

Optical fibre cables —

Part 3: Sectional specification — Outdoor cables

The European Standard EN 60794-3:2002 has the status of a
British Standard

ICS 33.180.10

National foreword

This British Standard is the official English language version of EN 60794-3:2002. It is identical with IEC 60794-3:2001. It supersedes BS EN 60794-3:1998 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/1, Optical fibres and cables, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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European Committee for Electrotechnical Standardization
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Foreword

The text of document 86A/684/FDIS, future edition 3 of IEC 60794-3, prepared by SC 86A, Fibres and cables, of IEC TC 86, Fibre optics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60794-3 on 2002-03-05.

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Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annex A is informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60794-3:2001 was approved by CENELEC as a European Standard without any modification.

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OPTICAL FIBRE CABLES –

Part 3: Sectional specification – Outdoor cables

1 Scope

This part of IEC 60794 specifies the requirements of single-mode optical fibre cables and cable elements which are intended to be used primarily in public telecommunications networks. Other types of applications requiring similar types of cables can be considered.

Requirements for cables to be used in ducts, for directly buried application, aerial cables and cables for lake and river crossings are included in this standard.

For aerial application, this standard does not cover all functional aspects of cables installed in the vicinity of overhead power lines. In the case of such application, additional requirements and test methods may be necessary. Moreover, this standard 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 standard 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 referenced documents are indispensable for the application 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 60189 (all parts), *Low-frequency cables and wires with PVC insulation and PVC sheath*

IEC 60304:1982, *Standard colours for insulation for low-frequency cables and wires*

IEC 60708-1:1981, *Low-frequency cables with polyolefin insulation and moisture barrier polyolefin sheath – Part 1: General design details and requirements*

IEC 60793 (all parts), *Optical fibres*

IEC 60793-1-21:2001, *Optical fibres – Part 1-21: Measurement and test procedures – Coating geometry measuring methods*

IEC 60793-1-32:2001, *Optical fibres – Part 1-32: Measurement and test procedures – Coating strippability*

IEC 60793-1-40:2001, *Optical fibres – Part 1-40: Attenuation measurement methods*

IEC 60793-1-44:2001, *Optical fibres – Part 1-44: Cut-off wavelength measurement methods*

IEC 60793-2:1998, *Optical fibres – Part 2: Product specifications*

IEC 60794-1-1:1999, *Optical fibre cables – Part 1-1: Generic specification – General*

IEC 60794-1-2:1999, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*

IEC 60811-5-1:1990, *Common test methods for insulating and sheathing materials of electric cables – Part 5: Methods specific to filling compounds – Section 1: Drop point – Separation of oil – Lower temperature brittleness – Total acid number – Absence of corrosive components – Permittivity at 23 °C – DC resistivity at 23 °C and 100 °C*

IEC/TR 61282-3:2001, *Guidelines for the calculation of PMD in fibre optic systems*

IEC/TS 61941:2000, *Optical fibres – Polarization mode dispersion measurement techniques for single-mode optical fibres*

ITU-T Recommendation K.25:2000, *Protection of optical fibre cables*

3 Terms and definitions

For the purpose of this part of IEC 60794, the following terms and definitions apply.

3.1

differential group delay, ps

DGD

relative time delay between the two fundamental polarisation modes (principal states of polarisation) at the end of an optical fibre cable, at a particular time and wavelength

3.2

polarisation mode dispersion value, ps

PMD value

average of DGD values across wavelengths

3.3

polarisation mode dispersion coefficient, ps/ $\sqrt{\text{km}}$

PMD coefficient

PMD value of an optical fibre cable divided by the square root of its length (km)

3.4

cable section

individual reel of cable, as produced

3.5

link

length of cable composed of a number of individual cable sections

NOTE Link PMD values are generally calculated according to the formulas in this standard but may be measured.

4 Symbols and abbreviations

λ_{cc}	Cabled fibre cut-off wavelength
SZ	Technique in which the lay reverses direction periodically

5 Optical fibre

5.1 General

Single-mode optical fibre which meets the requirements of IEC 60793-2 shall be used.

5.2 Attenuation

5.2.1 Attenuation coefficient

The typical maximum attenuation coefficient of a cable is dependent on the fibre type(s) used. Typical values are shown in 5.1 of IEC 60794-1-1. Particular values shall be agreed between the user and the manufacturer.

