t_1: 1 h

Number of cycles: 5

Requirements:

– the maximum change in attenuation during the test shall be specified in the relevant specification;
– there shall be no change in attenuation after the test.

5.4.2 Sheath shrinkage ~~(informative)~~

~~Information on cable shrinkage characterization of optical fibre cables, related test methods and guidance for shrinkage grade classification are given in IEC TR 62959[1]. Following an example for characterization.~~

~~Method: IEC 60794-1-22, F11~~

~~Exposure temperature: the highest operation temperature specified for the cable according to the performance category in Table 2.~~

~~Exposure duration: according to the performance category in Table 2.~~

~~Number of cycles: according to the performance category in Table 2.~~

~~Nominal length of samples: 1 m.~~

~~[1] Under preparation. Stage at the time of publication: IEC/PCC 62959:2019.~~

~~On completion of the corresponding number of cycles, report the maximum shrinkage of the cable samples. Requirements shall be specified in the product specification.~~

Method: IEC 60794-1-211, F11A

Low and high temperature: One pair should be selected in Table 2 according to the application.

Nominal length of samples: 1 m

Soak time t_1: 1 h

Number of cycles: 5

Requirement: The maximum sheath shrinkage shall be equal or less than 20 mm.

NOTE IEC TR 62959 provides information on cable shrinkage characterisation of optical fibre cables that consist of standard glass optical fibres for telecommunication applications. The characterisation is directed to the effects of cable shrinkage or cable element shrinkage on the termination of cables.

6 Transmission requirements

The transmission requirements shall be ~~verified~~ in accordance with ~~IEC 60793-1-40~~ IEC 60793-2-10 or IEC 60793-2-50 and shall be agreed between customer and supplier. Maximum cable attenuation shall comply with IEC 60794-1-1.

7 Fire performance

All cables according to this document shall pass fire performance specifications. The requirements may differ in different regions (e.g. North America, EU). But they also can differ from country to country.

NOTE 1 IEC TR 62222 provides guidance and recommendations for the requirements and test methods for the fire performance of communication cables when installed in buildings. The recommendations relate to typical applications and installation practices, and an assessment of the fire hazards presented. Account is also taken of applicable legislation and regulation.

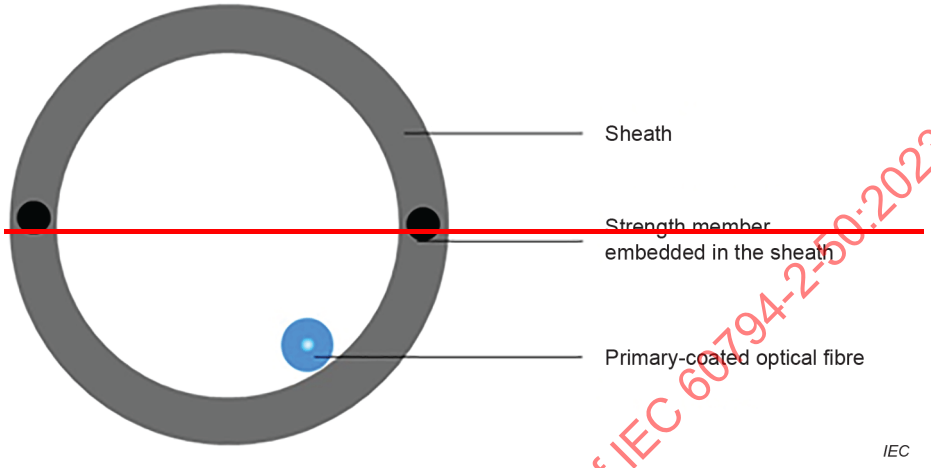
IEC TR 62222 references several IEC fire performance test methods and also other test methods that ~~may~~ can be required by local or national legislation and regulation. It is important that the tests to be applied fulfil the national legislation and regulation and the specific requirements by its intended use.

Products placed on the EU or UK market should determine whether harmonised EN 50575 is applicable after checking with local regulations.

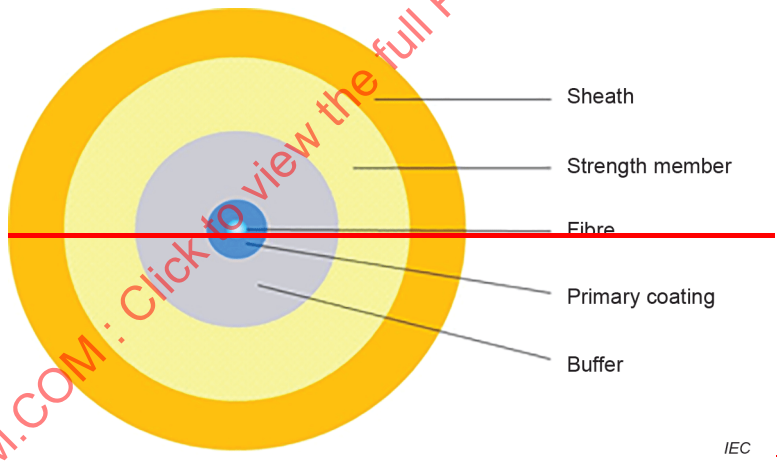
Annex A
(informative)

Examples of ~~types of~~ cable constructions

Figure A.1 to Figure A.7 shows examples of ~~types of~~ cable constructions. The main dimensions depend on agreement between customer and supplier.



