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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Optical fibres –
Part 2: Product specifications – General

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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FOREWORD

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International Standard IEC 60793-2 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This ninth edition cancels and replaces the eighth edition published in 2015. This edition constitutes a technical revision.

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

a) introduction of the revised fibre designations for most A1 sub-category fibres and all class B single-mode fibres;
b) addition of the new fibre model (A1-OM5) defined for A1 category;
c) addition of class D polarization maintaining fibres.

This document is to be read in conjunction with those parts of the IEC 60793-1 series that address individual measurements and tests for attributes of optical fibres.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
86A/1964/FDIS	86A/1974/RVD

Full information on the voting for the approval of this International Standard 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.

A list of all the parts in the IEC 60793 series, published under the general title *Optical fibres*, can be found on the IEC website.

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- withdrawn,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.

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OPTICAL FIBRES –

Part 2: Product specifications – General

1 Scope

This part of IEC 60793 contains the general specifications for both multimode and single-mode optical fibres.

Sectional specifications for each of the four categories of multimode fibres: A1, A2, A3, and A4 (part of the multimode fibre class A) contain requirements specific to each category.

Sectional specifications for each of the ~~two~~ three single-mode fibre classes, B, C and D contain requirements common to each class.

Each sectional specification includes family specifications (in normative annexes) that contain requirements for the applicable category or sub-categories. These sub-categories are distinguished on the basis of different fibre types or applications.

The requirements of this document apply to all classes.

Each sectional specification contains the requirements that are common to all the family specifications that are within it. These common requirements are copied to the family specification for ease of reference.

Tests or measurement methods are defined for each specified attribute. Where possible, these definitions are by reference to an IEC International Standard (see IEC 60793-1 series) – otherwise the test or measurement method is outlined in the relevant sectional specification.

Table 1 defines the sectional specifications. The relevant family specifications are defined within the sectional specifications as normative annexes (see Tables 2 to 5).

Annexes A and B summarize the existing fibre specifications.

Table 1 – Sectional specifications

Document ID	Fibre category/class	Cladding material	Core material	Index profile
IEC 60793-2-10	A1 multimode	Glass	Glass	Graded
IEC 60793-2-20	A2 multimode	Glass	Glass	Quasi-step or step
IEC 60793-2-30	A3 multimode	Plastic	Glass	Step or graded (under consideration)
IEC 60793-2-40	A4 multimode	Plastic	Plastic	Step, multi-step or graded
IEC 60793-2-50	B single-mode	Glass	Glass	Not applicable
IEC 60793-2-60	C single-mode	Glass	Glass	Not applicable
IEC 60793-2-70	D polarization-maintaining	Glass	Glass	Not applicable

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

IEC 60793-1 (all parts), *Optical fibres – Part 1: Measurement methods and test procedures*

IEC 60793-2-10:2019, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60793-2-20:2015, *Optical fibres – Part 2-20: Product specifications – Sectional specification for category A2 multimode fibres*

IEC 60793-2-30:2015, *Optical fibres – Part 2-30: Product specifications – Sectional specification for category A3 multimode fibres*

IEC 60793-2-40:2015, *Optical fibres – Part 2-40: Product specifications – Sectional specification for category A4 multimode fibres*

IEC 60793-2-50:2018, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

IEC 60793-2-60:2008, *Optical fibres – Part 2-60: Product specifications – Sectional specification for category C single-mode intraconnection fibres*

IEC 60793-2-70:2017, *Optical fibres – Part 2-70: Product specifications – Sectional specification for polarization-maintaining fibres*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at http://www.electropedia.org/

3.1
multimode fibre
optical fibre in the core of which the radiation of two or more bound modes can propagate at the wavelength of interest

[SOURCE: IEC 60050-731:1991, 731-02-03]

3.2
single-mode fibre
optical fibre in which the radiation of only one bound mode can propagate at the wavelength of interest

[SOURCE: IEC 60050-731:1991, 731-02-02, modified – Note deleted.]

