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INTERNATIONAL STANDARD

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

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CONTENTS

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OPTICAL FIBRES –

Part 2-20: Product specifications – Sectional specification for category A2 multimode fibres

FOREWORD

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International Standard IEC 60793-2-20 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition, published in 2007. This edition constitutes a technical revision.

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

a) Na_{th} has been replaced by NA_{ff};
b) specified test specimen length and measurement details for core diameter and NA_{ff} measurements.

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

CDV	Report on voting
86A/1602/CDV	86A/1628A/RVC

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 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 publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

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OPTICAL FIBRES –

Part 2-20: Product specifications – Sectional specification for category A2 multimode fibres

1 Scope

This part of IEC 60793 is applicable to sub-categories A2a, A2b, and A2c. These fibres are used or can be incorporated in information transmission equipment and optical fibre cables (typically up to 2 km).

Three types of requirements apply to these fibres:

- general requirements as defined in IEC 60793-2;
- specific requirements common to the category A2 multimodal fibres covered in this standard and which are given in Clause 3;
- particular requirements applicable to individual sub-categories or specific applications, which are defined in the normative family specification annexes.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60793-1-20:2001, *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 60793-1-40, *Optical fibres – Part 1-40: Measurement methods and test procedures – Attenuation*

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

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

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

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 60793-2, *Optical fibres –Part 2: Product specifications – General*

3 Specifications

3.1 General

The fibre shall consist of a glass core and a glass cladding in accordance with the definition given in IEC 60793-2.

3.2 Dimensional requirements

Relevant dimensional attributes and measurement methods are indicated in Table 1.

Dimensional requirements common to all sub-categories appear in Table 2.

Table 3 lists additional dimensional attributes that shall be specified by each sub-category.

Table 1 – Relevant dimensional attributes and measurement methods

Attribute	Measurement method
Cladding diameter	IEC 60793-1-20
Core diameter[a]	IEC 60793-1-20
Core non-circularity	IEC 60793-1-20
Core-cladding concentricity error	IEC 60793-1-20
Coating diameter	IEC 60793-1-21
Fibre length	IEC 60793-1-22
[a] Core diameter is specified at 850 nm ± 10 nm with a test specimen length of 2,0 m ± 0,2 m and a threshold value k_{CORE} of 0,5 (IEC 60793-1-20 Method B).	

Table 2 – Dimensional requirements common to all category A2 fibres

Attribute	Unit	Limit
Core non-circularity	%	≤ 4
Coating diameter	µm	[a]
Fibre length	km	[b]
[a] The diameter of the coating is dependent on the cable structure and applications.		
[b] Length requirements vary and should be agreed between supplier and customer.		

Table 3 – Additional dimensional attributes required for each sub-category

Attribute
Cladding diameter
Core diameter

3.3 Mechanical requirements

Relevant mechanical attributes and test methods are indicated in Table 4.

Mechanical requirements common to all sub-categories are given in Table 5.

Table 4 – Relevant mechanical attributes and test methods

Attribute	Test method
Tensile strength	IEC 60793-1-31 (0,5 m specimen length) Strain rate 3 %/min to 5 %/min
Proof test	IEC 60793-1-30

Table 5 – Mechanical requirements common to all category A2 fibres

Attribute	Unit	Limit
Proof stress level	GPa	≥ 0,345[a]
[a] For the relation between different units, see 7.4 of IEC TR 62048:2014.		

3.4 Transmission requirements

Relevant transmission attributes and measurement methods are given in Table 6.

Requirements common to all sub-categories are given in Table 7.

Table 6 – Relevant transmission attributes and measurement methods

Attribute	Test
Attenuation coefficient [a]	IEC 60793-1-40
Modal bandwidth[a]	IEC 60793-1-41
Numerical aperture NA_{ff} [a,b]	IEC 60793-1-43
Change of optical transmission	IEC 60793-1-46

[a] When measuring attenuation, modal bandwidth and numerical aperture, the appropriate launching conditions should be applied as specified in the corresponding measurement methods (IEC 60793-1-40, IEC 60793-1-41 and IEC 60793-1-43).

[b] Numerical aperture (NA_{ff}) is specified at a test specimen length of 2,0 m ± 0,2 m with a threshold value, k_{NA} of 0,5 measured at 850 nm.