~~**Figure A.1 – Simplex loose non-buffered fibre cable**~~



~~**Figure A.2 – Simplex fibre cable**~~

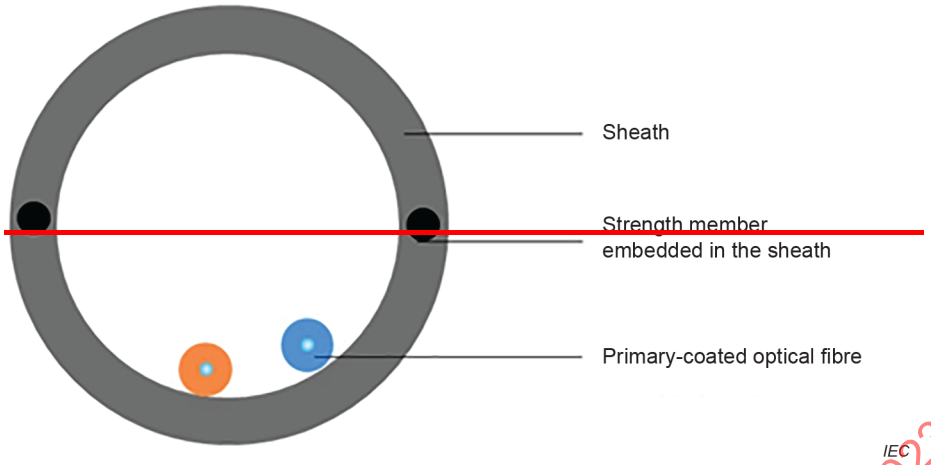


Figure A.3 – Duplex loose non-buffered fibre cable

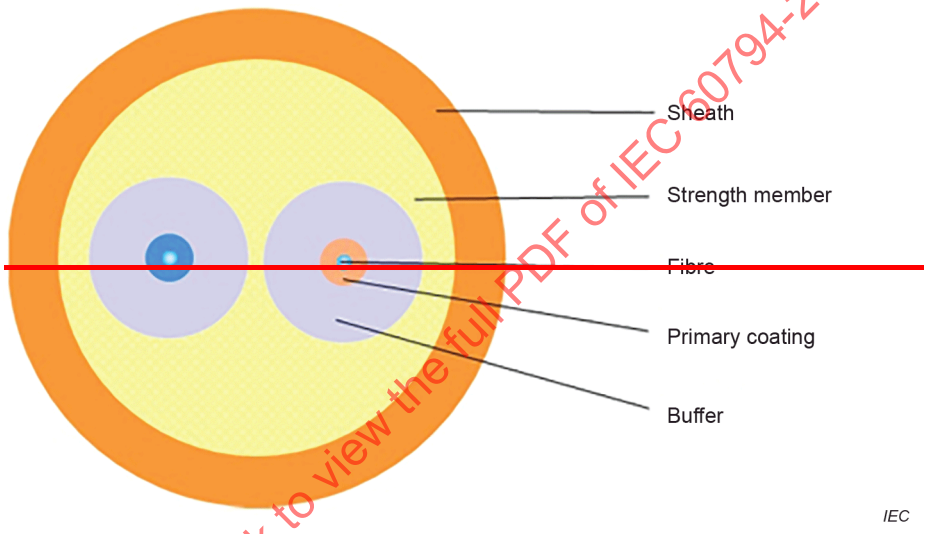


Figure A.4 – Duplex fibre cable

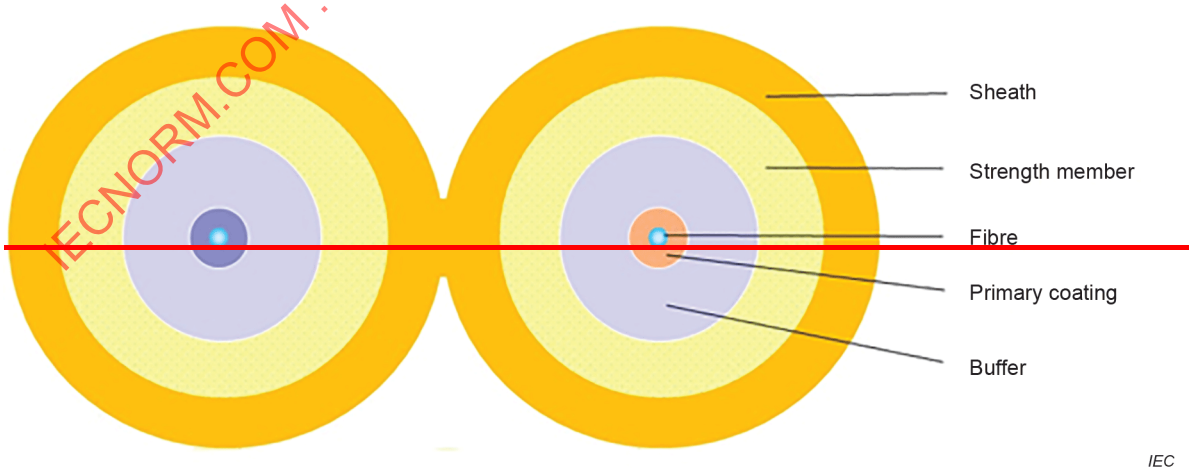


Figure A.5 – Duplex fibre zip cord

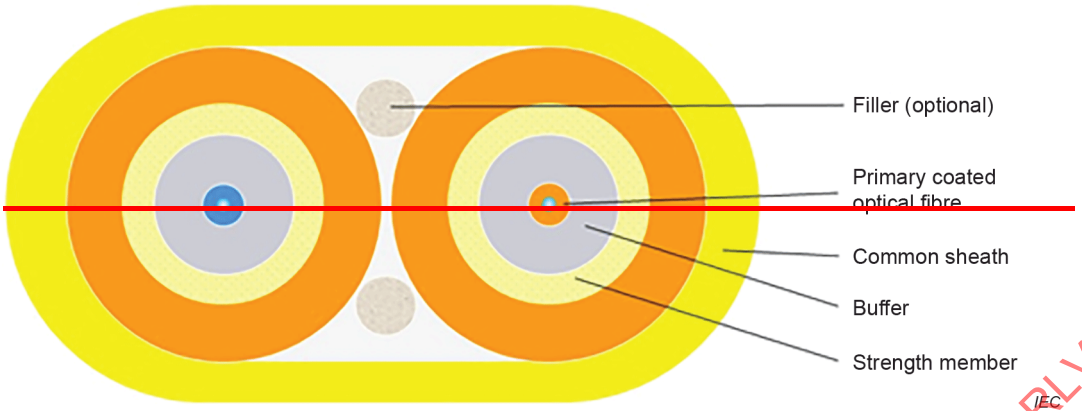


Figure A.6 – Duplex flat cable

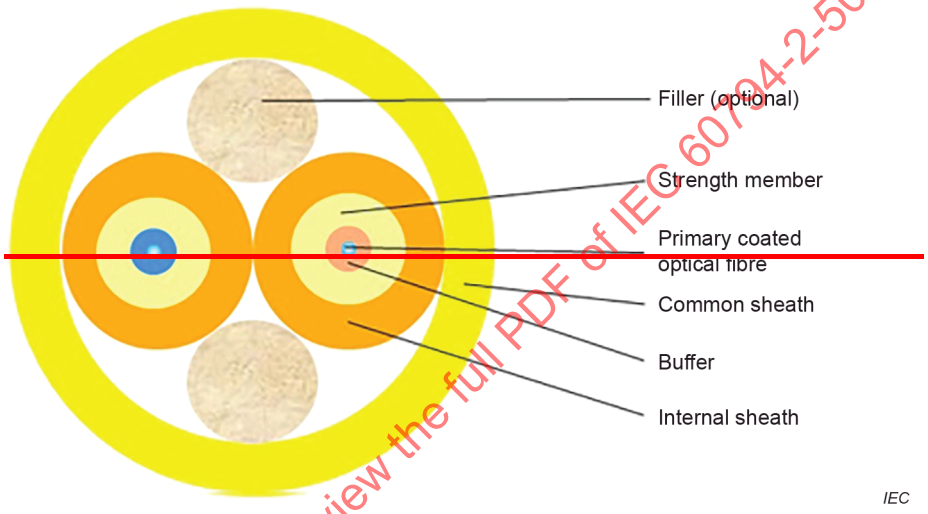


Figure A.7 – Duplex round cable (breakout cable)

