

INTERNATIONAL STANDARD



**Optical fibre cables –
Part 2-30: Indoor cables – Family specification for optical fibre ribbon cables for
use in terminated cable assemblies**

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL FIBRE CABLES –

Part 2-30: Indoor cables – Family specification for optical fibre ribbon cables for use in terminated cable assemblies

FOREWORD

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International Standard IEC 60794-2-30 has been prepared by sub-committee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

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

- a) removal of Annex C;
- b) reference to the most recent fibre standards;
- c) reference to IEC 60794-1-21, IEC 60794-1-22, IEC 60794-1-23 and IEC 60794-1-24.

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

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

CDV	Report on voting
86A/1704/CDV	86A/1808/RVC

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

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

A list of all 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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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OPTICAL FIBRE CABLES –

Part 2-30: Indoor cables – Family specification for optical fibre ribbon cables for use in terminated cable assemblies

1 Scope

This part of IEC 60794 is a family specification which covers indoor optical fibre ribbon cables for ~~indoor~~ use in terminated cable assemblies. The requirements of the sectional specification IEC 60794-2 are applicable to cables covered by this document.

The requirements of this document are written to define flat ribbon cables. This document can be applicable to other cable constructions. Parts of IEC 60794-3 which are applicable for ribbon tests are the subject of IEC 60794-1-31.

Annex B contains requirements that supersede the normal requirements in case the cables are intended to be used in installations governed by the MICE table of ISO ~~IEC 24702~~ 11801-3 [4]¹.

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.

NOTE These reference complete the normative references already listed in the generic specifications (IEC 60794-1-1, ~~Clause 2~~, and IEC 60794-1-2, ~~Clause 2~~) or in the sectional specification (IEC 60794-2, ~~Clause 2~~).

IEC 60304: ~~1982~~, *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 60793-1-40, *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 specification – Sectional specification for class B single-mode fibres*

IEC 60794-1-1, *Optical fibre cables – Part 1-1: Generic specification – General* ~~86A/1054/NP~~

¹ Numbers in square brackets refer to the Bibliography.

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 test methods*

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

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

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

IEC 60794-3, *Optical fibre cables – Part 3: Outdoor cables – Sectional specification*

~~IEC 60811-1-1:1993, Common test methods for insulating and sheathing materials of electric cables and optical cables – Part 1-1: Methods for general application – Measurement of thickness and overall dimensions – Tests for determining the mechanical properties~~

~~IEC 60811-1-4:1985, Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Four: Tests at low temperatures.~~

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*

IEC 60811-504, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 504: Mechanical tests – Bending tests at low temperature for insulation and sheaths*

3 Terms and definitions

No terms and definitions are listed in this document.

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>

4 Construction

4.1 General

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

The cable shall be designed and manufactured for a predicted 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.

4.2 Optical fibres and primary coating

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

Category A1 multimode fibres which meet the requirements of IEC 60793-2-10 or categories B1.1, B1.2, B1.3, B2, B4, B5 and B6 single-mode optical fibres which meet the requirements of IEC 60793-2-50 shall be used. The linear coefficient of optical fibre attenuation and attenuation point discontinuity may be affected by the cable manufacturing process. Maximum values for these optical characteristics shall be agreed between the customer and the supplier.

4.3 Buffer

None.

4.4 Ruggedized fibre

None.

4.5 Slotted core

None.

4.6 Tube

None.

4.7 Stranded loose tube

None.

4.8 Ribbon structure

~~The ribbon structure shall conform to 6.5 and 8.2.3 of IEC 60794-3. Fibres shall be formed into units of typically two, four, six, eight, or twelve fibres each. The fibres within the units shall remain parallel and not cross over. An example of a ribbon construction is shown in Figure A.1~~

The ribbon structure shall be in accordance with IEC 60794-3.

4.9 Strength and anti-buckling members

The optical fibre ribbon cable may incorporate a tensile strength member. The strength member ~~can~~ may be a layer of suitable material, longitudinally or helically applied, and/or may be embedded in the overall sheath.

4.10 Ripcord

None.

4.11 Sheath

The optical fibre ribbon shall be uniformly covered with a protective sheath generally as shown in Figure A.1.

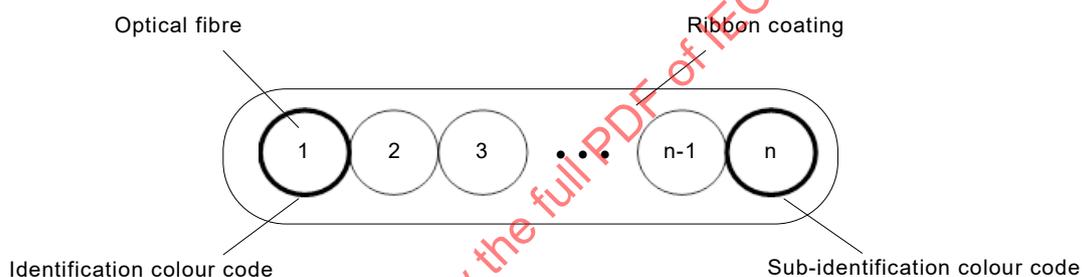
4.12 Sheath marking

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

4.13 Identification

The coated fibre shall be distinguishable by means of colour coding and positioning. For example (see Figure 1):

- a fibre ribbon has an identification coloured fibre on one side and a sub-identification coloured one on the other side;
- the identification and the sub-identification coloured fibres are the first and the last in the fibre ribbon, respectively;
- any colour of the identification colours group is different from that of the sub-identification colours group;
- the colour types and the order used for identification and sub-identification should be agreed between the customer and the supplier. The colours of the other fibres shall be agreed by the customer and/or the supplier;
- the colour range used is similar to the first 12 colours described in Table 1 of IEC 60794-2:2002, i.e., blue, yellow, red, white, green, violet, orange, grey, turquoise, black, brown and pink.



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NOTE 1 The identification colour enables each fibre ribbon to be identified individually within a group of ribbons.

NOTE 2 The sub-identification colour shows the ribbon group.

NOTE 3 The identification and the sub-identification colour in a ribbon enables each fibre to be identified individually within the ribbon.

Figure 1 – Example of identification by means of colour coding and positioning

Other methods of identification are under consideration.

4.14 Example of cable construction

An example of a ribbon cable construction is shown in Figure A.1. Other configurations are not precluded if they meet the mechanical, environmental and transmission requirements given in this document.

5 Dimensions

5.1 Optical fibres and primary coating

The dimensions of the individual primary coated fibres in the finished product shall be in accordance with IEC 60793-2.

5.2 Ribbon structural geometry

The ribbon geometry shall ~~conform to 8.2.3 of~~ be in accordance with IEC 60794-3.

5.3 Optical fibre ribbon cable

The structural geometry of the optical fibre ribbon cables shall be designed so as to comply with the mechanical, environmental and transmission requirements as defined in this document. For instance, either rectangular or circular structure can be chosen.

~~Unless otherwise specified~~ In the case of a rectangular structure, the dimensions and the structural geometry of optical fibre ribbon cables shall be as shown in Table 1.

Other structures can be applied if agreed between the supplier and the customer.

Table 1 – Dimensions of optical fibre ribbon cables

Number of fibres	Optical fibre ribbon cables			
	Width mm		Height mm	
	Nominal	Maximum tolerance	Nominal	Maximum tolerance
2	3,0 to 3,5	± 0,4	2,3 to 2,7	± 0,3
4	3,0 to 3,5	± 0,4	2,3 to 2,7	± 0,3
6	3,5 to 4,0	± 0,4	2,3 to 2,7	± 0,3
8	2,5 to 4,5	± 0,4	0,9 to 3,0	± 0,3
12	3,5 to 5,5	± 0,4	0,9 to 3,0	± 0,3

NOTE These dimensions apply to the ribbon cable including the sheath and any strength members.

6 Tests

6.1 General

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

Some of the following tests can be performed on a short sample length of optical fibre ribbon cable which is still an integral part of a longer length. For testing, the force shall be applied on the flat sides of the cable. Thus, it becomes possible to detect permanent changes in attenuation. The wavelength and maximum increase in attenuation change can be agreed between the customer and the supplier.

