IEC 60794-6-10

Edition 1.0 2020-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Optical fibre cables –
Part 6-10: Indoor-outdoor cables – Family specification for universal indoor-outdoor cables

Câbles à fibres optiques –
Partie 6-10: Câbles intérieurs/extérieurs – Spécification de famille pour les câbles intérieurs/extérieurs universels

IEC 60794-6-10:2020-09(en-fr)

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OPTICAL FIBRE CABLES –

Part 6-10: Indoor-outdoor cables – Family specification for universal indoor-outdoor cables

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

FDIS	Report on voting
86A/2036/FDIS	86A/2050/RVD

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

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

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.

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OPTICAL FIBRE CABLES –

Part 6-10: Indoor-outdoor cables – Family specification for universal indoor-outdoor cables

1 Scope

This part of IEC 60794 is a family specification covering features of optical fibre cables applicable to outdoor as well as indoor environments, called "universal indoor-outdoor cables". These cables generally possess the characteristics associated with outdoor cable designs (according to IEC 60794-3, however typically less stringent, and typically "non armoured") having the thermal and mechanical robustness that makes them suitable for use in the outside plant, while simultaneously being flexible enough, compact and lightweight and exhibiting the fire performance required in indoor premises. A typical application is for example the centralized cabling in central office and the premises or local area network where the same cable design is used for the entire length of the cabling link including both the indoor as well as the outdoor portions.

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 60332-1 (all parts), *Tests on electric and optical fibre cables under fire conditions – Part 1: Test for vertical flame propagation for a single insulated wire or cable*

IEC 60332-3 (all parts), *Tests on electric and optical fibre cables under fire conditions – Part 3: Test for vertical flame spread of vertically-mounted bunched wires or cables*

IEC 60754-2:2011, *Test on gases evolved during combustion of materials from cables – Part 2: Determination of acidity (by pH measurement) and conductivity*

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

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

IEC 60794-1-22:2017, *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 element test methods*

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IEC 60794-1-24, *Optical fibre cables – Part 1-24: Generic specification – Basic optical cable test procedures – Electrical test methods*

IEC 60794-1-31:2018, *Optical fibre cables – Part 1-31 : Generic specification – Optical cable elements – Optical fibre ribbon*

IEC 60794-1-215, *Optical fibre cables – Part 1-215: Generic specification – Basic optical cable test procedures – Environmental test methods – Cable external freezing test, Method F15*

IEC 60794-2 (all parts), *Optical fibre cables – Part 2: Indoor cables*

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

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

IEC 60794-3-10:2015, *Optical fibre cables – Part 3-10: Outdoor cables – Family specification for duct, directly buried and lashed aerial optical telecommunication cables*

IEC 60794-6:2020, *Optical fibre cables – Part 6: Indoor-outdoor cables – Sectional specification for indoor-outdoor cables*

IEC 60811-202:2012, *Electric and optical cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath*
IEC 60811-202:2012/AMD1:2017

IEC 60811-203:2012, *Electric and optical cables – Test methods for non-metallic materials – Part 203: General tests – Measurement of overall dimensions*

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 60811-604, *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 61034 (all parts), *Measurement of smoke density of cables burning under defined conditions*

ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

3 Terms, definitions and abbreviated terms

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

3.1 Terms and definitions

No terms and definitions are listed in this document.

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3.2 Symbols and abbreviated terms

HFFR halogen free flame retardant

4 General specifications

4.1 Optical fibres

The optical fibre shall conform to the requirements of IEC 60793-2-10 or IEC 60793-2-50. The fibre type shall be agreed between the customer and supplier. The cabled fibre shall conform to IEC 60794-2 (all parts) as well as IEC 60794-3 (all parts).

4.2 Cable elements

The cable elements shall conform to IEC 60794-2 (all parts) and/or IEC 60794-3 (all parts).

5 Specifications for universal indoor-outdoor cables – Construction

Performance parameters for universal indoor-outdoor cable according to IEC 60794-6:2020, Table 1, shall be addressed by designs following the intent of IEC 60794-3-10. As for typical outdoor cable designs, the cable attenuation performance is extended over a wide range of temperatures. In addition, fire performance and flexibility requirements according to IEC 60794-2 shall be fulfilled. Typical examples of universal indoor-outdoor cable designs are shown in Annex A.

6 Details of family specifications and test conditions for universal indoor-outdoor cables

6.1 Applicable tests

Compliance with this document shall be verified by carrying out tests selected from Table 1. It is not intended that all tests that are specified in 6.2 to 6.5 be carried out in all cases. The tests to be applied and the frequency of testing shall be agreed between the customer and supplier.

