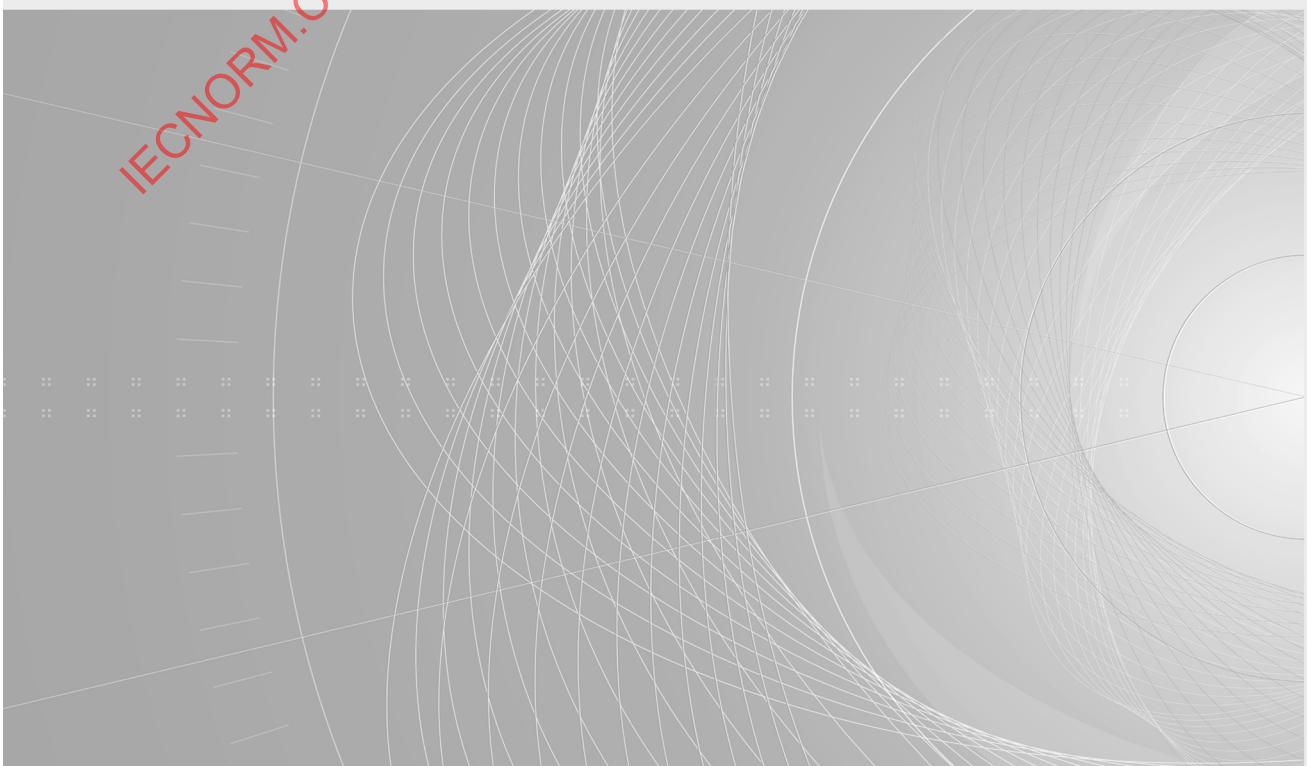
IEC TR 62362

Edition 2.0 2020-09
REDLINE VERSION

TECHNICAL REPORT

colour inside

Selection of optical fibre cable specifications relative to mechanical, ingress, climatic or electromagnetic characteristics – Guidance



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INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SELECTION OF OPTICAL FIBRE CABLE SPECIFICATIONS RELATIVE TO MECHANICAL, INGRESS, CLIMATIC OR ELECTROMAGNETIC CHARACTERISTICS – GUIDANCE

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IEC 62362 which is a Technical Report, has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2010. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) replacement of references and information from ISO/IEC 24702 and ISO/IEC 11801 with ISO/IEC 11801-1;
b) update of the MICE table;
c) update of the current optical fibre designations of IEC 60793-2-10 and IEC 60793-2-50.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86A/1987/DTR	86A/2029/RVDTR

Full information on the voting for the approval of this technical report 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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Optical fibre cable specification standards are defined in IEC 60794 (all parts), which are listed in Annex B. They are organized in a hierarchy similar to the IECQ system. They differ from the IECQ system in that they are all performance standards. ~~Optical fibre cable standards mainly cover the attributes and tests that protect the fibre from the environment, including installation, and the fibre attributes that may be affected by cabling.~~ Optical fibre cable standards specify the attributes and tests on cables intended to verify adequate protection of fibres against external influences during the cabling process, cable installation handling and from environmental effects during storage and operation. The attributes of the fibres within the cable are defined by reference to optical fibre specification standards of the IEC 60793 series, which are listed in Annex C. A complete and up-to-date listing of standards in the IEC 60793 and IEC 60794 series is available on the IEC website: http://www.iec.ch.

The different levels of hierarchy are: ~~general~~ generic, sectional, family and product. The primary distinction between these is the level of detail. Typically, more options or wider ranges are present at the higher level. At a given level, the distinctions are with respect to application or cable construction. ~~The references section~~ Clause 2 of this document gives a more complete mapping. Parts of the family specification include blank detail specifications for various attributes that do not have normative requirements.

~~At the sectional specification level, two main categories are indoor and outdoor cables. Typically the outdoor cables have tougher tests than the indoor cables. At the product specification level, there are series of standards intended to support ISO/IEC 11801 for premises cabling, using both indoor and outdoor varieties.~~

~~This guidance will not attempt to reproduce the requirements of all the different specifications. For each of the MICE attributes, it will discuss the situation and mention the key options.~~

At the sectional specification level, the main categories are indoor cables, outdoor cables, cables along overhead lines, microduct cabling and indoor/outdoor cables. Typically, the outdoor cables have tougher tests than the indoor cables. At the product specification level, there is a series of standards intended to support ISO/IEC 11801 (all parts) for premises cabling, using both indoor and outdoor varieties.

