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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Optical fibre cables –
Part 3: Outdoor cables – Sectional specification

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FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60794-3:2014. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60794-3 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical change with respect to the previous edition: the ribbon specification has been removed, because it is covered in IEC 60794-1-31.

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

Draft	Report on voting
86A/2155/FDIS	86A/2184/RVD

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

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.

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

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- withdrawn,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
- 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.

INTRODUCTION

IEC 60794-1-21, IEC 60794-1-22, IEC 60794-1-23, and IEC 60794-1-24 have been (or will be) divided into multiple standards which defines one test method each. IEC 60794-1-2:2021 gives cross references between old standards and new standards.

OPTICAL FIBRE CABLES –

Part 3: Outdoor cables – Sectional specification

1 Scope

This part of IEC 60794 specifies the requirements for optical fibre cables and cable elements which are intended to be used externally in communications networks. Other types of applications requiring similar types of cables can be considered.

Requirements for cables to be used in ducts, for directly buried applications, aerial cables and cables for lake and river crossings are included in this document. Also included are cables for specialized use in sewers and in water and gas pipes.

For aerial application, this document does not cover all functional aspects of cables installed in the vicinity of overhead power lines. For such applications, additional requirements and test methods ~~may~~ can be necessary. Moreover, this document excludes optical ground wires and cables attached to the phase or earth conductors of overhead power lines.

For cables for lake and river crossings, this document does not cover methods of cable repair, nor repair capability, nor does it cover cables for use with underwater line amplifiers.

~~NOTE IEC TR 62839-1[1] gives rules to built an environmental declaration if needed.~~

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 60708, *Low-frequency cables with polyolefin insulation and moisture barrier polyolefin sheath*

IEC 60793-1-21, *Optical fibres – Part 1-21: Measurement methods and test procedures – Coating geometry* ~~[1]~~

IEC 60793-1-32, *Optical fibres – Part 1-32: Measurement methods and test procedures – Coating strippability*

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

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

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

~~[1] To be published.~~

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

IEC 60794-1-21:2015, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical test methods*[2]

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 elements test methods*

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 60811-401, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven*

IEC 60811-406, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 406: Miscellaneous tests – Resistance to stress cracking of polyethylene and polypropylene compounds*

IEC 60811-501, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: ~~General~~ Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds*

IEC 60811-604:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 604: Physical tests – Measurement of absence of corrosive components in filling compounds*

IEC 60811-607, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 607: Physical tests – Test for the assessment of carbon black dispersion in polyethylene and polypropylene*

~~IEC TR 62690, *Hydrogen effects in optical fibre cables – Guidelines*~~

~~IEC TR 62691, *Optical fibre cables – Guide to the installation of optical fibre cables*~~

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

[2] ~~To be published.~~

4 Optical fibre

4.1 General

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

4.2 Attenuation

4.2.1 Attenuation coefficient

The maximum cabled fibre attenuation coefficient shall conform to IEC 60794-1-1. Particular values may be agreed between the customer and supplier.

The attenuation coefficient shall be measured in accordance with IEC 60793-1-40.

4.2.2 Attenuation uniformity – Attenuation discontinuities

Attenuation uniformity shall conform to IEC 60794-1-1.

4.3 Cut-off wavelength

For single-mode fibre, the cabled fibre cut-off wavelength λ_{cc} shall be less than the operational wavelength, when measured in accordance with IEC 60793-1-44, and in conformity with IEC 60794-1-1.

4.4 Fibre colouring

If the primary coated fibres are coloured for identification, the coloured coating shall be readily identifiable throughout the lifetime of the cable and shall be a reasonable match to IEC 60304.

4.5 Polarization mode dispersion (PMD)

Cabled single-mode fibre PMD shall conform to IEC 60794-1-1.

5 Cable element

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~~ IEC 60794-1-23, method G10A, G10B, or G10C[3] method A, B, and C). Aging condition should be in accordance with IEC 60794-1-22, method F9[4], but alternative ageing conditions and tests may be agreed between the customer and supplier.

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3 These are intented to be replaced. See Introduction.

4 This is intented to be replaced. See Introduction.

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 in 5.2 to 5.7. Optical elements and each fibre within a cable element shall be uniquely identified, for example by colours, a positional configuration, markings, tapes, threads or as specified in the detail specification.

Tests may be performed on cable elements either in uncabled form or in a 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.

Different types of optical elements are described in 5.2 to 5.7 and in IEC 60794-1-3.

5.2 Tight secondary coating or buffer

If a tight secondary coating is required, it shall consist of one or more layers of polymeric material. The coating shall be easily removable for splicing. For tight buffers, the buffer and fibre primary coating shall be removable in one operation over a length of 10 mm to 25 mm, depending on customer requirements. The nominal overall diameter of the secondary coating shall be between 800 µm and 900 µm. The value, which shall be agreed between the customer and supplier, shall have a tolerance of ±50 µm. The fibre/secondary coating eccentricity shall not exceed 75 µm, unless otherwise agreed between the customer and supplier.

