

INTERNATIONAL STANDARD

**Optical fibre cables –
Part 2-30: Indoor cables – Family specification for ribbon cables**



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Part 2-30: Indoor cables – Family specification for ribbon cables**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL FIBRE CABLES –

Part 2-30: Indoor cables – Family specification for ribbon cables

FOREWORD

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International Standard IEC 60794-2-30 has been prepared by sub-committee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2003. It constitutes a technical revision. The main changes are listed below:

- a) subclause 5.4 has been detailed according to the fibre type;
- b) Annex A has been added to show an example of cable construction;
- c) Annex B has been added which is a blank detail specification including Mice classification and requirements;
- d) a bibliography has been added

This standard shall be used in conjunction with IEC 60794-1-1 and IEC 60794-1-2, and IEC 60794-2.

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

FDIS	Report on voting
86A/1233/FDIS	86A/1244/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 maintenance result 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- withdrawn,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.

OPTICAL FIBRE CABLES –

Part 2-30: Indoor cables – Family specification for ribbon cables

1 Scope

This part of IEC 60794 is a family specification which covers optical fibre ribbon cables for indoor use. The requirements of the sectional specification IEC 60794-2 are applicable to cables covered by this standard.

Clause B.2 contains requirements that supersede the normal requirements in case the cables are intended to be used in installations governed by the MICE table of ISO/IEC 24702.

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.

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

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

IEC 60793-1-20, *Optical fibres – Part 1-20: Measurement methods and test procedures – Fibre geometry*

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 – Cutoff wavelength*

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 60794-1-1, *Optical fibre cables – Part 1-1: Generic specification – General 86A/1054/NP*

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

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

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

IEC 60811-1-1:1993, *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 60811-1-4:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Four: Tests at low temperatures.*

3 Construction

3.1 General

In addition to the constructional requirements in IEC 60794-2, the following considerations apply to indoor ribbon cables.

The cable shall be designed and manufactured for a predicted operating lifetime of at least 15 years. In this context, the attenuation of the installed cable at the operational wavelength(s) shall not exceed values agreed between the customer and the supplier. The materials in the cable shall not present a health hazard within its intended use.

There shall be no fibre splice in a delivery length unless otherwise agreed by the customer and the supplier.

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

3.2 Optical fibres and primary coating

Multimode or single-mode optical fibres meeting the requirements of IEC 60793-2 shall be used.

3.3 Buffer

None.

3.4 Ruggedized fibre

None.

3.5 Slotted core

None.

3.6 Tube

None.

3.7 Stranded loose tube

None.

3.8 Ribbon structure

The ribbon structure shall conform to 6.5 and 8.2.3 of IEC 60794-3. Fibres shall be formed into units of typically two, four, six, eight, or twelve fibres each. The fibres within the units shall remain parallel and not cross over. An example of a ribbon construction is shown in Figure A.1

3.9 Strength and anti-buckling members

The optical fibre ribbon cable may incorporate a tensile strength member. The strength member can be a layer of suitable material, longitudinally or helically applied, and/or may be embedded in the overall sheath.

3.10 Ripcord

None.

3.11 Sheath

The optical fibre ribbon shall be uniformly covered with a protective sheath generally as shown in Figure A.1.

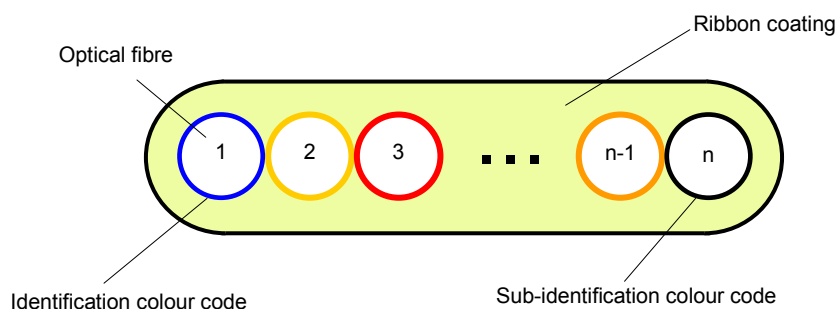
3.12 Sheath marking

If required, the cable shall be marked as agreed between the customer and the supplier.