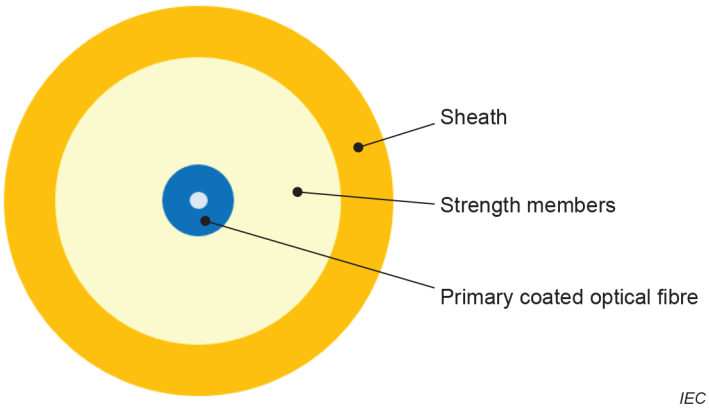


Figure A.1 – Simplex non-buffered cable

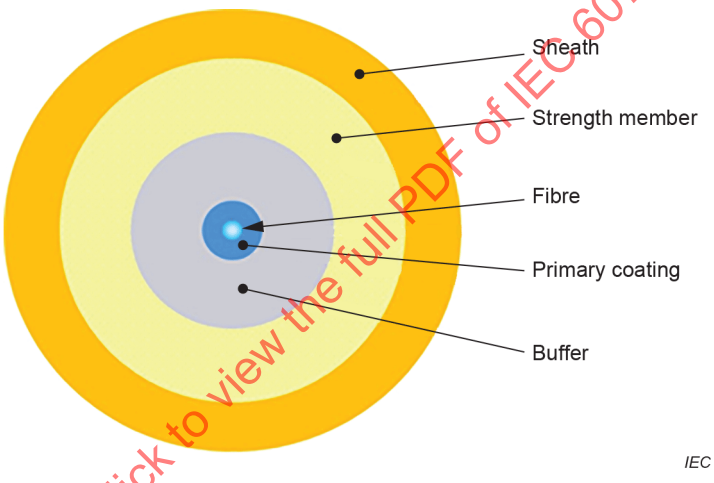


Figure A.2 – Simplex cable

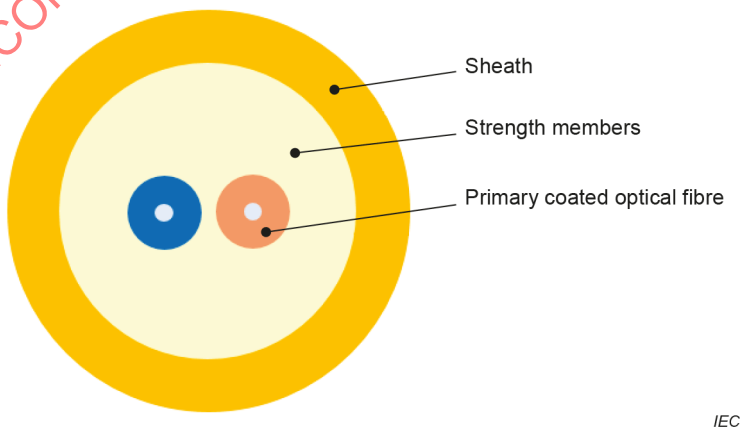


Figure A.3 – Duplex non-buffered cable

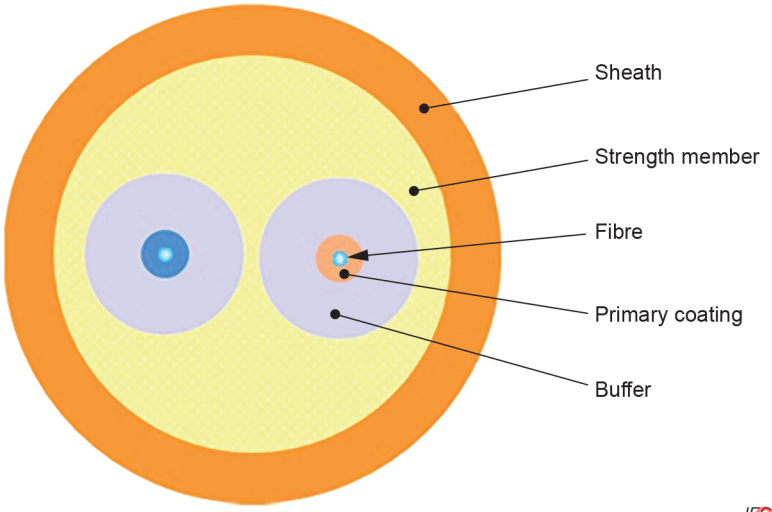


Figure A.4 – Duplex cable

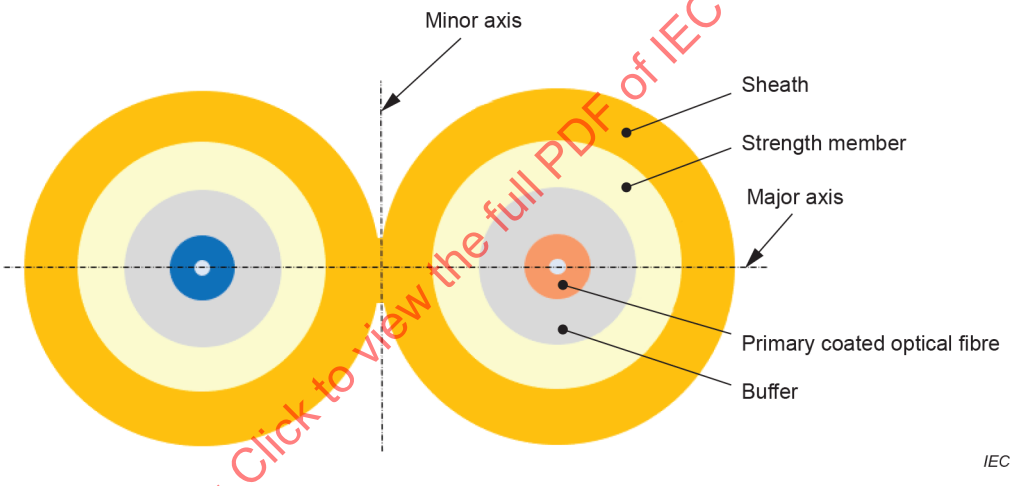


Figure A.5 – Duplex zip cord cable

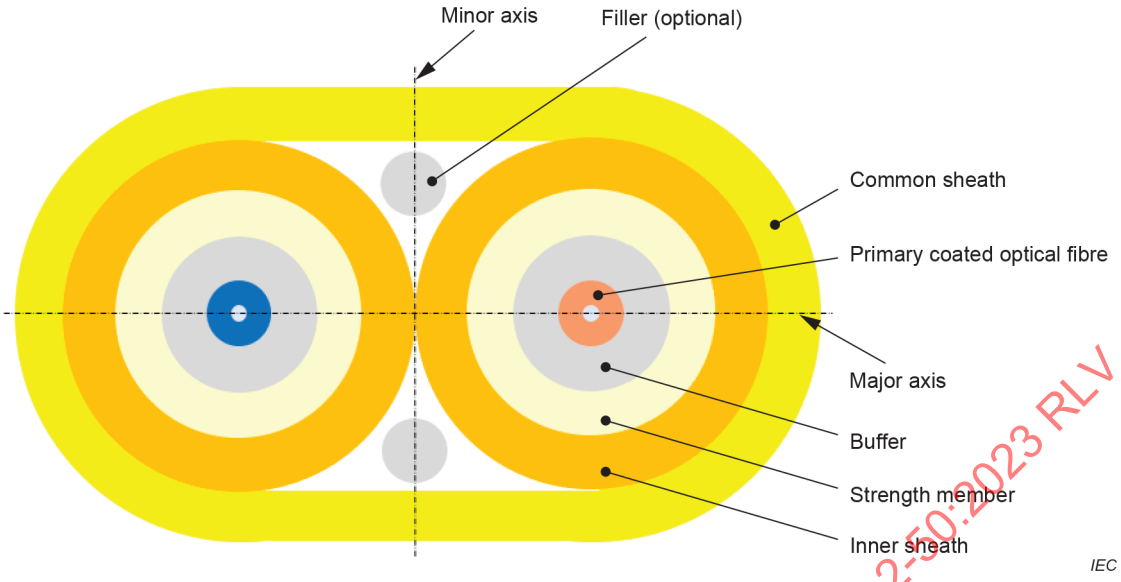


Figure A.6 – Duplex flat cable

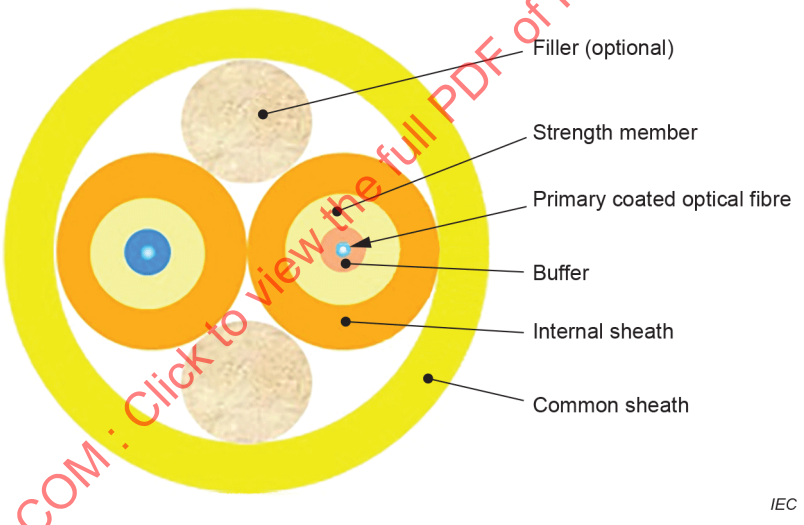


Figure A.7 – Duplex round cable (breakout cable)

Connectors for indoor use are usually not terminated to a duplex flat cable shown in Figure A.6 and not to a duplex round cable (breakout cable) shown in Figure A.7 directly, but terminated to each sub-unit that contains an optical fibre (simplex cable).