3.3
core
central region of an optical fibre through which most of the optical power is transmitted

[SOURCE: IEC 60050-731:1991, 731-02-04]

3.4
cladding
dielectric material of an optical fibre surrounding the core

[SOURCE: IEC 60050-731:1991, 731-02-05]

3.5
primary coating
thin coating applied directly to the cladding, usually at the time of the fibre drawing, in one or more layers, to preserve integrity of the cladding surface

Note 1 to entry A secondary coating may be applied directly to the primary coating of one or more fibres, to reinforce the protection of the optical fibre during handling and cabling.

[SOURCE: IEC 60050-731:1991, 731-02-57, modified – The ~~phrase~~ wording "usually at the time of the fibre drawing, in one or more layers," and Note 1 have been added.]

3.6
fibre buffer
material or assembly of materials used to protect the optical fibre against physical damage

[SOURCE: IEC 60050-731:1991, 731-02-56]

~~**3.7**~~
~~**coloured coating and/or buffer**~~
~~thin coating and/or buffer applied on the primary coating and/or buffer or on the secondary coating in order to make each fibre distinguishable by its colour~~

3.7
coloured coating
thin coating applied on the primary coating or on the secondary coating in order to make each fibre distinguishable by its colour

3.8
coloured buffer
buffer applied on the primary coating and/or secondary coating in order to make each fibre distinguishable by its colour

4 Quality assurance

It is the responsibility of the supplier to establish quality assurance by quality control procedures which ensures that the product meets the requirements of this document and the related sectional specifications and family specifications. It is not intended that a complete testing programme be carried out on every length of fibre. When the customer wishes to specify acceptance tests or other quality procedures, it is essential that an agreement be reached between the supplier and the customer at the time of ordering.

5 Construction of optical fibres

5.1 Class A – Multimode fibres

The main fibre categories are based on g, the refractive index profile parameter, see Table 2.

The normalized index profile is expressed as:

$$\delta(x) = 1 - x^g \tag{1}$$

where

$$\delta(x) = \frac{n(x) - n(1)}{n(0) - n(1)} \tag{2}$$

$x = \frac{r}{a}$ $(0 \le r \le a)$ is the normalized radial position; (3)

a is the core radius;

$n(x)$ is the refractive index at normalized position x.

Table 2 – Main categories of multimode fibres

Category	Material	Type	Limits
A1	Glass core/glass cladding	Graded index fibre	$1 \le g < 3$
A2	Glass core/glass cladding	Step and quasi-step index fibre	$3 \le g < \infty$
A3	Glass core/plastic cladding	Step index fibre or graded index fibre (under consideration)	$10 \le g < \infty$ $1 \le g \le 3$
A4	Plastic core/plastic cladding	Step, multi-step, or graded index fibre	$1 \le g < \infty$
NOTE Attention is drawn to the index profile as stated in the detail specification. The fibre category is determined on the basis of the material type and the g value which best fits the normalized refractive index profile, falling within the category defined above.			

A further differentiation of sub-categories (and models) inside the main categories is given in Table 3.

Table 3 – Sub-categories of multimode fibres

Category	Sub-categories/Models	Nominal core diameter µm	Nominal cladding diameter µm	Nominal coating diameter µm	Nominal numerical aperture (NA_{ff})
A1					
	A1a With models: A1a.1a (traditional macrobend loss) A1a.1b (enhanced macrobend loss) A1a.2a (traditional macrobend loss) A1a.2b (enhanced macrobend loss) A1a.3a (traditional macrobend loss) A1a.3b (enhanced macrobend loss)	50	125	245	0,20
	A1b	62,5	125	245	0,275
	A1d	100	140	245	0,26 or 0,29
A2					
	A2a	100	140	NS	0,23 or 0,26
	A2b	200	240	NS	0,23 or 0,26
	A2c	200	280	NS	0,23 or 0,26
A3					
	A3a	200	300	900	0,40
	A3b	200	380	600	0,40
	A3c	200	230	500	0,40
	A3d	200	230	500	0,35
	A3e	200	230	500	0,37
	A3f (Under consideration)	50	230	500	0,20
	A3g (Under consideration)	62,5	230	500	0,275
A4					
	A4a (With models A4a.1 and A4a.2)	NS	1 000	NA	(A4a.1): 0,50 (A4a.2): 0,485
	A4b	NS	750	NA	0,50
	A4c	NS	500	NA	0,50
	A4d	NS	1 000	NA	0,30
	A4e	≥500	750	NA	0,25
	A4f	200	490	NA	0,19
	A4g	120	490	NA	0,19
	A4h	62,5	245	NA	0,19

NOTE 1 NA = not applicable; NS = not specified.

