IEC 60794-1-31

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Optical fibre cables –
Part 1-31: Generic specification – Optical cable elements – Optical fibre ribbon

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IEC 60794-1-31:2021-06 RLV(en)

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

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

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.180.10; 33.180.99

ISBN 978-2-8322-9975-3

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OPTICAL FIBRE CABLES –

Part 1-31: Generic specification – Optical cable elements – Optical fibre ribbon

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IEC 60794-1-31 has been prepared by subcommittee SC86A: Fibres and cables, of IEC technical committee 86: Fibre optics. It is an International Standard.

This second edition cancels and replaces the first edition published in 2018. This edition constitutes a technical revision.

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

a) The geometrical requirements for optical fibre ribbon with typically 250 µm coating diameter have been modified and those for the optical fibre ribbon with typically 200 µm coating diameter have been added.
b) "Identification by positional identification" and "Identification by ribbon coding and fibre colouring" are moved to a new informative Annex A.

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

CDV	Report on voting
86A/2071/CDV	86A/2109/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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 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
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OPTICAL FIBRE CABLES –

Part 1-31: Generic specification – Optical cable elements – Optical fibre ribbon

1 Scope

This part of IEC 60794, which is a generic specification, covers optical fibre ribbons. Requirements which are described in this part apply to optical fibre ribbon cables for use with telecommunication equipment and devices employing similar techniques, in particular optical fibre cables in IEC 60794-2 for indoor use, in IEC 60794-3 for outdoor use, in IEC 60794-4 for self-supporting overhead use, in IEC 60794-5 for air blown use and in ~~IEC 60794-3~~ IEC 60794-6 for indoor/outdoor use. The detailed specification can be verified in specifications for each application ~~are given in~~ such as IEC 60794-2 and IEC 60794-3.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

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

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

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

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

IEC 60794-4, *Optical fibre cables – Part 4: Sectional specification – Aerial optical cables along electrical power lines*

IEC 60794-5, *Optical fibre cables – Part 5: Sectional specification – Microduct cabling for installation by blowing*

IEC 60794-6, *Optical fibre cables – Part 6: Indoor-outdoor cables – Sectional specification for indoor-outdoor cables*

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3 Terms, definitions, symbols and abbreviated terms

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

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

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

4 Requirements

4.1 General

Optical fibre ribbons are optical fibres which can be assembled in a composite linear array.

Fibres shall be arranged in parallel and formed into ribbons of typically four, six, eight, twelve, sixteen, twenty-four, thirty-two, or thirty-six fibres each according to user requirements, and shall be capable of mass splicing.

Some parameters shall be measured in the ribbon since the corresponding tests on the primary coated fibre or finished cable are not sufficient for complete characterization. These parameters are identified below.

4.2 Construction

4.2.1 Ribbon structure

Ribbon structures are typically designated as edge-bonded, encapsulated or partially-bonded. Edge-bonded and encapsulated structures are differentiated by the amount of buffering afforded to the fibres by the bonding agent. The partially-bonded ribbon ~~may~~ can be of either structure but with the buffer applied periodically.

Figure 1 illustrates the edge-bonded structure in which the bonding agent is applied predominantly between the fibres. Figure 2 illustrates the encapsulated structure in which the bonding agent extends well beyond the extreme surface of any fibre. Figure 3 illustrates the partially-bonded structure in which neighbouring fibres are fixed together periodically in the longitudinal direction.

The edge-bonded and encapsulated ribbons are predominantly rigid in the transverse direction. The partially-bonded structure enables the optical fibre ribbon to be rolled up easily and accommodated very tightly in cables.

