

# INTERNATIONAL STANDARD

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

IEC 60793-2-40:2009

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Withhold





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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**OPTICAL FIBRES –**

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

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International Standard IEC 60793-2-40 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 2006 and constitutes a technical revision which defines an enhanced A4a fibre named A4a.2 while the existing A4a fibre has been renamed A4a.1.

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

|              |                  |
|--------------|------------------|
| CDV          | Report on voting |
| 86A/1237/CDV | 86A/1264/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 of 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 maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

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Withdrawn

## OPTICAL FIBRES –

### Part 2-40: Product specifications – Sectional specification for category A4 multimode fibres

#### 1 Scope

This part of IEC 60793-2 is applicable to optical fibre categories A4a, A4b, A4c, A4d, A4e, A4f, A4g and A4h. These fibres have a plastic core and plastic cladding and may have step-index, multi-step index, or graded-index profiles. The fibres are used in information transmission equipment and optical fibre cables. Table 1 summarizes some of the salient characteristics and applications of these fibres.

**Table 1 – Characteristics and applications of category A4 Fibres**

|  | A4a   | A4b                   | A4c               | A4d   | A4e   | A4f  | A4g                | A4h  |
|--|---|-----------------------|-------------------|---|---|--|--------------------|--|
| Core diameter (µm)   | See Note 1  | See Note 1            | See Note 1        | See Note 1  | ≥500  | 200  | 120                | 62,5   |
| Cladding diameter (µm)   | 1000  | 750                   | 500               | 1000  | 750   | 490  | 490                | 245  |
| Numerical aperture   | 0,50 <sup>t</sup>   | 0,50 <sup>t</sup>     | 0,50 <sup>t</sup> | 0,30 <sup>t</sup>                                   | 0,25 <sup>t</sup>                                   | 0,190 <sup>e</sup>   | 0,190 <sup>e</sup> | 0,190 <sup>e</sup>                                     |
| Operating wavelength(s) (nm)   | 650<br>See Note 2   | 650                   | 650               | 650   | 650   | 650, 850, 1300   | 650, 850, 1300     | 850, 1300  |
| Applications   | Digital audio interface, automobile, industrial and sensor<br>Data transmission | industrial and sensor | sensor            | Digital audiovisual interface and data transmission | Digital audiovisual interface and data transmission | Industrial and mobile; compatible with A3 transmission equipment | Data transmission  | Data transmission; primarily used in ribbon structures |
| NOTE 1 Typically 15µm to 35µm smaller than the cladding diameter.          |   |                       |                   |   |   |  |                    |  |
| NOTE 2 Other potential wavelengths for A4a fibre are described in Annex J. |   |                       |                   |   |   |  |                    |  |
| <sup>t</sup> Theoretical.  |   |                       |                   |   |   |  |                    |  |
| <sup>e</sup> Measured effective.   |   |                       |                   |   |   |  |                    |  |

In addition to the applications shown in Table 1, other applications for A4 fibres include, but are not restricted to, the following: support for short reach high bit-rate systems in telephony, distribution and local networks, carrying data, voice and/or video services and on-premises intrabuilding and interbuilding fibre installations, including LANs, PBXs, video, various multiplexing uses, and miscellaneous related uses, such as consumer electronics and industrial and mobile networks.

Three types of requirements apply to A4 fibres:

- general requirements, as defined in IEC 60793-2;
- specific requirements common to category A4 multimode fibres covered in this standard and that are given in Clause 3;
- particular requirements applicable to individual fibre types or specific applications and that are defined in this standard in the normative family specification annexes.



## 2 Normative references

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

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

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

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

IEC 60793-1-22:2001, *Optical fibres – Part 1-22: Measurement methods and test procedures – Length measurement*

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

IEC 60793-1-41:2001, *Optical fibres – Part 1-41: Measurement methods and test procedures – Bandwidth*

IEC 60793-1-42:2007, *Optical fibres – Part 1-42: Measurement methods and test procedures – Chromatic dispersion*

IEC 60793-1-43:2001, *Optical fibres – Part 1-43: Measurement methods and test procedures – Numerical aperture*

IEC 60793-1-46:2001, *Optical fibres – Part 1-46: Measurement methods and test procedures – Monitoring of changes in optical transmittance*

IEC 60793-1-47:2009, *Optical fibres – Part 1-47: Measurement methods and test procedures – Macrobending loss*

IEC 60793-1-50:2001, *Optical fibres – Part 1-50: Measurement methods and test procedures – Damp heat (steady state)*

IEC 60793-1-51:2001, *Optical fibres – Part 1-51: Measurement methods and test procedures – Dry heat*

IEC 60793-1-52:2001, *Optical fibres – Part 1-52: Measurement methods and test procedures – Change of temperature*

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

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

## 3 Specifications

### 3.1 Dimensional requirements

Relevant dimensional attributes and measurement methods are given in Table 2.

Requirements common to all category A4 fibres are indicated in Table 3.

Tables 4 and 5 list additional attributes that shall be specified by each family specification.

