IEC 60794-2-10

Edition 3.0 2023-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Optical fibre cables –
Part 2-10: Indoor optical fibre cables – Family specification for simplex and duplex cables

Câbles à fibres optiques –
Partie 2-10: Câbles intérieurs à fibres optiques – Spécification de famille pour les câbles simplex et duplex

IEC 60794-2-10:2023-03(en-fr)

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OPTICAL FIBRE CABLES –

Part 2-10: Indoor optical fibre cables – Family specification for simplex and duplex cables

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IEC 60794-2-10 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 2011. This edition constitutes a technical revision.

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

a) updating of normative references;

b) updating of all relevant A1 and B1 fibre category and sub-category designations.

This International Standard is to be used in conjunction with IEC 60794-1-1:2022, IEC 60794-1-2:2021, IEC 60794-1-21:2015 and IEC 60794-1-21:2015/AMD1:2020, IEC 60794-1-22:2017, IEC 60794-1-23:2019 and IEC 60794-2:2017.

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

Draft	Report on voting
86A/2277/FDIS	86A/2311/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 parts of 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

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OPTICAL FIBRE CABLES –

Part 2-10: Indoor optical fibre cables – Family specification for simplex and duplex cables

1 Scope

This part of IEC 60794 is a family specification that covers simplex and duplex optical fibre cables for indoor use. The requirements of IEC 60794-2 are applicable to cables covered by this document.

For cables intended for installation in industrial applications specified in ISO/IEC 11801-1, MICE specifications can be additionally required (see Clause B.2).

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 60304, *Standard colours for insulation for low-frequency cables and wires*

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

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

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

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 60794-1-1:2022, *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 60794-1-21, *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 test methods*

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

IEC 60794-2:2017, *Optical fibre cables – Part 2: Indoor cables – Sectional specification*

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

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

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

4 Construction

4.1 General

In addition to the constructional requirements in IEC 60794-2, the following apply to simplex and duplex indoor cables.

The cable shall be designed and manufactured for an expected operating lifetime of at least 15 years. In this context, the attenuation of the installed cable at the operational wavelength(s) shall not exceed the values agreed between the customer and the supplier. The materials in the cable shall not present a health or environmental hazard within its intended use.

There shall be no fibre splice in a delivery length unless otherwise agreed between the customer and the supplier.

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 shall be used which meet the requirements of IEC 60793-2.

4.3 Buffer

If a buffer is required, it shall consist of one or more layers of inert material. The buffer shall be easily removable. For tight buffers, the buffer and fibre primary coating shall be removable in one operation over a minimum length of 15 mm, depending on customer requirements. For semi-tight buffers, the buffer shall be easily removable over a minimum length of 300 mm. For loose buffers, the buffer shall be easily removable over a length of not less than 1,0 m.

Buffer dimensions are shown in Table 1.

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Table 1 – Dimensions of buffered fibres

Buffer type	Nominal diameter mm	Tolerances mm
Semi-tight or loose buffer	0,3 to 1,3	± 0,05
Tight buffer	0,3 to 1,0	± 0,05

4.4 Ruggedised fibre

Further protection can be provided to buffered fibres by surrounding one or two of the fibres with non-metallic strength members within a sheath of suitable polymeric material.

4.5 Slotted core

Cables of this construction are not commonly used.

4.6 Tube

One or two primary coated or buffered fibres are packaged (loosely or not) in a tube construction which may be filled. The tube may be reinforced with a composite wall.

The polymeric tube may be hard, in order to provide crush protection to the fibre bundle, or soft to enable easy strippability of the tube without the use of specialized tools.

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.

4.7 Stranded loose tube

Cables of this construction are not commonly used, however two general designs can be employed:

a) loose tubes laid in parallel;

b) a number of homogeneous loose tubes stranded helically or with the reverse-oscillating (SZ) method

4.8 Ribbon structure

Cables of this construction are not commonly used.

4.9 Strength and anti-buckling members

The cable shall be designed with sufficient strength members to meet installation and service conditions so that the fibres are not subjected to strain in excess of limits agreed between the customer and the supplier.

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

4.10 Ripcord

Ripcords are not commonly used.

4.11 Sheath

The cable shall have an overall protective sheath. The cable dimension(s) shall be specified in the relevant specification.

