

BS EN 60794-3-30:2008



BSI British Standards

Optical fibres —

Part 3-30: Outdoor cables – Family specification for optical telecommunication cables for lakes, river crossings and coastal application

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National foreword

This British Standard is the UK implementation of EN 60794-3-30:2008. It is identical to IEC 60794-3-30:2008. It supersedes BS EN 60794-3-30:2003 which is withdrawn.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.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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English version

**Optical fibre cables -
Part 3-30: Outdoor cables -
Family specification for optical telecommunication cables
for lakes, river crossings and coastal application
(IEC 60794-3-30:2008)**

Câbles à fibres optiques -
Partie 3-30: Câbles extérieurs -
Spécification de famille
pour les câbles optiques
de télécommunication utilisés
pour les traversées de lacs, de rivières,
et pour applications côtières
(CEI 60794-3-30:2008)

Lichtwellenleiterkabel -
Teil 3-30: Außenkabel -
Familienspezifikation
für LWL-Fernmeldekabel
für die Durchquerung
von Seen und Flüssen und
für Küstenanwendungen
(IEC 60794-3-30:2008)

This European Standard was approved by CENELEC on 2008-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 86A/1203/FDIS, future edition 2 of IEC 60794-3-30, 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 60794-3-30 on 2008-10-01.

This European Standard supersedes EN 60794-3-30:2003.

The main changes with respect to EN 60794-3-30:2003 are listed below:

- the title of the specification has been updated to include coastal applications;
- fibre specifications have been enlarged to include fibre Type B5;
- an annex has been added for additional requirements according to the MICE table.

This European Standard is to be read in conjunction with EN 60794-1-1, EN 60794-1-2 and EN 60794-3.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2009-07-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-10-01

Endorsement notice

The text of the International Standard IEC 60794-3-30:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60654	NOTE Harmonized in EN 60654 series (not modified).
IEC 60654-4	NOTE Harmonized as EN 60654-4:1997 (not modified).
IEC 60721	NOTE Harmonized in EN 60721 series (not modified).
IEC 60721-1	NOTE Harmonized as EN 60721-1:1995 (not modified).
IEC 60721-3-3	NOTE Harmonized as EN 60721-3-3:1995 (not modified).
IEC 61000-6-2	NOTE Harmonized as EN 61000-6-2:2005 (not modified).
IEC 61918	NOTE Harmonized as EN 61918:2008 (modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

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

Addition to Annex ZA of EN 60794-1-1, EN 60794-1-2 and EN 60794-3:

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60793-1-48	- ¹⁾	Optical fibres - Part 1-48: Measurement methods and test procedures - Polarization mode dispersion	EN 60793-1-48	2007 ²⁾
IEC 60793-2-50	- ¹⁾	Optical fibres - Part 2-50: Product specifications - Sectional specification for class B single-mode fibres	EN 60793-2-50	2008 ²⁾

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

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OPTICAL FIBRE CABLES –

Part 3-30: Outdoor cables – Family specification for optical telecommunication cables for lakes, river crossings and coastal application

1 Scope

This family specification covers optical telecommunication cables to be used as underwater cables for lakes, river crossings and coastal applications. Requirements of the sectional specification IEC 60794-3 for duct, buried, aerial and lake, river crossings and coastal applications cables are applicable to cables covered by this standard. This standard does not cover methods of cable repair nor repair capability, nor does it cover cables for use with lake, river crossings and coastal applications line amplifiers.

Clause 4 of this standard describes a blank detail specification for optical telecommunication cables to be used for lakes, river crossings and coastal applications. It incorporates some minimum requirements.

Annex A describes a blank detail specification which may be used to prepare detail specifications.

Annex B describes the cable construction.

Annex C describes a blank detail specification for ISO/IEC 24702 applications (MICE).

The parameters specified in this standard may be affected by measurement uncertainty arising either from measurement errors or calibration errors due to lack of suitable standards. Acceptance criteria are interpreted with respect to this consideration (see IEC 60794-3, Clause 9).

The number of fibres tested should be representative of the cable design and should be agreed between the customer and the supplier.

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.

They complete the normative references already listed in the generic specification (IEC 60794-1-1, Clause 2 and IEC 60794-1-2, Clause 2) and in the sectional specification (IEC 60794-3, Clause 2).