6.2 Dimensions

The dimensions and structural geometry of optical fibre ribbon can be verified with a type test described in ~~8.2.3 of~~ IEC 60794-3 to establish and ~~assure~~ ensure proper control of the ribbon manufacturing process. Once the process is established, and in order to ensure functional performance, the dimensions of ribbons may be controlled and verified, for final inspection purposes, with a dial gauge as described in Method G4 of ~~IEC 60794-1-2~~ IEC 60794-1-23. The size of the optical fibre ribbon cable, width and height, shall be measured in accordance with the methods of ~~IEC 60811-1-1~~ IEC 60811-203.

6.3 Mechanical requirements

6.3.1 Cable tensile performance

Method:	IEC 60794-1-2-E1A IEC 60794-1-21, E1
Diameter of chuck drums and transfer devices:	not lower than the minimum dynamic bending diameter specified for the cable
Velocity of transfer device:	either 100 mm/min or 100 N/min
Load:	200 N applied for 5 min
Length of sample:	sufficient to achieve the desired accuracy of measurement of attenuation and shall be agreed between the customer and the supplier.
Requirement:	no change in attenuation after the test, and there shall be no damage to the cable elements.

6.3.2 Cable crush

Method:	IEC 60794-1-2 IEC 60794-1-21, E3
Force:	500 N
Duration:	1 min
Length between test locations:	500 mm
Requirement:	no change in attenuation after the test, and there shall be no damage to the cable elements.

NOTE The force is applied on the flat sides of the cable.

6.3.3 Cable impact

Method:	IEC 60794-1-2 IEC 60794-1-21, E4
Radius of striking surface:	12,5 mm
Impact energy:	1,0 J
Number of impacts:	at least 3, each separated by at least 500 mm
Requirement:	no fibre breakage

NOTE The force is applied on the flat sides of the cable.

6.3.4 Cable bending

Method:	IEC 60794-1-2 IEC 60794-1-21, E11A
Mandrel diameter:	50 mm
Number of turns per helix:	6
Number of cycles:	10
Requirements:	no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

6.3.5 Cable repeated bending

Method:	IEC 60794-1-2 IEC 60794-1-21, E6
Bending radius:	100 mm
Number of cycles:	300
Mass of weights:	2 kg
Requirement:	no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

6.3.6 Cable bending under tension

None.

6.3.7 Cable bending at low temperature

Method:	IEC 60794-1-2 IEC 60794-1-21, E11A (see also IEC 60811-1-4, Clause 8 IEC 60811-504)
Bending radius:	10 times cable diameter for flat cables; diameter is the minor minimum dimension. For cables with preferential bend, the diameter is perpendicular to the plane of bending.
Number of cycles:	2
Test temperature:	0 °C, -10 °C or -15 °C depending on application and customer requirements
Number of turns per helix:	according to Clause 8 of IEC 60811-1-4 IEC 60811-504
Requirements:	in addition to the requirement of Clause 8 of IEC 60811-1-4 IEC 60811-504, no fibre shall break during the test.

6.3.8 Cable flexing

Method:	IEC 60794-1-2 IEC 60794-1-21, E8
Number of cycles:	300
Pulley diameter:	100 mm
Mass of weight:	2 kg
Requirement:	no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

6.3.9 Cable torsion

Method:	IEC 60794-1-2 IEC 60794-1-21, E7
Number of cycles:	20
Distance between fixed and rotation clamp:	250 mm
Tension load:	20 N
Requirement:	no fibre breakage

6.3.10 Cable kink

None.

6.4 Environmental requirements – Temperature cycling

Method:	IEC 60794-1-2 IEC 60794-1-22, F1
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

Temperature: see Table 2
 Requirement: the wavelength and maximum increase in attenuation shall be agreed between the customer and the supplier

Table 2 – Temperature cycling conditions

	Temperature T_A	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) ~~should~~ shall be selected depending on application and customer requirements, for example, condition c) is for appropriate ~~for applications to~~ implementation of ISO/IEC 11801 [3].

6.5 Transmission requirements

6.5.1 General

The transmission requirements shall be verified in accordance with IEC 60793-2-10 or IEC 60793-2-50 and shall be agreed between the customer and the supplier. Maximum cable attenuation shall comply with IEC 60794-1-1. See Tables 3 to 11.

~~NOTE—1 625 nm performance is optional depending upon agreement between the customer and the supplier.~~

6.5.2 Single mode optical fibres

Table 3 – Common single-mode fibre requirements

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Uncabled optical fibre	4.1	IEC 60793-2		
Cabled fibre cut-off wavelength	4.42	$\lambda_{cc} < \lambda$ operational	IEC 60793-1-44	
Fibre colouring	4.1	IEC 60304	Visual inspection	
Outer diameter including colouring	4.1	As IEC 60793-2	IEC 60793-1-20	
Attenuation discontinuities at 1 550 nm	4.42	$\leq 0,10$ dB	IEC 60793-1-40	

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

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

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.42	According to detail specification	IEC 60793-1-40	
at 1 310 nm		$\leq 0,40$ dB/km		
at 1 550 nm		$\leq 0,30$ dB/km		
at 1 625 nm		$\leq 0,30$ dB/km		

6.5.4 Single-mode dispersion unshifted optical fibre (B1.2)

Table 5 – Cabled attenuation requirements for B1.2 optical fibre

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.42	According to detail specification	IEC 60793-1-40	
at 1 550 nm		≤ 0,25 dB/km		
at 1 625 nm		≤ 0,40 dB/km		

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

Table 6 – Cabled attenuation requirements for B1.3 optical fibre

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.42	According to detail specification	IEC 60793-1-40	
at 1 310 nm to 1 625 nm		≤ 0,40 dB/km		
at 1 383 nm		≤ 0,40 dB/km		
at 1 550 nm		≤ 0,30 dB/km		

6.5.6 Single-mode dispersion shifted optical fibre (B2)

Table 7 – Cabled attenuation requirements for B2 optical fibre

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.42	According to detail specification	IEC 60793-1-40	
at 1 310 nm		≤ 0,50 dB/km		
at 1 550 nm		≤ 0,30 dB/km		
at 1 625 nm		≤ 0,40 dB/km		

6.5.7 Single-mode non-zero dispersion optical fibre (B4)

Table 8 – Cabled attenuation requirements for B4 optical fibre

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.42	According to detail specification	IEC 60793-1-40	
at 1 550 nm		≤ 0,30 dB/km		
at 1 625 nm		≤ 0,40 dB/km		

6.5.8 Single-mode wide band non-zero dispersion optical fibre (B5)**Table 9 – Cabled attenuation requirements for B5 optical fibre**

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.42	According to detail specification	IEC 60793-1-40	
at 1 460 nm		≤ 0,40 dB/km		
at 1 550 nm		≤ 0,30 dB/km		
at 1 625 nm		≤ 0,40 dB/km		

6.5.9 Single-mode bending loss insensitive optical fibre (B6)**Table 10 – Cabled attenuation requirements for B6 optical fibre**

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 1 310 nm to 1 625 nm		≤ 0,40 dB/km		
at 1 383 nm		≤ 0,40 dB/km		
at 1 550 nm		≤ 0,30 dB/km		

6.5.10 Multimode fibres**Table 11 – Requirements for multimode optical fibre (A1a and A1b)**

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Uncabled optical fibre	4.1	IEC 60793-2-10		
Attenuation coefficient (cabled fibres)	4.42	According to detail specification	IEC 60793-1-40	
at 850 nm		3,5 dB/km		
at 1 300 nm		1,5 dB/km		
Attenuation discontinuities at 850 nm and 1 300 nm	4.42	≤ 0,20 0,10 dB	IEC 60793-1-40	
Fibre colouring	4.1	IEC 60304	Visual inspection	
Outer diameter including colouring	4.1	As IEC 60793-2	IEC 60793-1-20	

6.6 Fire performance

~~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. Applicable legislation and regulation are also taken into account.~~

~~IEC/TR 62222 references several IEC fire performance test methods and also other test methods that may be required by local or national legislation and regulation. The tests to be applied, and the requirements, shall be agreed between the customer and supplier taking into account the fire hazard presented by the end use application of the patchcord assembly in which the cable is intended to be used.~~

IEC TR 62222 [1] provides 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 also take into account legislation and regulation applicable to the fire performance of cables that govern the tests to be performed.