NOTE 2 All three A1a models indicated in Table 3 differ in bandwidth (or DMD) requirements.

Category	Sub-category	Model	Nominal core diameter µm	Nominal cladding diameter µm	Nominal coating diameter µm	Nominal numerical aperture (NA_{ff})
A1						
	A1-OM2	A1-OM2a (traditional macrobend loss)	50	125	245	0,20
		A1-OM2b (enhanced macrobend loss)				
	A1-OM3	A1-OM3a (traditional macrobend loss)				
		A1-OM3b (enhanced macrobend loss)				
	A1-OM4	A1-OM4a (traditional macrobend loss)				
		A1-OM4b (enhanced macrobend loss)				
	A1-OM5	A1-OM5a (traditional macrobend loss)				
		A1-OM5b (enhanced macrobend loss)				
	A1-OM1		62,5	125	245	0,275
	A1d		100	140	245	0,26 or 0,29
A2						
	A2a		100	140	NS	0,23 or 0,26
	A2b		200	240	NS	0,23 or 0,26
	A2c		200	280	NS	0,23 or 0,26
A3						
	A3a		200	300	900	0,40
	A3b		200	380	600	0,40
	A3c		200	230	500	0,40
	A3d		200	230	500	0,35
	A3e		200	230	500	0,37
	A3f		50	230	500	0,20
	A3g		62,5	230	500	0,275
A4						
	A4a	A4a.1	NS	1 000	NA	(A4a.1): 0,50
		A4a.2				(A4a.2): 0,485
	A4b		NS	750	NA	0,50
	A4c		NS	500	NA	0,50
	A4d		NS	1 000	NA	0,30
	A4e		≥ 500	750	NA	0,25
	A4f		200	490	NA	0,19
	A4g		120	490	NA	0,19
	A4h		62,5	245	NA	0,19

Category	Sub-category	Model	Nominal core diameter µm	Nominal cladding diameter µm	Nominal coating diameter µm	Nominal numerical aperture (NA_{ff})
NOTE 1 NA = not applicable; NS = not specified. NOTE 2 All five A1-OMx sub-categories indicated differ in bandwidth (or DMD) requirements. NOTE 3 Most A1 sub-categories have been changed in terms of fibre designation, starting from IEC 60793-2-10:2019 (edition 7). See Table 1 of IEC 60793-2-10:2019 for cross-references to former fibre designations.						

5.2 Class B – Single-mode fibres

The categories of single-mode fibres currently in use are given in Table 4.

Table 4 – Categories of glass core/glass clad single-mode fibres

~~Category~~	~~Type~~	~~Description~~
~~B1.1~~	~~Dispersion unshifted~~	~~This dispersion unshifted single-mode fibre is optimised for use in the 1 310 nm region but can be used in the 1 550 nm and 1 625 nm regions. Depending on link length and bit rates, dispersion may need accommodation in the 1 550 nm region.~~
~~B1.2~~	~~Cut-off shifted~~	~~This category of dispersion unshifted single-mode fibre is optimised for low loss in the 1 550 nm region.~~
~~B1.3~~	~~Extended band~~	~~This dispersion unshifted single-mode fibre can be used from 1 260 nm up to 1 625 nm. Chromatic dispersion in this band may impose requirements either on the maximum link length, or the need for accommodation.~~
~~B2~~	~~Dispersion shifted~~	~~This dispersion-shifted single-mode fibre is optimised for single-channel transmission in the 1 550 nm region. Multiple channels can only be transmitted if care is taken to avoid the effects of four-wave mixing by, for example, moderating the power levels or appropriate spacing or placement of the channels.~~ ~~Two sub-categories are recognized (B2_a and B2_b) differing in chromatic dispersion characteristics.~~
~~B4~~	~~Non-zero dispersion-shifted~~	~~This dispersion-shifted single-mode fibre is optimised for multiple channel transmission in the 1 550 nm region. The dispersion coefficient is required to be non-zero throughout the band from 1 530 nm to 1 565 nm, but may be either positive or negative. Depending on the dispersion characteristics, multiple channel transmission may be possible at bands either above or below the normal 1 550 nm region.~~ ~~Three sub-categories are recognized (B4_c, B4_d and B4_e), differing in chromatic dispersion characteristics.~~
~~B5~~	~~Wideband non-zero dispersion-shifted~~	~~This wideband non-zero dispersion-shifted single-mode fibre is optimised for multiple channel transmission in the wavelength range of 1 460 nm to 1 625 nm with the positive value of the chromatic dispersion coefficient that is greater than some non-zero value. This fibre can be used for both CWDM and DWDM systems throughout the wavelength region between 1 460 nm and 1 625 nm.~~