Table 7 –Requirements common to all category A2 fibres

Attribute	Unit	Limit
Attenuation coefficient at λ_Y nm[a]	dB/km	≤ 10
Modal bandwidth at λ_Y nm[a]	MHz · km	≥ 10
Numerical aperture (NA_{ff})	Unitless	0,23 ± 0,03 or 0,26 ± 0,03
[a] The wavelength, λ_Y, shall be agreed between supplier and customer.		

3.5 Environmental requirements

Relevant environmental attributes and test methods are given in Table 8.

Table 8 – Relevant environmental attributes and test methods

Attribute	Test method
Damp heat tests	IEC 60793-1-50
Dry heat tests	IEC 60793-1-51
Change of temperature tests	IEC 60793-1-52

Annex A
(normative)

Specifications for sub-category A2a multimode fibres

A.1 General

The clauses and tables in Annex A contain the particular requirements applicable to A2a fibres. Common requirements, repeated here for ease of reference from the sectional specification, are noted by an entry in the “Reference” column. Relevant notes from the sectional specification are not repeated but indicated with a superscript “SS”.

A.2 Dimensional requirements

Table A.1 contains dimensional requirements specific to A2a fibres.

Table A.1 –Dimensional requirements specific to A2a fibres

Attribute	Unit	Limit	Reference
Cladding diameter	µm	140 ±10	3.2
Core diameter	µm	100 ±4	3.2 Table 1
Core non-circularity	%	≤ 4	3.2
Coating diameter	µm	See 3.2	3.2
Fibre length	km	See 3.2	3.2

A.3 Mechanical requirements

Table A.2 contains mechanical requirements specific to A2a fibres.

Table A.2 – Mechanical requirements specific to A2a fibres

Attribute	Unit	Limit	Reference
Proof stress level	GPa	≥ 0,345[SS]	3.3

A.4 Transmission requirements

Table A.3 contains transmission requirements specific to A2a fibres.

Table A.3 –Transmission requirements specific to A2a fibres

Attribute	Unit	Limit	Reference
Attenuation coefficient at λ_Y nm^{SS}	dB/km	≤ 10	3.4
Modal bandwidth at λ_Y nm^{SS}	MHz · km	≥ 10	3.4
Numerical aperture (NA_{ff})	Unitless	0,23 ±0,03 or 0,26 ±0,03	3.4 Table 6

A.5 Environmental requirements

Tables A.4 and A.5 contain environmental exposure tests and measurement methods specific to A2a fibres. Test and measurements shall be documented in two forms:

– relevant environmental attributes, test methods and test conditions are given in Table A.4;

– measurements of a particular mechanical and transmission attribute that may change during exposure to the environmental test are listed in Table A.5.

Table A.4 – Environmental exposure tests

Environment	Test method	Test condition
Damp heat	IEC 60793-1-50	+70 °C, 85 % RH, 30 days
Dry heat	IEC 60793-1-51	+70 °C, 30 days
Change of temperature	IEC 60793-1-52	T_a: –20 °C, T_b:+70 °C

Table A.5 – Attributes measured

Attribute	Unit	Limit	Reference
Change in optical transmission at attenuation coefficient at λ_Y nm^{SS}	dB/km	≤ 2	
Tensile strength	GPa at 15 % and 50 % Weibull probability levels	2,20 at 15 % 2,41 at 50 %	

These tests are normally conducted periodically as type-tests for a fibre design. Unless otherwise indicated, the recovery period allowed between the completion of the environmental exposure and measuring the attributes shall be as stated in the particular environmental test method.

Annex B
(normative)

Specifications for sub-category A2b multimode fibres

B.1 General

The clauses and tables in Annex B contain the particular requirements applicable to A2b fibres. Common requirements, repeated here for ease of reference from the sectional specification, are noted by an entry in the “Reference” column. Relevant notes from the sectional specification are not repeated but indicated with a superscript “SS”.

B.2 Dimensional requirements

Table B.1 contains dimensional requirements specific to A2b fibres.

Table B.1 – Dimensional requirements specific to A2b fibres

Attribute	Unit	Limit	Reference
Cladding diameter	µm	240 ±10	3.2
Core diameter	µm	200 ±8	3.2 Table 1
Core non-circularity	%	≤ 4	3.2
Coating diameter	µm	See 3.2	3.2
Fibre length	km	See 3.2	3.2

B.3 Mechanical requirements

Table B.2 contains mechanical requirements specific to A2b fibres.

Table B.2 – Mechanical requirements specific to A2b fibres

Attribute	Unit	Limit	Reference
Proof stress level	GPa	≥ 0,345^{SS}	3.3

B.4 Transmission requirements

Table B.3 contains transmission requirements specific to A2b fibres.

