

Optical fibres —

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

The European Standard EN 60793-1-20:2002 has the status of a
British Standard

ICS 33.180.10

National foreword

This British Standard is the official English language version of EN 60793-1-20:2002. It is identical with IEC 60793-1-20:2001. It partly supersedes BS EN 188000:1994 which will be withdrawn upon publication of the full BS EN 60793-1 series.

The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/1, Optical fibres and cables, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 6 June 2002

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Fibres optiques
Partie 1-20: Méthodes de mesure
et procédures d'essai –
Géométrie de la fibre
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Teil 1-20: Messmethoden
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Fasergeometrie
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This European Standard was approved by CENELEC on 2002-03-05. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 86A/685/FDIS, 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 was approved by CENELEC as EN 60793-1-20 on 2002-03-05.

This European Standard supersedes subclause 2.6 (test method 101), subclause 2.7 (test method 102) and subclause 2.9 (test method 104) of EN 188000:1992.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2002-12-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2005-03-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A, B, C, D and ZA are normative.
Annex ZA has been added by CENELEC.

Compared to IEC 60793-1:1989 and IEC 60793-2:1992, IEC/SC 86A has adopted a revised structure of the new IEC 60793 series: The individual measurement methods and test procedures for optical fibres are published as "Part 1-XX"; the product standards are published as "Part 2-XX".

The general relationship between the new series of EN 60793 and the superseded European Standards of the EN 188000 series is as follows:

EN	Title	supersedes
EN 60793-1-XX	Optical fibres -- Part 1-XX: Measurement methods and test procedures	Individual subclauses of EN 188000:1992
EN 60793-2-XX	Optical fibres -- Part 2-XX: Product specifications	EN 188100:1995 EN 188101:1995 EN 188102:1995 EN 188200:1995 EN 188201:1995 EN 188202:1995

EN 60793-1-2X consists of the following parts, under the general title: Optical fibres:

- Part 1-20: Measurement methods and test procedures – Fibre geometry
- Part 1-21: Measurement methods and test procedures – Coating geometry
- Part 1-22: Measurement methods and test procedures – Length measurement

Endorsement notice

The text of the International Standard IEC 60793-1-20:2001 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

Publications in the IEC 60793-1 series concern measurement methods and test procedures as they apply to optical fibres.

Within the same series several different areas are grouped, as follows:

- parts 1-10 to 1-19: General
- parts 1-20 to 1-29: Measurement methods and test procedures for dimensions
- parts 1-30 to 1-39: Measurement methods and test procedures for mechanical characteristics
- parts 1-40 to 1-49: Measurement methods and test procedures for transmission and optical characteristics
- parts 1-50 to 1-59: Measurement methods and test procedures for environmental characteristics.

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 geometrical characteristics of uncoated optical fibres are fundamental values and are necessary for carrying out subsequent procedures such as handling, splicing, connectorization, cabling and measurements.

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

3 Overview of method

This standard gives four methods for measuring fibre geometry characteristics which are given in terms of the following parameters:

- cladding diameter;
- cladding non-circularity;
- core diameter (category A fibre only);
- core non-circularity (category A fibre only);
- core-cladding concentricity error;
- theoretical numerical aperture (optional – category A fibre only).

Table 1 – Measurement methods

Method	Characteristics covered	Fibre category(ies) covered	Former designation
A Refracted near-field	All	All A and B ^{a, b}	IEC 60793-1-A1A
B Transverse interference	Core diameter, core non-circularity and theoretical numerical aperture	All A ^b	IEC 60793-1-A1B
C Near-field light	All but theoretical numerical aperture	A1, A2, A3, all B ^c	IEC 60793-1-A2
D Mechanical diameter	Cladding diameter and cladding non-circularity only	All ^d	IEC 60793-1-A4
^a The core diameter of single-mode fibres is not specified. ^b Measurement of core diameter and the maximum theoretical numerical aperture of category A1 fibres may also be made by this method. ^c The single near-field scan method can be used to determine a cross-sectional diameter of the core of category A1 fibres. This cross-sectional diameter may deviate from the core diameter determined by method C due to effects of core non-circularity. A core non-circularity value can be determined by scanning in multiple axes. ^d In practice, for smooth and substantially circular fibres, method D gives a similar result to that obtained by methods A, B and C, in which case non-circularity of fibre can also be determined.			

Information common to all four methods appears in clauses 2 to 10, and information pertaining to each individual method appears in annexes A, B, C and D, respectively.

4 Definitions

For the purpose of this part of IEC 60793, the following definitions apply.

4.1

reference surface

surface defined in the detail specification, which may be either core or cladding

4.2

core concentricity error

distance between the centre of the cladding and

- the centre of the near field profile for category B fibres;
- the centre of the core, for category A fibres.

4.3

core diameter of category A multimode fibre

defined from the refractive index profile as that diameter passing through the core centre and intersecting the index profile at the points n_3 such that:

$$n_3 = n_2 + k(n_1 - n_2)$$

where

n_2 is the refractive index of the homogeneous cladding;

n_1 is the maximum refractive index;

k is a constant commonly called the "k factor".

The refractive index profile can be measured by profiling techniques such as the refracted near-field (RNF) or transverse interferometry (TI) measurements, and by measurement of the near field of a fully illuminated core such as the transmitted near-field measurement (TNF).

It is recommended that curve fitting be used with both the index profiling and the TNF techniques to improve the measurement precision of the core diameter.

NOTE 1 Typically, $k = 0,025$ for either the fitted profiling methods or the unfitted TNF method, and is equivalent to $k = 0$ for the fitted TNF method.

NOTE 2 For fibres with refractive index profiles that have gradual transition region at their core/cladding boundary, a value of $k = 0,05$ for the unfitted TNF method is equivalent to $k = 0$ for the fitted TNF method.

NOTE 3 For category B fibres, the centre of the core is defined as the centre of the near field profile and not of the refractive index profile. The core boundary is not defined. Instead, the mode field diameter is defined and specified.

5 Reference test method

The reference test method (RTM), which shall be the one used to settle disputes, depends on fibre category such as:

- category A fibres: method C

NOTE The characteristics of the core of category A fibres are defined in terms of refractive index profile, which is measured with method A. Use method C to settle disputes with regard to cladding diameter, cladding non-circularity and core-cladding concentricity error of category A fibres.

- category B fibres: method C.

6 Apparatus

Annexes A, B, C and D include layout drawings and other equipment requirements for each of the methods A, B, C and D, respectively.

7 Sampling and specimens

7.1 Specimen length

See annexes A, B, C and D, respectively, for the applicable requirements.

7.2 Specimen end face

For methods A and C only, prepare a clean, flat end face, perpendicular to the fibre axis, at the input and output ends of each specimen. The accuracy of measurements performed by methods A and C is affected by a non-perpendicular end face. End angles less than 1° are recommended.

See C.2 for the tighter requirements on end faces when using method C.

Because method D is side-view only, it does not have tight end face requirements.

8 Procedure

Use the procedures given in IEC 61745 for calibration. Annexes A, B, C and D document the procedures for methods A, B, C and D, respectively.