~~Category~~	~~Type~~	~~Description~~
~~B6~~	~~Bending loss insensitive~~	~~This category of single-mode fibre is optimised for improved bending loss.~~ ~~Four sub-categories are recognized:~~ ~~B6_a1 and B6_a2 fibres are a subset of category B1.3 fibres and therefore are compliant with B1.3 fibres and have the same transmission properties. Sub-category B6_a1 fibres are appropriate for a minimum bend radius of 10 mm; sub-category B6_a2 fibres for a minimum bend radius of 7,5 mm.~~ ~~B6_b2 and B6_b3 fibres are intended to be used for restricted distances (less than 1 000 m) at the end of Access networks, in particular inside buildings or near buildings (e.g. outside building riser cabling). Application length of B6_b fibre, however, depends on the deployment strategy of each network operator.~~ ~~Sub-category B6_b fibres are not necessarily compliant with category B1.3 fibres in terms of chromatic dispersion coefficient specifications. These fibres, however, are system compatible with B6_a (and B1.3) fibres in Access networks.~~ ~~Sub-category B6_b2 fibres are appropriate for a minimum bend radius of 7,5 mm; sub-category B6_b3 fibres for a minimum bend radius of 5 mm.~~

Category	Type	Description
B-652	Dispersion unshifted	Dispersion unshifted single-mode fibre. Two sub-categories are recognized: B-652.B is optimised for use in the 1 310 nm region but can be used in the 1 550 nm and 1 625 nm regions. Depending on link length and bit rates, dispersion may need accommodation in the 1 550 nm region. B-652.D can be used over the extended wavelength range from 1 260 nm up to 1 625 nm. Chromatic dispersion in this band may impose requirements either on the maximum link length or the need for accommodation.
B-653	Dispersion shifted	This dispersion-shifted single-mode fibre is optimised for single-channel transmission in the 1 550 nm region. Multiple channels can only be transmitted if care is taken to avoid the effects of four-wave mixing by, for example, moderating the power levels or appropriate spacing or placement of the channels. Two sub-categories are recognized (B-653.A and B-653.B) differing in chromatic dispersion characteristics.
B-654	Cut-off shifted	This category of dispersion unshifted single-mode fibre is optimised for low loss in the 1 550 nm region. Five sub-categories are recognized (B-654.A, B-654.B, B-654.C, B-654.D and B-654.E) differing in chromatic dispersion and mode field characteristics.
B-655	Non-zero dispersion-shifted	This dispersion-shifted single-mode fibre is optimised for multiple channel transmission in the 1 550 nm region. The dispersion coefficient is required to be non-zero throughout the band from 1 530 nm to 1 565 nm, but may be either positive or negative. Depending on the dispersion characteristics, multiple channel transmission may be possible at bands either above or below the normal 1 550 nm region. Three sub-categories are recognized (B-655.C, B-655.D and B-655.E), differing in chromatic dispersion characteristics.
B-656	Wideband non-zero dispersion-shifted	This wideband non-zero dispersion-shifted single-mode fibre is optimised for multiple channel transmission in the wavelength range of 1 460 nm to 1 625 nm with the positive value of the chromatic dispersion coefficient that is greater than some non-zero value. This fibre can be used for both CWDM and DWDM systems throughout the wavelength region between 1 460 nm and 1 625 nm.