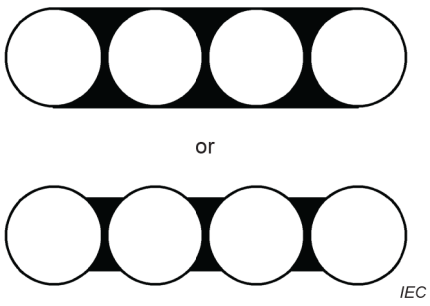

Figure 1 – Cross-section of a typical edge-bonded ribbon (thinner ribbon)

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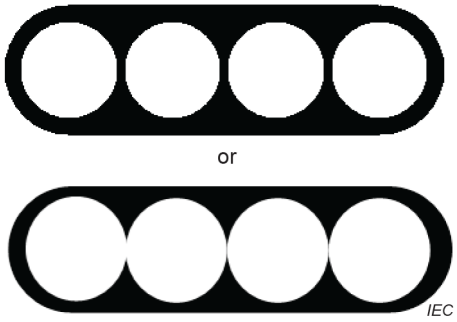

Figure 2 – Cross-section of a typical encapsulated ribbon (thicker ribbon)

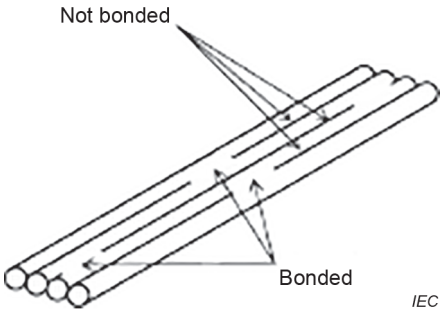

Figure 3 – Overview of a typical partially-bonded ribbon

4.2.2 Optical fibres

Category A1 multimode fibres which meet the requirements of IEC 60793-2-10 or Category B single-mode optical fibres which meet the requirements of IEC 60793-2-50 shall be used. Diameter over the fibre coating is typically 250 µm or 200 µm. Other fibres may be used to construct ribbons meeting the intent of this specification. Additional considerations with respect to connectivity and tools are required when dealing with ribbons containing different fibre dimensions.

~~NOTE Dimensions for ribbons with fibre coatings other than the typical 250 µm can be established between the customer and supplier. There exist alternative coating diameters (such as 200 µm) which can be used and require additional considerations with respect to connectivity and tools.~~

4.3 Dimensions

Unless otherwise specified in the detail specification, the maximum dimensions and the structural geometry of optical fibre ribbons shall be as shown in Table 1 for typical 250 µm coating diameter fibres and Table 2 for typical 200 µm coating diameter fibres. The definitions of each dimension are defined in IEC 60794-1-23 and illustrated in Figure 4.

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Table 1 – Maximum dimensions of optical fibre ribbons for typical 250 µm coating diameter fibre

Number of fibres[a]	Width	Height		
			Extreme fibres	Planarity
	w	*h*	*b*	*p*
	µm	µm	µm	µm
4	1 220	360	786	50
6	1 648	360	1 310	50
8	~~2 300[e]~~ 2 172	~~380~~ 360	1 834	50
8	2 300	380	Per 4f unit[b]	Per 4f unit[b]
12	3 400	~~380~~ 360	2 882	75
16	4 340	360	3 930	100
16	4 400	380	Per 8f unit[b]	Per 8f unit[b]
24	6 500	380[c]	Per 12f unit[b]	Per 12f unit[b]
32[d]	~~4 400~~ 8 688	~~ffs~~ [e] 380[c]	Per 8f unit[b]	Per 8f unit[b]
36	9 800	380[c]	Per 12f unit[b]	Per 12f unit[b]

If the ribbon has flexibility, for example in the case of having a partially-bonded configuration, the dimensions of the ribbon should be measured under the condition in which the tested ribbon is configured in such a way where all the individual fibres are aligned ~~to be a coplanar~~ in approximately the same plane across the ribbon width, with the ribbon in an unexpanded state. The example of a typical partially-bonded ribbon is illustrated in Figure 3.

[a] Dimensions for other ribbons with fibre counts not listed above should be established between the customer and supplier.

[b] Per unit values are measured with the ribbon separated into the intended sub-units.

[c] ~~Maximum width shall be 2 300 in case the 8-fibre ribbon can be separated into two four-fibre sub-units.~~ The maximum height of 380 µm can be used in case the optical fibre ribbon can be separated into sub-units.

