



BSI Standards Publication

## Optical fibre cables

Part 3-70: Outdoor cables — Family specification for outdoor optical fibre cables for rapid/multiple deployment

### **National foreword**

This British Standard is the UK implementation of EN 60794-3-70:2016. It is identical to IEC 60794-3-70:2016.

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

A list of organizations represented on this committee can be obtained on request to its secretary.

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EUROPEAN STANDARD

**EN 60794-3-70**

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2016

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English Version

Optical fibre cables - Part 3-70: Outdoor cables - Family  
specification for outdoor optical fibre cables for rapid/multiple  
deployment  
(IEC 60794-3-70:2016)

Câbles à fibres optiques - Partie 3-70: Câbles extérieurs -  
Spécification de famille pour câbles à fibres optiques  
extérieurs pour déploiement rapide/multiple  
(IEC 60794-3-70:2016)

Lichtwellenleiter - Teil 3-70: Außenkabel -  
Familienspezifikation für Lichtwellenleiter-Außenkabel für  
schnelle/mehrfache Verlegung  
(IEC 60794-3-70:2016)

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

## **European foreword**

The text of document 86A/1692/FDIS, future edition 1 of IEC 60794-3-70, prepared by SC 86A "Fibres and cables" of IEC/TC 86 "Fibre optics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60794-3-70:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-12-03
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-03-03

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## **Endorsement notice**

The text of the International Standard IEC 60794-3-70:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated :

IEC 60793-1-40                      NOTE    Harmonized as EN 60793-1-40.

IEC 60811-404                      NOTE    Harmonized as EN 60811-404.

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60793-2-10	2011	Optical fibres -- Part 2-10: Product specifications - Sectional specification for category A1 multimode fibres	EN 60793-2-10	2011
IEC 60793-2-50	2012	Optical fibres -- Part 2-50: Product specifications - Sectional specification for class B single-mode fibres	EN 60793-2-50	2013
IEC 60794-1-1	-		EN 60794-1-1	-
IEC 60794-1-2	-	Optical fibre cables -- Part 1-2: Generic specification - Cross reference table for optical cable test procedures	EN 60794-1-2	-
IEC 60794-1-21	-	Optical fibre cables -- Part 1-21: Generic specification - Basic optical cable test procedures - Mechanical tests methods	EN 60794-1-21	-
IEC 60794-1-22	-	Optical fibre cables -- Part 1-22: Generic specification - Basic optical cable test procedures - Environmental test methods	EN 60794-1-22	-
IEC 60794-1-23	-	Optical fibre cables -- Part 1-23: Generic specification - Basic optical cable test procedures - Cable element test methods	EN 60794-1-23	-
IEC 60794-3	-	Optical fibre cables - Part 3: Outdoor cables - Sectional specification	EN 60794-3	-
ISO 4892-2	-	Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps	EN ISO 4892-2	-

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## OPTICAL FIBRE CABLES –

**Part 3-70: Outdoor cables –  
Family specification for outdoor optical  
fibre cables for rapid/multiple deployment**

## FOREWORD

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International Standard IEC 60794-3-70 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This International Standard is to be used in conjunction with IEC 60794-1-1, IEC 60794-1-2 and IEC 60794-3.

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

FDIS	Report on voting
86A/1692/FDIS	86A/1708/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 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 publication will remain unchanged until the stability date indicated on the IEC website 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.

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## OPTICAL FIBRE CABLES –

### Part 3-70: Outdoor cables – Family specification for outdoor optical fibre cables for rapid/multiple deployment

#### 1 Scope

This part of IEC 60794 is a family specification that covers outdoor optical fibre cables intended for rugged terrestrial rapid/multiple deployment. These cables, with enhanced mechanical, environmental and ingress performance may be used wherever a rapid or multiple deployment is relevant (e.g. mobile broadcast units, emergency rescue services, outdoor motion-robotics, etc.).

#### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60793-2-10:2011, *Optical fibres – Part 2-10, Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60793-2-50:2012, *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 – Cross reference table for optical cable test procedures*

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

IEC 60794-1-22, *Optical fibre cables – Part 1-22: Generic specification – Basic optical cable test procedures – Environmental tests methods*

IEC 60794-1-23, *Optical fibre cables – Part 1-23: Generic specification – Basic optical cable test procedures – Cable element test methods*

IEC 60794-3, *Optical fibre cables – Part 3: Outdoor cables – Sectional specification*

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

#### 3 General requirements

The cable shall comply with the sectional specification, IEC 60794-3, and meet the requirements which are defined in it.

The optical fibre contained in cables covered by this standard shall comply with one of the following standards, and meet the normative requirements defined within them as applicable:

- IEC 60793-2-50:2012, Annex A (Single-mode fibre category B1.1);
- IEC 60793-2-50:2012, Annex C (Single-mode fibre category B1.3);
- IEC 60793-2-50:2012, Annex G (Single-mode fibre sub-categories B6\_a1 and B6\_a2);
- IEC 60793-2-10:2011, Annex A (Multimode fibre sub-category A1a, 50 µm core diameter);
- IEC 60793-2-10:2011, Annex B (Multimode fibre sub-category A1b, 62,5 µm core diameter).

To enable compatibility with ISO/IEC 11801 and ISO/IEC 24702, optical performance level requirements are presented in terms of the performance classification codes as follows:

- OS1 Single-mode fibre, B1.1, B1.3, B6\_a1 or B6\_a2
- OS2 Single-mode fibre, B1.3, B6\_a1 or B6\_a2
- OM1 Multimode fibre, A1a or A1b
- OM2 Multimode fibre, A1a or A1b
- OM3 Multimode fibre, A1a.2
- OM4 Multimode fibre, A1a.3

NOTE These codes are informative from the perspective of the requirements defined in this detailed specification.

## 4 Specification for outdoor optical fibre cables for rapid/multiple deployment

### 4.1 Construction

#### 4.1.1 General

In addition to the construction requirements of IEC 60794-3, where applicable, the following considerations apply to outdoor optical fibre cables for rapid/multiple deployment.

Rapid/multiple deployment optical fibre cables are designed to be used in un-protected outdoor terrestrial environments thereby requiring enhanced mechanical, environmental and ingress performance.

#### 4.1.2 Rapid/multiple deployment optical fibre cables

Rapid/multiple deployment optical fibre cables are suitable for use by manual or mechanically assisted deployment. They are differentiated from other outdoor optical fibre cables due to:

- repeated deployment/installation;
- unprotected working environment;
- often stored in relatively small diameter drums;
- uncontrolled or non-regulated cable route.

All the above, as well as additional factors require these cables to have enhanced mechanical (i.e. tensile, crush, bend radius, torsion, abrasion, kink, memory) environmental (i.e. temperature, UV resistance, cold-bend) and ingress (i.e. fuel, solvent and oil resistance, waterblocking) performance over the cable's lifetime. These are to be incorporated into the cable's design.

## 4.2 Optical fibres

For the purposes of this standard, supported optical fibres are those detailed in Clause 3. There shall be no fibre splice in a delivered length unless otherwise agreed by customer and supplier.

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

Transmission performance of the cabled optical fibres shall be in accordance with IEC 60794-1-1.

## 4.3 Secondary coating

Although the different recognized secondary coatings detailed in IEC 60794-3 (tight buffer, tube, ribbon, slotted core etc.) are supported by this standard, the type of secondary coating, materials and dimensions shall be as required by the cable detail specification.

NOTE Both laboratory testing as well as field use have demonstrated the tight buffer to be most optimized to meet all the relevant performance test requirements detailed in Clause 5 of this standard.

## 4.4 Outer sheath

The cable shall have a seamless sheath made of a UV-stabilised weather-resistant polymeric compound, unless otherwise agreed between the customer and supplier.

The sheath thickness and cable overall diameter and its variations shall take into account the operating conditions and shall be determined by agreement between the customer and supplier.