It is not the intention of this document to reproduce the requirements of all relevant specifications, but rather to discuss typical application situations and mention key options for tests, while seeking to guarantee the performance of cables in operation.

SELECTION OF OPTICAL FIBRE CABLE SPECIFICATIONS RELATIVE TO MECHANICAL, INGRESS, CLIMATIC OR ELECTROMAGNETIC CHARACTERISTICS – GUIDANCE

1 Scope

The purpose of this document is to provide information on the specification of optical fibre cables with respect to the mechanical, ingress, climatic and chemical or electromagnetic characteristics (MICE) as classified in ~~ISO/IEC 24702~~ ISO/IEC 11801-1.

In this classification system, each letter of the four initials of the acronym are subscripted with a value from one to three to indicate different severities. The current attributes and severities are found in Annex A.

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

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

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

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

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components – Performance standard*

ISO/IEC 11801 (all parts), *Information technology – Generic cabling for customer premises*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

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

3.2 ~~Acronyms~~ Abbreviated terms

MICE mechanical, ingress, climatic and chemical, electromagnetic

4 MICE attributes and severities

4.1 General

The MICE classification system has three levels of severity:

1) $M_1I_1C_1E_1$ describes a typical environment such as that assumed in ISO/IEC 11801-2; (i.e. office premises, etc.);
2) $M_2I_2C_2E_2$ describes a ~~worst-case~~ light industrial environment;
3) $M_3I_3C_3E_3$ describes a ~~worst-case~~ harsh industrial environment.

See Annex A for a more detailed description of the MICE severity levels.

4.2 Mechanical

4.2.1 Shock/bump

Shock and bump are not specified for optical fibre cables. They are inherently robust in this respect. ~~A more important attribute is bending.~~

4.2.2 Vibration

Vibration in the industrial premises (as opposed to wind induced vibration on aerially deployed cables) is not specified for optical fibre cables. They are inherently robust in this respect.

4.2.3 Tensile force

For outdoor ~~premises~~ cables specified in IEC 60794-3 (all parts), manufacturers specify a rated tensile force. The requirement is that the fibre shall not exceed a percentage of the proof test strain (to be agreed between customer and supplier) when the cable is tested at the rated load.

For indoor cables, the different family specifications of IEC 60794-2 (all parts) have different requirements on the tensile load ranging from 70 N to 400 N.

4.2.4 Crush

For optical fibre cables, the crushing force is applied in a plate to plate test.

For indoor cables, crush is specified at 500 N. For outdoor cables, different levels are specified depending on whether the cable is armoured or not. ~~For unarmoured cable, values of between 1 500 N and 3 000 N may be specified. For armoured cable, values between 2 200 N and 10 000 N may be specified.~~ For unarmoured cable, values of between 750 N and 1 500 N are specified. For armoured cable, values between 1 100 N and 2 200 N are specified.

4.2.5 Impact

For indoor cables, a value of 1 J and a hammer with a striking surface of 12,5 mm radius ~~is~~ are specified. For un-armoured outdoor cables, a value of ~~either~~ 10 J and a hammer with a striking surface of 300 mm radius ~~or 3 J with a 10 mm radius is~~ are specified.

4.2.6 Bending, flexing and torsion

All the family specifications have requirements on these attributes.

For bending, there are multiple tests such as bending under tension, repeated bending and simple bending. The bending diameter is typically 20 times the cable diameter.

For flexing, the bending diameter is typically 20 times the cable diameter, with 25 cycles typically applied.

For torsion, the test length, load, and number of turns varies depending on the family specification. For indoor cables, the length is ~~from 250 mm to 1 000 mm, loaded at 20 N with 20 cycles applied~~ 125 x cable diameter or 250 mm, loaded at 20 N with 10 or 20 cycles (per detailed specification) applied.

4.3 Ingress

4.3.1 Basic consideration

Optical fibre cables come in a variety of constructions. Some examples are slotted core, loose tube, tight buffered. The slotted core and loose tube can be filled or unfilled. These different constructions have different ingress characteristics.

4.3.2 Particulate ingress

Particulate ingress is not specified for optical fibre cables. They are inherently robust in this respect.

4.3.3 Water immersion

On cables for which water immersion is specified, the test is different from that found in Annex A. The requirement is that a pressure equivalent to 1 m of water is applied at or near one end of a short (< 3 m) cable. After 24 h, ~~the requirement is:~~ no water shall be found at the other end.

It is expected that cables passing this test would pass both I_2 and I_3 severities.

4.4 Climatic

4.4.1 General

Terminations such as cable closures are generally considered separately from the cables and are covered by standards from the IEC 61753 series prepared by IEC SC 86B.

NOTE The values that appear in Table 1 to Table 3 below indicate levels of resistance to climatic phenomena. Values of 1 to 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.

4.4.2 Ambient temperature

The different specifications allow different ranges of values to be specified by the customer, depending on the climate in which the cable will be installed. For the detailed specifications for premises cabling, –20 °C to +60 °C are specified. Other ranges and combinations from –45 °C to +70 °C are also found as options in the family specifications.

4.4.3 Rate of change of temperature

~~This is not specified. All the cables that pass the other requirements will, however, have the capability of 3 °C/min.~~ The rate of change of temperature is not specified in the product specifications of cables. IEC 60794-1-22, methods F1 and F12, specify a rate of heating that shall not exceed 60 °C per hour. However, it is assumed that all the cables have the capability of 3 °C/min.

4.4.4 Humidity

For further study.

4.4.5 Solar radiation

Resistance to solar radiation in the industrial premises environment is not specified in the product specifications of cables. Resistance to solar radiation is a property of the sheath material. The severities associated with some common generic materials are indicated in Table 1.