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4.12 Sheath marking

Local regulations for sheath marking can apply. In the absence of local regulations, there can be an agreement between the customer and supplier.

4.13 Identification

In case of duplex cables, the cable design should enable clear polarity identification for each individual fibre. When fibre colouring is used for identification, standard colours shall be used as closely as possible (reasonable match) to IEC 60304.

4.14 Examples of typical cable designs

Examples of typical cable designs are shown in Annex A. Other configurations are not excluded if they meet the mechanical, environmental and transmission requirements given in this document.

5 Dimensions – Optical fibres and primary coating

The dimensions of the individual primary coated fibres in the finished product shall be in accordance with one of the sectional specifications defined in IEC 60793-2 series. The fibre dimensions (e.g. cladding diameter or outer diameter including colouring) shall be verified in accordance with IEC 60793-1-20 for fibre geometry or IEC 60793-1-21 for coating geometry. Cable and cable element dimensions shall be measured in accordance with IEC 60794-1-1. For dimensions of buffers see Table 2.

6 Tests

6.1 General

Compliance with the specification requirements shall be verified by carrying out tests selected from the 6.2 to 6.5. It is not intended that all tests shall be carried out; the frequency of testing shall be agreed between the customer and supplier.

Unless otherwise specified, all tests shall be carried out at standard atmospheric conditions in accordance with IEC 60794-1-2.

These tests are not intended to define end-of-life performance.

See Annex B for a blank detail specification.

6.2 Dimensions

The fibre dimensions and tolerances shall be checked in accordance with the test method as specified in IEC 60793-1-20 for fibre geometry or IEC 60793-1-21 for coating geometry. 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 60811-201 for insulation thickness and IEC 60811-203 for overall dimensions.

6.3 Mechanical requirements

6.3.1 General

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 it becomes possible to detect permanent changes in attenuation. The maximum value of this attenuation change shall be agreed between the customer and supplier.

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6.3.2 Tensile performance

Method:	IEC 60794-1-21, E1
Diameter of chuck drums and transfer devices:	not less than 250 mm
Rate of transfer device:	either 100 mm/min or 100 N/min
Load:	T_M = 75 N applied for 10 min for simplex cables and normal duplex cables T_M = 150 N applied for 10 min for duplex cables which consist of independent simplex cables (see NOTE 1)

NOTE 1 In case of duplex cables that include two simplex cables and bearing the applied tensile force by the strength members of each simplex cable, as shown in Figure A.5 Figure A.6 (without the optional strength member) and Figure A.7, the tensile requirement for the duplex cable will be double that for the simplex cable. The rationale is that those simplex cables can be taken out from the duplex cable and will be independently used.

NOTE 2 The requirements of tensile load depend on the construction of cables. Lower values can be adopted for some types of cables, for example small factor simplex cables.

Length of sample:	no less than 50 m unless specified in the relevant specification. For cables requiring specialized anchoring devices, the minimum length shall be 25 m.
Requirements:	no change in attenuation after the test and there shall be no damage to the cable elements for 1 % proof-tested fibres, the fibre strain under short-term tensile load (T_M) the fibre strain shall not exceed 60 % of the fibre proof strain and the attenuation change during test shall be measured and recorded. Other criteria may be agreed between the customer and the supplier. Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements.

6.3.3 Crush

Method:	IEC 60794-1-21, E3A
Force (short term):	500 N
Duration:	1 min
Length between test locations:	500 mm
Requirements:	no change in attenuation after the test and there shall be no damage to the cable elements

NOTE In the case of flat cables the force is applied on the flat sides of the cable.

6.3.4 Impact

Method:	IEC 60794-1-21, E4
Impact energy:	1,0 J
Number of impacts:	at least 3, each separated by at least 500 mm
Requirements:	no fibre breakage

NOTE In the case of flat cables the force is applied on the flat sides of the cable.

6.3.5 Bend

Method:	IEC 60794-1-21, E11A
Mandrel diameter:	60 mm

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Number of turns:	6
Number of cycles:	10
Requirements:	no fibre breakage

NOTE In the case of flat cables the force is applied on the flat sides of the cable.

6.3.6 Repeated bending

None.

6.3.7 Bending under tension

None.

6.3.8 Bending at low temperature

None.