Annex B
(informative)

Guidance on the selection of tests applicable to optical fibre cables for use in ~~patchcords~~ terminated cable assemblies

Annex B provides guidance on the selection of the tests to be applied according to the description in Clause 5.

Table B.1 summarizes all cable test methods used for ~~patchcords~~ terminated cable assemblies and provides information on the purpose of the various test methods.

Table B.1 – Cable test method summary

Clause/ Subclause	Test method	Purpose
5.2	**Dimensions**	
		The check of fibre dimensions and tolerances ensures that the cable mates with other patchcord components (e.g. connectors) to support processing and installation.
5.3	**Mechanical requirements**	
5.3.1	Tensile performance	Determines the optical transmission and mechanical changes that typically occur due to tensile loading, primarily as a result of installation or re-patching related forces. Cables used in patchcord applications are not likely to see high tensile forces due to the relatively short lengths employed. The tensile capability of connectorized cable is addressed in the ~~product~~ performance specifications for finished cable assemblies.
5.3.2	Crush	Determines the optical transmission and mechanical changes that may occur in cable subjected to compressive loading perpendicular to the axis of the cable. This test evaluates the ability of the cable construction to isolate the optical fibres from external compressive forces (e.g. induced by a person standing on the cable).
5.3.3	Impact	Determines the optical transmission and mechanical changes that may occur when the cable is subjected to an impact perpendicular to its jacket surface. It is used to evaluate the ability of the cable to survive impact forces as may be encountered during installation efforts, during shipping or handling, or post installation.
5.3.4	Repeated bending	Determines the ability of a cable to withstand flexure through a 180° arc for a prescribed number of cycles. It is used to evaluate the ability of the cable to survive repeated bending as may be encountered during installation or repositioning of the installed patchcord.
5.3.5	Bend	The bend test determines the ability of an optical fibre cable to withstand repeated wrapping around a mandrel to replicate forces that might be encountered during installation or repositioning of installed patchcords.
5.3.6	Torsion	Determines the optical transmission and mechanical changes that may occur in a cable due to twisting along the longitudinal axis. Cables used in patchcord applications are not likely to see excessive twisting due to the relatively short lengths employed.
5.3.7	Bend at low temperature	Determines the ability of a cable to withstand bending at low temperatures as might be encountered during initial installation in a specific environment. Cables used in indoor patchcord applications are not likely to see installation at low temperatures due to the environment in which they are employed.
5.3.8	Kink	Determines the minimum loop diameter at the onset of the kinking of an optical fibre cable. Cables used in indoor patchcord applications are subject to frequent handling and routing in confined spaces that increase the risk of kinking.

Clause/ Subclause	Test method	Purpose
5.3.9	Sheath pull-off force	Determines the force required to remove a given length of cable sheath from the other cable components. The ability to remove a length of the cable sheath is an important consideration for the manufacture of patchcords, but does not significantly affect the deployment of completed patchcords.
5.3.10	Abrasion resistance of ~~sheath~~ cable marking	Determines the ability of the sheath markings of a finished cable to withstand abrasion. This test does not affect the optical performance of the cable but is a visual characteristic.
5.3.11	Buffered fibre movement in compression	Determines the ability of the cable to allow movement of the buffered fibre and monitors the reaction force when a buffered fibre in a cable intended for use in patchcords moves under compression. The ability of movement of the buffered fibre is an important requirement in conjunction with spring-loaded optical connectors. It enables a continuously low attenuation of mated connectors.
5.4	**Environmental requirements**	
5.4.1	Temperature cycling	Determines the performance of an optical fibre cable at the operational temperature extremes. Because the expansion coefficients and rigidity moduli of the various materials that constitute the cable are different from those for the optical fibres themselves, bend effects that affect the optical performance of the cable can occur with temperature changes.
5.4.2	Sheath shrinkage	~~Cable shrinkage is often used as a performance criterion for optical fibre cables. However, low cable shrinkage does not necessarily guarantee good cable performance.~~ Determines the irreversible contraction of the cable sheath after exposure to elevated temperature. Cable shrinkage can be used as an additional indicator for the characterisation of cables. Acceptable cable shrinkage limit is also dependent on the used connector and cable type as well as the real termination situation.
6	**Transmission requirements**	
		Determines the optical performance of the completed cable. It is recommended that all production product be appropriately tested for optical performance to ensure that it is viable for the intended purpose.
7	**Fire performance**	
		Fire-performance requirements of optical fibre cables are often dictated by local regulation, laws and codes, and are dependent upon the application for which it is being used. Users are encouraged to contact the authority having jurisdiction in order to determine the minimum fire-performance requirements for a particular application.

Table B.2 serves as a template that can be used by customers and suppliers to agree on specific testing requirements for product purchases. Note that some tests are destructive in nature and therefore are not intended to be carried out on production product. Such tests are generally used for the initial qualification testing, periodic re-qualification testing, or type testing of production lots to validate the basic product design.

Table B.2 – Blank detail specification for cable testing agreement

Clause/ Subclause	Test method	Testing			
		Notes	Production testing	Type testing	Qualification testing
5.2	**Dimensions**	[a]			
5.3	**Mechanical requirements**	[b]			
5.3.1	Tensile performance				
5.3.2	Crush				
5.3.3	Impact				
5.3.4	Repeated bending				
5.3.5	Bend				
5.3.6	Torsion				
5.3.7	Bend at low temperature				
5.3.8	Kink				
5.3.9	Sheath pull-off force				
5.3.10	Abrasion resistance of ~~sheath~~ cable marking				
5.3.11	Buffered fibre movement in compression				
5.4	**Environmental requirements**	[b]			
5.4.1	Temperature cycling				
5.4.2	Sheath shrinkage				
6	**Transmission requirements**	[a]			
7	**Fire performance**	[b]			

[a] Recommended critical attributes and dimensions to be verified for all production product.

[b] Typically not needed for production product since these tests are considered destructive. They can be used for type approval and initial product qualification to confirm key performance requirements.

Bibliography

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

IEC 61753-1, *Fibre optic interconnecting devices and passive components – Performance standard – Part 1: General and guidance*

IEC TR 62222, *Fire performance of communication cables installed in buildings*

IEC TR 62959, *Optical fibre cables – Shrinkage effects on cable and cable element end termination – Guidance*[2]

ISO/IEC 11801 (all parts), *Information technology – Generic cabling for customer premises*

ISO/IEC 11801-1, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

ISO/IEC TR 29106, *Information technology – Generic cabling – Introduction to the MICE environmental classification*

EN 50575, *Power, control and communication cables – Cables for general applications in construction works subject to reaction to fire requirements*

[2] Under preparation. Stage at the time of publication: IEC/PCC 62959:2019.

IEC 60794-2-50

Edition 3.0 2023-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

IEC 60794-2-50:2023-04(en-fr)

CONTENTS

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

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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 °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.

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

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.

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 ±0,05 dB for single-mode fibres and ±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 ±0,2 mm.

The deviation of the average sheath thickness shall be within the tolerance of ±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 mm ≤ d ≤ 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 ≤ 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 ≤ 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 ≤ 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 ≤ 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

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.

5.3.8 Kink

Method: IEC 60794-1-21, E10

Inner loop diameter (for non-circular cables, the cable diameter is the minor dimension):

– for cables with outer diameter ≤ 3,0 mm, to be 15 mm;
– for cables with outer diameter > 3,0 mm, to be 5 times the cable outer diameter.

NOTE This is not an operational parameter; this is to address short-term installation/handling performance.

Requirement: no kink on cable shall occur when submitted to the specified loop diameter.

5.3.9 Sheath pull-off force

Method: IEC 60794-1-21, E21

Rate of separation: ≤ 200 mm/min

Strip length: 50 mm

Requirement: the force to strip the sheath shall not be greater than 15 N.

5.3.10 Abrasion resistance of cable marking

Method: IEC 60794-1-21, E2B, method 2

Number of cycles: 50

Requirement: the marking shall be legible on completion of the test, after the number of specified cycles.