A specific grade of the generic material may have a different performance to that identified in Table 1.

Table 1 – Resistance to solar radiation

Material	Climatic classification, C		
	Natural	Stabilized	With ~2,5 % of active carbon black content
Medium-density polyethylene	0	3	3
Track-resistant medium-density polyethylene	0	3	3
High-density polyethylene	0	3	3
Thermoplastic (co)polyester elastomer	0	3	3
Polyvinyl chloride	1	3	3
Polyvinylidene fluoride	1	3	3
Nylon 12 (polyamide)	1	3	3
Thermoplastic polyurethane (TPU)	1	3	3
NOTE The values in this table indicate levels of resistance to climatic phenomena. Values of 1 to 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.			

4.4.6 Liquid pollution

Resistance to liquid pollution is not specified in the product specifications of cables. Resistance to liquid pollution is a property of the sheath material. The severities associated with some common generic materials are indicated in Table 2.

A specific grade of the generic material may have a different performance to that identified in Table ~~1~~2.

Table 2 – Liquid pollution

Material	Chemical classification, C				
	Sodium chloride (salt/sea water)	Oil (dry-air concentration)	Sodium stearate (soap)	Detergent	Conductive materials in solution
Low-density polyethylene	3	3	3	3	3
Medium-density polyethylene	3	3	3	3	3
Track-resistant medium-density polyethylene	3	3	3	3	3
High-density polyethylene	3	3	3	3	3
Thermoplastic (co)polyester elastomer	3	3	3	3	3
Polyvinyl chloride	2	2	2	2	3
Polyvinylidene fluoride	3	3	3	3	3
Nylon (polyamid 12)	2	2	2	2	3
Thermoplastic polyurethane (TPU)	3	3	3	3	3
NOTE The values in this table indicate levels of resistance to climatic phenomena. Values of 1 to 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.					

4.4.7 Gaseous pollution

Resistance to gaseous pollution is not specified in the product specifications of cables. Resistance to gaseous pollution is a property of the sheath material. The severities associated with some common generic materials are indicated in Table 3 and Table 4.

A specific grade of the generic material may have a different performance to that identified in the Table ~~1~~3 and Table 4.

Table 3 – Gaseous pollution resistance

Material	Chemical classification, C, by pollutant				
	Hydrogen sulphide	Sulphur dioxide	Chlorine wet	Chlorine dry	Hydrogen chloride 10 %
Low-density polyethylene	2	2	0	0	2
Medium-density polyethylene	2	2	0	0	2
Track-resistant medium-density polyethylene	2	2	0	0	2
High-density polyethylene	2	2	0	0	2
Thermoplastic (co)polyester elastomer	2	2	1	1	0
Polyvinyl chloride	3	3	1	0	3
Polyvinylidene fluoride	3	2	3	3	3
Nylon (polyamid 12)	3	1	0	0	0
Thermoplastic polyurethane (TPU)	3	3	2	2	3
NOTE The values in this table indicate levels of resistance to climatic phenomena. Values of 1 to 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.					

Table 4 – Gaseous pollution resistance

Material	Pollutant				
	Hydrogen chloride 37 %	Hydrogen fluoride	Ammonia	Oxides of nitrogen	Ozone 100 %
Low-density polyethylene	2	2	3	0	0
Medium-density polyethylene	2	0	3	0	0
Track tesistant medium-density polyethylene	2	0	3	0	0
High-density polyethylene	2	0	3	0	0
Thermoplastic (co)polyester elastomer	0	0	0	0	0
Polyvinyl chloride	3	2	3	1	1
Polyvinylidene fluoride	3	3	3	2	2
Nylon (polyamid 12)	0	0	3	1	1
Thermoplastic polyurethane (TPU)	3	2	3	3	3

4.5 Electromagnetic

Cables can be dielectric, or can contain metallic elements such as armour, strength members or sheaths. With the exception of possible damage on cables with metallic sheathes due to lightning strikes, optical fibre cables are immune to all of the attributes for this category.

Annex A
(informative)

Details of MICE classification

The details associated with ~~ISO/IEC 24702~~ ISO/IEC 11801-1 are presented in ~~the following tables~~ Table A.1 to Table A.4.

Table A.1 – Details of MICE classification (mechanical)

Mechanical	M_1	M_2	M_3
Shock/bump [a]			
Peak acceleration	40 ~~ms^2~~ ms^{-2}	100 ~~ms^2~~ ms^{-2}	250 ~~ms^2~~ ms^{-2}
Vibration			
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm
Acceleration amplitude (9 Hz to 500 Hz)	5 ~~ms^2~~ ms^{-2}	20 ~~ms^2~~ ms^{-2}	50 ~~ms^2~~ ms^{-2}
Tensile ~~force~~ strength	[b]	[b]	[b]
Crush Per IEC 60794-1-~~2, Method~~ 21, method E.3	45 N over ~~25~~ 100 mm (linear) min.	1 100 N over ~~150~~ 100 mm (linear) min.	2 200 N over ~~150~~ 100 mm (linear) min.
	180 N	735 N	1 470 N
Impact	1 J	10 J	30 J
Bending, flexing and torsion	[b]	[b]	[b]

[a] Bump: the repetitive nature of the shock experienced by the channel shall be taken into account.

[b] This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.

