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Optical fibres -- Part 1-20: Measurement methods and test procedures - Fibre geometry (IEC 60793-1-20:2014)

Lichtwellenleiter - Teil 1-20: Messmethoden und Prüfverfahren - Fasergeometrie (IEC 60793-1-20:2014)

Fibres optiques -- Partie 1-20: Méthodes de mesure et procédures d'essai - Géométrie de la fibre (IEC 60793-1-20:2014)

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33.180.10 (Optična) vlakna in kabli Fibres and cables

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**Optical fibres - Part 1-20: Measurement methods and test
procedures - Fibre geometry
(IEC 60793-1-20:2014)**

Fibres optiques - Partie 1-20: Méthodes de mesure et
procédures d'essai - Géométrie de la fibre
(CEI 60793-1-20:2014)

Lichtwellenleiter - Teil 1-20: Messmethoden und
Prüfverfahren - Fasergeometrie
(IEC 60793-1-20:2014)

This European Standard was approved by CENELEC on 2014-11-14. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 86A/1562/CDV, future edition 1 of IEC 60793-1-20, prepared by SC 86A "Fibres and cables" of IEC/TC 86 "Fibre optics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60793-1-20:2014.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-08-14
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-11-14

This document supersedes EN 60793-1-20:2002.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

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The text of the International Standard IEC 60793-1-20:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated :

IEC 60793-1-45

NOTE

Harmonized as EN 60793-1-45.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60793-2-10	-	Optical fibres - Part 2-10: Product specifications - Sectional specification for category A1 multimode fibres	EN 60793-2-10	-
IEC 60793-2-20	-	Optical fibres - Part 2-20: Product specifications - Sectional specification for category A2 multimode fibres	EN 60793-2-20	-
IEC 60793-2-30	-	Optical fibres - Part 2-30: Product specifications - Sectional specification for category A3 multimode fibres	EN 60793-2-30	-
IEC 60793-2-40	-	Optical fibres - Part 2-40: Product specifications - Sectional specification for category A4 multimode fibres	EN 60793-2-40	-
IEC 60793-2-50	-	Optical fibres - Part 2-50: Product specifications - Sectional specification for class B single- mode fibres	EN 60793-2-50	-
IEC 60793-2-60	-	Optical fibres - Part 2-60: Product specifications - Sectional specification for category C single-mode intraconnection fibres	EN 60793-2-60	-
IEC 61745	-	End-face image analysis procedure for the calibration of optical fibre geometry test sets	-	-

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Partie 1-20: Méthodes de mesure et procédures d'essai – Géométrie de la fibre
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OPTICAL FIBRES –

**Part 1-20: Measurement methods and test procedures –
Fibre geometry**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60793-1-20 has been prepared by subcommittee SC86A: Fibre and cables, of IEC technical committee TC86: Fibre optics.

This second edition cancels and replaces the first edition, published in 2001, and constitutes a technical revision.

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

- the reference test method for all fibre types is changed to the video grey scale transmitted near field method from the refracted near field method;
- the test lengths for all fibre types are now to be specified in the fibre’s detail specification;
- the core illumination wavelength for all multimode fibre types may now to be specified in the fibre’s detail specification although defaults are given;

- the core k -factor (decision level) is now to be specified in the detail specification for all multimode fibre types;
- this edition is substantially more specific in describing the measurement; data reduction and transformation is fully described;
- the data reduction methodology for both refracted near-field and transmitted near-field methods are now unified and consistent.

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

CDV	Report on voting
86A/1562/CDV	86A/1623/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 [SIST EN 60793-1-20:2015](http://standards.iteh.ai/catalog/standards/sist/1db0366-f4ca-4460-94fd-e7e42fcd8c7a/sist-en-60793-1-20-2015)
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INTRODUCTION

This standard gives two methods for measuring fibre geometry characteristics:

- Method A: Refracted near-field, described in Annex A;
- Method B: Transmitted near-field, described in Annex B.