3.13 Identification

The coated fibre shall be distinguishable by means of colour coding and positioning. For example (see Figure 1):

- a fibre ribbon has an identification coloured fibre on one side and a sub-identification coloured one on the other side;
- the identification and the sub-identification coloured fibres are the first and the last in the fibre ribbon, respectively;
- any colour of the identification colours group is different from that of the sub-identification colours group;
- the colour types and the order used for identification and sub-identification should be agreed between the customer and the supplier. The colours of the other fibres shall be agreed by the customer and/or the supplier;
- the colour range used is similar to the first 12 colours described in Table 1 of IEC 60794-2, i.e. blue, yellow, red, white, green, violet, orange, grey, turquoise, black, brown and pink.



NOTE 1 The identification colour enables each fibre ribbon to be identified individually within a group of ribbons.

NOTE 2 The sub-identification colour shows the ribbon group.

NOTE 3 The identification and the sub-identification colour in a ribbon enables each fibre to be identified individually within the ribbon.

Figure 1 – Example of identification by means of colour coding and positioning

Other methods of identification are under consideration.

3.14 Example of cable construction

An example of a ribbon cable construction is shown in Figure A.1. Other configurations are not precluded if they meet the mechanical, environmental and transmission requirements given in this specification.

4 Dimensions

4.1 Optical fibres and primary coating

The dimensions of the individual primary coated fibres in the finished product shall be in accordance with IEC 60793-2.

4.2 Ribbon structural geometry

The ribbon geometry shall conform to 8.2.3 of IEC 60794-3.

4.3 Optical fibre ribbon cable

Unless otherwise specified, the dimensions and the structural geometry of optical fibre ribbon cables shall be as shown in Table 1.

Table 1 – Dimensions of optical fibre ribbon cables

Number of fibres	Optical fibre ribbon cables			
	Width mm		Height mm	
	Nominal	Maximum tolerance	Nominal	Maximum tolerance
2	3,0 - 3,5	± 0,4	2,3 - 2,7	± 0,3
4	3,0 - 3,5	± 0,4	2,3 - 2,7	± 0,3
6	3,5 - 4,0	± 0,4	2,3 - 2,7	± 0,3
8	2,5 - 4,5	± 0,4	0,9 - 3,0	± 0,3
12	3,5 - 5,5	± 0,4	0,9 - 3,0	± 0,3
NOTE These dimensions apply to the ribbon cable including the sheath and any strength members.				

5 Tests

Compliance with the relevant detail specification requirements shall be verified by carrying out tests selected from the following subclauses. It is not intended that all the tests shall be carried out; the tests which are to be performed and the frequency of testing shall be agreed between the customer and the supplier.

5.1 Dimensions

The dimensions and structural geometry of optical fibre ribbon can be verified with a type test described in 8.2.3 of IEC 60794-3 to establish and assure proper control of the ribbon manufacturing process. Once the process is established, and in order to ensure functional performance, the dimensions of ribbons may be controlled and verified, for final inspection purpose, with a dial gauge as described in Method G4 of IEC 60794-1-2. The size of optical fibre ribbon cable, width and height, shall be measured in accordance with the methods of IEC 60811-1-1.

5.2 Mechanical requirements

Some of the following tests can be performed on a short sample length of optical fibre ribbon cable which is still an integral part of a longer length. For testing, the force shall be applied on the flat sides of the cable. Thus it becomes possible to detect permanent changes in attenuation. The wavelength and maximum increase in attenuation change can be agreed between the customer and the supplier.

5.2.1 Tensile performance

Method:	IEC 60794-1-2-E1A
Diameter of chuck drums not lower than the minimum dynamic bending and transfer devices:	diameter specified for the cable.
Velocity of transfer device:	either 100 mm/min or 100N/min
Load:	200 N applied for 5 min
Length of sample:	sufficient to achieve the desired accuracy of measurement of attenuation and shall be agreed between the customer and the supplier
Requirement:	no change in attenuation after the test, and there shall be no damage to the cable elements

5.2.2 Crush

Method:	IEC 60794-1-2-E3
Force:	500 N
Duration:	1 min
Length between test locations:	500 mm
Requirement:	no change in attenuation after the test, and there shall be no damage to the cable elements

NOTE The force is applied on the flat sides of the cable.

