IEC 60794-3

Edition 5.0 2022-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Câbles à fibres optiques –
Partie 3: Câbles extérieurs – Spécification intermédiaire

IEC 60794-3:2022-02(en-fr)

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FOREWORD

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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- withdrawn,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.

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 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.

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*

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: 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*

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*

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: 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*

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 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 60794-1-23, method G10A, G10B, or G10C[1] method A, B, and C). Aging condition should be in accordance with IEC 60794-1-22, method F9[2], but 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 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.

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1 These are intented to be replaced. See Introduction.

2 This is intented to be replaced. See Introduction.

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[3].

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 60794-1-22, method F16[4], when tested in tube or cabled form.

5.6 Ribbon

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.

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[3] This is intented to be replaced. See Introduction.

[4] This is intented to be replaced. See Introduction.

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.

6 Optical fibre cable construction

6.1 General

The intention is that the cable should be designed and manufactured for a predicted operating lifetime of at least 20 years. In this context, the attenuation of the installed cable at the operational wavelength(s) shall not exceed values agreed between the customer and supplier. The tests of this document are intended to assess the performance of cables, as manufactured and under agreed ageing and performance-limit tests. These tests are not intended to define end-of-life performance, but may be used as agreed between customer and supplier to predict such performance. The materials in the cable shall not present a health hazard within its intended use.

The fibres in the cables are usually of the same type, but some cables may contain multiple specified fibre types and fibres of the same type may have different origins.

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

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

For the particular case of cables for aerial application, to avoid excess fibre strain induced by the environmental conditions, such as wind loading or ice loading, the cable construction, and particularly the strength members, shall be selected to limit this strain to the value agreed between the customer and supplier.

6.2 Lay-up of the cable elements

Optical elements as described in Clause 5 may be laid up as follows:

a) 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 different configurations in slotted core such as tight coated, ribbon or tube;

d) a number of different configurations in a tube such as tight coated or ribbon;

e) if required, insulated copper conductors in single, pair or quad construction may be laid up with the optical elements.