~~[d] A thirty-two-fibre ribbon consists of two layers of sixteen-fibre ribbons.~~

~~[e] ffs= for further specification.~~

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Table 2 – Maximum dimensions of optical fibre ribbons for typical 200 µm coating diameter fibre

Number of fibres[a]	Width	Height	Fibre alignment	
			Extreme fibres	Planarity
	w	*h*	*b*	*p*
	µm	µm	µm	µm
4	1 130	325	685	50
6	1 570	325	1 142	50
8	2 010	325	1 598	50
8	TBD	TBD	Per 4f unit[c]	Per 4f unit[c]
12	2 890	325	2512	75
16	3 770	325	3425	100
16	TBD	TBD	Per 8f unit[c]	Per 8f unit[c]
24[b]	TBD	TBD	TBD	TBD
32[b]	TBD	TBD	TBD	TBD
36[b]	TBD	TBD	TBD	TBD

If the ribbon has flexibility, for example in the case of having a partially-bonded configuration, the dimensions of the ribbon should be measured under the condition in which the tested ribbon is configured in such a way where all the individual fibres are aligned in approximately the same plane across the ribbon width, with the ribbon in an unexpanded state. The example of a typical partially-bonded ribbon is illustrated in Figure 3.

For optical fibre ribbons for a typical 200 µm coating diameter fibre where neighbouring fibres are not in contact with each other as illustrated in Figure 1 and Figure 2 (upper figure), or in partially-bonded structure as illustrated in Figure 3, a greater value can be agreed between manufacturer and user. Even in that case, the maximum width (w) and extreme fibres (b) should not exceed those of optical fibre ribbon for typical 250 µm coating diameter fibre as shown in Table 1.

[a] Dimensions for other ribbons with fibre counts not listed above should be established between the customer and supplier.

[b] For these fibre counts, the optical fibre ribbon can be separated into sub-units if designed to do so.

[c] Per unit values are measured with the ribbon separated into the intended sub-units.

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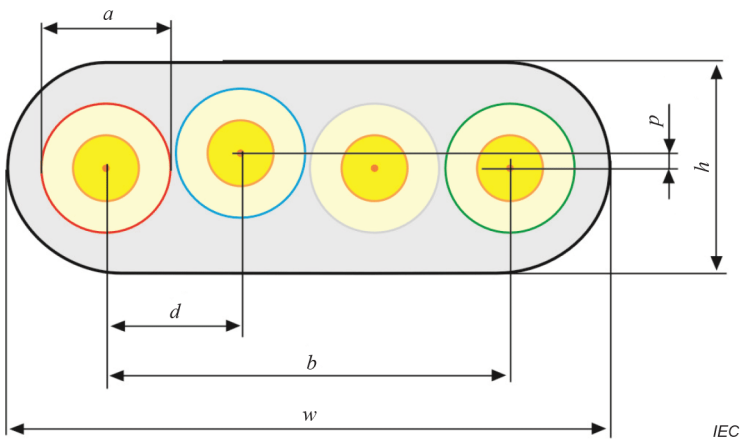

Key

a diameter of a coloured fibre

w width of that area

h height of that area

d distance between adjacent fibres

b distance between the extreme fibres

p planarity of the ribbon which is defined as the sum of the absolute values of the maximum positive and maximum negative vertical separation from the basis line

In consideration of the precision of fibre geometric attributes and the relatively larger precision of ribbon geometry requirements, it is acceptable for glass core/glass cladding fibres to use the edge of the cladding for the measurements according to Table 1 and Table 2, as illustrated in Figure 4, in lieu of the fibre centres. In this case, the measurements shall be made on the same side of all fibres (e.g. top or bottom, left or right side). This is consistent with IEC 60794-1-23, method G2.

NOTE The maximum dimensions and the structural geometry of optical fibre ribbons for 24 or more typical 200 µm coating diameter fibres are currently under study.

Figure 4 – Example of cross-sectional drawing illustrating fibre ribbon geometry (four-fibre ribbon)

More stringent requirements may be agreed between the customer and supplier, as needed, depending on the splice or the connector technique employed.

