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INTERNATIONAL STANDARD

colour inside

Optical fibre cables –
Part 3-11: Outdoor cables – Product specification for duct, directly buried, and lashed aerial single-mode optical fibre telecommunication cables

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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FOREWORD

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International Standard IEC 60794-3-11 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2007. It constitutes a technical revision.

The main changes with respect to the previous edition are as follows:

– the title of the specification has been updated to include lashed applications;
– the fibres specification clause (subclause 5.2.2) has been enlarged to include fibre types B6_a.

The text of this standard is based on the following documents:

FDIS	Report on voting
86A/1314/FDIS	86A/1326/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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OPTICAL FIBRE CABLES –

Part 3-11: Outdoor cables – Product specification for duct, directly buried, and lashed aerial single-mode optical fibre telecommunication cables

1 Scope

This part of IEC 60794 sets forth technical requirements and characteristics of single-mode optical fibre cables for duct and direct buried installation.

This specification includes functional mechanical, environmental and optical requirements, recommended features and test methods for assessing the product against the stated requirements.

The specified test methods, where applicable, are those referenced in IEC 60794-1-1 and described in detail in IEC 60794-1-2.

The requirements of this specification supplement those of IEC 60794-3 and IEC 60794-3-10

Multimode fibre requirements are not addressed in this standard; see IEC 60794-3-12.

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

IEC 60793-1-22, *Optical fibres – Part 1-22: Measurement methods and test procedures – Length measurement*

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

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

IEC 60793-1-48, *Optical fibres – Part 1-48: Measurement methods and test procedures – Polarization mode dispersion*

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

IEC 60794-3 (all parts), *Optical fibre cables – Part 3: Sectional specification – Outdoor cables*

IEC 60794-3-10, *Optical fibre cables – Part 3-10: Outdoor cables – Family specification for duct, directly buried and lashed aerial optical telecommunication cables*

IEC 60811-1-1, *Common test methods for insulating and sheathing materials of electric cables and optical cables – Part 1-1: Methods for general application – Measurement of thickness and overall dimensions – Tests for determining the mechanical properties*

IEC/TR 61931, *Fibre optic – Terminology*

IEC/TR 62000, *Single mode fibre compatibility guidelines*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61931 apply.

3.2 Symbols

The following symbols are used in this document:

λ_{cc} cable cut-off wavelength

d outer cable diameter

SZ technique in which the lay reverses direction periodically.

4 General information

4.1 Overview

Single-mode optical fibres are widely used for telecommunication purposes and are cabled to satisfy the functional requirements of the installation environment. Further, cables placed into ducts and sub-ducts may be installed using solely, or a combination of, pushing, pulling, and air-assisted installation techniques. For duct installation, the environment and infrastructure can be varied and may also involve the use of single and multiple sub-ducts. Directly buried cables may be installed by a variety of methods such as ploughing and trenching with different environments and infrastructure. This may require specific cable design solutions based on multiple layers of armours and sheaths. It is recognised that certain designs of cable for direct buried applications involving such solutions may also be suitable for duct installation. The functional requirements and test methods featured in this specification are based upon adherence to established and recognised installation techniques such as those included in Annex C of IEC 60794-1-1.

NOTE Annex C of IEC 60794-1 should become a technical report.

4.2 General cable description

4.2.1 Characteristics of optical fibre

Single-mode optical fibres are classified according to their operational wavelength and dispersion characteristics. The fibres covered by this specification are categorised as type B and are described in IEC 60793-2-50. The fibre types featured in this specification are listed below:

- dispersion unshifted (B1.1, B1.3);
- bending loss insensitive (B6);
- dispersion shifted (B2);

- cut-off shifted (B1.2), non-zero dispersion (B4) - While cut-off shifted B1.2 fibre can be used in terrestrial applications, it is mainly used in submarine applications;
- wide-band non-zero dispersion-shifted (B5).

(See Annex A for ITU-T cabled optical fibre references).

4.2.2 Characteristics of optical fibre cable elements

Optical fibre cable elements such as buffer tubes (loose or not), slotted core, fibre ribbons, fibre bundles and central/core tubes shall be suitably designed to provide adequate means of fibre location, identification, modularity, protection during cable manufacture, installation and termination. The structure of these elements, and the materials used in their manufacture, shall not have any long term detrimental effects on fibre performance during the service life of the cable, splice enclosure and/or cabinet. To satisfy these functional requirements, the different elements shall comply with the requirements of IEC 60794-3 series as well as those outlined in Clause 6 of this standard.