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*

3 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

λ_{cc}	cabled fibre cut-off wavelength
$\lambda_{operational}$	operational wavelength
d	nominal outer diameter of the cable
DS	detail specification
T_L	long term tensile load
T_M	the acceptable amount of short-term tensile load that can be applied to the cable without permanent degradation of the characteristics of the fibres in the tensile performance test
T_{A1}	temperature cycling test low-temperature limit according to IEC 60794-1-2, Method F1
T_{A2}	temperature cycling test low-temperature limit according to IEC 60794-1-2, Method F1
T_{B1}	temperature cycling test high-temperature limit according to IEC 60794-1-2, Method F1
T_{B2}	temperature cycling test high-temperature limit according to IEC 60794-1-2, Method F1
t_1	temperature cycling test dwell time
$n \times d$	a value times cable outer diameter used for bends, mandrels, etc.

4 Family specification for optical telecommunication cables to be used in lakes, river crossings and coastal application (blank detail specification and minimum requirements)

4.1 Optical fibres

Attenuation values at 1 625 nm are optionally specified by the user.

4.1.1 Single-mode dispersion unshifted (B1.1) optical fibre

Characteristics (9)	IEC 60794-3 Clause/sub-clause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Uncabled optical fibre	5.1	IEC 60793-2-50		
Attenuation coefficient (cabled fibres)	5.2	According DS	IEC 60793-1-40	
at 1 310 nm at 1 550 nm at 1 625 nm	5.2.1	$\leq 0,40$ dB/km $\leq 0,30$ dB/km $\leq 0,40$ dB/km		1 625 nm performance is optional depending on agreement between customer and supplier
Attenuation discontinuities at 1 310 and 1 550 nm	5.2.2	$\leq 0,10$ dB	IEC 60793-1-40	

Characteristics (9)	IEC 60794-3 Clause/sub-clause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Cabled fibre cut-off wavelength	5.3	$\lambda_{cc} < \lambda_{operational}$	IEC 60793-1-44	
Fibre colouring	5.4	IEC 60304	Visual inspection	
Polarisation mode dispersion PMD ₀	5.5	As IEC 60794-3	IEC 60793-1-48	
Outer diameter including colouring	8.2.1.1	As IEC 60793-2-50	IEC 60793-1-21	

4.1.2 Single-mode dispersion unshifted (B1.2) optical fibre

Characteristics (9)	IEC 60794-3 Clause/sub-clause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Uncabled optical fibre	5.1	IEC 60793-2-50		
Attenuation coefficient (cabled fibres)	5.2	According DS	IEC 60793-1-40	
at 1 550 nm at 1 625 nm	5.2.1	$\leq 0,30$ dB/km $\leq 0,40$ dB/km		1 625 nm performance is optional depending on agreement between customer and supplier
Attenuation discontinuities at 1 310 and 1 550 nm	5.2.2	$\leq 0,10$ dB	IEC 60793-1-40	
Cabled fibre cut-off wavelength	5.3	$\lambda_{cc} < \lambda_{operational}$	IEC 60793-1-44	
Fibre colouring	5.4	IEC 60304	Visual inspection	
Polarisation mode dispersion PMD ₀	5.5	As IEC 60794-3	IEC 60793-1-48	
Outer diameter including colouring	8.2.1.1	As IEC 60793-2-50	IEC 60793-1-21	

4.1.3 Single-mode dispersion unshifted (B1.3) optical fibre

Characteristics (9)	IEC 60794-3 Clause/sub-clause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Uncabled optical fibre	5.1	IEC 60793-2-50		
Attenuation coefficient (cabled fibres)	5.2	According DS	IEC 60793-1-40	
at 1 310 at 1 383 +/- 3 nm at 1 550 at 1 625 nm	5.2.1	≤ 0,40 dB/km ≤ 0,40 dB/km ≤ 0,30 dB/km ≤ 0,40 dB/km		1 625 nm performance is optional depending on agreement between customer and supplier
Attenuation discontinuities at 1 310 and 1 550 nm	5.2.2	≤ 0,10 dB	IEC 60793-1-40	
Cabled fibre cut-off wavelength	5.3	$\lambda_{cc} < \lambda_{operational}$	IEC 60793-1-44	
Fibre colouring	5.4	IEC 60304	Visual inspection	
Polarisation mode dispersion PMD ₀	5.5	As IEC 60794-3	IEC 60793-1-48	
Outer diameter including colouring	8.2.1.1	As IEC 60793-2-50	IEC 60793-1-21	