5.3.11 Buffered fibre movement under compression

Method: IEC 60794-1-21, E22

Compression distance: 1 mm

Number of movements: 5

Requirements:

– the maximum increase in attenuation during the test shall be specified in the relevant specification;
– the reaction force shall be less than 1 N at 0,4 mm.

5.4 Environmental requirements

5.4.1 Temperature cycling

Method: IEC 60794-1-22, method F12

Length of device under test (DUT): 10 m

NOTE The length of the DUT is the length between the fixing points of all components of the cable. The cable sample length is longer to allow for connection to the optical measurement device outside the temperature chamber.

At both ends of the length of the DUT, all components of the cable shall be fixed together, for example with clamps or glue.

For indoor simplex and duplex cables, –10 °C and +60 °C are the recommended low and high temperatures. Specific operating temperatures can be agreed between customer and supplier. Table 2 gives the preferred operating temperatures.

Table 2 – Preferred low and high temperatures

Low temperature T_A °C	High temperature T_B °C	Sources of temperatures (informative)		Remark
		Performance categories of connectors, components and protective housings [a]	Environmental classification of customer premises cabling [b]	
–10	+60	C	$M_xI_xC_1E_x$	Recommended
–10	+70	C^{HD}	-	
–25	+70	OP	$M_xI_xC_2E_x$	
–25	+85	OP^{HD}	-	

A suitable operating service environment (performance category) or environmental classification should be selected according to the application. A complete list of operating service environments can be found in IEC 60794-1-1.

[a] Included in IEC 61753-1. The abbreviations represent:

C: indoor controlled environment;

OP: outdoor protected environment;

HD: indicates an extended upper temperature necessary due to additional dissipation by active electronics.

[b] Included in ISO/IEC 11801-1. For an introduction to the MICE environmental classification system, use ISO/IEC TR 29106. The abbreviation MICE represents: mechanical, ingress, climatic, electromagnetic.

Soak time t_1: 1 h

Number of cycles: 5

Requirements:

– the maximum change in attenuation during the test shall be specified in the relevant specification;
– there shall be no change in attenuation after the test.

5.4.2 Sheath shrinkage

Method: IEC 60794-1-211, F11A

Low and high temperature: One pair should be selected in Table 2 according to the application.

Nominal length of samples: 1 m

Soak time t_1: 1 h

Number of cycles: 5

Requirement: The maximum sheath shrinkage shall be equal or less than 20 mm.

NOTE IEC TR 62959 provides information on cable shrinkage characterisation of optical fibre cables that consist of standard glass optical fibres for telecommunication applications. The characterisation is directed to the effects of cable shrinkage or cable element shrinkage on the termination of cables.

6 Transmission requirements

The transmission requirements shall be in accordance with IEC 60793-2-10 or IEC 60793-2-50 and shall be agreed between customer and supplier. Maximum cable attenuation shall comply with IEC 60794-1-1.

7 Fire performance

All cables according to this document shall pass fire performance specifications. The requirements may differ in different regions (e.g. North America, EU). But they also can differ from country to country.

NOTE 1 IEC TR 62222 provides guidance and recommendations for the requirements and test methods for the fire performance of communication cables when installed in buildings. The recommendations relate to typical applications and installation practices, and an assessment of the fire hazards presented. Account is also taken of applicable legislation and regulation.

IEC TR 62222 references several IEC fire performance test methods and also other test methods that can be required by local or national legislation and regulation. It is important that the tests to be applied fulfil the national legislation and regulation and the specific requirements by its intended use.

Products placed on the EU or UK market should determine whether harmonised EN 50575 is applicable after checking with local regulations.

Annex A
(informative)

Examples of cable constructions

Figure A.1 to Figure A.7 shows examples of cable constructions. The main dimensions depend on agreement between customer and supplier.