Tests to be performed shall be agreed between the customer and the supplier.

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Annex A
(informative)

Example of cable construction

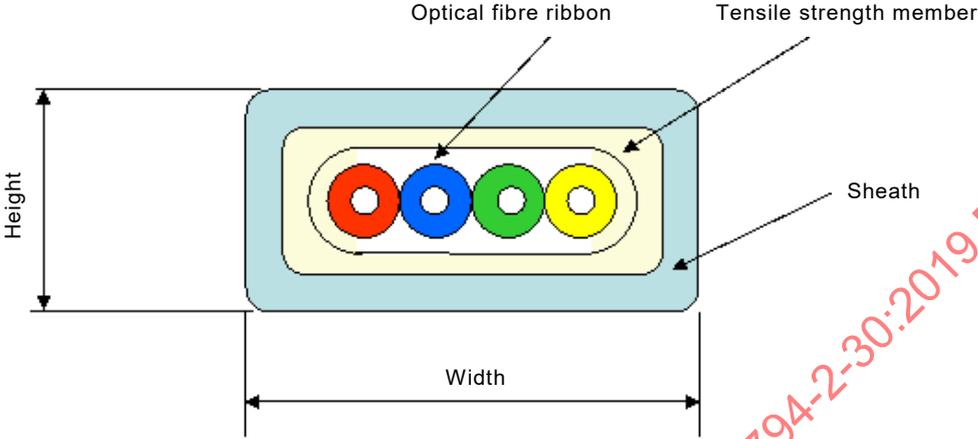


Figure A.1 – Example of cross-section of a four-fibre ribbon cable

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Annex B
(informative)

Family specification indoor cables – Optical fibre ribbon cables

B.1 Blank detail specification

B.1.1 Cable description

See Table B.1.

Table B.1 – Cable description

(1) Prepared by		(2) Document No: Issue: Date:
(3) Available from:	(4) Generic specification: Sectional specification:	IEC 60794-1-1 IEC 60794-2
(5) Additional references: ISO/IEC 24702 if required		
(6) Cable description:		
(7) Cable construction:		
Optical fibres		
Range of fibre count		
Modularity		
Construction – Optical fibres and primary coating – Ribbon – Strength and anti-buckling members Outer sheath – Material – Minimum wall thickness Marking identification – Customer requirement – Identification of manufacturer		Additional remarks
(8) Application information:		
Application (indoor) Maximum outer diameter (d) or width and height Rated maximum tensile load Minimum bending radius for operation Temperature range: – Transport and storage – Installation – Operation Manufacturing cable length – Typical – Nominal/tolerances:		Mm N mm or nxd °C °C °C M –0 +1 %

B.1.2 Cable element

See Table B.2.

Table B.2 – Cable element

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Optical fibres and primary coating	3.2	According to detail specification		
Buffer	3.3	According to detail specification	Visual inspection	
Ribbon	3.8	According to detail specification	IEC 60794-1-2 IEC 60794-1-23 G2, G3 or G4	
Strength and anti-buckling member	3.9	According to detail specification	Visual inspection	

B.1.3 Cable construction

See Table B.3.

Table B.3 – Cable construction

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Cable core		According to detail specification	Visual inspection	
Strength member	3.9	According to detail specification	Visual inspection	
– Longitudinal				
– Helical				
– Embedded in the sheath				
Sheath	3.11	According to detail specification		
– Material		According to detail specification	IEC 60811-1-1 IEC 60811-202	
– Minimum sheath thickness		According to detail specification	IEC 60811-1-1 IEC 60811-203	
– Width and height		According to detail specification		
– Optional protection		According to detail specification		
– Abrasion resistance		According to detail specification	IEC 60794-1-2 IEC 60794-1-21, Method E2A	
Sheath marking	3.12	According to detail specification	Visual inspection	
– Configuration, dimensions		According to detail specification		
– Abrasion resistance		According to detail specification	IEC 60794-1-2 IEC 60794-1-21, Method E2B	Steel needle diameter $d = 1,0$ mm Load: 4 N
Cable length				

B.1.4 Installation and operating conditions

See Table B.4.

Table B.4 – Installation and operating conditions

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
General requirements				
Bend of cable element		According to detail specification	IEC 60794-1-2 IEC 60794-1-23, Method G1	
Ribbons:	3.8			
– dimensions		According to detail specification	IEC 60794-3, 8.2.3.1	
– separability of individual fibres from ribbon		According to detail specification	IEC 60794-1-2 IEC 60794-1-23, Method G5 or according to detail specification	
– ribbon stripping		According to detail specification		
– torsion		According to detail specification	IEC 60794-1-2 IEC 60794-1-23, Method G6	

B.1.5 Mechanical, environmental and fire performance tests

See Table B.5.

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Table B.5 – Tests applicable

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Tensile performance	4.2.1	See 5.2.1 6.3.1	IEC 60794-1-2 IEC 60794-1-21, Method E1A	
Crush	4.2.2	See 5.2.2 6.3.2	IEC 60794-1-2 IEC 60794-1-21, Method E3	
Impact	4.2.3	See 5.2.3 6.3.3	IEC 60794-1-2 IEC 60794-1-21, Method E4	
Bending	4.2.4	See 5.2.4 6.3.4	IEC 60794-1-2 IEC 60794-1-21, Method E11A	
Repeated bending	4.2.5	See 5.2.5 6.3.5	IEC 60794-1-2 IEC 60794-1-21, Method E6	
Bending at low temperature	4.2.7	See 5.2.7 6.3.7	IEC 60794-1-2 IEC 60794-1-21, Method E11A	
Flexing	4.2.8	See 5.2.8 6.3.8	IEC 60794-1-2 IEC 60794-1-21, Method E8	
Torsion	4.2.9	See 5.2.9 6.3.9	IEC 60794-1-2 IEC 60794-1-21, Method E7	
Temperature cycling	4.3.1	See 5.3.1 6.4	IEC 60794-1-2 IEC 60794-1-22, Method F1	
Fire performance	4.5	See 5.5 6.6	IEC TR 62222	

B.2 Additional requirements for Cables subject to the MICE environmental classification (ISO/IEC 24702 ISO 11801-3 and related standards)

B.2.1 General

Cables intended for installation in ~~ISO/IEC 24702~~ conformity with ISO 11801-3 and related standards may require the specification of additional tests to ensure their suitability in the applicable environments defined by the mechanical, ingress, climatic and chemical, and electromagnetic (MICE) classification. ~~For supplemental guidance see IEC/TR 62362. Required tests may be selected from Table B.6 below.~~

Such tests are outside of the scope of IEC 60794 (all parts), and MICE criteria are not part of the requirements in IEC 60794 (all parts). The MICE tests may be the same as, similar to, or substantially different from, the tests required by IEC 60794 (all parts). Cables manufactured in accordance with IEC 60794 (all parts) may or may not meet the MICE criteria. For supplemental guidance see IEC TR 62362 [2].

B.2.2 — Applicable additional specifications for industrial premises installations as defined in ISO/IEC 24702

Table B.6 — Specifications for industrial premises installations as defined in ISO/IEC 24702