4.1.4 Single-mode dispersion shifted (B2) optical fibre

Characteristics (9)	IEC 60794-3 Clause/sub-clause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Uncabled optical fibre	5.1	IEC 60793-2-50		
Attenuation coefficient (cabled fibres)	5.2.1	According DS	IEC 60793-1-40	
at 1 550 nm	5.2.1	≤ 0,30 dB/km		
Attenuation discontinuities at 1 550 nm	5.2.2	≤ 0,10 dB	IEC 60793-1-40	
Cabled fibre cut-off wavelength	5.3	$\lambda_{cc} < \lambda_{operational}$	IEC 60793-1-44	
Fibre colouring	5.4	IEC 60304	Visual inspection	
Polarisation mode dispersion PMD ₀	5.5	As IEC 60794-3	IEC 60793-1-48	
Outer diameter including colouring	8.2.1.1	As IEC 60793-2-50	IEC 60793-1-21	

4.1.5 Single-mode non-zero dispersion (B4) optical fibre

Characteristics (9)	IEC 60794-3 Clause/sub-clause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Uncabled optical fibre	5.1	IEC 60793-2-50		
Attenuation coefficient (cabled fibres)	5.2	According DS	IEC 60793-1-40	
at 1 550 nm at 1 625 nm	5.2.1	$\leq 0,30$ dB/km $\leq 0,40$ dB/km		1 625 nm performance is optional depending on agreement between customer and supplier
Attenuation discontinuities at 1 550 nm	5.2.2	$\leq 0,10$ dB	IEC 60793-1-40	
Cabled fibre cut-off wavelength	5.3	$\lambda_{cc} < \lambda_{operational}$	IEC 60793-1-44	
Fibre colouring	5.4	IEC 60304	Visual inspection	
Polarisation mode dispersion PMD ₀	5.5	As IEC 60794-3	IEC 60793-1-48	
Outer diameter including colouring	8.2.1.1	As IEC 60793-2-50	IEC 60793-1-21	

4.1.6 Single-mode non-zero dispersion shifted (B5) optical fibre

Characteristics (9)	IEC 60794-3 Clause/sub clause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Uncabled optical fibre	5.1	IEC 60793-2-50		
Attenuation coefficient (cabled fibres)	5.2.1	According DS	IEC 60793-1-40	
at 1 460 nm at 1 550 nm and at 1 625 nm	5.2.1	≤ 0,40 dB/km ≤ 0,30 dB/km ≤ 0,40 dB/km		1625 nm performance is optional depending on agreement between customer and supplier
Attenuation discontinuities at 1 550 nm	5.2.2	≤ 0,10 dB	IEC 60793-1-40	
Cabled fibre cut-off wavelength	5.3	$\lambda_{cc} < \lambda_{operational}$	IEC 60793-1-44	
Fibre colouring	5.4	IEC 60304	Visual inspection	
Polarisation mode dispersion PMD ₀	5.5	As IEC 60794-3	IEC 60793-1-48	
Outer diameter including colouring	8.2.1.1	As IEC 60793-2-50	IEC 60793-1-21	

4.2 Cable element

Characteristics (9)	IEC 60794-3 Clause/subclause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Cable element				
Compatibility	6	According DS	Under consideration	
Slotted core	6.3	According DS	Visual inspection	
Loose tube	6.4	According DS	Visual inspection	
Compound flow and evaporation		According DS	IEC 60794-1-2 Methods E14 and E15	
Outer diameter	8.2.1.1	According DS	IEC 60811-1-1	
Tight buffer	6.1	According DS	Visual inspection	
Outer diameter	8.2.1.1	According DS	IEC 60793-1-21	
Ribbon	6.5	According DS	Visual inspection	
Filler		According DS		
Insulated copper conductor		According DS		
Central strength member		According DS		

4.3 Installation and operating conditions

Characteristics (9)	IEC 60794-3 Clause/subclause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
General requirements	8.1	Agreement between customer and supplier		
Bend test	8.2.1.2	According DS	IEC 60794-1-2 Method G1	
Tube kinking	8.2.2.1	According DS	IEC 60794-1-2 Method G7	
Ribbons:				
- Dimensions	8.2.3.1	IEC 60794-3, Table 1	IEC 60794-1-2 Method G2, G3 or G4	
- Separability of individual fibres from a ribbon	8.2.3.2.1	IEC 60794-3, 8.2.3.2.1 or according DS	IEC 60794-1-2 Method G5 or according DS	
- Ribbon stripping	8.2.3.2.2	According DS	According DS	
- Torsion	8.2.3.2.3	According DS	IEC 60794-1-2 Method G6	

4.4 Mechanical and environmental tests ¹⁾

The number of fibres tested shall be representative of the cable design and shall be agreed between the customer and the supplier.