Table A.2 – Details of MICE classification (ingress)

Ingress	I_1	I_2	I_3
Particulate ingress (dia. max)	12,5 mm	50 µm	50 µm
Immersion	None	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 immersion ≤ 1 m for ≤ 30 min

Table A.3 – Details of MICE classification (climatic and chemical)

Climatic and chemical	C_1	C_2	C_3
Ambient temperature	–10° C to +60° C	–25° C to +70° C	–40° C to +70° C
Rate of change of temperature	0,1° C per minute	1,0° C per minute	3,0° C per minute
Humidity	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)
Solar radiation	700 ~~Wm^2~~ Wm^{-2}	1 120 ~~Wm^2~~ Wm^{-2}	1 120 ~~Wm^2~~ Wm^{-2}
Liquid pollution ~~C~~[a] Contaminants	Concentration × 10^{-6}	Concentration × 10^{-6}	Concentration × 10^{-6}
Sodium chloride (salt/sea water)	0	< 0,3	< 0,3
Oil (dry-air concentration) (for oil types see [b])	0	< 0,005	< 0,5
Sodium stearate (soap)	None	5 × 10^4 aqueous non-gelling	> 5 × 10^4 aqueous gelling
Detergent	None	~~For further study~~ ffs	~~For further study~~ ffs
Conductive materials	None	Temporary	Present

~~**Table A.4 – Details of MICE classification (Gas)**~~

Gaseous pollution ~~(see Note 3)~~ Contaminants [c]	Mean/Peak (concentration × 10^{-6})	Mean/peak (concentration × 10^{-6})	Mean/peak (concentration × 10^{-6})
Hydrogen sulphide	< 0,003 / < 0,01	< 0,05 / < 0,5	< 10 / < 50
Sulphur dioxide	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15
Sulphur trioxide (ffs)	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15
Chlorine wet (> 50 % humidity)	< 0,000 5 / < 0,001	< 0,005 / < 0,03	< 0,05 / < 0,3
Chlorine dry (< > 50 % humidity)	< 0,002 / < 0,01	< 0,02 / < 0,1	< 0,2 / < 1,0
Hydrogen chloride	≤ 0,06	< 0,06 / < 0,3	< 0,6 / < 3,0
Hydrogen fluoride	< 0,001 / < 0,005	< 0,01 / < 0,05	< 0,1 / < 1,0
Ammonia	< 1 / < 5	< 10 / < 50	< 50 / < 250
Oxides of nitrogen	< 0,05 / < 0,1	< 0,5 / < 1	< 5 / < 10
Ozone	< 0,002 / < 0,005	< 0,025 / < 0,05	< 0,1 / < 1

[a] A single dimensional characteristic, i.e. concentration × 10^{-6}, was chosen to unify limits from different standards.

Table A.~~5~~4 – Details of MICE classification (electromagnetic)

Electromagnetic	E1	E2	E3
Electrostatic discharge – Contact (0,667 μC)	4 kV	4 kV	4 kV
Electrostatic discharge – Air (0,132 μC)	8 kV	8 kV	8 kV
Radiated RF – AM	3 V/m at 80 MHz to 1 000 MHz 3 V/m at 1 400 MHz to 2 000 MHz 1 V/m at 2 000 MHz to 2 700 MHz	3 V/m at 80 MHz to 1 000 MHz 3 V/m at 1 400 MHz to 2 000 MHz 1 V/m at 2 000 MHz to 2 700 MHz	10 V/m at 80 MHz to 1 000 MHz 3 V/m at 1 400 MHz to 2 000 MHz 1 V/m at 2 000 MHz to 2 700 MHz
Conducted RF	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz
EFT/B (comms)	500 V	1 000 V	1 000 V
Surge (transient ground potential difference) – signal, line to earth	500 V	1 000 V	1 000 V
Magnetic field (50 Hz to 60 Hz)	1 Am^{-1}	3 Am^{-1}	30 Am^{-1}
Magnetic field (60 Hz to 20 000 Hz)	~~For further study.~~ ffs	~~For further study.~~ ffs	~~For further study.~~ ffs

~~a Bump: the repetitive nature of the shock experienced by the channel shall be taken into account.~~

~~b This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.~~

~~c A single dimensional characteristic, i.e. concentration × 10^{-6}, was chosen to unify limits from different standards."~~

Annex B
(informative)

IEC optical fibre cable standards

The following is a list of existing IEC optical cable standards:

IEC 60794-1-1, *Optical fibre cables – Part 1-1: Generic specification – General*

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

IEC 60794-1-3, *Optical fibre cables – Part 1-3: Generic specification – Optical cable elements*

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 test methods*

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

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

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

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

IEC 60794-2-10, *Optical fibre cables – Part 2-10: Indoor optical fibre cables – Family specification for simplex and duplex cables*

IEC 60794-2-11, *Optical fibre cables – Part 2-11: Indoor ~~optical fibre~~ cables – Detailed specification for simplex and duplex cables for use in premises cabling*

IEC 60794-2-20, *Optical fibre cables – Part 2-20: Indoor cables – Family specification for multi-fibre optical distribution cables*

IEC 60794-2-21, *Optical fibre cables – Part 2-21: Indoor ~~optical fibre~~ cables – Detailed specification for multi-fibre optical distribution cables for use in premises cabling*

IEC 60794-2-22, *Optical fibre cables – Part 2-22: Indoor cables – Detailed specification for multi-simplex breakout optical cables to be terminated with connectors*

IEC 60794-2-30, *Optical fibre cables – Part 2-30: Indoor cables – Family specification for optical fibre ribbon cables for use in premises cabling*

IEC 60794-2-31, *Optical fibre cables – Part 2-31: Indoor ~~optical fibre~~ cables – Detailed specification for optical fibre ribbon cables for use in premises cabling*

IEC 60794-2-40, *Optical fibre cables – Part 2-40: Indoor optical fibre cables – Family specification for A4 fibre cables ~~with plastic optical fibres~~*

IEC 60794-2-41, *Optical fibre cables – Part 2-41: Indoor cables – Product specification for simplex and duplex buffered A4 fibres*

IEC 60794-2-42, *Optical fibre cables – Part 2-42: Indoor optical fibre cables – Product specification for simplex and duplex cables with A4 fibres*

IEC 60794-2-50, *Optical fibre cables – Part 2-50: Indoor optical fibre cables – Family specification for simplex and duplex cables for use in terminated cable assemblies*