Characteristics	MICE classification of ISO/IEC 24702 and related standards (see ^a , ^b and ^c below for further information)			Test method
	M ₁	M ₂	M ₃	
MECHANICAL				
Shock/bump ^a				
Peak acceleration	40 ms ⁻²	100 ms ⁻²	250 ms ⁻²	IEC 60721-3-3
Vibration ^a				
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm	IEC 60721
Acceleration amplitude (9 Hz to 500 Hz)	5 ms ⁻²	20 ms ⁻²	50 ms ⁻²	IEC 60721
Tensile force (see NOTE 1)	As required	As required	As required	IEC 60794-1-2, Method E1
Crush ^c	45 N/25 mm	1 100 N/150 mm	2 200 N/150 mm	IEC 60794-1-2 Method E3
Impact	1 J	10 J	30 J	IEC 60794-1-2, Method E4
Bending (see NOTE 1)	As required	As required	As required	IEC 60794-1-2, Method E6
Flexing (see NOTE 1)	As required	As required	As required	IEC 60794-1-2, Method E.8
Torsion (see NOTE 1)	As required	As required	As required	IEC 60794-1-2, Method E7
INGRESS	I ₁	I ₂	I ₃	
Immersion ^b	N/A	Intermittent liquid jet ≤12,5 l/min ≥6,3 mm/jet >2,5 m distance	Intermittent liquid jet ≤12,5 l/min ≥6,3 mm/jet >2,5 m distance and immersion ≤1m for ≤30 min	IEC 60794-1-2, Method F3
CLIMATIC and CHEMICAL	C ₁	C ₂	C ₃	
Temperature cycling (ambient and rate of change)	-10 °C to +60 °C	-25 °C to +70 °C	-40 °C to +70 °C	IEC 60794-1-2, Method F1
Solar radiation ^b	700 Wm ⁻²	1 120 Wm ⁻²	1 120 Wm ⁻²	IEC 60721-1
Humidity ^b	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)	IEC 60721-3-3
Liquid pollution contaminants ^b	Concentration × 10 ⁻⁶	Concentration × 10 ⁻⁶	Concentration × 10 ⁻⁶	
Sodium chloride (salt/sea water) ^b	0	<0,3	<0,3	IEC 60721-1
Oil (dry-air concentration) ^b (for oil types see NOTE 1)	0	<0,005	<0,5	
Sodium stearate (soap) ^a	None	>5 × 10 ⁻⁴ aqueous non-gelling	>5 × 10 ⁻⁴ aqueous gelling	IEC 24702
Gaseous pollution contaminants ^b	Mean/peak concentration × 10 ⁻⁶	Mean/peak concentration × 10 ⁻⁶	Mean/peak concentration × 10 ⁻⁶	
Hydrogen sulphide ^a	<0,003/<0,01	<0,05/<0,5	<10/<50	IEC 60654-4
Sulphur dioxide ^a	<0,01/<0,03	<0,1/<0,3	<5/<15	IEC 60654
Sulphur trioxide ^a (ffs)	<0,01/<0,03	<0,1/<0,3	<5/<15	IEC 60654

Characteristics	MICE-classification of ISO/IEC 24702 and related standards (see ^a , ^b and ^c below for further information)			Test method
Chlorine wet (>50 % humidity) ^b	<0,0005 / <0,001	<0,005/ <0,03	<0,05/ <0,3	IEC 60654
Chlorine dry (<50 % humidity) ^b	<0,002/ <0,01	<0,02/ <0,1	<0,2/ <1,0	IEC 60654
Hydrogen chloride ^b	0/ <0,06	<0,06/ <0,3	<0,6/ <3,0	IEC 60654
Hydrogen fluoride ^b	<0,001/ <0,005	<0,01/ <0,05	<0,1/ <1,0	IEC 60654
Ammonia ^b	<1,0/ <5,0	<10,0/ <50,0	<50/ <250	IEC 60654
Oxides of nitrogen ^b	<0,05/ <0,1	<0,5/ <1,0	<5/ <10	IEC 60654
Ozone ^b	<0,002/ <0,005	<0,025/ <0,05	<0,1/ <1	IEC 60654
ELECTROMAGNETIC (for cables containing electrically conductive elements)	E₁	E₂	E₃	
Electrostatic discharge — Contact (0,667 μC) ^a	4 kV	4 kV	4 kV	IEC 61326
Electrostatic discharge — Air (0,132 μC) ^a	8 kV	8 kV	8 kV	IEC 61326
Radiated RF — AM ^a	3 V/m @ (80 to 1 000) MHz 3 V/m @ (1 400 to 2 000) MHz 1 V/m @ (2 000 to 2 700) MHz	3 V/m @ (80 to 1 000) MHz 3 V/m @ (1 400 to 2 000) MHz 1 V/m @ (2 000 to 2 700) MHz	10 V/m @ (80 to 1 000) MHz 3 V/m @ (1 400 to 2 000) MHz 1 V/m @ (2 000 to 2 700) MHz	IEC 61000-2-5
Conducted RF ^a	3 V @ 150 kHz to 80 MHz	3 V @ 150 kHz to 80 MHz	10 V @ 150 kHz to 80 MHz	IEC 61000-6-2
EFT/B (comms) ^b	500 V	1 000 V	1 000 V	IEC 61326
Surge (transient ground potential difference) - signal, line to earth ^b	500 V	1 000 V	1 000 V	IEC 61000-6-2
Magnetic field (50/60 Hz) ^b	1 A m ⁻¹	3 A m ⁻¹	30 A m ⁻¹	IEC 61326
NOTE 1—This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.				
^a —Subclause 6.2.2 of ISO/IEC 24702 provides a basis for requirements.				
^b —Annex F of ISO/IEC 24702 explains the background to classification boundaries.				
^c —Limits values should be normalized for a 100 mm plate that is requested by the test procedure.				

Bibliography

~~IEC 60654, Industrial-process measurement and control equipment – Operating conditions~~

~~IEC 60721, Classification of environmental conditions~~

~~IEC 60793-2-50, Optical fibres – Part 2-50: Products specification – Sectional specification for class B single-mode fibres~~

~~IEC 61000-2-5, Electromagnetic compatibility (EMC) – Part 2: Environment – Section 5: Classification of electromagnetic environments. Basic EMC publication~~

~~IEC 61000-6-2, Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments~~

~~IEC 61326, Electrical equipment for measurement, control and laboratory use – EMC requirements~~

~~ISO/IEC 24702, Information technology – Generic cabling – Industrial premises~~

- [1] IEC TR 62222, *Fire performance of communication cables installed in buildings*
- [2] IEC TR 62362, *Selection of optical fibre cable specifications relative to mechanical, ingress, climatic or electromagnetic characteristics – Guidance*
- [3] ISO/IEC 11801:2002, *Information technology – Generic cabling for customer premises*
- [4] ISO 11801-3, *Information technology – Generic cabling – Industrial premises*
- [5] IEC 60794-1-31, *Optical fibre cables – Part 1-31: Generic specification – Optical cable elements – Optical fibre ribbon*
- [6] IEC 60793-1-21, *Optical fibres – Part 1-21: Measurement methods and test procedures – Coating geometry*
- [7] IEC 60794-1-24, *Optical fibre cables – Part 1-24: Generic specification – Basic optical cable test procedures – Electrical test methods*
- [8] IEC 60794-2:2002², *Optical fibre cables – Part 2: Indoor cables – Sectional specification*
- [9] IEC 60811-501, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds*

² Withdrawn.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Optical fibre cables –

Part 2-30: Indoor cables – Family specification for optical fibre ribbon cables for use in terminated cable assemblies

Câbles à fibres optiques –

Partie 2-30: Câbles intérieurs – Spécification de famille pour les câbles à rubans de fibres optiques utilisés dans les assemblages de câbles connectés

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL FIBRE CABLES –

**Part 2-30: Indoor cables –
Family specification for optical fibre ribbon
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.
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International Standard IEC 60794-2-30 has been prepared by sub-committee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

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

- a) removal of Annex C;
- b) reference to the most recent fibre standards;
- c) reference to IEC 60794-1-21, IEC 60794-1-22, IEC 60794-1-23 and IEC 60794-1-24.

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

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

CDV	Report on voting
86A/1704/CDV	86A/1808/RVC

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

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

A list of all 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 "<http://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.

OPTICAL FIBRE CABLES –

Part 2-30: Indoor cables – Family specification for optical fibre ribbon cables for use in terminated cable assemblies

1 Scope

This part of IEC 60794 is a family specification which covers indoor optical fibre ribbon cables for use in terminated cable assemblies. The requirements of the sectional specification IEC 60794-2 are applicable to cables covered by this document.

The requirements of this document are written to define flat ribbon cables. This document can be applicable to other cable constructions. Parts of IEC 60794-3 which are applicable for ribbon tests are the subject of IEC 60794-1-31.

Annex B contains requirements that supersede the normal requirements in case the cables are intended to be used in installation governed by the MICE table of ISO 11801-3 [4]¹.

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.

NOTE These reference complete the normative references already listed in the generic specifications (IEC 60794-1-1 and IEC 60794-1-2).

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 60793-1-40, *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 specification – Sectional specification for class B single-mode fibres*

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

¹ Numbers in square brackets refer to the Bibliography.