**Table 2 – Dimensional attributes and measurement methods**

| Attributes                        | Measurement methods |
|-----------------------------------|---------------------|
| Cladding diameter                 | IEC 60793-1-20      |
| Cladding non-circularity          | IEC 60793-1-20      |
| Core diameter                     | IEC 60793-1-20      |
| Fibre length                      | IEC 60793-1-22      |
| Core-cladding concentricity error | IEC 60793-1-20      |
| Core non-circularity              | IEC 60793-1-20      |

**Table 3 – Requirements common to all category A4 fibres**

| Attributes   | Unit | Limits          |
|--|------|-----------------|
| Cladding non-circularity   | %    | ≤6 <sup>a</sup> |
| Core diameter  | µm   | b               |
| Fibre length   | km   | c               |
| <p><sup>a</sup> Unless otherwise specified in the family specification.</p> <p><sup>b</sup> For A4a, A4b, A4c and A4d fibre, the core diameter is typically 15 µm to 35 µm smaller than the cladding diameter. For A4e, A4f, A4g and A4h fibre, the core diameter varies and is listed in the family specification.</p> <p><sup>c</sup> Length requirements vary and should be agreed between the supplier and the customer.</p> |      |                 |

**Table 4 – Additional attributes required in A4a through A4e family specifications**

| Attributes        |
|-------------------|
| Cladding diameter |

**Table 5 – Additional attributes required in A4f through A4h family specifications**

| Attributes                        |
|-----------------------------------|
| Cladding diameter                 |
| Core non-circularity              |
| Core-cladding concentricity error |

### 3.2 Mechanical requirements

Mechanical attributes, test methods, and requirements for buffered fibre can be found in IEC 60794-2-41.

Relevant mechanical attributes and test methods are given in Table 6.

Requirements common to all category A4 fibres are indicated in Table 7.

Additional attributes that shall be specified in the family specifications for categories A4a through A4e are given in Table 8.

Additional attributes that shall be specified in the family specifications for categories A4f through A4h are given in Table 9.

**Table 6 – Mechanical attributes and test methods**

| Attributes          | Test methods |
|---------------------|--------------|
| Tensile performance | 3.2.1        |

**Table 7 – Requirements common to category A4 fibres**

| Attribute                | Unit | Limit |
|--------------------------|------|-------|
| Elongation at yield peak | %    | ≥4,0  |

**Table 8 – Additional attributes required in family specification for categories A4a through A4e fibres**

| Attributes                 |
|----------------------------|
| Tensile load at yield peak |

**Table 9 – Additional attributes required in family specification for categories A4f through A4h fibres**

| Attributes                            |
|---------------------------------------|
| Tensile load at yield peak            |
| Tensile load to induce 4 % elongation |

### 3.2.1 Tensile load test

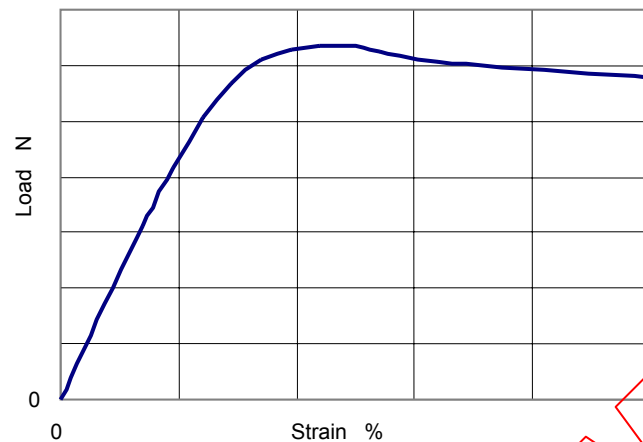
#### 3.2.1.1 Object

The purpose of this test is to characterize the ability of the fibre to support a load during handling. Its purpose is to obtain values of the fibre's tensile strength.

The fibre samples are subjected to a mechanical environment as specified below. The test shall be carried out at the standard test conditions in compliance with IEC 60068-1.

#### 3.2.1.2 Definition of yield peak

Figure 1 shows a typical load vs. elongation curve for a plastic optical fibre. The curve exhibits an initial monotonic increase in tensile load with applied elongation that goes through a load peak. The peak is followed by a decrease in load as the sample begins to undergo a ductile, irreversible elongation. Localized necking and drawing of the sample may accompany the process. This phenomenon is known as yielding and the peak is termed a yield peak.



**Figure 1 – Tensile load versus elongation for a plastic optical fibre**

**3.2.1.3 Test apparatus**

The length of the sample between two clamping devices shall be between 100 mm and 200 mm.

The tensile strength measuring apparatus shall be a device, for example a vertical tensile tester, that provides relative motion to the test fibre. The apparatus shall be capable of imparting constant motion without jerking the fibre under test. The apparatus shall have the ability to simultaneously measure and record the resulting tensile force or load. To prevent fibre breakage, the means used to secure the fibre ends at the clamping points shall not stress the fibre excessively.

**3.2.1.4 Procedure**

The tensile speed shall be 100 mm/min ( $\pm 10\%$ ). Yield strength and yield elongation are obtained from the load-elongation curve described in 3.2.1.2. Unless otherwise specified, tensile load at the yield peak and tensile load to induce 4 % elongation shall be recorded.

NOTE Elongation to breaking point is not applicable to A4 fibres.

**3.2.1.5 Requirements**

The requirements are stated in the family specifications in the normative annexes. If the fibre sample breaks at a clamping point, the test shall be regarded as invalid and another test shall be carried out. The number of samples tested shall be sufficient to allow for a statistical analysis.

**3.3 Transmission requirements**

Relevant transmission attributes and measurement methods are given in Table 10.

Additional attributes required in the family specifications are indicated in Table 11.