5.2.3 Impact

Method:	IEC 60794-1-2-E4
Radius of striking surface:	12,5 mm
Impact energy:	1,0 J
Number of impacts:	at least 3, each separated at least 500 mm
Requirement:	no fibre breakage

NOTE The force is applied on the flat sides of the cable.

5.2.4 Bend

Method:	IEC 60794-1-2-E11A
Mandrel diameter:	50 mm
Number of turns per helix:	6
Number of cycles:	10
Requirements:	no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

5.2.5 Repeated bending

Method:	IEC 60794-1-2-E6
Bending radius:	100 mm
Number of cycles:	300
Mass of weights:	2 kg
Requirement:	no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

5.2.6 Bending under tension

None.

5.2.7 Bending at low temperature

Method:	IEC 60794-1-2-E11A (see also IEC 60811-1-4, Clause 8)
Bending radius:	10 times cable diameter (for flat cables, the diameter is the minor dimension)
Number of cycles:	2
Test temperature:	0 °C, –10 °C or –15 °C depending on application and customer requirements
Number of turns per helix:	according to Clause 8 of IEC 60811-1-4
Requirements:	in addition to the requirement of Clause 8 of IEC 60811-1-4, no fibre shall break during the test

5.2.8 Flexing

Method:	IEC 60794-1-2-E8
Number of cycles:	300
Pulley diameter:	100 mm
Mass of weight:	2 kg
Requirement:	no fibre breakage

NOTE The bending is applied in the vertical direction to the flat sides of the cable.

5.2.9 Torsion

Method:	IEC 60794-1-2-E7
Number of cycles:	20
Distance between fixed and rotation clamp:	250 mm
Tension load:	20 N
Requirement:	no fibre breakage

5.2.10 Kink

None.

5.3 Environmental requirements**5.3.1 Temperature cycling**

Method: IEC 60794-1-2-F1

Table 2 – Temperature cycling conditions

	Temperature T_A	Temperature T_B
a)	0 °C	50 °C
b)	–5 °C	50 °C
c)	–20 °C	60 °C
d)	–40 °C	60 °C
NOTE Condition a), b), c) or d) should be selected depending on application and customer requirements, for example, condition c) is appropriate for applications to ISO/IEC 11801.		

Period t_1 :	sufficient so that the cable has reached, and stabilised to, the specified temperature
Number of cycles:	2
Length of sample:	sufficient to achieve the desired accuracy of measurement of attenuation
Requirement:	the wavelength and maximum increase in attenuation shall be agreed between the customer and the supplier

5.4 Transmission requirements

The transmission requirements shall be verified in accordance with IEC 60793-2 and shall be agreed between the customer and the supplier. Maximum cable attenuation shall comply with 5.1 of IEC 60794-1-1.

NOTE 1 625 nm performance is optional depending upon agreement between the customer and supplier

5.4.1 Single-mode optical fibres

Table 3 – Common single-mode fibre requirements

Characteristics	IEC 60794-2 Clause/subclause	Family requirements	Test methods	Remarks
Uncabled optical fibre	4.1	IEC 60793-2		
Cabled fibre cut-off Wavelength	4.4	$\lambda_{cc} < \lambda_{\text{operational}}$	IEC 60793-1-44	
Fibre colouring	4.1	IEC 60304	Visual inspection	
Outer diameter including colouring	4.1	As IEC 60793-2	IEC 60793-1-20	
Attenuation discontinuities at 1 550 nm	4.4	$\leq 0,10$ dB	IEC 60793-1-40	

5.4.2 Single-mode dispersion unshifted (B1.1) optical fibre**Table 4 – Cabled attenuation requirements for B1.1 optical fibre**

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.4	According to DS	IEC 60793-1-40	
at 1 310nm at 1 550 nm at 1 625 nm		$\leq 0,40$ dB/km $\leq 0,30$ dB/km $\leq 0,30$ dB/km		

5.4.3 Single-mode dispersion unshifted (B1.2) optical fibre**Table 5 – Cabled attenuation requirements for B1.2 optical fibre**

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.4	Acc. DS	IEC 60793-1-40	
at 1 550 nm at 1 625 nm		$\leq 0,25$ dB/km $\leq 0,40$ dB/km		

5.4.4 Single-mode dispersion unshifted (B1.3) optical fibre**Table 6 – Cabled attenuation requirements for B1.3 optical fibre**