## 4.5 Mechanical and environmental tests

Based on the expected operating conditions over the life of the product, including the mechanical loads exerted on the product during deployment and operation, the following sections specify product performance for rapid/multiple deployment optical fibre cables. Unless otherwise specified, the installation temperature range shall be: -40 °C to +70 °C.

# 5 Testing of rapid/multiple deployment optical fibre cables

## 5.1 General

Some of the tests detailed in Table 1 below may not be applicable to certain cable designs and intended applications. For further guidance on the applicability of test methods and frequency of testing, see IEC 60794-1-1.

Tests on single-mode fibre cables are typically carried out at 1 550 nm. Multimode fibre cables are typically tested at 1 300 nm. Measurements at other wavelengths or range of wavelengths can be agreed upon between the customer and supplier.

## 5.2 Applicable tests

See Table 1.

**Table 1 – Tests applicable for mechanical and environmental performance of a rapid/multiple deployment optical fibre cable**

Characteristic	Family Requirement	Test Method	Remark
Tensile performance	5.3	IEC 60794-1-21 Method E1	
Abrasion	5.4	IEC 60794-1-21 Method E2A	
Crush	5.5	IEC 60794-1-21 Method E3	
Impact	5.6	IEC 60794-1-21 Method E4	
Ribbon stripping	5.7	IEC 60794-1-21 Method E5B	if ribbons are used
Repeated bending	5.8	IEC 60794-1-21 Method E6	
Torsion	5.9	IEC 60794-1-21 Method E7	
Flexing	5.10	IEC 60794-1-21 Method E8	
Kink	5.11	IEC 60794-1-21 Method E10	
Bend	5.12	IEC 60794-1-21 Method E11A	
Bending under Tension	5.13	IEC 60794-1-21 Method E18A	
Temperature cycling	5.14	IEC 60794-1-22 Method F1	
Water penetration	5.15	IEC 60794-1-22 Method F5B	
Ageing	5.16	IEC 60794-1-22 Method F9	
UV resistance	5.17	IEC 60794-1-22 Method F14	
External freezing	5.18	IEC 60794-1-22 Method F15	
Separability of individual fibres from ribbon	5.19	IEC 60794-1-23 Method G5	if ribbons are used
Tube kinking	5.20	IEC 60794-1-23 Method G7	if loose tubes are used
Fuel solvent resistance			IEC 60811-404 may be applicable

## 5.3 Tensile performance

### a) Family requirements

For some of the parameters specified, the objective is a level of strain that will not compromise fibre mechanical reliability. For 1 % proof-tested fibres, the fibre strain under long term tensile load ( $T_L$ ) shall not exceed 20 % of this fibre proof strain (equal to absolute 0,2 %

strain) and there shall be no change in attenuation during the test. Under short term tensile load ( $T_M$ ) the fibre strain shall not exceed 60% of the fibre proof strain and the attenuation change during test shall be measured and recorded. Other criteria may be agreed between the customer and the supplier. For fibres proof tested at higher levels the safe long-term load will not scale linearly with proof strain, so a lower percentage of the proof strain is applicable. For greater than 1 % up to 2 % proof-tested fibres, fibre strain at  $T_L$  shall be limited to 17 % of the proof-test strain (equal to absolute 0,34 % strain for 2 % proof tested fibres).

b) Test conditions

Method: IEC 60794-1-21, Method E1

Tensile short-term load on cable: 2 700 N or  $1 \times$  the weight of 1,0 km length of cable in N, the larger of the two.

NOTE Other tensile loads can be agreed between customer and supplier.

## 5.4 Abrasion

a) Family requirements

There shall be no perforation of the sheath after performing 100 cycles. Other criteria may be agreed between customer and supplier.

b) Test conditions

Method: IEC 60794-1-21, Method E2A

Applied force: 7 N

Diameter of needle: 0,5 mm

## 5.5 Crush

a) Family requirements

After removal of the short-term load, there shall be no change in attenuation. Under visual examination, there shall be no damage to the sheath or to the cable elements. The imprint of the plate or mandrel on the cable is not considered mechanical damage.

b) Test conditions

Method: IEC 60794-1-21, Method E3A

Short-term Load (plate/plate): 8 000 N

Duration of load: 1 min

NOTE Other compression loads can be agreed between customer and supplier.