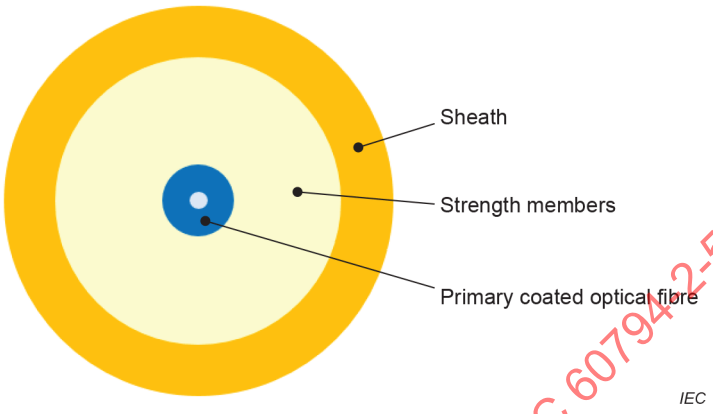


Figure A.1 – Simplex non-buffered cable

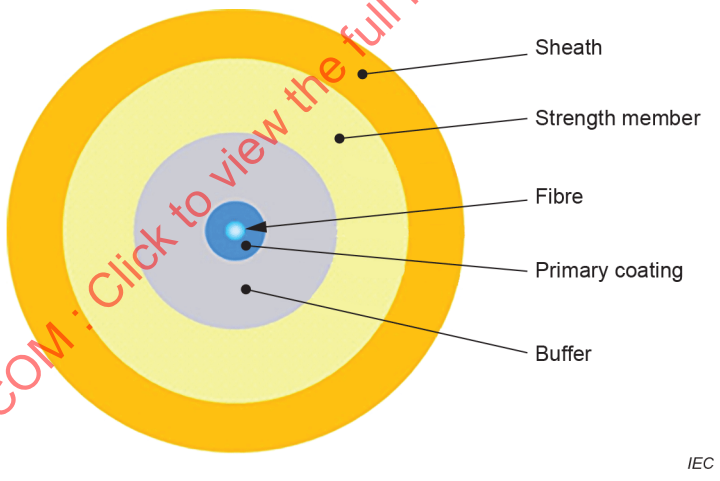


Figure A.2 – Simplex cable

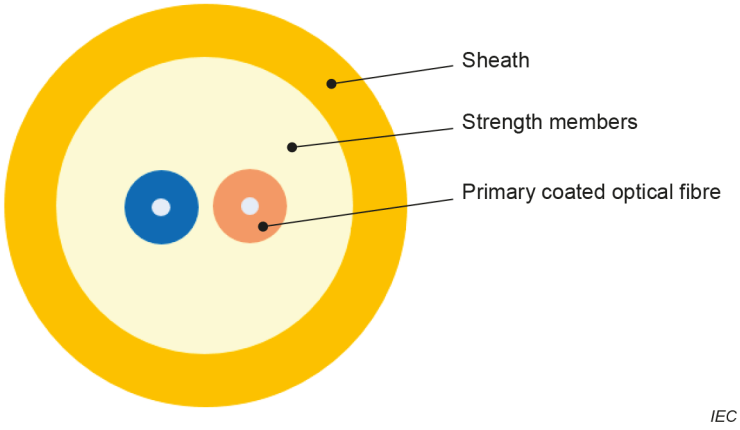


Figure A.3 – Duplex non-buffered cable

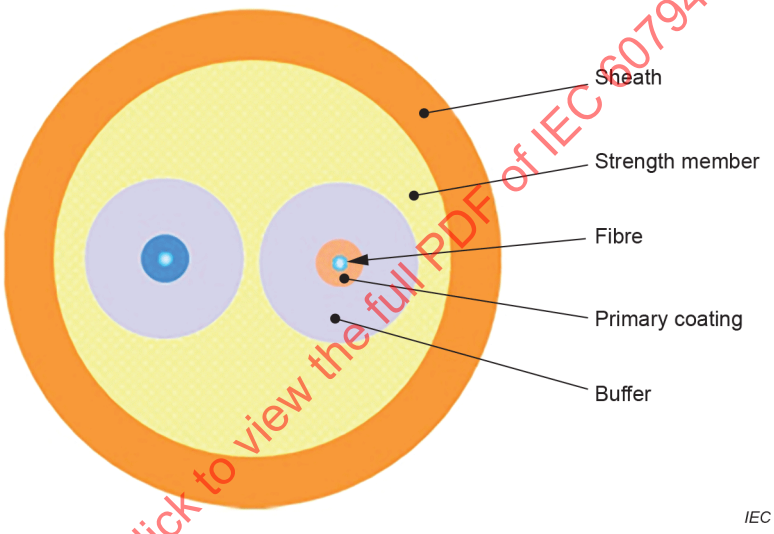


Figure A.4 – Duplex cable

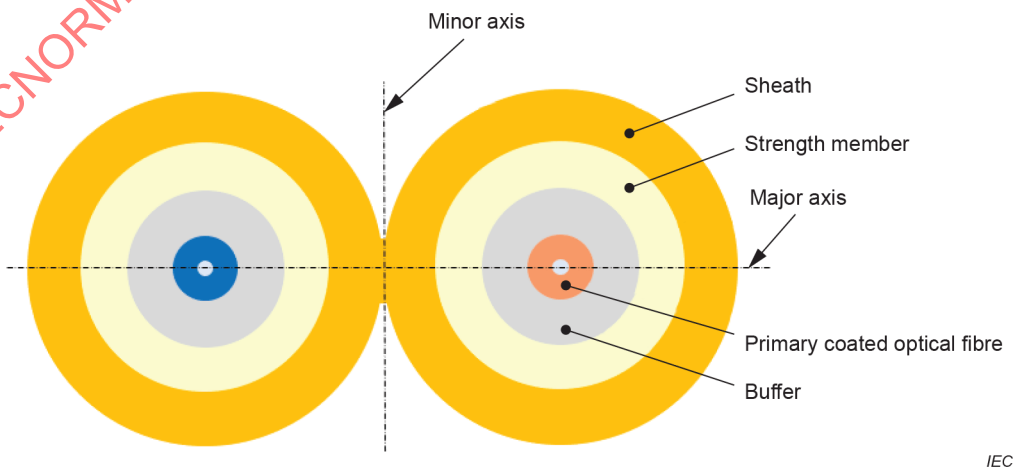


Figure A.5 – Duplex zip cord cable

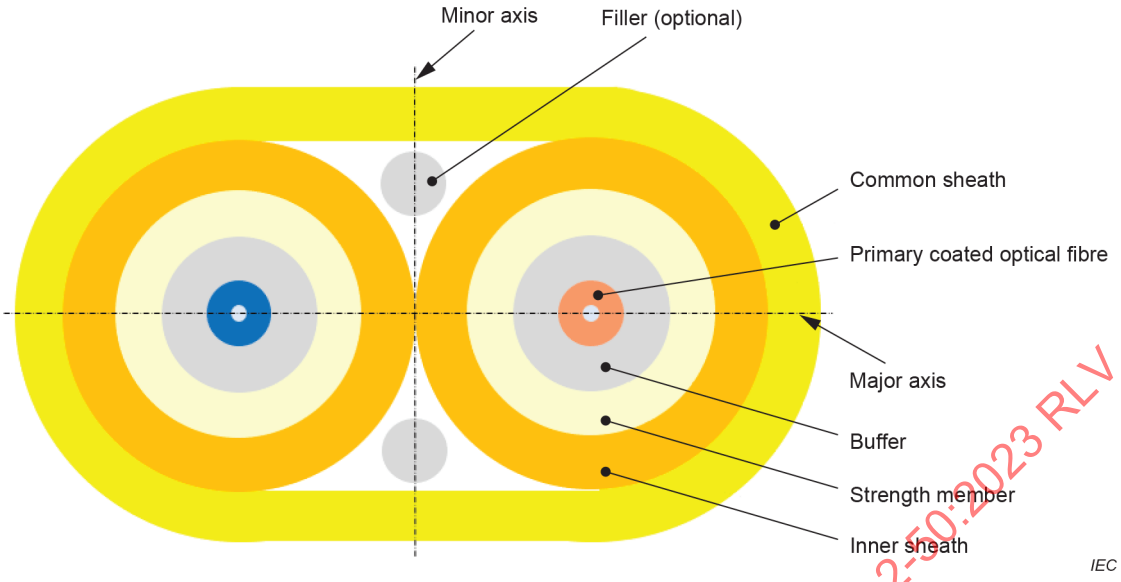


Figure A.6 – Duplex flat cable

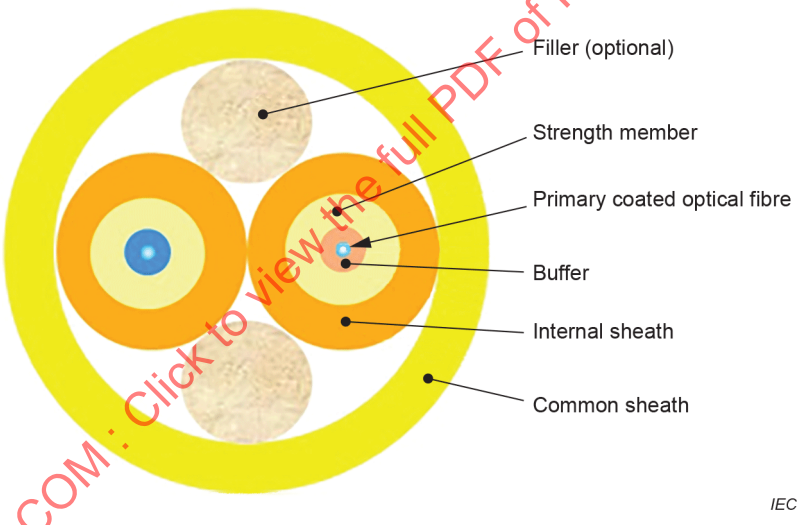


Figure A.7 – Duplex round cable (breakout cable)

Connectors for indoor use are usually not terminated to a duplex flat cable shown in Figure A.6 and not to a duplex round cable (breakout cable) shown in Figure A.7 directly, but terminated to each sub-unit that contains an optical fibre (simplex cable).

Annex B
(informative)

Guidance on the selection of tests applicable to optical fibre cables for use in terminated cable assemblies

Annex B provides guidance on the selection of the tests to be applied according to the description in Clause 5.

Table B.1 summarizes all cable test methods used for terminated cable assemblies and provides information on the purpose of the various test methods.

Table B.1 – Cable test method summary

Clause/ Subclause	Test method	Purpose
5.2	**Dimensions**	
		The check of fibre dimensions and tolerances ensures that the cable mates with other patchcord components (e.g. connectors) to support processing and installation.
5.3	**Mechanical requirements**	
5.3.1	Tensile performance	Determines the optical transmission and mechanical changes that typically occur due to tensile loading, primarily as a result of installation or re-patching related forces. Cables used in patchcord applications are not likely to see high tensile forces due to the relatively short lengths employed. The tensile capability of connectorized cable is addressed in the performance specifications for finished cable assemblies.
5.3.2	Crush	Determines the optical transmission and mechanical changes that may occur in cable subjected to compressive loading perpendicular to the axis of the cable. This test evaluates the ability of the cable construction to isolate the optical fibres from external compressive forces (e.g. induced by a person standing on the cable).
5.3.3	Impact	Determines the optical transmission and mechanical changes that may occur when the cable is subjected to an impact perpendicular to its jacket surface. It is used to evaluate the ability of the cable to survive impact forces as may be encountered during installation efforts, during shipping or handling, or post installation.
5.3.4	Repeated bending	Determines the ability of a cable to withstand flexure through a 180° arc for a prescribed number of cycles. It is used to evaluate the ability of the cable to survive repeated bending as may be encountered during installation or repositioning of the installed patchcord.
5.3.5	Bend	The bend test determines the ability of an optical fibre cable to withstand repeated wrapping around a mandrel to replicate forces that might be encountered during installation or repositioning of installed patchcords.
5.3.6	Torsion	Determines the optical transmission and mechanical changes that may occur in a cable due to twisting along the longitudinal axis. Cables used in patchcord applications are not likely to see excessive twisting due to the relatively short lengths employed.
5.3.7	Bend at low temperature	Determines the ability of a cable to withstand bending at low temperatures as might be encountered during initial installation in a specific environment. Cables used in indoor patchcord applications are not likely to see installation at low temperatures due to the environment in which they are employed.
5.3.8	Kink	Determines the minimum loop diameter at the onset of the kinking of an optical fibre cable. Cables used in indoor patchcord applications are subject to frequent handling and routing in confined spaces that increase the risk of kinking.