The colour of the tight secondary coating shall be readily identifiable throughout the life-time of the cable and shall be a reasonable match to IEC 60304.

5.3 Ruggedized fibre

Further protection can be provided to tight secondary coated fibres by surrounding one or more with non-metallic strength members within a sheath of suitable material (e.g. for fan-out cables).

5.4 Slotted core

The slotted core is obtained by extruding a suitable material (for example polyethylene or polypropylene) with a defined number of slots, providing helical or SZ configuration along the core. One or more primary coated fibres or optical element is located in each slot which may be filled by compound.

The slotted core usually contains a central element which may be either metallic or non-metallic. In this case, there shall be adequate adhesion between the central element and the extruded core in order to obtain the required temperature stability and tensile behaviour for the slotted core element.

The profile of the slot shall be uniform and shall ensure the optical and mechanical performance required of the optical cable.

5.5 Polymeric tube

One or more primary coated fibres or other optical elements are packaged (loosely or not) in a tube construction which may be filled by compound. The tube may be reinforced with a composite wall. The polymeric tube may be hard, to provide some crush protection to the fibre bundle, or soft to enable easy strippability of the tube without specialized tools.

If required, the suitability of the tube shall be determined by an evaluation of its kink resistance in accordance with IEC 60794-1-23, method G7[5].

If used, the filling compound in the tube shall comply with IEC 60794-1-21:2015, method E15. The filled tube shall comply with ~~IEC 60794-1-21, Method E14~~ IEC 60794-1-22, method F16[6], when tested in tube or cabled form.

5.6 Ribbon

~~5.6.1 General~~

~~Optical fibre ribbons are optical fibres assembled in a composite linear array.~~

~~Fibres shall be arranged in parallel and formed into ribbons of typically 4, 6, 8, 12, 24 or 36 fibres each according to user requirements. The fibres within the ribbons shall remain parallel and not cross over.~~

~~The design intent is that adjacent fibres within a ribbon are contiguous and that fibre centre lines are straight, parallel and coplanar.~~

~~Unless otherwise specified, each ribbon shall be uniquely identified with a printed legend or by uniquely colouring the reference fibre in the ribbon and/or by colouring the matrix material of the ribbon.~~

~~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.~~

~~5.6.2 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.~~

~~Table 1 – Maximum dimensions of optical fibre ribbons~~

			~~Fibre alignment~~	
	~~Width~~	~~Height~~	~~Extreme fibres~~	~~Planarity~~
~~Number of fibres~~ [a]	~~w~~	~~h~~	~~b~~	~~p~~
	~~µm~~	~~µm~~	~~µm~~	~~µm~~
~~4~~	~~1 220~~	~~360~~	~~786~~	~~50~~
~~6~~	~~1 648~~	~~360~~	~~1 310~~	~~50~~
~~8~~	~~2 172~~	~~360~~	~~1 834~~	~~50~~
~~12~~	~~3 220~~	~~360~~	~~2 882~~	~~75~~
~~24~~	~~6 500~~	~~360~~	~~Per 12f unit~~ [a]	~~Per 12f uni~~ [a]
~~36~~	~~9 800~~	~~360~~	~~Per 12f unit~~ [a]	~~Per 12f unit~~ [a]
[a] ~~Per unit values are measured with the ribbon separated into the intended sub-units.~~				

5 This is intented to be replaced. See Introduction.

6 This is intented to be replaced. See Introduction.

~~More stringent requirements may need to be agreed between the customer and supplier, 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 a dial gauge (IEC 60794-1-23, Method G4) or by the visual measurement methods.~~

~~**5.6.3 Mechanical requirements**~~

~~**5.6.3.1 Separability of individual fibres from a ribbon**~~

~~If fibre breakout capability is required, the ribbons shall be constructed in such a way that fibres can be separated from the ribbon construction, into sub-units or individual optical fibres, while meeting the following criteria:~~

~~a) 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;~~

~~b) breakout shall be accomplished without specialized tools or apparatus;~~

~~c) the fibre breakout procedure shall not be permanently detrimental to the fibre optical and mechanical performance;~~

~~d) any colour coding of fibres shall remain sufficiently intact to enable individual fibres to be distinguished from each other.~~

~~**5.6.3.2 Ribbon stripping**~~

~~The coating of individual fibres as well as the residual ribbon bonding material shall be easily removable. The method of removal shall be agreed between the customer and supplier or shall be defined in the detail specification.~~

~~**5.6.3.3 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.~~

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

Ribbon structure, dimensions, mechanical requirements, and identification are specified in IEC 60794-1-31.

5.7 Metallic tube

5.7.1 Metallic tube on the optical core

A metallic tube (for example, aluminium tube) may be applied over the optical core (for example, aluminium spacer or stranded tube).

5.7.2 Fibres directly located in a metallic tube

One or more primary coated and coloured fibres are packaged in a metallic hermetically sealed tube, which shall be filled, if necessary, with a suitable compound to avoid water penetration.

The inside surface of the tube should be smooth without any defects.