Table B.3 – Transmission requirements specific to A2b fibres

Attribute	Unit	Limit	Reference
Attenuation coefficient at λ_Y nm^{SS}	dB/km	≤ 10	3.4
Modal bandwidth at λ_Y nm^{SS}	MHz · km	≥ 10	3.4
Numerical aperture (NA_{ff})	Unitless	0,23 ±0,03 or 0,26 ±0,03	3.4 Table 6

B.5 Environmental requirements

Tables B.4 and B.5 contain environmental exposure tests and measurement methods specific to A2b fibres. Test and measurements shall be documented in two forms:

– relevant environmental attributes, test methods and test conditions are given in Table B.4.

– measurements of a particular mechanical and transmission attribute that may change during exposure to the environmental test are listed in Table B.5.

Table B.4 – Environmental exposure tests

Environment	Test method	Test condition
Damp heat	IEC 60793-1-50	+70 °C, 85 % RH, 30 days
Dry heat	IEC 60793-1-51	+70 °C, 30 days
Change of temperature	IEC 60793-1-52	T_a: -20 °C, T_b:+70 °C

Table B.5 – Attributes measured

Attribute	Unit	Limit	Reference
Change in optical transmission at attenuation coefficient at λ_Y nm^{SS}	dB/km	≤ 2	
Tensile strength	GPa at 15 % and 50 % Weibull probability levels	0,75 at 15 % 0,82 at 50 %	

These tests are normally conducted periodically as type tests for a fibre design. Unless otherwise indicated, the recovery period allowed between the completion of the environmental exposure and measuring the attributes shall be as stated in the particular environmental test method.

Annex C
(normative)

Specifications for sub-category A2c multimode fibres

C.1 General

The clauses and tables in Annex C contain the particular requirements applicable to A2c fibres. Common requirements, repeated here for ease of reference from the sectional specification, are noted by an entry in the “Reference” column. Relevant notes from the sectional specification are not repeated but indicated with a superscript “SS”.

C.2 Dimensional requirements

Table C.1 contains dimensional requirements specific to A2c fibres.

Table C.1 – Dimensional requirements specific to A2c fibres

Attribute	Unit	Limit	Reference
Cladding diameter	µm	280 ±10	3.2
Core diameter	µm	200 ±8	3.2 Table 1
Core non-circularity	%	≤ 4	3.2
Coating diameter	µm	See 3.2	3.2
Fibre length	km	See 3.2	3.2

C.3 Mechanical requirements

Table C.2 contains mechanical requirements specific to A2c fibres.

Table C.2 – Mechanical requirements specific to A2c fibres

Attribute	Unit	Limit	Reference
Proof stress level	GPa	≥ 0,345[SS]	3.3

C.4 Transmission requirements

Table C.3 contains transmission requirements for A2c fibres.

Table C.3 – Transmission requirements specific to A2c fibres

Attribute	Unit	Limit	Reference
Attenuation coefficient at λ_Y nm[SS]	dB/km	≤ 10	3.4
Modal bandwidth at λ_Y nm[SS]	MHz · km	≥ 10	3.4
Numerical aperture (NA_{ff})	Unitless	0,23 ±0,03 or 0,26 ±0,03	3.4 Table 6

C.5 Environmental requirements

Tables C.4 and C.5 contain environmental exposure tests and measurement methods specific to A2c fibres. Test and measurements shall be documented in two forms:

– relevant environmental attributes, test methods and test conditions are given in Table C.4.

– measurements of a particular mechanical and transmission attribute that may change during exposure to the environmental test are listed in Table C.5.

Table C.4 – Environmental exposure tests

Environment	Test method	Test condition
Damp heat	IEC 60793-1-50	+70 °C, 85 % RH, 30 days
Dry heat	IEC 60793-1-51	+70 °C, 30 days
Change of temperature	IEC 60793-1-52	T_a: -20 °C, T_b:+70 °C

Table C.5 – Attributes measured

Attribute	Unit	Limit	Reference
Change in optical transmission at attenuation coefficient at λ_Y nm^{SS}	dB/km	≤ 2	
Tensile strength	GPa at 15 % and 50 % Weibull probability levels	0,55 at 15 % 0,60 at 50 %	

These tests are normally conducted periodically as type tests for a fibre design. Unless otherwise indicated, the recovery period allowed between the completion of the environmental exposure and measuring the attributes shall be as stated in the particular environmental test method.

Bibliography

IEC TR 62048:2014, *Optical fibres – Reliability – Power law theory*

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