IEC 60794-2

Edition 4.0 2017-06

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Optical fibre cables –
Part 2: Indoor cables – Sectional specification

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Câbles à fibres optiques –
Partie 2: Câbles intérieurs – Spécification intermédiaire

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IEC 60794-2:2017-06(en-fr)

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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OPTICAL FIBRE CABLES –

Part 2: Indoor cables – Sectional specification

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

This fourth edition cancels and replaces the third edition published in 2002. This edition constitutes a technical revision.

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

a) the specification has been streamlined by cross-referencing with IEC 60794-1-1 and IEC TR 61931;
b) the document structure has been aligned with IEC 60794-3, and Clause 4 on optical fibres was added;
c) transmission requirements in Clause 4 were added;

d) the electrical conductors and the lay-up of the cable elements were introduced into Article 5 on cable elements and construction;

e) 5.13 on identification was separated in fibre, unit and sheath colour coding;

f) the colour coding proposals were extended to accommodate latest fibre categories;

g) Article 6 on installation and operating condition was added;

h) cable element tests and cable tests have been simplified by the use of tables instead of text;

i) a bibliography has been added.

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

FDIS	Report on voting
86A/1793/FDIS	86A/1805/RVD

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.

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OPTICAL FIBRE CABLES –

Part 2: Indoor cables – Sectional specification

1 Scope

This part of IEC 60794 is a sectional specification. It gives the requirements that apply to optical fibre cables for indoor use in communications networks. Other types of applications requiring similar types of cables can be considered.

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 wire*

IEC 60793-1-40, *Optical fibres – Part 1-40: Measurement methods and test procedures – Attenuation*

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

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IEC 60793-2-10:2015, *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 60794-1-1:2015, *Optical fibre cables – Part 1-1: Generic specification – General*

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*

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

IEC 60794-1-24, *Optical fibre cables – Part 1-24: Generic specification – Basic optical cable test procedures – Electrical test methods*

IEC 60794-2 (all parts), *Optical fibre cables – Part 2: Indoor cables*

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 TR 61931, *Optical fibre – Terminology*

ISO/IEC 11801, *Information technology – Generic cabling for customer premises*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviations given in IEC 60794-1-1 and IEC TR 61931 apply.

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4 Optical fibres

4.1 General

Optical fibre shall be used which meets the requirements of IEC 60793-2. The fibre type shall be agreed between the customer and supplier.

4.2 Transmission requirements

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The transmission requirements of the cabled fibres shall conform to the family, detailed or product specifications of IEC 60794-2 (all parts). Particular values may be agreed between the customer and supplier. The attenuation coefficient shall be measured in accordance with IEC 60793-1-40.

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5 Cable elements and cable construction

5.1 General

Generally, optical cables comprise several elements or individual constituents, depending on the cable design which takes into account the cable application, operating environment and manufacturing processes, as well as the need to protect the fibre during handling and cabling.

The material(s) used for a cable element shall be selected to be compatible with the other elements in contact with it. An appropriate compatibility test method shall be defined in the family or detail specification.

When the fibres are in contact with a filling compound, the compatibility of the filling compound with the fibre coating shall be demonstrated by testing coating stripping force stability after accelerated ageing in accordance with IEC 60794-1-21, method E5. Alternative ageing conditions and tests may be agreed between the customer and supplier.

Optical elements are cable elements containing optical fibres and are designed to be a primary functional unit of the cable core. They may comprise any of the cable elements described below. Optical elements and each fibre within a cable element shall be uniquely identified as described in 5.13.

Tests may be performed on cable elements either in uncabled form or in finished cable. Unless otherwise specified, testing shall be performed on cable elements in a finished cable. This means that testing shall be performed only on a finished cable if the cable element manufacturing operation is done by the same manufacturer as the cabling operation. Testing

shall be performed on cable elements only if the cable element is supplied by a third party; this does not exclude testing of the finished cable.

Testing of elements as defined in the applicable IEC 60794-2 series specification can be used as a guide for internal verification by a manufacturer.