¹⁾ The cables may be tested with the appropriate suspension equipment during tensile testing.

4.4.1 Tests applicable

Characteristics (9)	IEC 60794-3 Clause/sub-clause (10)	Family requirements (11)	Tests methods (12)	Remarks (13)
Tensile performance	9.1	See 4.4.2.1 and according DS	IEC 60794-1-2 Method E1A and E1B	See 4.4.2.1
Installation capability				
Repeated bending	9.2.2	See 4.4.2.2	IEC 60794-1-2 Method E6	
- Impact	9.2.3	See 4.4.2.3	IEC 60794-1-2 Method E4	
- Torsion	9.2.5	See 4.4.2.4	IEC 60794-1-2 Method E7	
- Temperature cycling	9.5	See 4.4.2.7	IEC 60794-1-2 Method F1	
- Hydrostatic pressure	9.2.6	See 4.4.2.8	IEC 60794-1-2 Method F10	
- Coiling performance	9.2.7	See 4.4.2.9	IEC 60794-1-2 Method E20	
Bending under tension	9.2.1	See 4.6.2.10	IEC 60794-1-2 Method E18	
Cable bend	9.3	See 4.4.2.5	IEC 60794-1-2 Method E11	See 4.4.2.5
Crush	9.4	See 4.4.2.6	IEC 60794-1-2 Method E3	See 4.4.2.6
Ageing	9.6			
- Coating adhesion stability	9.6.1	According DS	IEC 60794-1-2 Method E5	
- Finished cable	9.6.2	Under consideration	IEC 60794-1-2 Method F9	
Water penetration	9.7	Under consideration	IEC 60794-1-2 Method F5B	
Hydrogen resistance		Under consideration		

4.4.2 Details on family requirements and test conditions for optical fibre cable tests

The expression of "no change in attenuation" means that any change in measurement value, either positive or negative, within the uncertainty of measurement shall be ignored. The uncertainty of measurement for this standard shall be $< 0,05$ dB for attenuation.

4.4.2.1 Tensile performance

a) Family requirements

Under long term tensile load (T_L) the fibre strain shall not exceed 20 % of the fibre proof strain and there shall be no change in attenuation during the test. Under installation 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.

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

b) Test conditions

Cable length under tension: not less than 50 m. Taking into account the measurement accuracy and end effects, shorter lengths may be used by agreement between the customer and the supplier.

Fibre length: finished cable length.

Tensile load on cable: long term tensile load (T_L) and installation load (T_M). Other loads may be applied in accordance with particular user conditions.

T_L design water depth \times weight of cable in water (N).

T_M $\geq 2,5 \times$ design water depth \times weight of cable in water (N).

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

4.4.2.2 Repeated bending

a) Family requirements

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

b) Test conditions

Bending radius: $20 d$ to $30 d$ for general use.

Load: sufficient to keep the cable in place during the test.

Number of cycles: > 30 .

Duration of cycle: > 10 s.

4.4.2.3 Impact

a) Family requirements

There shall be no change in attenuation at 1 550 nm after the test. For 1 625 nm applications, performance criteria shall be mutually agreed upon between the customer and supplier.

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

Striking face radius:	10 mm to 300 mm.
Diameter of steel base:	> 50 mm.
Impact energy:	50 J.
Number of impacts:	3 in 3 different locations spaced not less than 500 mm apart.

4.4.2.4 Torsion

a) Family requirements

Under consideration.

b) Test conditions

Under consideration.

4.4.2.5 Cable bend

a) Family requirements

There shall be no change in attenuation at 1 550 nm after the test. For 1 625 nm applications, performance criteria shall be mutually agreed upon between the customer and the supplier.

The same acceptance criteria shall apply when the bend test is carried out at low temperature in accordance with particular user conditions.

b) Test conditions

Diameter of mandrel:	minimum cable bending diameter.
Number of turns/helix:	4.
Number of cycles:	3 to 6 depending on user requirements.