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.4	According to DS	IEC 60793-1-40	
at 1 310 to 1 625 nm at 1 383 nm at 1 550 nm		$\leq 0,40$ dB/km $\leq 0,40$ dB/km $\leq 0,30$ dB/km		

5.4.5 Single-mode dispersion shifted (B2) optical fibre**Table 7 – Cabled attenuation requirements for B2 optical fibre**

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.4	According to DS	IEC 60793-1-40	
at 1 310 nm at 1 550 nm at 1 625 nm		$\leq 0,50$ dB/km $\leq 0,30$ dB/km $\leq 0,40$ dB/km		

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

Table 8 – Cabled attenuation requirements for B4 optical fibre

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.4	According to DS	IEC 60793-1-40	
at 1 550 nm		$\leq 0,30$ dB/km		
at 1 625 nm		$\leq 0,40$ dB/km		

5.4.7 Single-mode wide band non-zero dispersion (B5) optical fibre

Table 9 – Cabled attenuation requirements for B5 optical fibre

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Attenuation coefficient (cabled fibres)	4.4	According to DS	IEC 60793-1-40	
at 1 460 nm		$\leq 0,40$ dB/km		
at 1 550 nm		$\leq 0,30$ dB/km		
at 1 625 nm		$\leq 0,40$ dB/km		

5.4.8 Multimode fibres

Table 10 – Requirements for multimode (A1a and A1b) optical fibre

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Uncabled optical fibre	4.1	IEC 60793-2-10		
Attenuation coefficient (cabled fibres)	4.4	According to DS	IEC 60793-1-40	
at 850 nm		3,5 dB/km		
at 1 300 nm		1,5 dB/km		
Attenuation discontinuities at 850 and 1 300 nm	4.4	$\leq 0,20$ dB	IEC 60793-1-40	
Fibre colouring	4.1	IEC 60304	Visual inspection	
Outer diameter including colouring	4.1	As IEC 60793-2	IEC 60793-1-20	

5.5 Fire Performance

IEC/TR 62222 provides guidance and recommendations for the requirements and test methods for the fire performance of communication cables when installed in buildings. The recommendations relate to typical applications and installation practices, and an assessment of the fire hazards presented. Applicable legislation and regulation are also taken into account.

IEC/TR 62222 references several IEC fire performance test methods and also other test methods that may be required by local or national legislation and regulation. The tests to be applied, and the requirements, shall be agreed between the customer and supplier taking into

account the fire hazard presented by the end use application of the patchcord assembly in which the cable is intended to be used.

Annex A (informative)

Example of cable construction

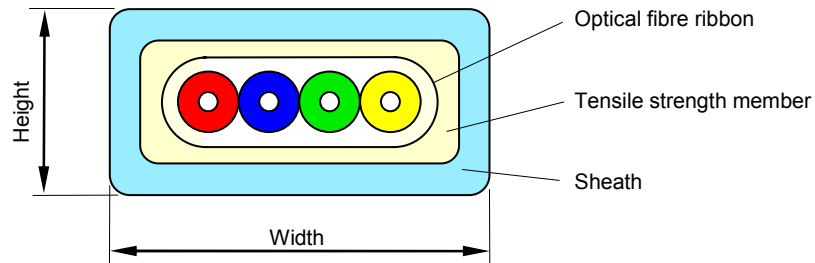


Figure A.1 – Example of cross-section of a four-fibre ribbon cable

Annex B (informative)

Family specification indoor cables – Optical fibre ribbon cables

B.1 Blank detail specification

B.1.1 Cable description

Table B.1 – Cable description

(1) Prepared by		(2) Document No : Issue : Date :
(3) Available from :	(4) Generic Specification : Sectional Specification :	IEC 60794-1-1 IEC 60794-2
(5) Additional references : ISO/IEC 24702 if required		
(6) Cable description :		
(7) Cable construction :		
Optical fibres		
Range of fibre count		
Modularity		
Construction - optical fibres and primary coating - ribbon - strength and anti-buckling members Outer sheath - material - minimum wall thickness Marking identification - customer requirement - identification of manufacturer		Additional remarks

(8) Application information :	
Application (indoor)	
Maximum outer diameter (d) or width and height	mm
Rated maximum tensile load	N
Minimum bending radius for operation	mm or nxd
Temperature range :	
- transport and storage	°C
- installation	°C
- operation	°C
Manufacturing cable length	
- typical	m
- nominal/tolerances :	-0 +1 %