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 test methods*

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

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

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

IEC 60794-3, *Optical fibre cables – Part 3: Outdoor 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*

IEC 60811-504, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 504: Mechanical tests – Bending tests at low temperature for insulation and sheaths*

3 Terms and definitions

No terms and definitions are listed in this document.

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>

4 Construction

4.1 General

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

The cable shall be designed and manufactured for a predicted 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.

4.2 Optical fibres and primary coating

Category A1 multimode fibres which meet the requirements of IEC 60793-2-10 or categories B1.1, B1.2, B1.3, B2, B4, B5 and B6 single-mode optical fibres which meet the requirements

of IEC 60793-2-50 shall be used. The linear coefficient of optical fibre attenuation and attenuation point discontinuity may be affected by the cable manufacturing process. Maximum values for these optical characteristics shall be agreed between the customer and the supplier.

4.3 Buffer

None.

4.4 Ruggedized fibre

None.

4.5 Slotted core

None.

4.6 Tube

None.

4.7 Stranded loose tube

None.

4.8 Ribbon structure

The ribbon structure shall be in accordance with IEC 60794-3.

4.9 Strength and anti-buckling members

The optical fibre ribbon cable may incorporate a tensile strength member. The strength member may be a layer of suitable material, longitudinally or helically applied, and/or may be embedded in the overall sheath.

4.10 Ripcord

None.

4.11 Sheath

The optical fibre ribbon shall be uniformly covered with a protective sheath generally as shown in Figure A.1.

4.12 Sheath marking

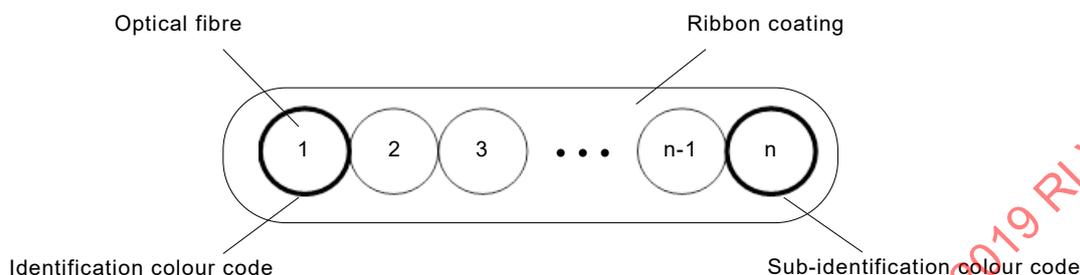
If required, the cable shall be marked as agreed between the customer and the supplier.

4.13 Identification

The coated fibre shall be distinguishable by means of colour coding and positioning. For example (see Figure 1):

- a) a fibre ribbon has an identification coloured fibre on one side and a sub-identification coloured one on the other side;
- b) the identification and the sub-identification coloured fibres are the first and the last in the fibre ribbon, respectively;
- c) any colour of the identification colours group is different from that of the sub-identification colours group;

- d) the colour types and the order used for identification and sub-identification should be agreed between the customer and the supplier. The colours of the other fibres shall be agreed by the customer and/or the supplier;
- e) the colour range used is similar to the first 12 colours described in Table 1 of IEC 60794-2:2002, i.e., blue, yellow, red, white, green, violet, orange, grey, turquoise, black, brown and pink.



IEC

NOTE 1 The identification colour enables each fibre ribbon to be identified individually within a group of ribbons.

NOTE 2 The sub-identification colour shows the ribbon group.

NOTE 3 The identification and the sub-identification colour in a ribbon enables each fibre to be identified individually within the ribbon.

Figure 1 – Example of identification by means of colour coding and positioning

Other methods of identification are under consideration.

4.14 Example of cable construction

An example of a ribbon cable construction is shown in Figure A.1. Other configurations are not precluded if they meet the mechanical, environmental and transmission requirements given in this document.

5 Dimensions

5.1 Optical fibres and primary coating

The dimensions of the individual primary coated fibres in the finished product shall be in accordance with IEC 60793-2.

5.2 Ribbon structural geometry

The ribbon geometry shall be in accordance with IEC 60794-3.

5.3 Optical fibre ribbon cable

The structural geometry of the optical fibre ribbon cables shall be designed so as to comply with the mechanical, environmental and transmission requirements as defined in this document. For instance, either rectangular or circular structure can be chosen.

In the case of a rectangular structure, the dimensions and the structural geometry of optical fibre ribbon cables shall be as shown in Table 1.

Other structures can be applied if agreed between the supplier and the customer.

Table 1 – Dimensions of optical fibre ribbon cables

Number of fibres	Optical fibre ribbon cables			
	Width mm		Height mm	
	Nominal	Maximum tolerance	Nominal	Maximum tolerance
2	3,0 to 3,5	± 0,4	2,3 to 2,7	± 0,3
4	3,0 to 3,5	± 0,4	2,3 to 2,7	± 0,3
6	3,5 to 4,0	± 0,4	2,3 to 2,7	± 0,3
8	2,5 to 4,5	± 0,4	0,9 to 3,0	± 0,3
12	3,5 to 5,5	± 0,4	0,9 to 3,0	± 0,3

NOTE These dimensions apply to the ribbon cable including the sheath and any strength members.

6 Tests

6.1 General

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

Some of the following tests can be performed on a short sample length of optical fibre ribbon cable which is still an integral part of a longer length. For testing, the force shall be applied on the flat sides of the cable. Thus, it becomes possible to detect permanent changes in attenuation. The wavelength and maximum increase in attenuation change can be agreed between the customer and the supplier.

6.2 Dimensions

The dimensions and structural geometry of optical fibre ribbon can be verified with a type test described in IEC 60794-3 to establish and ensure proper control of the ribbon manufacturing process. Once the process is established, and in order to ensure functional performance, the dimensions of ribbons may be controlled and verified, for final inspection purposes, with a dial gauge as described in Method G4 of IEC 60794-1-23. The size of the optical fibre ribbon cable, width and height shall be measured in accordance with the methods of IEC 60811-203.

6.3 Mechanical requirements

6.3.1 Cable tensile performance

Method:	IEC 60794-1-21, E1
Diameter of chuck drums and transfer devices:	not lower than the minimum dynamic bending diameter specified for the cable
Velocity of transfer device:	either 100 mm/min or 100 N/min
Load:	200 N applied for 5 min
Length of sample:	sufficient to achieve the desired accuracy of measurement of attenuation and shall be agreed between the customer and the supplier.
Requirement:	no change in attenuation after the test, and there shall be no damage to the cable elements.

6.3.2 Cable crush

Method:	IEC 60794-1-21, E3
Force:	500 N
Duration:	1 min
Length between test locations:	500 mm
Requirement:	no change in attenuation after the test, and there shall be no damage to the cable elements.

NOTE The force is applied on the flat sides of the cable.

6.3.3 Cable impact

Method:	IEC 60794-1-21, E4
Radius of striking surface:	12,5 mm
Impact energy:	1,0 J
Number of impacts:	at least 3, each separated by at least 500 mm
Requirement:	no fibre breakage

NOTE The force is applied on the flat sides of the cable.

6.3.4 Cable bending

Method:	IEC 60794-1-21, E11A
Mandrel diameter:	50 mm
Number of turns per helix:	6
Number of cycles:	10
Requirements:	no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

6.3.5 Cable repeated bending

Method:	IEC 60794-1-21, E6
Bending radius:	100 mm
Number of cycles:	300
Mass of weights:	2 kg
Requirement:	no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

6.3.6 Cable bending under tension

None.

6.3.7 Cable bending at low temperature

Method:	IEC 60794-1-21, E11A (see also IEC 60811-504)
Bending radius:	10 times cable diameter for flat cables; diameter is the minimum dimension. For cables with preferential bend, the diameter is perpendicular to the plane of bending.
Number of cycles:	2

Test temperature: 0 °C, –10 °C or –15 °C depending on application and customer requirements

Number of turns per helix: according to IEC 60811-504

Requirements: in addition to the requirement of IEC 60811-504, no fibre shall break during the test.

