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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

IEC TR 62362:2020-09 RLV(en)

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COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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,
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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.

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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

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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.

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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.

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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.

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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.					

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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.

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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

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