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

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

IEC 60794-3-11, *Optical fibre cables – Part 3-11 Outdoor cables – ~~Duct and~~ Product specification for duct, directly buried and lashed aerial single-mode optical fibre telecommunication cables ~~– Detailed specification~~*

IEC 60794-3-12, *Optical fibre cables – Part 3-12: Outdoor cables – Detailed specification for duct and directly buried optical telecommunication cables for use in premises cabling*

IEC 60794-3-20, *Optical fibre cables – Part 3-20: Outdoor cables – Family specification for ~~optical~~ self-supporting aerial telecommunication cables*

IEC 60794-3-21, *Optical fibre cables – Part 3-21: Outdoor cables – Detailed specification for optical self-supporting aerial telecommunication cables for use in premises cabling*

IEC 60794-3-30, *Optical fibre cables – Part 3-30: Outdoor cables – Family specification for optical telecommunication cables for lake, river crossings and coastal application*

IEC 60794-3-40, *Optical fibre cables – Part 3-40: Outdoor cables – Family specification for sewer cables and conduits for installation by blowing and/or pulling in non-man accessible storm and sanitary sewers*

IEC 60794-3-70, *Optical fibre cables – Part 3-70: Outdoor cables – Family specification for outdoor optical fibre cables for rapid/multiple deployment*

IEC 60794-4, *Optical fibre cables – Part 4: Sectional specification – Aerial optical cables along electrical power lines*

IEC 60794-4-10, *Optical fibre cables – Part 4-10: ~~Aerial optical cables along electrical power lines – Family specification for OPGW (Optical Ground Wire)~~ Family specification – Optical ground wires (OPGW) along electrical power lines*

IEC 60794-4-20, *Optical fibre cables – Part 4-20: Sectional specification – Aerial optical cables along electrical power lines – Family specification for ADSS (all dielectric self-supported) optical cables*

IEC 60794-5, *Optical fibre cables – Part 5: Sectional specification – Microduct cabling for installation by blowing*

IEC 60794-5-10, *Optical fibre cables – Part 5-10: Family specification – Outdoor microduct optical fibre cables, microducts and protected microducts for installation by blowing*

IEC 60794-5-20, *Optical fibre cables – Part 5-20: Family specification – Outdoor microduct fibre units, microducts and protected microducts for installation by blowing*

~~IEC 60794-2-41, *Optical fibre cables – Part 2-41: Indoor cables – Product specification for simplex and duplex buffered A4 fibres*~~

~~IEC 60794-2-42, *Optical fibre cables – Part 2-42: Indoor optical fibre cables – Product specification for simplex and duplex cables with A4 fibres*~~

~~IEC 60794-2-50, *Optical fibre cables – Part 2-50: Indoor cables – Family specification for simplex and duplex cables for use in terminated cable assemblies*~~

Annex C
(informative)

Fibre specifications and tests

C.1 Specifications

The fibre specifications are organized as a series of sectional specification standards beneath a general specification. Within each sectional specification, there is a series of normative annexes that define the requirements for the different family specifications. Within the single-mode fibre sectional specification, IEC 60793-2-50, for example, are the family specifications for the ~~B1.1, B1.2, B1.3, B2, B4, B5 and B6~~ B-652.B, B-652.D, B-653, B-654, B-655 and B-657 fibre categories.

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 60793-2-20, *Optical fibres – Part 2-20: Product specifications – Sectional specification for category A2 multimode fibres*

IEC 60793-2-30, *Optical fibres – Part 2-30: Product specifications – Sectional specification for category A3 multimode fibres*

IEC 60793-2-40, *Optical fibres – Part 2-40: Product specifications – Sectional specification for category A4 multimode fibres*

IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

C.2 Measurements and tests

The fibre tests and measurements are under a general and guidance standard and organized into groups relating to dimensional, mechanical, optical, and environmental attributes. When multiple measurement methods are defined, they appear as different normative annexes of these documents.

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

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

IEC 60793-1-21, *Optical fibres – Part 1-21: Measurement methods and test procedures – Coating geometry*

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

IEC 60793-1-30, *Optical fibres – Part 1-30: Measurement methods and test procedures – Fibre proof test*

IEC 60793-1-31, *Optical fibres – Part 1-31: Measurement methods and test procedures – Tensile strength*

IEC 60793-1-32, *Optical fibres – Part 1-32: Measurement methods and test procedures – Coating strippability*

IEC 60793-1-33, *Optical fibres – Part 1-33: Measurement methods and test procedures – Stress corrosion susceptibility*

IEC 60793-1-34, *Optical fibres – Part 1-34: Measurement methods and test procedures – Fibre curl*

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

IEC 60793-1-41, *Optical fibres – Part 1-41: Measurement methods and test procedures – Bandwidth*

IEC 60793-1-42, *Optical fibres – Part 1-42: Measurement methods and test procedures – Chromatic dispersion*

IEC 60793-1-43, *Optical fibres – Part 1-43: Measurement methods and test procedures – Numerical aperture*

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

IEC 60793-1-45, *Optical fibres – Part 1-45: Measurement methods and test procedures – Mode field diameter*

IEC 60793-1-46, *Optical fibres – Part 1-46: Measurement methods and test procedures – Monitoring of changes in optical transmittance*

IEC 60793-1-47, *Optical fibres – Part 1-47: Measurement methods and test procedures – Macrobending loss*

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

IEC 60793-1-49, *Optical fibres – Part 1-49: Measurement methods and test procedures – Differential mode delay*

IEC 60793-1-50, *Optical fibres – Part 1-50: Measurement methods and test procedures – Damp heat (steady state) tests*

IEC 60793-1-51, *Optical fibres – Part 1-51: Measurement methods and test procedures – Dry heat (steady state) tests*

IEC 60793-1-52, *Optical fibres – Part 1-52: Measurement methods and test procedures – Change of temperature tests*

IEC 60793-1-53, *Optical fibres – Part 1-53: Measurement methods and test procedures – Water immersion tests*

IEC 60793-1-54, *Optical fibres – Part 1-54: Measurement methods and test procedures – Gamma irradiation*

IEC 60793-1-60, *Optical fibres – Part 1-60: Measurement methods and test procedures – Beat length*

IEC 60793-1-61, *Optical fibres – Part 1-61: Measurement methods and test procedures – Polarization crosstalk*

C.3 Technical reports

Technical reports are used to document the measurement methods of attributes that are normally characterized for use in design or to document other information that is generally considered as useful but not normally specified.