6.3.8 Cable flexing

Method: IEC 60794-1-21, E8

Number of cycles: 300

Pulley diameter: 100 mm

Mass of weight: 2 kg

Requirement: no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

6.3.9 Cable torsion

Method: IEC 60794-1-21, E7

Number of cycles: 20

Distance between fixed and rotation clamp: 250 mm

Tension load: 20 N

Requirement: no fibre breakage

6.3.10 Cable kink

None.

6.4 Environmental requirements – Temperature cycling

Method: IEC 60794-1-22, F1

Number of cycles: 2

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

Temperature: see Table 2

Requirement: the wavelength and maximum increase in attenuation shall be agreed between the customer and the supplier

Table 2 – Temperature cycling conditions

	Temperature T_A	Temperature T_B
a)	0 °C	50 °C
b)	–5 °C	50 °C
c)	–20 °C	60 °C
d)	–45 °C	60 °C

Condition a), b), c) or d) shall be selected depending on application and customer requirements; for example, condition c) is for appropriate implementation of ISO/IEC 11801 [3].

6.5 Transmission requirements

6.5.1 General

The transmission requirements shall be verified in accordance with IEC 60793-2-10 or IEC 60793-2-50 and shall be agreed between the customer and the supplier. Maximum cable attenuation shall comply with IEC 60794-1-1. See Tables 3 to 11.

6.5.2 Single mode optical fibres

Table 3 – Common single-mode fibre requirements

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Uncabled optical fibre	4.1	IEC 60793-2		
Cabled fibre cut-off wavelength	4.2	$\lambda_{cc} < \lambda$ operational	IEC 60793-1-44	
Fibre colouring	4.1	IEC 60304	Visual inspection	
Outer diameter including colouring	4.1	As IEC 60793-2	IEC 60793-1-20	
Attenuation discontinuities at 1 550 nm	4.2	$\leq 0,10$ dB	IEC 60793-1-40	

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

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

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 1 310 nm		$\leq 0,40$ dB/km		
at 1 550 nm		$\leq 0,30$ dB/km		
at 1 625 nm		$\leq 0,30$ dB/km		

6.5.4 Single-mode dispersion unshifted optical fibre (B1.2)

Table 5 – Cabled attenuation requirements for B1.2 optical fibre

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 1 550 nm		$\leq 0,25$ dB/km		
at 1 625 nm		$\leq 0,40$ dB/km		

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

Table 6 – Cabled attenuation requirements for B1.3 optical fibre

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 1 310 nm to 1 625 nm		≤ 0,40 dB/km		
at 1 383 nm		≤ 0,40 dB/km		
at 1 550 nm		≤ 0,30 dB/km		

6.5.6 Single-mode dispersion shifted optical fibre (B2)

Table 7 – Cabled attenuation requirements for B2 optical fibre

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 1 310 nm		≤ 0,50 dB/km		
at 1 550 nm		≤ 0,30 dB/km		
at 1 625 nm		≤ 0,40 dB/km		

6.5.7 Single-mode non-zero dispersion optical fibre (B4)

Table 8 – Cabled attenuation requirements for B4 optical fibre

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 1 550 nm		≤ 0,30 dB/km		
at 1 625 nm		≤ 0,40 dB/km		

6.5.8 Single-mode wide band non-zero dispersion optical fibre (B5)

Table 9 – Cabled attenuation requirements for B5 optical fibre

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 1 460 nm		≤ 0,40 dB/km		
at 1 550 nm		≤ 0,30 dB/km		
at 1 625 nm		≤ 0,40 dB/km		

6.5.9 Single-mode bending loss insensitive optical fibre (B6)

Table 10 – Cabled attenuation requirements for B6 optical fibre

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 1 310 nm to 1 625 nm		≤ 0,40 dB/km		
at 1 383 nm		≤ 0,40 dB/km		
at 1 550 nm		≤ 0,30 dB/km		

6.5.10 Multimode fibres

Table 11 – Requirements for multimode optical fibre (A1a and A1b)

Characteristics	IEC 60794-2:2017 subclause	Family requirements	Test methods	Remarks
Uncabled optical fibre	4.1	IEC 60793-2-10		
Attenuation coefficient (cabled fibres)	4.2	According to detail specification	IEC 60793-1-40	
at 850 nm		3,5 dB/km		
at 1 300 nm		1,5 dB/km		
Attenuation discontinuities at 850 nm and 1 300 nm	4.2	≤ 0,10 dB	IEC 60793-1-40	
Fibre colouring	4.1	IEC 60304	Visual inspection	
Outer diameter including colouring	4.1	As IEC 60793-2	IEC 60793-1-20	

6.6 Fire performance

IEC TR 62222 [1] provides 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 also take into account legislation and regulation applicable to the fire performance of cables that govern the tests to be performed.

Tests to be performed shall be agreed between the customer and the supplier.

Annex A (informative)

Example of cable construction

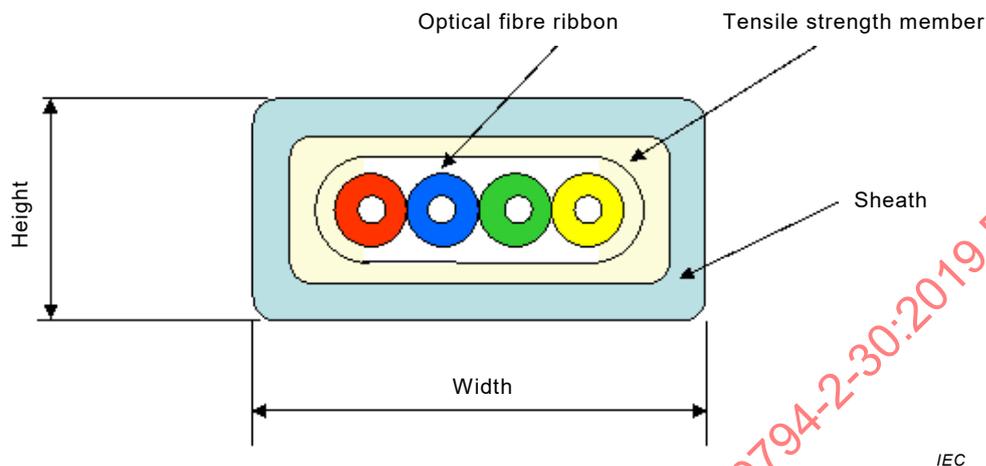


Figure A.1 – Example of cross-section of a four-fibre ribbon cable

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Annex B (informative)

Family specification indoor cables – Optical fibre ribbon cables

B.1 Blank detail specification

B.1.1 Cable description

See Table B.1.

Table B.1 – Cable description

(1) Prepared by		(2) Document No: Issue: Date:
(3) Available from:	(4) Generic specification: IEC 60794-1-1 Sectional specification: IEC 60794-2	
(5) Additional references: ISO/IEC 24702 if required		
(6) Cable description:		
(7) Cable construction:		
Optical fibres		
Range of fibre count		
Modularity		
Construction – Optical fibres and primary coating – Ribbon – Strength and anti-buckling members Outer sheath – Material – Minimum wall thickness Marking identification – Customer requirement – Identification of manufacturer		Additional remarks
(8) Application information:		
Application (indoor) Maximum outer diameter (d) or width and height Rated maximum tensile load Minimum bending radius for operation Temperature range: – Transport and storage – Installation – Operation Manufacturing cable length – Typical – Nominal/tolerances:		Mm N mm or nxd °C °C °C M –0 +1 %

B.1.2 Cable element

See Table B.2.

Table B.2 – Cable element

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Optical fibres and primary coating	3.2	According to detail specification		
Buffer	3.3	According to detail specification	Visual inspection	
Ribbon	3.8	According to detail specification	IEC 60794-1-23 G2, G3 or G4	
Strength and anti-buckling member	3.9	According to detail specification	Visual inspection	

B.1.3 Cable construction

See Table B.3.

Table B.3 – Cable construction

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Cable core		According to detail specification	Visual inspection	
Strength member	3.9	According to detail specification	Visual inspection	
– Longitudinal				
– Helical				
– Embedded in the sheath				
Sheath	3.11	According to detail specification		
– Material		According to detail specification	IEC 60811-202	
– Minimum sheath thickness		According to detail specification	IEC 60811-203	
– Width and height		According to detail specification		
– Optional protection		According to detail specification		
– Abrasion resistance		According to detail specification	IEC 60794-1-21 Method E2A	
Sheath marking	3.12	According to detail specification	Visual inspection	
– Configuration, dimensions		According to detail specification		
– Abrasion resistance		According to detail specification	IEC 60794-1-21 Method E2B	Steel needle diameter $d = 1,0$ mm Load: 4 N
Cable length				

B.1.4 Installation and operating conditions

See Table B.4.