4.2.3 Characteristics of optical fibre cables

Optical fibre cables, for the intent of this standard, are completed cable products as shipped by the manufacturer typically on disposable reels. Such products do not require additional assembly, or the use of additional materials or protection to meet the requirements contained herein. Some assembly or added protection is usually required only where the cables are terminated to other cables or equipment, and typically involve the use of an optical fibre closure or other hardware to protect cable splice or connectorization points. The required levels of protection for the fibre can be achieved by laying up or assembling the cable elements in association with suitable strength and/or anti-buckling members. These can be either metallic or non-metallic and positioned at the centre of the cable core or as peripheral members in or underneath the outer cable sheath. The cable may also contain moisture barrier tapes, metallic or non-metallic tapes, and water blocking or swellable materials.

4.2.4 Environmental and product safety requirements

IEC Guide 104 should be taken into account as far as possible. The materials of the cables in contact with the environment shall not be hazardous to the environment and personnel.

It should be noted that the cables specified by this standard are rarely accessible once installed. Therefore, the risk of exposure to hazardous materials, if any, is mostly a concern in the handling of the cable during manufacturing and installation. Additionally, the type of outer sheath specified herein is generally considered to be non-toxic, therefore the risk to the environment or personnel is minimal once properly installed.

This standard does not address the use of all types of cable materials that may be utilized in various cable designs to support meeting the requirements unique to a specific type of special application (e.g., very high temperatures or resistance to specific chemical attack). In such cases, it is incumbent on the customer and supplier to agree on the requirements applicable to such materials and cable designs, and to determine any special handling precautions or instructions needed as a result of their use.

4.3 Optical fibre splice-ability

All of the single-mode fibre types covered in this specification can readily achieve very low splice loss levels using a range of commercially available splicing techniques.

Typical bi-directional splice losses at 1 550 nm should be below 0,1 dB, with an average of 0,05 dB for fusion splices between fibres of the same category (B1-B1, or B2-B2, etc.) performed by skilled operators on active alignment splicers according to the current best practices. Additional fibre compatibility guidelines are provided in IEC/TR 62000.

NOTE 1 Higher maximum splice losses can be tolerated without affecting the link transmission capability.

NOTE 2 Splices of fibres of the same category, but different manufacturers and/or different production processes, do generally not exceed the above values.

NOTE 3 If fibres of different categories (B1-B2, B1-B4, etc.) are spliced, typically the splice loss is slightly higher than with splices between fibres of the same category.

4.4 Testing

4.4.1 General

For all test procedures, the atmospheric conditions shall be (23 °C ± 5 °C, and 20 % to 70 % relative humidity), unless otherwise specified. All measured and computed values are to be rounded to the number of decimal places given in the corresponding acceptance criteria for each requirement. The number of fibres to be tested shall be agreed upon between the customer and supplier.

4.4.2 No change in attenuation

4.4.2.1 General

For some of the parameters specified in this standard, the objective is no change in attenuation.

These parameters may be affected by measurement uncertainty arising from measurement errors or calibration errors due to a lack of suitable reference standards. Acceptance criteria shall be interpreted with respect to this consideration.

4.4.2.2 No change in attenuation - single-mode

The total uncertainty of measurement for this standard shall be ≤ ± 0,05 dB for attenuation or ± 0,05 dB/km for attenuation coefficient. Any measured value within this range shall be considered as “no change in attenuation”.

The requirement for these parameters is indicated as “no change (≤ 0,05 dB)” or “no change (≤ 0,05 dB/km)”. By agreement between the customer and the supplier, minor deviation from this limit may be accepted at some low frequency, e.g. less than 10 %. However, for mechanical tests no deviation in excess of 0,15 dB shall be accepted. For environmental tests, no deviation in excess of 0,10 dB/km shall be accepted.

4.4.3 No change in fibre strain

For some of the parameters specified in this standard, the objective is zero strain.

These parameters may be affected by measurement uncertainty arising from measurement errors or calibration errors due to a lack of suitable reference standards. Acceptance criteria shall be interpreted with respect to this consideration.

The total uncertainty of measurement for this standard shall be ± 0,05 % strain. Any measured value within this range shall be considered as “zero”.

5 Requirements for cabled single-mode optical fibres

5.1 Fibre materials

Use optical fibre as specified in IEC 60793-2-50.