B.1.2 Cable element

Table B.2 – Cable element

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Optical fibres and primary coating	3.2	According to DS		
Buffer	3.3	According to DS	Visual inspection	
Ribbon	3.8	According to DS	IEC 60794-1-2 G2, G3 or G4	
Strength and anti-buckling members	3.9	According to DS	Visual inspection	

B.1.3 Cable construction

Table B.3 – Cable construction

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Cable core		According to DS	Visual inspection	
Strength member	3.9	According to DS	Visual inspection	
- longitudinal				
- helical				
- embedded in the sheath				
Sheath	3.11	According to DS		
- material		According to DS	IEC 60811-1-1	
- minimum sheath thickness		According to DS	IEC 60811-1-1	
- width and height		According to DS	IEC 60811-1-1	
- optional protection		According to DS	IEC 60794-1-2, Method E2A	
- abrasion resistance		According to DS		
Sheath marking	3.12	According to DS	Visual inspection	
- configuration, dimensions		According to DS	IEC 60794-1-2, Method E2B	Steel needle diameter d = 1,0 mm load : 4 N
- abrasion resistance				
Cable length				

B.1.4 Installation and operating conditions**Table B.4 – Installation and operating conditions**

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
General requirements				
Bend of cable element		According to DS	IEC 60794-1-2, Method G1	
Ribbons :	3.8			
- dimensions		According to DS	IEC 60794-3, 8.2.3.1	
- separability of individual fibres from ribbon		According to DS	IEC 60794-1-2, Method G5 or according to DS	
- ribbon stripping		According to DS		
- torsion		According to DS	IEC 60794-1-2, Method G6	

B.1.5 Mechanical, environmental and fire performance tests**Table B.5 – Tests applicable**

Characteristics (9)	IEC 60794-2 Clause/subclause (10)	Family (11) requirements	Test methods (12)	Remarks (13)
Tensile performance	4.2.1	See 5.2.1	IEC 60794-1-2, Method E1A	
Crush	4.2.2	See 5.2.2	IEC 60794-1-2, Method E3	
Impact	4.2.3	See 5.2.3	IEC 60794-1-2 Method E4	
Bending	4.2.4	See 5.2.4	IEC 60794-1-2, Method E11A	
Repeated bending	4.2.5	See 5.2.5	IEC 60794-1-2, Method E6	
Bending at low temperature	4.2.7	See 5.2.7	IEC 60794-1-2 Method E11A	
Flexing	4.2.8	See 5.2.8	IEC 60794-1-2, Method E8	
Torsion	4.2.9	See 5.2.9	IEC 60794-1-2, Method E7	
Temperature cycling	4.3.1	See 5.3.1	IEC 60794-1-2, Method F1	
Fire performance	4.5	See 5.5	IEC/TR 62222	

B.2 Additional requirements for cables subject to the MICE environmental classification (ISO/IEC 24702 and related standards)

B.2.1 General

Cables intended for installation in ISO/IEC 24702 and related standards 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/TR 62362. Required tests may be selected from Table B.6 below.

B.2.2 Applicable additional specifications for industrial premises installations as defined in ISO/IEC 24702

Table B.6 – Specifications for industrial premises installations as defined in ISO/IEC 24702

Characteristics	MICE classification of ISO/IEC 24702 and related standards (see a, b and c below for further information)			Test method
MECHANICAL	M₁	M₂	M₃	
Shock/bump ^a				
Peak acceleration	40 ms ⁻²	100 ms ⁻²	250 ms ⁻²	IEC 60721-3-3
Vibration ^a				
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm	IEC 60721
Acceleration amplitude (9 Hz to 500 Hz)	5 ms ⁻²	20 ms ⁻²	50 ms ⁻²	IEC 60721
Tensile force (see NOTE 1)	As required	As required	As required	IEC 60794-1-2, Method E1
Crush ^c	45 N/25 mm	1 100 N/150 mm	2 200 N/150 mm	IEC 60794-1-2, Method E3
Impact	1 J	10 J	30 J	IEC 60794-1-2, Method E4
Bending (see NOTE 1)	As required	As required	As required	IEC 60794-1-2, Method E6
Flexing (see NOTE 1)	As required	As required	As required	IEC 60794-1-2, Method E.8
Torsion (see NOTE 1)	As required	As required	As required	IEC 60794-1-2, Method E7
INGRESS	I₁	I₂	I₃	
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 ≤ 1m 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 ^b	700 Wm ⁻²	1 120 Wm ⁻²	1 120 Wm ⁻²	IEC 60721-1
Humidity ^b	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)	IEC 60721-3-3
Liquid pollution contaminants ^b	Concentration × 10 ⁻⁶	Concentration × 10 ⁻⁶	Concentration × 10 ⁻⁶	
Sodium chloride (salt/sea water) ^b	0	< 0,3	< 0,3	IEC 60721-1