Table B.4 – Installation and operating conditions

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
General requirements	3.8			
Bend of cable element		According to detail specification	IEC 60794-1-23 Method G1	
Ribbons:				
– dimensions		According to detail specification	IEC 60794-3	
– separability of individual fibres from ribbon		According to detail specification	IEC 60794-1-23 Method G5 or according to detail specification	
– ribbon stripping		According to detail specification		
– torsion		According to detail specification	IEC 60794-1-23 Method G6	

B.1.5 Mechanical, environmental and fire performance tests

See Table B.5.

Table B.5 – Tests applicable

Characteristics (9)	IEC 60794-2:2017 subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Tensile performance	4.2.1	See 6.3.1	IEC 60794-1-21 Method E1	
Crush	4.2.2	See 6.3.2	IEC 60794-1-21 Method E3	
Impact	4.2.3	See 6.3.3	IEC 60794-1-21 Method E4	
Bending	4.2.4	See 6.3.4	IEC 60794-1-21 Method E11A	
Repeated bending	4.2.5	See 6.3.5	IEC 60794-1-21 Method E6	
Bending at low temperature	4.2.7	See 6.3.7	IEC 60794-1-21 Method E11A	
Flexing	4.2.8	See 6.3.8	IEC 60794-1-21 Method E8	
Torsion	4.2.9	See 6.3.9	IEC 60794-1-21 Method E7	
Temperature cycling	4.3.1	See 6.4	IEC 60794-1-22 Method F1	
Fire performance	4.5	See 6.6	IEC TR 62222	

B.2 Cables subject to the MICE environmental classification (ISO 11801-3 and related standards)

Cables intended for installation in conformity with ISO 11801-3 and related standards may require the specification of additional tests to ensure their suitability in the applicable environments defined by the mechanical, ingress, climatic and chemical, and electromagnetic (MICE) classification. Such tests are outside of the scope of IEC 60794 (all parts), and MICE criteria are not part of the requirements in IEC 60794 (all parts). The MICE tests may be the same as, similar to, or substantially different from, the tests required by IEC 60794 (all parts).

Cables manufactured in accordance with IEC 60794 (all parts) may or may not meet the MICE criteria. For supplemental guidance see IEC TR 62362 [2].

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² Withdrawn.

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

CÂBLES À FIBRES OPTIQUES –

**Partie 2-30: Câbles intérieurs –
Spécification de famille pour les câbles à rubans de fibres
optiques utilisés dans les assemblages de câbles connectés**

AVANT-PROPOS

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La Norme internationale IEC 60794-2-30 a été établie par le sous-comité 86A: Fibres et câbles, du comité d'études 86 de l'IEC: Fibres optiques.

Cette troisième édition annule et remplace la deuxième édition parue en 2008. Cette édition constitue une révision technique.

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

- a) retrait de l'Annexe C;
- b) référence aux normes les plus récentes relatives aux fibres;

c) référence à l'IEC 60794-1-21, l'IEC 60794-1-22, l'IEC 60794-1-23 et l'IEC 60794-1-24.

La présente norme doit être utilisée conjointement avec l'IEC 60794-1-1, l'IEC 60794-1-2 et l'IEC 60794-2.

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

CDV	Rapport de vote
86A/1704/CDV	86A/1808/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de la présente Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60794, publiées sous le titre général *Câbles à fibres optiques*, peut être consultée 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 "<http://webstore.iec.ch>" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
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CÂBLES À FIBRES OPTIQUES –

Partie 2-30: Câbles intérieurs – Spécification de famille pour les câbles à rubans de fibres optiques utilisés dans les assemblages de câbles connectés

1 Domaine d'application

Cette partie de l'IEC 60794 est une spécification de famille qui couvre les câbles à rubans de fibres optiques intérieurs pour usage dans les assemblages de câbles connectés. Les exigences de la spécification intermédiaire IEC 60794-2 sont applicables aux câbles couverts par le présent document.

Les exigences présent document sont écrites pour définir un câble à ruban plat. Le présent document peut être applicable à d'autres constructions de câbles. Les parties de l'IEC 60794-3 qui sont applicables pour les essais de rubans constituent le sujet de l'IEC 60794-1-31.

L'Annexe B contient des exigences qui remplacent les exigences normales dans le cas où les câbles sont destinés à être utilisés dans une installation régie par le tableau MICE de l'ISO 11801-3 [4]¹.

2 Références normatives

Les documents suivants cités dans le texte 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).

NOTE Ces références complètent les références normatives déjà présentées dans les spécifications génériques (IEC 60794-1-1 et IEC 60794-1-2).

IEC 60304, *Couleurs de référence de l'enveloppe isolante pour câbles et fils pour basses fréquences*

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

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

IEC 60793-1-44, *Fibres optiques – Partie 1-44: Méthodes de mesure et procédures d'essai – Longueur d'onde de coupure*

IEC 60793-2, *Fibres optiques – Partie 2: Spécifications de produits – Généralités*

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*

¹ Les nombres entre crochets font référence à la bibliographie.

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 – Lignes directrices générales*

IEC 60794-1-21, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical test methods* (disponible en anglais seulement)

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, *Optical fibre cables – Part 1-23: Generic specification – Basic optical cable test procedures – Cable element test methods* (disponible en anglais seulement)

IEC 60794-2:2017, *Câbles à fibres optiques – Partie 2: Câbles intérieurs – Spécification intermédiaire*

IEC 60794-3, *Câbles à fibres optiques – Partie 3: Câbles extérieurs – 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*

IEC 60811-504, *Câbles électriques et à fibres optiques – Méthodes d'essai pour les matériaux non métalliques – Partie 504: Essais mécaniques – Essai d'enroulement à basse température pour les enveloppes isolantes et les gaines*

3 Termes et définitions

Aucun terme n'est défini dans le présent document.

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>

4 Construction

4.1 Généralités

Outre les exigences de construction de l'IEC 60794-2, les considérations suivantes s'appliquent aux câbles à rubans pour usage dans des assemblages de câbles connectés.

Le câble doit être conçu et fabriqué pour une durée de vie en service estimée d'au moins 15 ans. Dans ce contexte, l'affaiblissement du câble installé à la ou aux longueurs d'ondes de fonctionnement ne doit pas dépasser les valeurs convenues entre le client et le fournisseur. Les matériaux utilisés dans le câble ne doivent pas présenter de danger pour la santé dans le cadre de l'utilisation prévue.

Il ne doit pas y avoir d'épissure de fibre dans une longueur de livraison sauf accord contraire entre le client et le fournisseur.

Il doit être possible d'identifier chaque fibre individuelle sur toute la longueur du câble.

4.2 Fibres optiques et revêtement primaire

Les fibres multimodales de catégorie A1 qui satisfont aux exigences de l'IEC 60793-2-10 ou les fibres optiques unimodales de catégories B1.1, B1.2, B1.3, B2, B4, B5 et B6 qui satisfont aux exigences de l'IEC 60793-2-50 doivent être utilisées. Le coefficient linéaire d'affaiblissement des fibres optiques et de discontinuité du point d'affaiblissement peut être affecté par le processus de fabrication des câbles. Les valeurs maximales de ces caractéristiques optiques doivent être convenues entre le client et le fournisseur.

4.3 Matelas protecteur

Aucun.

4.4 Fibre renforcée

Aucune.

4.5 Jonc rainuré

Aucun.

4.6 Tube

Aucun.

4.7 Tube assemblé à structure libre

Aucun.

4.8 Structure en ruban

La structure en ruban doit être conforme à l'IEC 60794-3.

4.9 Renfort de traction et d'anti-déformation

Le câble à rubans de fibres optiques peut comporter un renfort de traction. Le renfort de traction peut être constitué par une couche de matériau approprié, appliquée en long ou en hélice et/ou peut être noyé dans la gaine extérieure.