4.4.2.6 Crush

a) Family requirements

Under load there shall be no increase in attenuation in the 1 550 nm region. For 1 625 nm applications, performance criteria shall be mutually agreed upon between the customer and supplier.

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 sheath is not considered mechanical damage.

NOTE It is recommended that additional testing considerations, such as the number of positions that the load is applied to the test specimen are defined.

b) Test conditions

Load (plate/plate):	> 10 kN.
and/or	
Load (mandrel/plate):	≥ 2,5 kN.
Duration of load:	15 min.

4.4.2.7 Temperature cycling

a) Family requirements

For T_{A1} to T_{B1} there shall be no change in attenuation at 1 550 nm. For 1 625 nm applications, performance criteria shall be mutually agreed upon between the customer and the supplier. The ambient temperature is the reference temperature for the test.

For T_{A1} to T_{A2} and T_{B1} to T_{B2} , the change in attenuation coefficient shall be lower than 0,15 dB/km at 1 550 nm. On completion of the test, there shall be no change in attenuation. For 1 625 nm applications, performance criteria shall be mutually agreed upon between the customer and the supplier.

b) Test conditions

Sample length:	finished cable length of at least 1 000 m.
High temperature, T_{B2} :	+ 60 °C to + 70 °C depending on user requirements.
High temperature, T_{B1} :	+ 30 °C to + 60 °C depending on user requirements.
Low temperature, T_{A1} :	– 10 °C.
Low temperature, T_{A2} :	– 10 °C to – 40 °C or – 45 °C, depending on user requirements.
Rate of heating and cooling:	sufficiently slow so that the effect of changing the temperature does not cause temperature shock.
t_1 :	temperature cycling test dwell time.
Number of cycles:	2, but additional cycles may be required in accordance with particular user requirements.

4.4.2.8 Hydrostatic pressure

a) Family requirements

There shall be no change in attenuation at 1 550 nm after the test. For 1 625 nm applications, performance criteria shall be mutually agreed upon between the customer and the supplier.

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

b) Test conditions

Length: to be agreed between the customer and the supplier.

Pressure: 110 kPa × (maximum water depth, in m) / 10.

Test time: > 24 h.

4.4.2.9 Coiling performance

a) Family requirements

There shall be no change in attenuation at 1 550 nm after the test. For 1 625 nm applications, performance criteria shall be mutually agreed upon between the customer and the supplier.

The cable shall form a smooth circle and stay in contact with the ground all the way around the circumference.

b) Test conditions

Diameter: minimum specified coiling diameter.

Number of turns: 10.

Temperature: 10 °C + 5 °C unless otherwise agreed between the customer and the supplier.

4.4.2.10 Bending under tension

a) Family requirements

Under load, there shall be no change in attenuation at 1 550 nm after the test. For 1 625 nm applications, performance criteria shall be mutually agreed upon between the customer and the supplier.

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

NOTE The examination may be limited to the cable length in contact with the roller radius surface.

b) Test conditions

Roller radius: \geq than the minimum bending radius of the cable.

Load: According to 4.4.2.1, load 1).

Number of cycles: 10.

Test speed: 0,5 m/s.

4.4.2.11 Hydrogen resistance

Under consideration.

Annex A (informative)

Family specification for optical telecommunication cables to be used in lakes, river crossings and coastal application (Blank detail specification and minimum requirements) – Cable description

(1) Prepared by		(2) Document N°: Issue : Date :
(3) Available from:	(4) Generic specification: Sectional specification:	IEC 60794-1-1; IEC 60794-1-2 IEC 60794-3
(5) Additional references:		
(6) Cable description:		
(7) Cable construction:		
Optical fibres		
Range of fibre count		
Modularity		
Construction - Single coloured fibre - Loose tube – filled - Loose tube – unfilled - Slotted core – filled - Slotted core – unfilled - Tight secondary coating - Ribbon in slotted core - Ribbon in loose tube - Central (strength) member – metallic - Central (strength) member – non metallic - Core filling – continuous - Core filling – regular water blocking - Core filling – water swellable materials Lay-up - Stranding (helical or SZ) - Single unit - Hybrid configuration		Additional remarks
(7) Cable construction (continued) Insulated copper conductors Inner sheath Peripheral strength member - Metallic - Non-metallic Moisture barrier		Additional remarks