## 5.6 Impact

a) Family requirements

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.

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

Striking surface curvature radius: 300 mm

Impact energy: 22 J

NOTE Other impact energies greater than 10 J can be agreed between customer and supplier.

### 5.7 Ribbon strippability

#### a) Family requirements

At least 25 mm of the ribbon matrix and the fibres' protective coatings shall be removable with commercially available stripping tools with no fibre breakage. Any remaining coating residue shall be readily removable using isopropyl alcohol wipes.

#### b) Test conditions

Method: IEC 60794-1-21, Method E5B

### 5.8 Repeated bending

#### a) Family requirements

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

There shall be no change in attenuation after the test.

#### b) Test conditions

Method: IEC 60794-1-21, Method E6

Bending diameter:  $10 \times d$

Load: Adequate to ensure uniform contact with the mandrel

Number of cycles: 10 000

### 5.9 Torsion

#### a) Family requirements

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

There shall be no change in attenuation after the test.

#### b) Test conditions

Method: IEC 60794-1-21, Method E7

Length under test:  $125 \times d$

Number of cycles: 1 000

NOTE Other lengths can be agreed between customer and supplier.

### 5.10 Flexing

#### a) Family requirements

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

There shall be no change in attenuation after the test.

#### b) Test conditions

Method: IEC 60794-1-21, Method E8

Number of cycles: 10 000

Diameter of pulleys A and B:  $20 \times d$

Carriage speed: 1,0 m/s

Mass of weights: Adequate enough to ensure uniform contact with pulleys

NOTE Test details mass of weights, acceleration and deceleration of the carriage, traverse length of the carriage and minimal distance of pulleys A and B to the nearest fixed pulley can be agreed between supplier and customer.

### 5.11 Kink

#### a) Family requirements

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

#### b) Test conditions

Method: IEC 60794-1-21, Method E10

Minimum diameter:  $10 \times d$

### 5.12 Bend

#### a) Family requirements

There shall be no change in attenuation after the test.

The change in attenuation during the test shall be  $\leq 0,2$  dB for single-mode fibre and  $\leq 0,4$  dB for multimode fibre.

#### b) Test conditions

Method: IEC 60794-1-21, Method E11A

Temperature: Ambient

Diameter of mandrel:  $10 \times d$

Number of turns/helix: 4

Number of cycles: 3

NOTE Other temperatures can be agreed between customer and supplier.

### 5.13 Bending under tension

#### a) Family requirements

Under visual examination without magnification there shall be no damage to the sheath nor to the cable elements.

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

#### b) Test conditions

Method: IEC 60794-1-21, Method E18A, Procedure 1

Diameter of mandrel:  $10 \times d$

Tension: 500 N

Number of moving cycles: 10

### 5.14 Temperature cycling

#### a) Family requirements

Attenuation measurements shall be taken during the last cycle.

For  $T_{A1}$  to  $T_{B1}$  the change in the attenuation coefficient shall be:

- $\leq 0,2$  dB/km for single-mode fibre and shall be reversible to measurement uncertainty when measured in the 1 550 nm region

- $\leq 0,4$  dB/km for multimode fibre and shall be reversible to measurement uncertainty when measured in the 1 300 nm region.

For  $T_{A2}$  to  $T_{B2}$ , the change in attenuation coefficient shall be:

- $\leq 0,3$  dB/km for single-mode fibre and shall be reversible to measurement uncertainty when measured in the 1 550 nm region.
- $\leq 0,5$  dB/km for multimode fibre and shall be reversible to measurement uncertainty when measured in the 1 300 nm region.