5.2 Buffer

The buffer consists of a suitable material applied loosely or tightly over the coated fibre. The interstices between the coated fibre and loose buffer can be filled with a suitable and easily deformable material. Dimensions and stripability requirements shall conform to the family, detailed or product specification of IEC 60794-2 (all parts).

5.3 Ruggedized fibre element

Further protection can be provided to one or more fibres, buffered fibres, ribbons or polymeric tubes with or without strength members by surrounding within a single element sheath of suitable material. Such an element may be called a "breakout element" or "subcable".

5.4 Polymeric tube

If the fibres are deployed in a tube, one or more individual primary coated fibres or ribbons are packaged (loosely or not) in a tube construction which can be filled or unfilled. The tube may be reinforced with a composite wall.

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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.

If used, the filling compound in the tube shall comply with IEC 60794-1-23, method G9. The filled tube shall comply with IEC 60794-1-22, method F9, when tested in tube or cabled form.

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5.5 Ribbon structure

If the fibres are deployed in the form of a ribbon, the ribbon structure should conform to IEC 60794-1-31[1]. Fibres shall be formed into units of typically two, four, six, eight, twelve, sixteen or twenty-four fibres each.

5.6 Slotted core

The slotted core is obtained by extruding a suitable material with a defined number of slots, providing helical or SZ configuration along the core. One or more primary coated fibres or optical elements such as ribbons or fibre bundles are located in each slot.

5.7 Strength and anti-buckling members

In general, 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 specified in IEC 60794-1-1:2015, 3.5.

The strength and/or anti-buckling members 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.

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[1] Under preparation. Stage at the time of publication: IEC CD 60494-1-31:2017.

5.8 Electrical conductors

Electrical conductors may be bare or insulated solid or stranded wires made from copper, aluminium or alloys, twisted pairs of insulated copper wires (balanced signals) or coaxial conductors (unbalanced signals).

5.9 Lay-up of the cable elements

Optical elements as described in 5.2 to 5.8 may be laid up as follows:

a) one or more optical element(s) without a stranding lay;

b) a number of homogeneous optical elements using helical or SZ configurations (ribbon elements may be laid up by stacking two or more elements);

c) a number of optical elements like buffered fibres, ribbons or polymeric tubes in slotted core;

d) a number of optical elements like buffered fibres or ribbons in a polymeric tube;

e) if required, electrical conductors as described in 5.8.

5.10 Ripcord

If required, one or two ripcords may be provided beneath the sheath.

If required, the suitability of the ripcord shall be determined by a functional test in accordance with IEC 60794-1-21, method E25.

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5.11 Sheath

The cable core shall be uniformly covered with a protective sheath.

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5.12 Sheath marking

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

Common methods of marking are embossing, sintering, imprinting, hot foil and surface printing by inkjet or laser.

The information given in the marking text may include cable length, the number of fibres, fibre type, manufacturer's name and the production batch identification.

The abrasion resistance of the sheath markings shall be demonstrated in accordance with IEC 60794-1-21, method E2B.

5.13 Identification

5.13.1 General

The fibre, tube and sheath colour codes that are given in Table 1 and 2 are examples of possible standard colour identification systems. The final decision on acceptable system is taken by the user (agreement between the customer and the manufacturer).

Coding is essential to uniquely identifying each fibre in a cable. Coding of fibres almost universally involves colouring of the fibre coating or buffer. The coding scheme employed will usually require inclusion of coding of fibre, subunits, and units within the cable.

Standard colours shall be a reasonable match to IEC 60304. The colour code sequence shall be agreed between customer and the manufacturer, because it is not specified in IEC 60304.

NOTE Colour coding is frequently governed by regional norms. At the date of publication it was planned to issue a technical report gathering major colour codes.

5.13.2 Fibre identification

Unless otherwise specified, fibres in tubes shall be uniquely identified by different colours described in IEC 60304.

5.13.3 Unit colour coding

Unless otherwise specified, subunits and units within the cables shall be uniquely identified.

Units and subunits may be polymeric tubes, buffered fibres, ribbons or ruggedized fibre elements.