6.3.9 Flexing

None.

6.3.10 Torsion

Method:	IEC 60794-1-21, E7
Number of cycles:	10
Distance between fixed and rotating clamp:	125 x cable diameter but no less than 0,3 m and not more than 1 m
Tension load:	20 N
Requirements:	no fibre breakage

6.3.11 Kink

Method:	IEC 60794-1-21, E10
Minimum loop diameter:	20 times cable diameter
Requirement:	no kink shall occur

6.4 Environmental requirements – Temperature cycling

For indoor simplex and duplex cables, -10 °C and +60 °C are the recommended low and high temperatures. Based on different environment classifications, other operating temperatures can be agreed upon between customer and supplier. Table 2 gives the operating temperature limits based on environmental classification.

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Table 2 – Method: IEC 60794-1-22, F1

Low temperature T_{A2} °C	High temperature T_{B2} °C	Sources of temperature limits	
		Performance categories of connectors, components and protective housings [a]	Environmental classification of customer premises cabling [b]
-10	+60	C (recommended)	$M_xI_xC_1E_x$
-25	+70	OP	$M_xI_xC_2E_x$
-40	+70	I	$M_xI_xC_3E_x$

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

[a] Included in IEC 61753-1. The abbreviated terms stand for:
C: indoor controlled environment;
OP: outdoor protected environment;
I: industrial environment;

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

Period t_1: sufficient so that the cable has reached, and stabilised to, the specified temperature

Number of cycles: 2

Length of sample: sufficient to achieve the desired accuracy of measurement of attenuation

Requirement: maximum increase in attenuation to be agreed between customer and supplier

6.5 Transmission requirements

6.5.1 General

The transmission requirements shall be in accordance with one of the sectional specifications defined in the IEC 60793-2 series and shall be agreed between the customer and supplier. The maximum cabled fibre attenuation shall comply with this specification.

6.5.2 Single-mode optical fibres

See Table 3.

Table 3 – Common single-mode optical fibre requirements

Characteristics	IEC 60794-2:2017, subclause No.	Requirements	Test methods	Remarks
Uncabled optical fibre	4.2	IEC 60793-2-50		
Cabled fibre cut-off wavelength	4.2	$\lambda_{cc} < \lambda$ operational	IEC 60793-1-44	
Point discontinuities at 1 550 nm	4.2	≤ 0,10 dB	IEC 60793-1-40	

6.5.3 Single-mode dispersion unshifted (B-652.B) optical fibre

See Table 4.

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Table 4 – Cabled fibre attenuation requirements for B-652.B optical fibre

Characteristics	IEC 60794-2:2017, subclause No.	Requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	7.3	Acc. DS	IEC 60793-1-40	
at 1 310 nm at 1 550 nm at 1 625 nm		≤ 1,0 dB/km ≤ 1,0 dB/km ≤ 1,0 dB/km		

6.5.4 Single-mode dispersion unshifted (B-652.D) optical fibre

See Table 5.

Table 5 – Cabled fibre attenuation requirements for B-652.D optical fibre

Characteristics	IEC 60794-2:2017, subclause No.	Requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	7.3	Acc. DS	IEC 60793-1-40	
at 1 310 nm to 1 625 nm at 1 383 nm at 1 550 nm		≤ 1,0 dB/km ≤ 1,0 dB/km ≤ 1,0 dB/km		

6.5.5 Single-mode (B-657.A) optical fibre

See Table 6.

Table 6 – Cabled fibre attenuation requirements for B-657.A optical fibre

Characteristics	IEC 60794-2:2017, subclause No.	Requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	7.3	Acc. DS	IEC 60793-1-40	
at 1 310 nm to 1 625 nm at 1 383 nm at 1 550 nm		≤ 1,0 dB/km ≤ 1,0 dB/km ≤ 1,0 dB/km		

6.5.6 Single-mode (B-657.B) optical fibre

See Table 7.

Table 7 – Cabled fibre attenuation requirements for B-657.B optical fibre

Characteristics	IEC 60794-2:2017, subclause No.	Requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	7.3	Acc. DS	IEC 60793-1-40	
at 1 310 nm at 1 550 nm at 1 625 nm		≤ 1,0 dB/km ≤ 1,0 dB/km ≤ 1,0 dB/km		

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