Table 1 – Tests applicable for mechanical and environmental performance of universal indoor-outdoor cables

Characteristics	Detail specifications	Test methods	Remarks
Mechanical tests			Typically required of most cable designs
Tensile performance	See 6.2.2	IEC 60794-1-21, method E1	
Abrasion	See 6.2.3	IEC 60794-1-21, method E2A, E2B	Method E2A for sheath abrasion Method E2B, method 2, for cable marking abrasion
Crush	See 6.2.4	IEC 60794-1-21, method E3A	
Impact	See 6.2.5	IEC 60794-1-21, method E4	
Repeated bending	See 6.2.6	IEC 60794-1-21, method E6	
Torsion	See 6.2.7	IEC 60794-1-21, method E7	

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Characteristics	Detail specifications	Test methods	Remarks
Bend	See 6.2.8	IEC 60794-1-21, method E11A or E11B	
Bending under tension	See 6.2.9	IEC 60794-1-21, method E18A	Diameter of mandrel should be 40 x cable diameter. Load should be as per 6.2.2
Kink	See 6.2.10	IEC 60794-1-21, method E10	
Rip cord functional	See 6.2.11	IEC 60794-1-21, method E25	
Environmental tests			
Temperature cycling	See 6.3.1	IEC 60794-1-22, method F1	
Water penetration	See 6.3.2	IEC 60794-1-22, method F5B, F5C	Method F5A is an option not frequently used
Ageing	See 6.3.3	IEC 60794-1-22, method F9	
UV resistance	See 6.3.4	IEC 60794-1-22, method F14 (ISO 4892-2)	
Environmental stress cracking	See 6.3.5	IEC 60811-406	Highly filled thermoplastics (e.g. FRNC materials) are more sensitive to stress cracking. The test was developed for PE and PP and thus shall be adapted.
Cable external freezing	See 6.3.6	IEC 60794-1-215, method F15A or F15B	
Compound flow	See 6.3.7	IEC 60794-1-22, method F16	
Bleeding and evaporation	See 6.3.8	IEC 60794-1-23, method G9	
Material compatibility	See 6.3.9	IEC 60794-1-219 should be applied	
Cable element tests			
Ribbon strippability	See 6.4.1	IEC 60794-1-23, method G10B	If ribbons are used
Ribbon tear (separability)	See 6.4.2	IEC 60794-1-23, method G5	If ribbons are used
Ribbon dimensions and geometry	See 6.4.3	IEC 60794-1-23, method G2	If ribbons are used
Ribbon torsion	See 6.4.4	IEC 60794-1-23, method G6	If ribbons are used
Ribbon residual twist	See 6.4.5	IEC 60794-1-23, method G8	If ribbons are used
Tube kinking	See 6.4.6	IEC 60794-1-23, method G7	
Bend for optical cable elements	See 6.4.7	IEC 60794-1-23, method G1	
Stripping force stability of cabled optical fibres	See 6.4.8	IEC 60794-1-23, method G10A	

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Characteristics	Detail specifications	Test methods	Remarks
Other tests			
Fire performance	See 6.5.1	IEC 60332-1 (all parts) IEC 60332-3 (all parts) IEC 61034 (all parts) IEC 60754-2	Regional legal requirements shall be fulfilled. For more details, see IEC TR 62222.
Electrical continuity	See 6.5.2	IEC 60794-1-24, method H3	For cables with metallic elements
Thickness of non-metallic sheath	See 6.5.3	IEC 60811-202	
Overall dimensions	See 6.5.4	IEC 60811-203	

6.2 Mechanical tests

6.2.1 General

The general optical criteria in mechanical tests is no change in attenuation, as described in IEC 60794-1-1. In some environmental and installation tests, some increase is accepted.

The number of fibres tested shall be representative of the cable design according to fibre sampling indicated in IEC 60794-1-1. Different sampling can be agreed between customer and supplier.

The minimum acceptance criteria for the different designs of cables shall be indicated in the product specification.

Test methods are defined in the generic specification IEC 60794-1-21, IEC 60794-1-22 and IEC 60794-1-23. Universal indoor-outdoor cables are generally designed according to IEC 60794-3. The mechanical performance is typically less stringent than specified in IEC 60794-3-10.

6.2.2 Tensile performance

a) Family specifications

While the cable is under short-term tensile load (T_M, rated tensile load),

- the axial fibre strain shall be < 60 % of the fibre proof strain, and
- the attenuation shall be measured and recorded.

While the cable is under the long-term tensile load (T_L, residual load),

- the axial fibre strain shall be:
  - < 20 % of fibre proof test, for fibre proof tested to ≤ 1 % strain (e.g., 0,69 GPa, 0,2 % absolute strain), and
  - < 17 % of fibre proof test, for fibre proof tested to greater than 1 % to 2 % strain (e.g., 0,69 GPa to 1,38 Gpa, 0,34 % absolute strain for 2 % proof tested fibre);

  NOTE For fibres proof tested at levels above 1 % strain, the safe long-term load will not scale linearly with proof strain, so a lower percentage of the proof stain is applicable. There is no agreement for strain limits for proof tests above 2 % strain.
- the change in attenuation shall be:
  - single-mode fibre: no change;
  - multimode fibre: ≤ 0,2 dB; and

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- any observed change in attenuation shall be agreed between customer and supplier.

Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements after the test.

b) Test conditions

Method: IEC 60794-1-21, method E1

Length under tension: > 50 m

Tensile load on cable: Long-term (T_L), short-term (T_M)

$T_M \geq 1{,}0 \times W$ (W = weight of 1 km cable)

$T_L = 0{,}3 \times T_M$

Other loads may be agreed between the customer and the supplier.

Diameter of test pulleys: Typically, 1 m but not less than the minimum loaded bending diameter specified for the cable.

6.2.3 Abrasion

a) Family specifications

Sheath abrasion: There shall be no perforation of the sheath after performing the needle test according to method E2A of IEC 60794-1-21.

Cable marking abrasion: The print shall be legible after the test performed according to method E2B of IEC 60794-1-21 (felt test).

b) Test conditions

Method: IEC 60794-1-21, method E2A

Load: 2 N

Number of cycles: 50

Method IEC 60794-1-21, method E2B, method 2

Load: 4 N

Number of cycles: 3

Other loads and number of cycles may be agreed between customer and supplier.

6.2.4 Crush

a) Family specifications

Under the short-term load, the attenuation change shall not exceed:

- 0,15 dB for single-mode fibres;
- 0,30 dB for multimode fibres.

At the end of the long-term loading, before releasing the load, there shall be no change in attenuation from the initial value(s).

Under visual examination, there shall be no damage to the sheath or to the cable elements. The imprint of the plate on the sheath is not considered mechanical damage.

b) Test conditions

Method: IEC 60794-1-21, method E3A

Short-term load (plate-plate): 1 000 N

Long-term load (plate-plate): 500 N

6.2.5 Impact

a) Family specifications

Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements. The imprint of the striking surface on the sheath is not considered mechanical damage. There shall be no permanent change in attenuation after the test.

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b) Test conditions

Method: IEC 60794-1-21, method E4

Number of impacts: One in 3 different places spaced not less than 500 mm apart

Impact energy: 10 J (un-armoured cable), 20 J (armoured cable)

Depending on the cable design, other energies can be selected in agreement between customer and manufacturer.

Striking Surface curvature radius: 300 mm minimum radius (flat hammer)

6.2.6 Repeated bending

a) Family specifications

Under visual examination without magnification, there shall be no damage to the sheath and to the cable elements.

b) Test conditions

Method: IEC 60794-1-21, method E6

Number of cycles: 25 or different number of cycles may be applied in accordance with the particular user conditions

Load: Adequate to assure uniform contact with the mandrel

Bending radius: 20 d

6.2.7 Torsion

a) Family specifications

Under visual examination without magnification, there shall be no damage to the sheath or to the cable elements.

b) Test conditions

Gauge length: 1 m

Method: IEC 60794-1-21, method E7 (as in IEC 60794-3-10:2015, 5.6.2)

6.2.8 Bend

a) Family specifications

There shall be no permanent change in attenuation after the test.

b) Test conditions

Method: IEC 60794-1-21, method E11. The default method is method E11A.

Diameter of mandrel: 20 d

Number of cycles: 3

Number of turns/helix: 4

Test temperature: Ambient (unless specifically requested otherwise).

Exceptions:

For large and/or stiff cables (e.g. where the mandrel diameter required is > 20 d, IEC 60794-1-21, method E11B, may be used).

For cable incorporating a non-metallic rod and/or metallic armouring, diameter of mandrel: 20 d or the minimum bend diameter specified for the cable

6.2.9 Bending under tension

a) Family specifications

Under visual examination without magnification, there shall be no damage to the sheath and/or to the cable elements.

The permanent increase in attenuation after the test shall be ≤ 0,2 dB for single-mode fibre and ≤ 0,4 dB for multimode fibre.

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b) Test conditions

Method:	IEC 60794-1-21, method E18A, procedure 1
Diameter of mandrel:	40 × d (different diameters could be agreed between customers and suppliers)
Tension:	≥ 1,0 × W (short term load T_M as defined in 6.2.2)
Number of moving cycles:	2

6.2.10 Kink

a) Family specifications

No kink shall occur at calculated bend diameters greater than the specified minimum.

b) Test conditions

Method: IEC 60794-1-21, method E10

6.2.11 Rip cord functional test

a) Family specifications

The rip cord shall rip through the cable sheath and shall not break for the entirety of the pull. If the rip cord breaks prior to reaching the 1 m mark, two additional follow-up specimens may be tested from the same cable length. The cable passes if neither of the two follow-up specimens breaks prior to reaching the 1 m mark.

If the rip cord pulls out of the end of the cable without slitting the sheath, repeat the test.

b) Test conditions

Method: IEC 60794-1-21, method E25

6.3 Environmental tests

6.3.1 Temperature cycling

a) Family specifications

For T_{A1} to T_{B1} there shall be no change in attenuation as defined in IEC 60794-1-1.

b) Test conditions

Method: IEC 60794-1-22, method F1 (T-cycle as indicated in Figure 1 of IEC 60794-1-22:2017)

Sample length: finished cable length, min. 500 m (fibre length should be longer than 1 000 m)

Documents
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Full document details: IEC 60794-6-10-2020