IEC TS 62033, *Attenuation uniformity in optical fibres*

IEC TR 62048, *Optical fibres – Reliability – Power law theory*

IEC TR 62221, *Optical fibres – Measurement methods – Microbending sensitivity*

IEC TR 62245, *Optical fibres – Measurement methods – Bend loss for A3 and A4 type fibres*

IEC TR 62283, *Optical fibres – Guidance for nuclear radiation tests ~~– Fibre optic guidance~~*

IEC TR 62284, *Effective area measurements of single-mode optical fibres – Guidance*

IEC TR 62285, *Application guide for non-linear coefficient measuring methods ~~– Application guide~~*

IEC TR 62316, *Guidance for the interpretation of OTDR backscattering traces for single-mode fibres*

IEC TR 62324, *Single-mode optical fibres – Raman gain efficiency measurement using continuous wave method – Guidance*

ISO/IEC TR 29106, *Information technology – Generic cabling – Introduction to the MICE environmental classification*

Bibliography

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

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

IEC 61918, *Industrial communication networks – Installation of communication networks in industrial premises*

ISO/IEC TR 29106, *Information technology – Generic cabling – Introduction to the MICE environmental classification*

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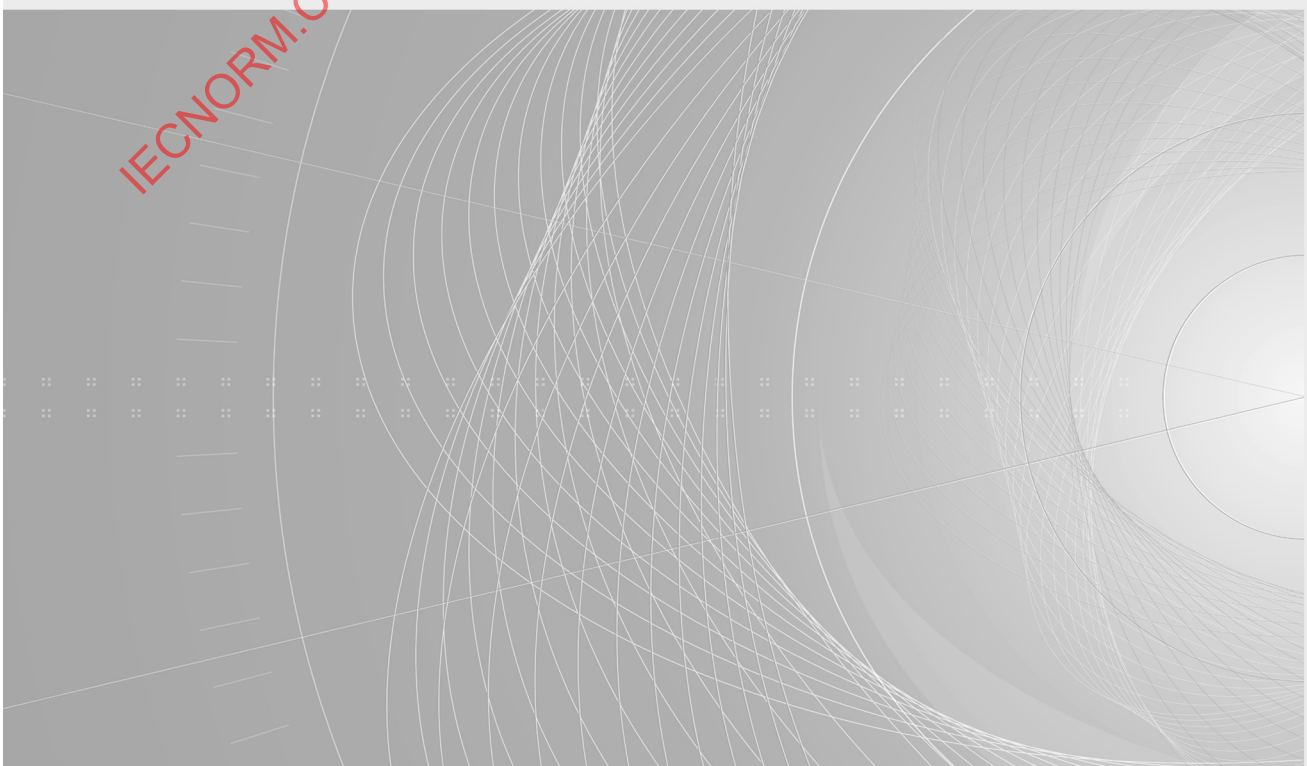
IEC TR 62362

Edition 2.0 2020-09

TECHNICAL REPORT

Selection of optical fibre cable specifications relative to mechanical, ingress, climatic or electromagnetic characteristics – Guidance



IEC TR 62362:2020-09 (en)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SELECTION OF OPTICAL FIBRE CABLE SPECIFICATIONS RELATIVE TO MECHANICAL, INGRESS, CLIMATIC OR ELECTROMAGNETIC CHARACTERISTICS – GUIDANCE

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IEC 62362 which is a Technical Report, has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2010. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) replacement of references and information from ISO/IEC 24702 and ISO/IEC 11801 with ISO/IEC 11801-1;
b) update of the MICE table;

c) update of the current optical fibre designations of IEC 60793-2-10 and IEC 60793-2-50.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86A/1987/DTR	86A/2029/RVDTR

Full information on the voting for the approval of this technical report 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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

INTRODUCTION

Optical fibre cable specification standards are defined in IEC 60794 (all parts), which are listed in Annex B. They are organized in a hierarchy similar to the IECQ system. They differ from the IECQ system in that they are all performance standards. Optical fibre cable standards specify the attributes and tests on cables intended to verify adequate protection of fibres against external influences during the cabling process, cable installation handling and from environmental effects during storage and operation.. The attributes of the fibres within the cable are defined by reference to optical fibre specification standards of the IEC 60793 series, which are listed in Annex C. A complete and up-to-date listing of standards in the IEC 60793 and IEC 60794 series is available on the IEC website: http://www.iec.ch.