Clause/ Subclause	Test method	Purpose
5.3.9	Sheath pull-off force	Determines the force required to remove a given length of cable sheath from the other cable components. The ability to remove a length of the cable sheath is an important consideration for the manufacture of patchcords, but does not significantly affect the deployment of completed patchcords.
5.3.10	Abrasion resistance of cable marking	Determines the ability of the sheath markings of a finished cable to withstand abrasion. This test does not affect the optical performance of the cable but is a visual characteristic.
5.3.11	Buffered fibre movement in compression	Determines the ability of the cable to allow movement of the buffered fibre and monitors the reaction force when a buffered fibre in a cable intended for use in patchcords moves under compression. The ability of movement of the buffered fibre is an important requirement in conjunction with spring-loaded optical connectors. It enables a continuously low attenuation of mated connectors.
5.4	**Environmental requirements**	
5.4.1	Temperature cycling	Determines the performance of an optical fibre cable at the operational temperature extremes. Because the expansion coefficients and rigidity moduli of the various materials that constitute the cable are different from those for the optical fibres themselves, bend effects that affect the optical performance of the cable can occur with temperature changes.
5.4.2	Sheath shrinkage	Determines the irreversible contraction of the cable sheath after exposure to elevated temperature. Cable shrinkage can be used as an additional indicator for the characterisation of cables. Acceptable cable shrinkage limit is also dependent on the used connector and cable type as well as the real termination situation.
6	**Transmission requirements**	
		Determines the optical performance of the completed cable. It is recommended that all production product be appropriately tested for optical performance to ensure that it is viable for the intended purpose.
7	**Fire performance**	
		Fire-performance requirements of optical fibre cables are often dictated by local regulation, laws and codes, and are dependent upon the application for which it is being used. Users are encouraged to contact the authority having jurisdiction in order to determine the minimum fire-performance requirements for a particular application.

Table B.2 serves as a template that can be used by customers and suppliers to agree on specific testing requirements for product purchases. Note that some tests are destructive in nature and therefore are not intended to be carried out on production product. Such tests are generally used for the initial qualification testing, periodic re-qualification testing, or type testing of production lots to validate the basic product design.

Table B.2 – Blank detail specification for cable testing agreement

Clause/ Subclause	Test method	Testing			
		Notes	Production testing	Type testing	Qualification testing
5.2	**Dimensions**	[a]			
5.3	**Mechanical requirements**	[b]			
5.3.1	Tensile performance				
5.3.2	Crush				
5.3.3	Impact				
5.3.4	Repeated bending				
5.3.5	Bend				
5.3.6	Torsion				
5.3.7	Bend at low temperature				
5.3.8	Kink				
5.3.9	Sheath pull-off force				
5.3.10	Abrasion resistance of cable marking				
5.3.11	Buffered fibre movement in compression				
5.4	**Environmental requirements**	[b]			
5.4.1	Temperature cycling				
5.4.2	Sheath shrinkage				
6	**Transmission requirements**	[a]			
7	**Fire performance**	[b]			

[a] Recommended critical attributes and dimensions to be verified for all production product.

[b] Typically not needed for production product since these tests are considered destructive. They can be used for type approval and initial product qualification to confirm key performance requirements.

Bibliography

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

IEC 61753-1, *Fibre optic interconnecting devices and passive components – Performance standard – Part 1: General and guidance*

IEC TR 62222, *Fire performance of communication cables installed in buildings*

IEC TR 62959, *Optical fibre cables – Shrinkage effects on cable and cable element end termination – Guidance*

ISO/IEC 11801 (all parts), *Information technology – Generic cabling for customer premises*

ISO/IEC 11801-1, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

ISO/IEC TR 29106, *Information technology – Generic cabling – Introduction to the MICE environmental classification*

EN 50575, *Power, control and communication cables – Cables for general applications in construction works subject to reaction to fire requirements*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

_____

CÂBLES À FIBRES OPTIQUES –

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

AVANT-PROPOS

1) La Commission Électrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses Publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets.

L'IEC 60794-2-50 a été établie par le sous-comité 86A: Fibres et câbles, du comité d'études 86 de l'IEC: Fibres optiques. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2020. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) ajout de l'IEC 60793-1-46 et de l'IEC 60794-1-211 dans les références normatives;
b) modification de la durée d'application des charges pour l'essai de traction qui est portée de 5 min à 10 min;

c) clarification de la distance entre les pinces pour l'essai de torsion de 125 fois le diamètre du câble, mais pas moins de 0,3 m;

d) recommandation des températures –10 °C et +60 °C pour les câbles intérieurs simplex et duplex et inclusion des températures hautes et basses pour les catégories C, C^{HD}, OP et OP^{HD} conformément aux environnements de service ou de fonctionnement de l'IEC 61753-1 pour les essais de cycles de température et de rétraction;

e) mise à jour de la norme d'essai de rétraction conformément à l'IEC 60794-1-211, F11A, et modification de l'exigence à 20 mm au maximum;

f) remplacement du texte du comportement au feu par une description améliorée.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
86A/2284/FDIS	86A/2316/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 60794, publiées sous le titre général *Câbles à fibres optiques*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. A cette date, le document sera:

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

Le présent document comprend les méthodes d'essai conformes à l'IEC 60794-1-21, à l'IEC 60794-1-22 et à l'IEC 60794-1-23 qui seront divisées en documents distincts et renumérotées individuellement dans les séries IEC 60794-1-1xx, IEC 60794-1-2xx et IEC 60794-1-3xx. Le détail des références croisées figure dans l'IEC 60794-1-2.

CÂBLES À FIBRES OPTIQUES –

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

1 Domaine d'application

La présente partie de l'IEC 60794 est une spécification de famille qui spécifie les exigences pour les câbles simplex et duplex à fibres optiques utilisés dans des câbles assemblés équipés ou comme terminaison pour des composants passifs.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60793-1-20, *Fibres optiques – Partie 1-20: Méthodes de mesure et procédures d'essai – Géométrie de la fibre*

IEC 60793-1-21, *Fibres optiques – Partie 1-21: Méthodes de mesure et procédures d'essai – Géométrie du revêtement*

IEC 60793-1-32, *Fibres optiques – Partie 1-32: Méthodes de mesure et procédures d'essai – Dénudabilité du revêtement*

IEC 60793-1-40, *Fibres optiques – Partie 1-40: Méthodes de mesure et procédures d'essai – Affaiblissement*

IEC 60793-1-46, *Fibres optiques – Partie 1-46: Méthodes de mesure et procédures d'essai – Contrôle des variations du facteur de transmission optique*

IEC 60793-2-10, *Fibres optiques – Partie 2-10: Spécifications de produits – Spécification intermédiaire pour les fibres multimodales de catégorie A1*

IEC 60793-2-50, *Fibres optiques – Partie 2-50: Spécifications de produits – Spécification intermédiaire pour les fibres unimodales de classe B*

IEC 60794-1-1, *Câbles à fibres optiques – Partie 1-1: Spécification générique – Généralités*

IEC 60794-1-2, *Câbles à fibres optiques – Partie 1-2: Spécification générique – Procédures fondamentales d'essais des câbles optiques – Recommandations générales*

IEC 60794-1-211, *Câbles à fibres optiques – Partie 1-211: Spécification générique – Procédures fondamentales d'essais des câbles optiques – Méthodes d'essais d'environnement – Rétraction de la gaine, méthode F11*

IEC 60794-1-21, *Câbles à fibres optiques – Partie 1-21: Spécification générique – Procédures fondamentales d'essais des câbles optiques – Méthodes d'essai mécanique*

