IEC 60794-2-10

Edition 2.0 2011-08

INTERNATIONAL STANDARD

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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 60794-2-10:2011

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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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International Standard IEC 60794-2-10 has been prepared by sub-committee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2003. It constitutes a technical revision.

The main changes with respect to the previous edition are as follows:

– A new clause has been introduced: Clause 4 – Dimensions.
– Test conditions and requirements have been made more accurate.
– The new Subclause 5.5 has been added to give useful figures.

This standard is to be used in conjunction with IEC 60794-1-1:2008, IEC 60794-1-2:2007 and IEC 60794-2.

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

FDIS	Report on voting
86A/1396/FDIS	86A/1412/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,
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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 except for cables used in terminated assemblies specified by IEC 60794-2-50. The requirements of the Sectional specification IEC 60794-2 are applicable to cables covered by this standard.

For the cables intended for installation in industrial applications specified in ISO/IEC 24702, MICE specifications may be additionally required (see Annex B.2).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 They complete the normative references already listed in the generic specification (IEC 60794-1-1, Clause 2, and IEC 60794-1-2, Clause 2).

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: Measurement methods and test procedures – Attenuation*

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 60794-1-1:2008, *Optical fibre cables – Part 1-1: Generic specification – General*

IEC 60794-1-2:2007, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*

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

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IEC 60811-1-1, *Common test methods for insulating and sheathing materials of electric cables – Part 1-1: Methods for general application – Measurement of thickness and overall dimensions – Tests for determining the mechanical properties*

NOTE 2 IEC 60811-1-1 is under revision to be replaced by IEC 60811-201, IEC 60811-202 and IEC 60811-203.

3 Construction

3.1 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 values agreed between the customer and the supplier. The materials in the cable shall not present a health hazard within its intended use.

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

It shall be possible to identify each individual fibre throughout the length of the cable.

3.2 Optical fibres and primary coating

Multimode or single-mode optical fibres shall be used which meet the requirements of IEC 60793-2.

3.3 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 length of 10 mm to 25 mm, depending on customer requirements. For semi-tight buffers, the buffer shall be easily removable over a length of 0,3 m to 0,5 m. 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.

Table 1 – Dimensions of buffered fibres

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

3.4 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 material.

3.5 Slotted core

Cables of this construction are not commonly used.

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3.6 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.

If required the suitability of the tube shall be determined by an evaluation of its kink resistance in accordance with IEC 60794-1-2, Method G7.

3.7 Stranded loose tube

Cables of this construction are not commonly used.

3.8 Ribbon structure

Cables of this construction are not commonly used.

3.9 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 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.

3.10 Ripcord

Ripcords are not commonly used.

3.11 Sheath

The cable shall have an overall protective sheath. The cable diameter shall be specified in the relevant detail specification (or product specification).

3.12 Sheath marking

If required, the cable shall be marked according to the local regulations or the agreement between the customer and the supplier.

3.13 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.

3.14 Examples of cable constructions

Examples of some main types of cable construction are shown in Annex A. Other configurations are not excluded if they meet the mechanical, environmental and transmission requirements given in this specification.

4 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. The fibre dimensions (e.g. cladding diameter or outer diameter including colouring) shall be verified in accordance with IEC 60793-1-20 or IEC 60793-1-21.

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5 Tests

5.1 General

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

Unless otherwise specified, all tests shall be carried out at ambient temperature.

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 60811-1-1.

5.3 Mechanical requirements

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 customer and supplier.

5.3.1 Tensile performance

Method:	IEC 60794-1-2, 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:	75 N applied for 10 min for simplex cables and normal duplex cables
	150 N applied for 10 min for duplex cables which consist of independent simplex cables (NOTE 1)

NOTE 1 In case of duplex cables including two simplex cables and bearing the applied tensile force by the strength members of each simplex cable, e.g. Figures A.5, A.6 (without optional strength member) and A.7, the tensile requirement for the duplex cable shall be double that for the simplex cable. The rationale is that those simplex cables may be taken out from the duplex cable and will be independently used.

NOTE 2 Requirements of tensile load depends on construction of cables. Lower values may be adopted for some types of cables e.g. small factor simplex cables.