Methods A and B apply to the geometry measurement of all class A multimode fibres, class B single-mode fibres and class C single-mode interconnection fibres. The fibre's applicable product specifications, IEC 60793-2-10, IEC 60793-2-20, IEC 60793-2-30, IEC 60793-2-40, IEC 60793-2-50 and IEC 60793-2-60, provide relevant measurement details, including sample lengths and k factors.

The geometric parameters measurable by the methods described in this standard are as follows:

- cladding diameter;
- cladding non-circularity;
- core diameter (class A fibre only);
- core non-circularity (class A fibre only);
- core-cladding concentricity error.

NOTE 1 The core diameter of class B and class C fibres is not specified. The equivalent parameter is mode field diameter, determined by IEC 60793-1-45.

NOTE 2 These methods specify both one-dimensional (1-D) and two-dimensional (2-D) data collection techniques and data analyses. The 1-D methods by themselves cannot determine non-circularity nor concentricity error. When non-circular bodies are measured with 1-D methods, body diameters suffer additional uncertainties. These limitations may be overcome by scanning and analysing multiple 1-D data sets. Clause 5 provides further information.

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Information common to both methods appears in Clauses 2 through 10, and information pertaining to each individual method appears in Annexes A and B, respectively. Annex C describes normative methods used to find the optical boundaries of the core and the cladding, Annex D describes normative procedures to fit ellipses to sets of detected boundaries. Annex E provides an informative fitting procedure of power-law models to graded-index core profiles. Annex F describes an informative methodology relating to the transformation of core diameter measurements determined with methods other than the reference method to approximate reference method values.

OPTICAL FIBRES –

Part 1–20: Measurement methods and test procedures – Fibre geometry

1 Scope

This part of IEC 60793 establishes uniform requirements for measuring the geometrical characteristics of uncoated optical fibres.

The geometry of uncoated optical fibres directly affect splicing, connectorization and cabling and so are fundamental parameters requiring careful specification, quality control, and thus measurement.

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 60793-2-10, *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 – 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*

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

IEC 61745, *End-face image analysis procedure for the calibration of optical fibre geometry test sets*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1

body

general term describing an entity whose geometry is measured (i.e. cladding or core)

3.1.2**reference point**

fixed coordinate in the scan's plane

Note 1 to entry: This point is arbitrary (say the lower left corner of a video image, or the rough centre of the fibre after the fibre is located in a scanning apparatus).

3.1.3**centre**

centre of a body in the measurement plane with respect to the reference point, expressed in micrometres

3.1.4**diameter**

average diameter, in micrometres, of a nearly circular body

3.1.5**non-circularity**

difference between the maximum and minimum radial deviation from the body's centre, normalized to the body's diameter, expressed as a per cent

3.1.6**concentricity error**

scalar distance, in micrometres between two body centres

3.1.7**scan**

term used to define the collection of data along one axis of the Cartesian coordinate plane, at a fixed angular orientation and a fixed offset from the reference point

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3.1.8**scan set or set**

one or more scans used together to determine the fibre's geometry

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Note 1 to entry: The set can be one scan (see limitations below), a set of scans at different angular orientations with respect to the fibre, or a raster scan (like a video image).

3.1.9**edge table**

set of number pairs representing a set of points in the scanning plane which define a closed curve line of delineation between the cladding and the surrounding media (the cladding edge table) or the core and the cladding (the core edge table)

3.1.10**elliptical model**

ellipse fit

best fit ellipse to an edge table

3.2 Symbols

The symbols defined below are used to indicate various aspects of a scanned data set. Scans can be one-dimensional, or two-dimensional raster scans (where the scan axes are orthogonal on a Cartesian plane), or a set of one-dimensional scans at a set of angles.

- i* The index used for the scanning axis or the 'fast' axis in the case of a raster scan.
- j* The index used for the 'slow' axis in a raster scan.
- k* The index used for the angle in a multi-angular scan set.
- I* The set of data from one-dimensional or two-dimensional scanning. The data can be near-field intensity data (from Method B) or index of refraction (Method A); in this