The identification may be done by different colours, printed numbers, printed strings, positional identification, or other methods agreed between customer and manufacturer.

In case of different colours of the units or subunits, the colours described in IEC 60304 may be used.

In Table 1, an example for colour code scheme for units in hybrid or composite cables is given. This colour code may be used also for coding of the colour of a single unit in a cable.

NOTE The term "hybrid" is used for cables comprising mixed media type, and the term "composite" for cables comprising mixed fibre types.

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Table 1 – Colour coding scheme for units in hybrid or composite cables (example)

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Fibre type	IEC 60793-2 category	ISO/IEC 11801 category[3] (cabled fibre)	Unit colour
Single-mode fibre	B1, B2 and B6 [1]	OS1 or OS2	Yellow
Dispersion shifted single-mode fibre	B4 and B5 [1]	None	Red or yellow
Multimode fibre with 50 μm core diameter	A1a.1 [2]	OM1 or OM2	Green
Multimode fibre with 50 μm core diameter	A1a.2 [2]	OM3	Green
Multimode fibre with 50 μm core diameter	A1a.3 [2]	OM4	Green
Multimode fibre with 62,5 μm core diameter	A1b [2]	OM1 or OM2	Blue
Multimode fibre with 100 μm core diameter	A1d [2]	None	Black
Other media for hybrid cable			As agreed between customer and the manufacturer

[1] According IEC 60793-2-50.

[2] According IEC 60793-2-10.

[3] For reference list for multimode fibre, see IEC 60793-2-10:2015, Table H.3.

5.13.4 Sheath colour coding

Sheath colour coding may be used to identify fibre types within the cable or the application of the cable, among other reasons. Sheath colour coding is most frequently used in indoor cables.

The cable sheath shall be colour coded or alternatively, a printing in the sheath indicates the fibre type. Table 2 gives the fibre types and as an example a colour code for cable outer sheaths.

Table 2 – Colour coding of cable outer sheaths (example)

Cables with fibre type	IEC 60793-2 category	ISO/IEC 11801 category[3] (cabled fibre)	Colour of sheath
Single-mode fibre	B1, B2 and B6 [1]	OS1 or OS2	Yellow
Dispersion shifted single-mode fibre	B4 and B5 [1]	none	Red
Multimode fibre with 50 µm core diameter	A1a.1 [2]	OM1 or OM2	Orange
Multimode fibre with 50 µm core diameter	A1a.2 [2]	OM3	Turquoise
Multimode fibre with 50 µm core diameter	A1a.3 [2]	OM4	Magenta (heather violet) [4]
Multimode fibre with 62,5 µm core diameter	A1b [2]	OM1 or OM2	Grey[5]
Multimode fibre with 100 µm core diameter	A1d [2]	none	Black[6]

[1] According IEC 60793-2-50.

[2] According IEC 60793-2-10.

[3] For reference list for multimode fibre, see IEC 60793-2-10:2015, Table H.3

[4] Sheath of cables with OM4 can be alternatively coloured in turquoise, because it is backward compatible to OM3.

[5] Sheath of cables with 62,5 µm multimode fibre can be alternatively coloured in orange.

[6] Sheath of cables with 100 µm multimode fibre can be alternatively coloured in orange.

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5.14 Examples of cable constructions

Examples are given in the family, detailed or product specifications of IEC 60794-2 (all parts).

6 Installation and operating conditions

Installation and operating conditions shall be agreed between the customer and supplier. Guidance is given in IEC TR 62691.

7 Tests

7.1 General

Compliance with specification requirements shall be verified by carrying out tests as required by the relevant family or detail specification. Suitable tests are detailed in Table 3 and Table 4. It is not intended that all tests shall be carried out; the frequency of testing shall be agreed between customer and manufacturer.

Guidance on qualification sampling and interpretation of test results are given in IEC 60794-1-1. The number of fibres tested shall be representative of the cable design and shall be agreed between the customer and manufacturer.

7.2 Characterization of cable elements

The following tests are intended to characterize the different types of cable elements.