The dimensions and structural geometry can be verified with a type test, described as the visual measurement method (IEC 60794-1-23, method G2) to establish and ensure proper control of the ribbon manufacturing process. Once the process is established, and in order to ensure functional performance, the width and height of the ribbons may be controlled and verified, for final inspection purposes, with an aperture gauge (IEC 60794-1-23, method G3) or by the visual measurement method.

4.4 Mechanical requirements

4.4.1 General

The optical fibre ribbon shall satisfy the specifications and be tested as indicated in 4.4.2 and 4.4.4.

Detailed specifications of an optical fibre ribbon shall be verified by application, such as indoor and outdoor use, and are described in the sectional specifications for optical cables. ~~Optical fibre ribbon shall satisfy specifications and be tested as indicated below.~~

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4.4.2 Separability of individual fibres from a ribbon

Fibre breakout capability at some level is generally required. Some ribbons of any type ~~may be intended to~~ can be separated into predefined units. Specific requirements for breakout and separability shall be as specified in the detail specifications.

The ribbons shall be constructed in such a way that fibres can be separated from the ribbon construction, and formed into sub-units or individual optical fibres, as specified in the detail specification, while meeting the following criteria:

- the ribbon shall be tested for the ability to break out individual fibres using the tear (separability) test shown in IEC 60794-1-23, method G5, or a method agreed upon between the customer and supplier;
- the end breakout shall be accomplished without specialized tools or apparatus;
- the mid-span breakout shall be accomplished following the ribbon manufacturer's procedures;
- the fibre breakout procedure shall not be permanently detrimental to the optical and mechanical performance of the fibre;
- any colour coding of fibres shall remain sufficiently intact within any 25 mm segment to enable individual fibres to be distinguished from each other.

4.4.3 Ribbon stripping

The coating of individual fibres as well as the residual ribbon bonding material shall be easily removable by an adequate stripping method, preferably thermal stripping. The ribbon bonding materials and primary coating layers should be removed as a "strip" to avoid excess dust generation. The method of removal shall be agreed between the customer and supplier or shall be defined in the detail specification.

4.4.4 Torsion

The mechanical and functional integrity of a fibre ribbon can be verified by carrying out the torsion test shown in IEC 60794-1-23, method G6.

4.5 Identification of the ribbon

~~4.5.1 General~~

Each fibre within a ribbon cable shall be uniquely identifiable using some scheme of ribbon identification and fibre identification within a ribbon. Common schemes include ribbon coding by printed legends, ribbon positioning (tubes, slots, etc.), fibre positional colour coding, colour coded matrix, and fibre colour coding within a ribbon. Fibres within each ribbon shall be identified by an agreed colour coding scheme or positional scheme. Examples of the colour coding scheme and positional scheme are described in Annex A. Specific colour order is not defined in IEC cable specifications due to regional differences. The guidance regarding the colour coding scheme is given in IEC TR 61394. The scheme shall be defined in the detail specification.

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Annex A
(informative)

Fibre identification

A.1 Identification by positional identification

If positional identification is specified, the scheme may follow the scheme described below and illustrated in Figure A.1. The fibre ~~shall~~ should be distinguishable by means of colour coding and positioning. For example (see Figure A.1):

a) a fibre ribbon has an identification coloured fibre on one side of the ribbon and a sub-identification coloured one on the other side or has two identification coloured fibres on one side. Sub-identification colour code can be used when the optical fibre ribbons are larger in number than the identification colour code;

b) any colour of the identification fibre colours group is different from that of the sub-identification fibre colours group. The side of the identification colours group corresponds to fibre no. 1 in the ribbon;

c) 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~~ should be agreed between the customer and the supplier;

d) the colour range used is as described in IEC 60304. The specific colour order is not defined in IEC cable specifications due to regional differences. ~~There are plans to collect the different regional colour schemes in a technical report.~~ The guidance will be described in IEC TR 63194 for colour coding scheme.

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.

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