The different levels of hierarchy are: generic, sectional, family and product. The primary distinction between these is the level of detail. Typically, more options or wider ranges are present at the higher level. At a given level, the distinctions are with respect to application or cable construction. Clause 2 of this document gives a more complete mapping. Parts of the family specification include blank detail specifications for various attributes that do not have normative requirements.

At the sectional specification level, the main categories are indoor cables, outdoor cables, cables along overhead lines, microduct cabling and indoor/outdoor cables. Typically, the outdoor cables have tougher tests than the indoor cables. At the product specification level, there is a series of standards intended to support ISO/IEC 11801 (all parts) for premises cabling, using both indoor and outdoor varieties.

It is not the intention of this document to reproduce the requirements of all relevant specifications, but rather to discuss typical application situations and mention key options for tests, while seeking to guarantee the performance of cables in operation.

SELECTION OF OPTICAL FIBRE CABLE SPECIFICATIONS RELATIVE TO MECHANICAL, INGRESS, CLIMATIC OR ELECTROMAGNETIC CHARACTERISTICS – GUIDANCE

1 Scope

The purpose of this document is to provide information on the specification of optical fibre cables with respect to the mechanical, ingress, climatic and chemical or electromagnetic characteristics (MICE) as classified in ISO/IEC 11801-1.

In this classification system, each letter of the four initials of the acronym are subscripted with a value from one to three to indicate different severities. The current attributes and severities are found in Annex A.

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

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

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

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components – Performance standard*

ISO/IEC 11801 (all parts), *Information technology – Generic cabling for customer premises*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

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

3.2 Abbreviated terms

MICE mechanical, ingress, climatic and chemical, electromagnetic

4 MICE attributes and severities

4.1 General

The MICE classification system has three levels of severity:

1) $M_1I_1C_1E_1$ describes a typical environment such as that assumed in ISO/IEC 11801-2; (i.e. office premises, etc.);
2) $M_2I_2C_2E_2$ describes a light industrial environment;
3) $M_3I_3C_3E_3$ describes a harsh industrial environment.

See Annex A for a more detailed description of the MICE severity levels.

4.2 Mechanical

4.2.1 Shock/bump

Shock and bump are not specified for optical fibre cables. They are inherently robust in this respect.

4.2.2 Vibration

Vibration in the industrial premises (as opposed to wind induced vibration on aerially deployed cables) is not specified for optical fibre cables. They are inherently robust in this respect.

4.2.3 Tensile force

For outdoor cables specified in IEC 60794-3 (all parts), manufacturers specify a rated tensile force. The requirement is that the fibre shall not exceed a percentage of the proof test strain (to be agreed between customer and supplier) when the cable is tested at the rated load.

For indoor cables, the different family specifications of IEC 60794-2 (all parts) have different requirements on the tensile load ranging from 70 N to 400 N.

4.2.4 Crush

For optical fibre cables, the crushing force is applied in a plate to plate test.

For indoor cables, crush is specified at 500 N. For outdoor cables, different levels are specified depending on whether the cable is armoured or not. For unarmoured cable, values of between 750 N and 1 500 N are specified. For armoured cable, values between 1 100 N and 2 200 N are specified.

4.2.5 Impact

For indoor cables, a value of 1 J and a hammer with a striking surface of 12,5 mm radius are specified. For un-armoured outdoor cables, a value of 10 J and a hammer with a striking surface of 300 mm radius are specified.

4.2.6 Bending, flexing and torsion

All the family specifications have requirements on these attributes.

For bending, there are multiple tests such as bending under tension, repeated bending and simple bending. The bending diameter is typically 20 times the cable diameter.

For flexing, the bending diameter is typically 20 times the cable diameter, with 25 cycles typically applied.

For torsion, the test length, load, and number of turns varies depending on the family specification. For indoor cables, the length is 125 x cable diameter or 250 mm, loaded at 20 N with 10 or 20 cycles (per detailed specification) applied.

4.3 Ingress

4.3.1 Basic consideration

Optical fibre cables come in a variety of constructions. Some examples are slotted core, loose tube, tight buffered. The slotted core and loose tube can be filled or unfilled. These different constructions have different ingress characteristics.

4.3.2 Particulate ingress

Particulate ingress is not specified for optical fibre cables. They are inherently robust in this respect.

4.3.3 Water immersion

On cables for which water immersion is specified, the test is different from that found in Annex A. The requirement is that a pressure equivalent to 1 m of water is applied at or near one end of a short (< 3 m) cable. After 24 h, no water shall be found at the other end.

It is expected that cables passing this test would pass both I_2 and I_3 severities.

4.4 Climatic

4.4.1 General

Terminations such as cable closures are generally considered separately from the cables and are covered by standards from the IEC 61753 series prepared by IEC SC 86B.

NOTE The values that appear in Table 1 to Table 3 below indicate levels of resistance to climatic phenomena. Values of 1 to 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.

4.4.2 Ambient temperature

The different specifications allow different ranges of values to be specified by the customer, depending on the climate in which the cable will be installed. For the detailed specifications for premises cabling, –20 °C to +60 °C are specified. Other ranges and combinations from –45 °C to +70 °C are also found as options in the family specifications.