The attenuation coefficient shall be measured in accordance with method A, B or C of IEC 60793-1-40.

5.2.2 Attenuation uniformity – Attenuation discontinuities

The local attenuation shall not have point discontinuities in excess of 0,10 dB. The test method best suited to provide the functional requirements is under consideration.

5.3 Cut-off wavelength

The cabled fibre cut-off wavelength, λ_{cc} , shall be less than the operational wavelength.

5.4 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. If required, the colouring shall permit sufficient light to be transmitted through the primary coating to allow local light injection and detection. Alternatively, the colour may be removed for this application.

5.5 Polarisation mode dispersion (PMD)

Cabled fibre PMD shall be specified/characterised on a statistical basis, not on an individual fibre basis, as described in annex A. Measurements on individual cabled fibres may be performed by any of the PMD measurement methods recognised by the IEC. Measurements on uncabled fibre can be used to generate cabled fibre statistics when the design and processes are stable and the relationship between the PMD coefficients of uncabled and cabled fibre are known. The following requirements pertain only to the aspect of the link calculated from cable information. To combine this information with other parts of the link, such as components and optical amplifiers, reference should be made to IEC 61282-3.

One of the following two methods shall be used to specify/characterise PMD. The method chosen shall be agreed upon between the buyer and the cable manufacturer.

a) Method 1

The manufacturer shall supply a PMD design value, PMD_Q , that serves as a statistical upper bound PMD coefficient of the concatenated optical fibre cables within a possible optical link. Unless otherwise specified in the detail specification, the PMD_Q value shall be less than $0,5 \text{ ps/km}^{1/2}$ with a probability of 10^{-4} that this value be exceeded for a numerical concatenation of at least 20 cables. The value shall be computed using a method agreed upon between the buyer and cable manufacturer. The relationship between this PMD design value and the performance of a digital transmission system is discussed in annex A.

b) Method 2

Provide cabled fibre with a low probability, P_F , that the instantaneous end-to-end PMD at a given wavelength exceeds a given value, I_{tot} . The probability, P_F , shall be calculated for a 400 km concatenated reference link comprised of 40 cable sections. The values for P_F and I_{tot} , and the particular statistical methodology shall be agreed between the buyer and the cable manufacturer. Unless otherwise specified in the detail specification, $P_F \leq 6,5 \times 10^{-8}$ for $I_{\text{tot}} = 25 \text{ ps}$.

NOTE $P_F \leq 6,5 \times 10^{-8}$ for $I_{\text{tot}} = 25 \text{ ps}$ corresponds to time over 25 ps equal to 0,002 min/year/km/circuit.

5.6 Jumper cable cut-off wavelength

If specified, the cut-off wavelength for jumper cables (λ_{c_j}) shall be measured in accordance with IEC 60793-1-44, using a loop bend diameter of $X \text{ mm}$. This jumper cable cut-off wavelength shall be less than the operational wavelength. (Lower values may be required for applications using jumper lengths of less than 2 m.)

NOTE Some administrations specify $X = 152 \text{ mm}$.

6 Cable element

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 so as 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.

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, for example, by colours, by a positional scheme, by markings or as specified in the detail specification.

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.)

Different types of optical elements are described below.

6.1 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 fibre splicing. The nominal overall diameter of the secondary coating shall be between 800 μm and 900 μm . The value, which shall be agreed between the user and the manufacturer, shall have a tolerance of $\pm 50 \mu\text{m}$. The fibre/secondary coating eccentricity shall not exceed 75 μm unless otherwise agreed between the user and the manufacturer.

The colour of the tight secondary coating shall be readily identifiable throughout the lifetime of the cable.

6.2 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 (for example, for fan-out cables).

6.3 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 elements are located in each slot that may be filled.

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.

6.4 Tube

One or more primary coated fibres or other optical elements are packaged (loosely or not) in a tube construction that may be filled. The tube may be reinforced with a composite wall.

If required, the suitability of the tube shall be determined by an evaluation of its kink resistance in accordance with method G7 of IEC 60794-1-2.

The filling compound in the tube shall comply with method E14 or method E15 of IEC 60794-1-2.

6.5 Ribbon

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

Fibres shall be arranged in parallel and formed into ribbons of typically 2, 4, 6, 8, 10, 12 or 24 fibres each according to user requirements. The fibres within the ribbons shall remain parallel and not cross over.