Characteristics	MICE classification of ISO/IEC 24702 and related standards (see ^a , ^b and ^c below for further information)			Test method
Oil (dry-air concentration) ^b (for oil types see NOTE 1)	0	< 0,005	< 0,5	
Sodium stearate (soap) ^a	None	> 5 × 10 ⁴ aqueous non-gelling	> 5 × 10 ⁴ aqueous gelling	IEC 24702
Gaseous pollution contaminants ^b	Mean/peak concentration × 10 ⁻⁶	Mean/peak concentration × 10 ⁻⁶	Mean/peak concentration × 10 ⁻⁶	
Hydrogen sulphide ^a	<0,003/<0,01	<0,05/<0,5	<10/<50	IEC 60654-4
Sulphur dioxide ^a	<0,01/<0,03	<0, 1/<0,3	<5/<15	IEC 60654
Sulphur trioxide ^a (ffs)	<0,01/<0,03	<0, 1/<0,3	<5/<15	IEC 60654
Chlorine wet (>50 % humidity) ^b	<0,0005 / <0,001	<0,005/<0,03	<0,05/<0,3	IEC 60654
Chlorine dry (<50 % humidity) ^b	<0,002/<0,01	<0,02/<0,1	<0,2/<1,0	IEC 60654
Hydrogen chloride ^b	0/<0,06	<0,06/<0,3	<0,6/<3,0	IEC 60654
Hydrogen fluoride ^b	<0,001/<0,005	<0,01/<0,05	<0,1/<1,0	IEC 60654
Ammonia ^b	<1,0/<5,0	<10,0/<50,0	<50/<250	IEC 60654
Oxides of nitrogen ^b	<0,05/<0,1	<0,5/<1,0	<5/<10	IEC 60654
Ozone ^b	<0,002/<0,005	<0,025/<0,05	<0,1/<1	IEC 60654
ELECTROMAGNETIC (for cables containing electrically conductive elements)	E₁	E₂	E₃	
Electrostatic discharge – Contact (0,667 μC) ^a	4 kV	4 kV	4 kV	IEC 61326
Electrostatic discharge – Air (0,132 μC) ^a	8 kV	8 kV	8 kV	IEC 61326
Radiated RF - AM ^a	3 V/m @ (80 to 1 000) MHz 3 V/m @ (1 400 to 2 000) MHz 1 V/m @ (2 000 to 2 700) MHz	3 V/m @ (80 to 1 000) MHz 3 V/m @ (1 400 to 2 000) MHz 1 V/m @ (2 000 to 2 700) MHz	10 V/m @ (80 to 1 000) MHz 3 V/m @ (1 400 to 2 000) MHz 1 V/m @ (2 000 to 2 700) MHz	IEC 61000-2-5
Conducted RF ^a	3 V@ 150 kHz to 80 MHz	3 V@ 150 kHz to 80 MHz	10 V@ 150 kHz to 80 MHz	IEC 61000-6-2
EFT/B (comms) ^b	500 V	1 000 V	1 000 V	IEC 61326
Surge (transient ground potential difference) - signal, line to earth ^b	500 V	1 000 V	1 000 V	IEC 61000-6-2
Magnetic field (50/60 Hz) ^b	1 Am ⁻¹	3 Am ⁻¹	30 Am ⁻¹	IEC 61326
NOTE 1 This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.				
^a Subclause 6.2.2 of ISO/IEC 24702 provides a basis for requirements.				
^b Annex F of ISO/IEC 24702 explains the background to classification boundaries.				
^c Limits values should be :normalized for a 100 mm plate that is requested by the test procedure.				

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