4.4.3 Rate of change of temperature

The rate of change of temperature is not specified in the product specifications of cables. IEC 60794-1-22, methods F1 and F12, specify a rate of heating that shall not exceed 60 °C per hour. However, it is assumed that all the cables have the capability of 3 °C/min.

4.4.4 Humidity

For further study.

4.4.5 Solar radiation

Resistance to solar radiation in the industrial premises environment is not specified in the product specifications of cables. Resistance to solar radiation is a property of the sheath material. The severities associated with some common generic materials are indicated in Table 1.

A specific grade of the generic material may have a different performance to that identified in Table 1.

Table 1 – Resistance to solar radiation

Material	Climatic classification, C		
	Natural	Stabilized	With ~2,5 % of active carbon black content
Medium-density polyethylene	0	3	3
Track-resistant medium-density polyethylene	0	3	3
High-density polyethylene	0	3	3
Thermoplastic (co)polyester elastomer	0	3	3
Polyvinyl chloride	1	3	3
Polyvinylidene fluoride	1	3	3
Nylon 12 (polyamide)	1	3	3
Thermoplastic polyurethane (TPU)	1	3	3
NOTE The values in this table indicate levels of resistance to climatic phenomena. Values of 1 to 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.			

4.4.6 Liquid pollution

Resistance to liquid pollution is not specified in the product specifications of cables. Resistance to liquid pollution is a property of the sheath material. The severities associated with some common generic materials are indicated in Table 2.

A specific grade of the generic material may have a different performance to that identified in Table 2.

Table 2 – Liquid pollution

Material	Chemical classification, C				
	Sodium chloride (salt/sea water)	Oil (dry-air concentration)	Sodium stearate (soap)	Detergent	Conductive materials in solution
Low-density polyethylene	3	3	3	3	3
Medium-density polyethylene	3	3	3	3	3
Track-resistant medium-density polyethylene	3	3	3	3	3
High-density polyethylene	3	3	3	3	3
Thermoplastic (co)polyester elastomer	3	3	3	3	3
Polyvinyl chloride	2	2	2	2	3
Polyvinylidene fluoride	3	3	3	3	3
Nylon (polyamid 12)	2	2	2	2	3
Thermoplastic polyurethane (TPU)	3	3	3	3	3
NOTE The values in this table indicate levels of resistance to climatic phenomena. Values of 1 to 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.					

4.4.7 Gaseous pollution

Resistance to gaseous pollution is not specified in the product specifications of cables. Resistance to gaseous pollution is a property of the sheath material. The severities associated with some common generic materials are indicated in Table 3 and Table 4.

A specific grade of the generic material may have a different performance to that identified in the Table 3 and Table 4.

Table 3 – Gaseous pollution resistance

Material	Chemical classification, C, by pollutant				
	Hydrogen sulphide	Sulphur dioxide	Chlorine wet	Chlorine dry	Hydrogen chloride 10 %
Low-density polyethylene	2	2	0	0	2
Medium-density polyethylene	2	2	0	0	2
Track resistant medium-density polyethylene	2	2	0	0	2
High-density polyethylene	2	2	0	0	2
Thermoplastic (co)polyester elastomer	2	2	1	1	0
Polyvinyl chloride	3	3	1	0	3
Polyvinylidene fluoride	3	2	3	3	3
Nylon (polyamid 12)	3	1	0	0	0
Thermoplastic polyurethane (TPU)	3	3	2	2	3
NOTE The values in this table indicate levels of resistance to climatic phenomena. Values of 1 to 3 correspond to the relevant level of severity in the MICE classification system. A value of 0 indicates no effective resistance to the climatic phenomena described.					

Table 4 – Gaseous pollution resistance

Material	Pollutant				
	Hydrogen chloride 37 %	Hydrogen fluoride	Ammonia	Oxides of nitrogen	Ozone 100 %
Low-density polyethylene	2	2	3	0	0
Medium-density polyethylene	2	0	3	0	0
Track resistant medium-density polyethylene	2	0	3	0	0
High-density polyethylene	2	0	3	0	0
Thermoplastic (co)polyester elastomer	0	0	0	0	0
Polyvinyl chloride	3	2	3	1	1
Polyvinylidene fluoride	3	3	3	2	2
Nylon (polyamid 12)	0	0	3	1	1
Thermoplastic polyurethane (TPU)	3	2	3	3	3

4.5 Electromagnetic

Cables can be dielectric, or can contain metallic elements such as armour, strength members or sheaths. With the exception of possible damage on cables with metallic sheathes due to lightning strikes, optical fibre cables are immune to all of the attributes for this category.

Annex A
(informative)

Details of MICE classification

The details associated with ISO/IEC 11801-1 are presented in Table A.1 to Table A.4.

Table A.1 – Details of MICE classification (mechanical)

Mechanical	M_1	M_2	M_3
Shock/bump [a]			
Peak acceleration	40 ms^{-2}	100 ms^{-2}	250 ms^{-2}
Vibration			
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm
Acceleration amplitude (9 Hz to 500 Hz)	5 ms^{-2}	20 ms^{-2}	50 ms^{-2}
Tensile strength	[b]	[b]	[b]
Crush Per IEC 60794-1-21, method E.3	45 N over 100 mm (linear) min.	1 100 N over 100 mm (linear) min.	2 200 N over 100 mm (linear) min.
	180 N	735 N	1 470 N
Impact	1 J	10 J	30 J
Bending, flexing and torsion	[b]	[b]	[b]

[a] Bump: the repetitive nature of the shock experienced by the channel shall be taken into account.

[b] This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.

Table A.2 – Details of MICE classification (ingress)

Ingress	I_1	I_2	I_3
Particulate ingress (dia. max)	12,5 mm	50 µm	50 µm
Immersion	None	Intermittent liquid ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance	Intermittent liquid ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance immersion ≤ 1 m for ≤ 30 min