<ul style="list-style-type: none"> - Single coated aluminium tape - Double coated aluminium tape - Double coated steel tape - Copper tube - Steel tube <p>Outer sheath</p> <p>Armouring</p> <ul style="list-style-type: none"> - Non-metallic armouring - Metallic armouring <p>Outer protection</p> <ul style="list-style-type: none"> - Polypropylene roves - Polyethylene sheath <p>Marking identification</p> <ul style="list-style-type: none"> - Customer requirement - Identification of manufacturer 	
(8) Application information:	
<p>Maximum outer diameter (d)</p> <p>Long term operational load (T_L)</p> <p>Installation load (T_M)</p> <p>Minimum bending radius for no load bending</p> <p>Minimum bending radius for rated load bending</p> <p>Temperature range:</p> <ul style="list-style-type: none"> - Transport and storage - Installation - Operation <ul style="list-style-type: none"> - On shore - In water <p>Cable weight</p> <p>Manufacturing cable length</p> <ul style="list-style-type: none"> - Typical - Nominal / tolerances 	<p>mm</p> <p>N</p> <p>N</p> <p>mm or $n \times d$</p> <p>mm or $n \times d$</p> <p>°C</p> <p>°C</p> <p>°C</p> <p>°C</p> <p>Kg / km</p> <p>m</p> <p>- 0 % + 1 %</p>

Annex B (normative)

Cable construction

Characteristics (9)	IEC 60794-3 Clause/sub- clause (10)	Family requirements (11)	Test methods (12)	Remarks (13)
Lay-up	7.2	According DS	Visual inspection	
Cable core Filling compound	7.3	According DS	Either IEC 60794-1-2 Method E14 or IEC 60811-5-1, Clause 4 IEC 60811-5-1, Clause 5 IEC 60811-5-1, Clause 8	
Strength member - Central - Peripheral	7.4	According DS	Visual inspection	
Moisture barrier				
For metallic tapes: - Thickness	7.5	According DS 4.9.2.1 of IEC 60708 or DS		
- Overlap		5.3 of IEC 60708 or DS		
- Adhesion		5.3 of IEC 60708		
- Tube		According DS		
Outer cable protection	7.6			
- Sheath or:		According DS		
- Polypropylene roves		According DS		
Optional protection		According DS		
Sheath marking Configuration /Dimensions	7.7	According DS	Visual inspection	
Abrasion resistance		According DS	IEC 60794-1-2, Method E2B Method 1 or IEC 60794-1-2, Method E2B Method 2	Steel needle diameter $d = 1,0$ mm load: 4 N Wool or rayon felt, weight ≥ 450 g
Sheath abrasion resistance	9.2.8	According DS	IEC 60794-1-2, Method E2A	
Cable length		Under consideration		

Annex C (informative)

BDS for ISO/IEC 24702 applications (MICE)

C.1 Additional requirements for industrial premises

Cables intended for installation in ISO/IEC 24702 and related standards (see Bibliography) may require the specification of additional tests to ensure their suitability in the applicable environments defined by the Mechanical, Ingress, Climatic and Chemical, and Electromagnetic (MICE) classification. For supplemental guidance, see IEC 62363. Required tests may be selected from table below.

C.2 Applicable additional specifications for industrial premises installations as defined in ISO/IEC 24702

Characteristics	MICE Classification of ISO/IEC 24702 and related standards			Test method
	M ₁	M ₂	M ₃	
Mechanical				
Shock/bump ^b				
Peak acceleration	40 ms ⁻²	100 ms ⁻²	250 ms ⁻²	IEC 60721-3-3
Vibration ^b				
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm	IEC 60721 series
Acceleration amplitude (9 Hz to 500 Hz)	5 ms ⁻²	20 ms ⁻²	50 ms ⁻²	IEC 60721 series
Tensile force (see ^a)	As required	As required	As required	IEC 60794-1-2 Method E1
Crush	45 N/ 25 mm	1 100 N/ 150 mm	2 200 N/ 150 mm	
Crush	Requirement above converted to requirement for IEC plate/plate test	Requirement above converted to requirement for IEC plate/plate test	Requirement above converted to requirement for IEC plate/plate test	IEC 60794-1-2 Method E3
Impact	1 J	10 J	30 J	IEC 60794-1-2 Method E4
Bending (see ^a)	As required	As required	As required	IEC 60794-1-2 Method E6
Flexing (see ^a)	As required	As required	As required	IEC 60794-1-2 Method E8
Torsion (see ^a)	As required	As required	As required	IEC 60794-1-2 Method E7