#### b) Test conditions

Method:	IEC 60794-1-22, Method F1.
Sample length under test:	Finished cable, length of at least 1 000 m.
High temperature, $T_{B2}$ :	+70 °C to +85 °C, depending on customer requirements.
High temperature, $T_{B1}$ :	+60 °C to +70 °C depending on customer requirements.
Low temperature, $T_{A1}$ :	–40 °C.
Low temperature, $T_{A2}$ :	$T_{A1}$ to –60 °C depending on customer requirements
Number of cycles:	2

NOTE Other temperature values corresponding to specific climate conditions can be agreed between supplier and customer. If, due to intended application length a shorter cable sample is agreed between supplier and customer, this length will be sufficient to ensure accurate, repeatable test results as per the dynamic range and resolution of the optical test equipment.

### 5.15 Water penetration

#### a) Family requirements

The cable shall not propagate water longitudinally according to requirements of IEC 60794-1-22, Method F5B or F5C as applicable.

#### b) Test conditions

Method: IEC 60794-1-22, Method F5B/F5C as applicable

### 5.16 Ageing

#### a) Family requirements

No change in optical transmittance after the test.

#### b) Test conditions

Method: IEC 60794-1-22, Method F9

### 5.17 UV resistance

#### a) Family requirements

After exposure, the average tensile and elongation of the test specimens from the outer sheath shall be a minimum of 80 % of the original value.

#### b) Test conditions

Method: IEC 60794-1-22, Method F14 and ISO 4892-2

### 5.18 External freezing

Method: IEC 60794-1-22, Method F15

Sample length:  $\geq 50$  m

NOTE It is assumed that a cable intended for outdoor use meets the external freezing requirements above, however, supplier and customer can agree to forego this test if deemed irrelevant to the intended application.



### **5.19 Fibre ribbon separability**

#### a) Family requirements

Maximum tear force: 4,4 N

#### b) Test conditions

Method: IEC 60794-1-23, Method G5

### **5.20 Tube kinking**

#### a) Family requirements

During the test no kinking of the sample shall be visible.

#### b) Test conditions

Method: IEC 60794-1-23 Method G7

*L*: 60 mm

*L*1: 350 mm

*L*2: 175 mm

Cycles: 10

NOTE Alternatively, *L*2 can be set as 100mm and the moving length *L* can be extended beyond 60mm in order to achieve the equivalent loop diameter.

## Annex A (normative)

### Blank detail specification and minimum requirements

See Table A.1 for the cable description.

**Table A.1 – Cable description**

(1)	Prepared by		(2) Document No: Issue: Date:
(3)	Available from:	(4)	Generic specifications: IEC 60794-1-1 and IEC 60794-1-2 Sectional specification: IEC 60794-3 Family specification: IEC 60794-3-70
(5)	<b>Additional references:</b>		
(6)	<b>Rapid/multiple deployment optical fibre cable description:</b>		
(7)	<b>Rapid/multiple deployment optical fibre cable construction:</b>		
	Optical fibre type (as per IEC 60793-2) Total fibre count Secondary coating construction Secondary coating material Secondary coating dimensions Strength member material Cable core construction Sheath material Sheath dimensions Additional armouring (Optional) – Non-metallic armouring – Metallic armouring Additional outer sheath (Optional) Marking identification – Customer requirement – Identification of manufacturer		Additional remarks
(8)	<b>Application information:</b>		
	Maximum outer diameter ( $d$ ) Rated maximum tensile load Minimum bending radius for no-load bending Minimum bending radius for rated-load bending  Temperature range: – Transport and storage – Installation – Operation  Length Marking on outer sheath – Typical – Accuracy		mm N mm or $n \times d$ mm or $n \times d$  °C °C °C  m -0 /+ 1 %

## Bibliography

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

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

IEC 60811-404, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 404: Miscellaneous tests – Mineral oil immersion tests for sheaths*

ISO/IEC 11801, *Information technology – Generic cabling for customer premises*

ISO/IEC 24702, *Information technology – Generic cabling – Industrial premises*

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