4.10 Filin de déchirement

Aucun.

4.11 Gaine

Le ruban de fibres optiques doit être uniformément recouvert d'une gaine de protection correspondant généralement à la représentation de la Figure A.1.

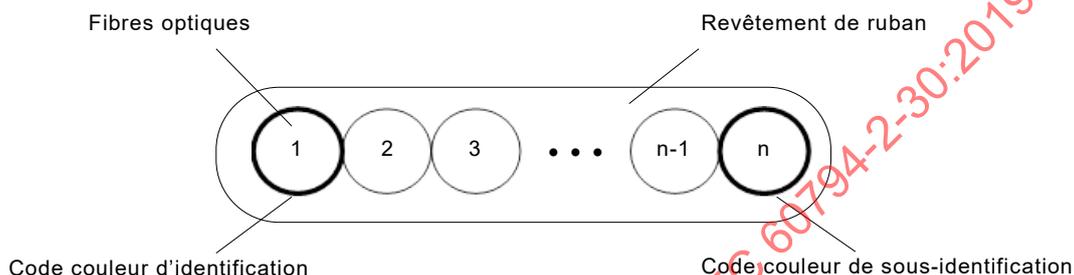
4.12 Marquage de la gaine

Si cela est exigé, le câble doit être marqué suivant une méthode convenue entre le client et le fournisseur.

4.13 Identification

La fibre sous revêtement doit pouvoir être distinguée au moyen d'une codification par couleurs et par le positionnement. Par exemple (voir Figure 1):

- a) un ruban de fibres possède une fibre colorée d'identification d'un côté et une fibre colorée de sous-identification de l'autre;
- b) les fibres colorées d'identification et de sous-identification sont, respectivement, la première et la dernière dans le ruban de fibres;
- c) les couleurs du groupe d'identification sont différentes de celles du groupe de sous-identification;
- d) il convient que les types de couleurs et l'ordre utilisés pour l'identification et la sous-identification fassent l'objet d'un accord entre le client et le fournisseur. Les couleurs des autres fibres doivent faire l'objet d'un accord entre le client et le fournisseur;
- e) la gamme de couleurs utilisée est similaire aux 12 premières couleurs décrites dans le Tableau 1 de l'IEC 60794-2:2002, c'est-à-dire, bleu, jaune, rouge, blanc, vert, violet, orange, gris, turquoise, noir, marron et rose.



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NOTE 1 La couleur d'identification permet l'identification individuelle de chaque ruban de fibre au sein d'un groupe de rubans.

NOTE 2 La couleur de sous-identification montre le groupe de rubans.

NOTE 3 La couleur d'identification et de sous-identification au sein d'un ruban permet l'identification individuelle de chaque fibre au sein du ruban.

Figure 1 – Exemple de codification par couleurs et par le positionnement

D'autres méthodes d'identification sont à l'étude.

4.14 Exemple de construction de câble

Un exemple de construction en ruban est donné à la Figure A.1. D'autres configurations ne sont pas exclues si elles satisfont aux exigences mécaniques, d'environnement et de transmission du présent document.

5 Dimensions

5.1 Fibres optiques et revêtement primaire

Les dimensions des différentes fibres sous revêtement primaire dans le produit fini doivent être conformes à l'IEC 60793-2.

5.2 Géométrie structurelle du ruban

La géométrie du ruban doit être conforme à l'IEC 60794-3.

5.3 Câble à rubans de fibres optiques

La géométrie structurelle des câbles à rubans de fibres optiques doit être conçue de manière à satisfaire aux exigences mécaniques, environnementales et de transmission telles que

définies dans le présent document. Une structure rectangulaire ou circulaire peut, par exemple, être choisie.

Dans le cas d'une structure rectangulaire, les dimensions et la géométrie structurelle des câbles à rubans de fibres optiques doivent suivre les valeurs du Tableau 1.

Une autre structure peut être appliquée d'un commun accord entre le fournisseur et le client.

Tableau 1 – Dimensions des câbles à rubans de fibres optiques

Nombre de fibres	Câbles à rubans de fibres optiques			
	Largeur mm		Hauteur mm	
	Nominale	Tolérance maximale	Nominale	Tolérance maximale
2	3,0 à 3,5	± 0,4	2,3 à 2,7	± 0,3
4	3,0 à 3,5	± 0,4	2,3 à 2,7	± 0,3
6	3,5 à 4,0	± 0,4	2,3 à 2,7	± 0,3
8	2,5 à 4,5	± 0,4	0,9 à 3,0	± 0,3
12	3,5 à 5,5	± 0,4	0,9 à 3,0	± 0,3

NOTE Ces dimensions s'appliquent au câble à rubans incluant le gainage et tous les renforts de traction.

6 Essais

6.1 Généralités

La conformité avec les exigences de la spécification particulière applicable doit être vérifiée en effectuant les essais choisis dans les paragraphes suivants. Il n'est pas prévu que tous les essais doivent être réalisés; le choix des essais à réaliser et la fréquence des essais doivent faire l'objet d'un accord entre le client et le fournisseur.

Certains des essais suivants peuvent être réalisés sur un échantillon de courte longueur du câble à rubans de fibres optiques qui fait encore partie intégrante d'une longueur plus grande. Pour les essais, la force doit être appliquée sur les côtés plats du câble. Il devient alors possible de détecter des variations permanentes d'affaiblissement. La longueur d'onde et l'augmentation maximale de cette variation d'affaiblissement peuvent faire l'objet d'un accord entre le client et le fournisseur.

6.2 Dimensions

Les dimensions et la géométrie structurelle des rubans de fibres optiques peuvent être vérifiées avec un essai de type décrit dans l'IEC 60794-3 pour établir et assurer un contrôle correct du processus de fabrication des rubans. Une fois le processus établi, et pour assurer les performances fonctionnelles, les dimensions des rubans peuvent être contrôlées et vérifiées, pour procéder à un examen final, avec un comparateur comme indiqué à la Méthode G4 de l'IEC 60794-1-23. La taille du câble à rubans de fibres optiques, largeur et hauteur, doit être mesurée conformément aux méthodes de l'IEC 60811-203.

6.3 Exigences mécaniques

6.3.1 Résistance du câble à la traction

Méthode:

IEC 60794-1-21, E1

Diamètre des tambours de blocage et des dispositifs de transfert:

non inférieur au diamètre minimal de courbure dynamique spécifié pour le câble.

Vitesse du dispositif de transfert:	soit 100 mm/min soit 100 N/min
Charge:	200 N appliquée pendant 5 min
Longueur de l'échantillon:	suffisante pour atteindre la précision désirée pour la mesure de la variation de l'affaiblissement et doit faire l'objet d'un accord entre le client et le fournisseur.
Exigence:	aucune variation d'affaiblissement après l'essai, et il ne doit pas y avoir de dommage sur les éléments du câble.

6.3.2 Ecrasement du câble

Méthode:	IEC 60794-1-21, E3
Force:	500 N
Durée:	1 min
Longueur entre emplacements d'essai:	500 mm
Exigence:	aucune variation d'affaiblissement après l'essai, et il ne doit pas y avoir de dommage sur les éléments du câble.

NOTE La force est appliquée sur les côtés plats du câble.

6.3.3 Chocs sur le câble

Méthode:	IEC 60794-1-21, E4
Rayon de la surface de frappe:	12,5 mm
Energie du choc:	1,0 J
Nombre de chocs:	au moins 3, séparés chacun de 500 mm au moins.
Exigence:	pas de rupture de fibre

NOTE La force est appliquée sur les côtés plats du câble.

6.3.4 Courbure du câble

Méthode:	IEC 60794-1-21, E11A
Diamètre du mandrin:	50 mm
Nombre de tours par hélice:	6
Nombre de cycles:	10
Exigences:	pas de rupture de fibre

NOTE La courbure est appliquée dans la direction verticale sur les côtés plats du câble.

6.3.5 Courbure répétée du câble

Méthode:	IEC 60794-1-21, E6
Rayon de courbure:	100 mm
Nombre de cycles:	300
Masse des poids:	2 kg
Exigence:	pas de rupture de fibre

NOTE La courbure est appliquée dans la direction verticale sur les côtés plats du câble.

6.3.6 Courbure sous tension du câble

Aucun.