Characteristics	MICE Classification of ISO/IEC 24702 and related standards			Test method
	I ₁	I ₂	I ₃	
Ingress				
Immersion ^b	N/A	Intermittent liquid jet ≤ 12,5 l / min ≥ 6,3 mm / jet > 2,5 m distance	Intermittent liquid jet ≤ 12,5 l / min ≥ 6,3 mm / jet > 2,5 m distance and immersion ≤ 1 m for ≤ 30 min	IEC 60794-1-2 Method F3
Climatic and chemical	C₁	C₂	C₃	
Temperature cycling (ambient and rate of change)	- 10 °C to + 60 °C	- 25 °C to + 70 °C	- 40 °C to + 70 °C	IEC 60794-1-2 Method F1
Solar radiation ^c	700 Wm ⁻²	1 120 Wm ⁻²	1 120 Wm ⁻²	IEC 60721-1
Humidity ^c	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)	IEC 60721-3-3
Liquid pollution contaminants ^d	Concentration × 10 ⁻⁶	Concentration × 10 ⁻⁶	Concentration × 10 ⁻⁶	
Sodium chloride (salt/sea water) ^c	0	< 0,3	< 0,3	IEC 60721-1
Oil (dry-air concentration) ^c (for oil types see Note 1)	0	< 0,005	< 0,5	
Sodium stearate (soap) ^b	None	> 5 × 10 ⁴ aqueous non-gelling	> 5 × 10 ⁴ aqueous gelling	ISO/IEC 24702
Gaseous pollution contaminants ^d	Mean/Peak Concentration × 10 ⁻⁶	Mean/Peak Concentration × 10 ⁻⁶	Mean/Peak Concentration × 10 ⁻⁶	
Hydrogen sulphide ^b	< 0,003 / < 0,01	< 0,05 / < 0,5	< 10 / < 50	IEC 60654-4
Sulphur dioxide ^b	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15	IEC 60654 series
Sulphur trioxide ^b (ffs)	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15	IEC 60654 series
Chlorine wet (> 50 % humidity) ^c	< 0,0005 / < 0,001	< 0,005 / < 0,03	< 0,05 / < 0,3	IEC 60654 series
Chlorine dry (< 50 % humidity) ^c	< 0,002 / < 0,01	< 0,02 / < 0,1	< 0,2 / < 1,0	IEC 60654 series
Hydrogen chloride ^c	0 / < 0,06	< 0,06 / < 0,3	< 0,6 / < 3,0	IEC 60654 series
Hydrogen fluoride ^c	< 0,001 / < 0,005	< 0,01 / < 0,05	< 0,1 / < 1,0	IEC 60654 series
Ammonia ^c	< 1,0 / < 5,0	< 10,0 / < 50,0	< 50 / < 250	IEC 60654 series
Oxides of nitrogen ^c	< 0,05 / < 0,1	< 0,5 / < 1,0	< 5 / < 10	IEC 60654 series
Ozone ^c	< 0,002 / < 0,005	< 0,025 / < 0,05	< 0,1 / < 1	IEC 60654 series

Characteristics	MICE Classification of ISO/IEC 24702 and related standards			Test method
	E ₁	E ₂	E ₃	
Electro-magnetic (for cables containing electrically conductive elements)				
Electrostatic discharge – Contact (0,667 µC) ^d	4 kV	4 kV	4 kV	IEC 61326
Electrostatic discharge – Air (0,132 µC) ^d	8 kV	8 kV	8 kV	IEC 61326
Radiated RF – AM ^b	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	10 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	IEC 61000-2-5
Conducted RF ^d	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz	IEC 61000-6-2
EFT/B (comms) ^c	500 V	1 000 V	1 000 V	IEC 61326
Surge (transient ground potential difference) - signal, line to earth ^c	500 V	1 000 V	1 000 V	IEC 61000-6-2
Magnetic field (50 / 60 Hz) ^c	1 Am ⁻¹	3 Am ⁻¹	30 Am ⁻¹	IEC 61326
<p>^a This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.</p> <p>^b Subclause 6.2.2 of ISO/IEC 24702 provides basis for requirement.</p> <p>^c Annex F of ISO/IEC 24702 explains background to classification boundaries.</p> <p>^d A single dimensional characteristic, i.e. concentration × 10⁻⁶, was chosen to unify limits from different standards.</p>				

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