IEC 60794-1-22, *Câbles à fibres optiques – Partie 1-22: Spécification générique – Procédures fondamentales d'essais des câbles optiques – Méthodes d'essais d'environnement*

IEC 60794-1-23, *Câbles à fibres optiques – Partie 1-23: Spécification générique – Procédures fondamentales d'essai des câbles optiques – Méthodes d'essai des éléments de câble*

IEC 60794-2, *Câbles à fibres optiques – Partie 2: Câbles intérieurs – Spécification intermédiaire*

IEC 60811-202, *Câbles électriques et à fibres optiques – Méthodes d'essai pour les matériaux non métalliques – Partie 202: Essais généraux – Mesure de l'épaisseur des gaines non métalliques*

IEC 60811-203, *Câbles électriques et à fibres optiques – Méthodes d'essai pour les matériaux non métalliques – Partie 203: Essais généraux – Mesure des dimensions extérieures*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 60794-1-1 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
câble assemblé équipé
câble équipé de connecteurs

Note 1 à l'article: Des exemples tirés de la série ISO/IEC 11801 sont les cordons à fibres optiques utilisés pour établir des connexions sur un panneau de brassage, un équipement et dans des zones de travail ou pour connecter des prises à l'équipement terminal.

Note 2 à l'article: Un cordon de brassage ou une jarretière est un type de câble assemblé équipé.

4 Construction

4.1 Généralités

Outre les exigences de construction de l'IEC 60794-2, les considérations suivantes s'appliquent aux câbles intérieurs simplex et duplex utilisés dans des câbles assemblés équipés.

Le présent document n'a pas pour objectif de spécifier des câbles assemblés équipés finis, achevés avec des terminaisons.

Il ne doit pas y avoir d'épissure de fibre dans une longueur de livraison. Il doit être possible d'identifier chaque fibre individuellement sur toute la longueur du câble.

4.2 Fibres optiques et revêtement primaire

Des fibres optiques multimodales ou unimodales répondant aux exigences de l'IEC 60793-2-10, sous-catégories A1-OM1 ou A1-OM2 à A1-OM5 ou de l'IEC 60793-2-50, classe B doivent être utilisées.

4.3 Revêtement protecteur

Si un revêtement protecteur serré ou semi-serré (appliqué de façon lâche) est exigé, celui-ci doit être constitué d'une ou plusieurs couches de matériau inerte. Sauf spécification contraire, le revêtement protecteur serré doit pouvoir être retiré en une opération avec le revêtement de fibres sur une longueur spécifiée. Les tubes semi-serrés peuvent être remplis. Pour un revêtement protecteur semi-serré et lâche, le matériau du revêtement protecteur est retiré sur une longueur spécifiée en laissant intact le revêtement primaire de la fibre.

Longueurs minimales spécifiées de dénudabilité de revêtement protecteur:

– serré: 15 mm;
– semi-serré: 300 mm;
– lâche: 1,0 m.

La force de dénudage doit être conforme aux valeurs indiquées dans la spécification correspondante et l'évaluation doit être réalisée conformément à l'IEC 60793-1-32.

Les dimensions des revêtements protecteurs sont données dans le Tableau 1.

Tableau 1 – Dimensions extérieures des fibres sous revêtement protecteur

Diamètre extérieur nominal mm	Tolérance mm
0,3 à 0,9	±0,05

Des niveaux de tolérance moins élevés peuvent être exigés pour les fibres sous revêtement protecteur qui ont un petit diamètre nominal dans la plage spécifiée. Dans de tels cas, les valeurs de tolérance doivent faire l'objet d'un accord entre le client et le fournisseur.

4.4 Tube

Une ou deux fibres sous revêtement primaire ou sous revêtement protecteur sont conditionnées dans une construction tubulaire qui peut être remplie. Un tube est un élément de câble qui n'est pas traité en 4.3 et dont le diamètre extérieur est généralement supérieur à la valeur spécifiée en 4.3. Le tube peut être renforcé par une paroi composite.

Si cela est exigé, la bonne adaptation du tube doit être déterminée par une évaluation de sa résistance à la plure conformément à la méthode G7 de l'IEC 60794-1-23.

4.5 Éléments de renfort et éléments antidéformation

Le câble doit être conçu avec des éléments de renfort suffisants pour satisfaire aux exigences du présent document.

Les éléments de renfort et/ou les éléments antidéformation peuvent être métalliques ou non et peuvent être situés dans le cœur du câble et/ou sous la gaine et/ou à l'intérieur la gaine.

4.6 Gaine

Le câble doit comporter une gaine de protection uniforme globale. Le diamètre du câble doit être indiqué dans la spécification correspondante. Le retrait de la gaine constitue une caractéristique importante de ces câbles. La force d'arrachage de la gaine doit être déterminée conformément à la méthode E21 de l'IEC 60794-1-21.

4.7 Marquage de la gaine

Si cela est exigé, le câble doit porter le marquage convenu entre le client et le fournisseur.

4.8 Exemples de constructions de câbles

Des exemples de constructions de câbles sont représentés à l'Annexe A.

D'autres configurations ne sont pas exclues si elles satisfont aux exigences mécaniques, environnementales, de transmission et de finition données dans le présent document.

5 Essais

5.1 Généralités

La conformité aux exigences de la spécification doit être vérifiée en réalisant des essais choisis dans l'Article 5. Il n'est pas prévu d'effectuer tous les essais dans tous les cas, et l'Annexe B fournit des recommandations sur le choix des essais applicables. Il est nécessaire que les essais à appliquer et leur fréquence fassent l'objet d'un accord entre le client et le fournisseur.

Certains des essais suivants peuvent être réalisés sur une petite longueur d'échantillon de câble faisant partie intégrante d'une plus grande longueur, ce qui permet de détecter des variations permanentes d'affaiblissement. Le but de l'exigence générale relative aux essais spécifiés dans le présent document consiste est de conserver le critère "d'absence de variation d'affaiblissement" à la fin de chaque évaluation, bien que l'incertitude de mesure due aux erreurs de mesure ou aux erreurs d'étalonnage puisse avoir un effet sur les paramètres spécifiés dans le présent document. L'incertitude optique totale de mesure pour le présent document doit être de ±0,05 dB pour les fibres unimodales et de ±0,2 dB pour les fibres multimodales. Toute valeur mesurée dans cette plage doit être considérée comme représentant une "absence de variation d'affaiblissement".

Les câbles à fibres optiques unimodales sont mesurés à 1 550 nm ou 1 625 nm et la longueur d'onde de mesure doit faire l'objet d'un accord entre le client et le fournisseur. Les câbles à fibres optiques multimodales sont mesurés à 850 nm ou 1 300 nm et la longueur d'onde de mesure doit faire l'objet d'un accord entre le client et le fournisseur. Les mesures d'affaiblissement doivent être effectuées conformément à l'IEC 60793-1-40. Les mesures de variation d'affaiblissement doivent être effectuées conformément à l'IEC 60793-1-46.

NOTE La longueur d'onde optimisée pour les fibres multimodales A1-OM3 et A1-OM4 est de 850 nm et pour les fibres A1-OM5, la plage de longueur d'onde opérationnelle cible est comprise entre 850 nm et 950 nm.

Si des boucles sont utilisées dans un essai pour attacher les extrémités d'un câble, le diamètre des boucles doit être supérieur ou égal au diamètre de courbure minimal spécifié du câble pour éviter d'endommager le câble et pour éviter un filtrage de mode excessif dans les fibres multimodales.

Sauf spécification contraire, tous les essais doivent être effectués dans des conditions d'essai étendues comme spécifié dans l'IEC 60794-1-2.

5.2 Dimensions

Les dimensions et les tolérances des fibres doivent être vérifiées conformément à la méthode d'essai de l'IEC 60793-1-20 ou de l'IEC 60793-1-21. Le diamètre du revêtement protecteur et du câble, ainsi que l'épaisseur de la gaine, doivent être mesurés conformément aux méthodes de l'IEC 60811-202 et de l'IEC 60811-203.