Length of sample:	sufficient to achieve the desired accuracy of measurement of attenuation change and shall be agreed between customer and supplier
Requirements:	no change in attenuation after the test and there shall be no damage to the cable elements
	Fibre strain shall not exceed a value agreed upon between customer and supplier

5.3.2 Crush

Method:	IEC 60794-1-2, E3
Force:	500 N
Duration:	1 min
Length between test locations:	500 mm

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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.

5.3.3 Impact

Method: IEC 60794-1-2, E4

Radius of striking surface: 12,5 mm

Impact energy: 1,0 J

Number of impacts: at least 3, each separated 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.

5.3.4 Bend

Method: IEC 60794-1-2, E11A

Mandrel diameter: 60 mm

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.

5.3.5 Repeated bending

None.

5.3.6 Bending under tension

None.

5.3.7 Bending at low temperature

None.

5.3.8 Flexing

None.

5.3.9 Torsion

Method: IEC 60794-1-2, E7

Number of cycles: 3

Distance between fixed and rotating clamp: 125 x cable diameter but not more than 1 m

Tension load: 20 N

Requirements: no fibre breakage

5.3.10 Kink

Method: IEC 60794-1-2, E10

Minimum loop diameter: 20 times cable diameter

Requirement: no kink shall occur

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5.4 Environmental requirements

5.4.1 Temperature cycling

See Table 2.

Method: IEC 60794-1-2, F1

Table 2 – Temperature cycling conditions

	Low temperature T_A	High temperature T_B
a)	0 °C	+50 °C
b)	–5 °C	+50 °C
c)	–20 °C	+60 °C
d)	–45 °C	+60 °C
NOTE Condition a), b), c) or d) will be selected depending on application and customer requirements, for example condition c) is appropriate for applications to ISO/IEC 11801.		

Period t_1: sufficient 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

5.5 Transmission requirements

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

NOTE 1 625 nm performance is optional depending on agreement between customer and supplier.

5.5.1 Single-mode optical fibres

See Table 3.

Table 3 – Common single-mode optical fibre requirements

Characteristics	IEC 60794-2 Clause no.	Requirements	Test Methods	Remarks
Uncabled optical fibre	3.2	IEC 60793-2-50		
Cabled fibre cut-off wavelength	4.4	$\lambda_{cc} < \lambda$ operational	IEC 60793-1-44	
Attenuation Discontinuities at 1 550 nm	4.4	≤ 0,10 dB	IEC 60793-1-40	

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5.5.2 Single-mode dispersion unshifted (B1.1) optical fibre

See Table 4.

Table 4 – Cabled fibre attenuation requirements for B1.1 optical fibre

Characteristics	IEC 60794-2 Clause	Requirements	Test Methods	Remarks
Attenuation coefficient (cabled fibres)	4.4	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		

5.5.3 Single-mode dispersion unshifted (B1.3) optical fibre

See Table 5.

Table 5 – Cabled fibre attenuation requirements for B1.3 optical fibre

Characteristics	IEC 60794-2 Clause	Requirements	Test Methods	Remarks
Attenuation coefficient (cabled fibres)	4.4	Acc. DS	IEC 60793-1-40	
at 1 310 to 1 625 nm at 1 383 nm at 1 550 nm		≤ 1,0 dB/km ≤ 1,0 dB/km ≤ 1,0 dB/km		

5.5.4 Single-mode (B6_a) optical fibre

See Table 6.

Table 6 – Cabled fibre attenuation requirements for B6_a optical fibre

Characteristics	IEC 60794-2 Clause	Requirements	Test Methods	Remarks
Attenuation coefficient (cabled fibres)	4.4	Acc. DS	IEC 60793-1-40	
at 1 310 to 1 625 nm at 1 383 nm at 1 550 nm		≤ 1,0 dB/km ≤ 1,0 dB/km ≤ 1,0 dB/km		

5.5.5 Single-mode (B6_b) optical fibre

See Table 7.

Table 7 – Cabled fibre attenuation requirements for B6_b optical fibre

Characteristics	IEC 60794-2 Clause	Requirements	Test Methods	Remarks
Attenuation coefficient (cabled fibres)	4.4	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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