

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61745:2018

<https://standards.iteh.ai/catalog/standards/sist/41bf3c54-5b18-4275-92e0-9c1796aa1c8c/sist-en-61745-2018>

EUROPEAN STANDARD

EN 61745

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2017

ICS 33.180.01

English Version

End-face image analysis procedure for the calibration of optical fibre geometry test sets (IEC 61745:2017)

Procédure d'analyse d'image d'extrémité pour l'étalonnage de dispositifs d'essais de géométrie des fibres optiques
(IEC 61745:2017)

Endflächen-Bildanalyseverfahren für die Kalibrierung von Prüfeinrichtungen für die Geometrie von Lichtwellenleitern
(IEC 61745:2017)

This European Standard was approved by CENELEC on 2017-09-01. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

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

EN 61745:2017**European foreword**

The text of document 86/510/CDV, future edition 2 of IEC 61745, prepared by IEC/TC 86 "Fibre optics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61745:2017.

The following dates are fixed:

latest date by which the document has to be implemented at (dop) 2018-06-01
national level by publication of an identical national
standard or by endorsement

latest date by which the national standards conflicting with (dow) 2020-09-01
the document have to be withdrawn

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

Endorsement notice**iTeh STANDARD PREVIEW**

The text of the International Standard IEC 61745:2017 was approved by CENELEC as a European Standard without any modification.

[SIST EN 61745:2018](https://standards.iteh.ai/catalog/standards/sist/41bf3c54-5b18-4275-92e0-9c1796aa1c8c/sist-en-61745-2018)

<https://standards.iteh.ai/catalog/standards/sist/41bf3c54-5b18-4275-92e0-9c1796aa1c8c/sist-en-61745-2018>



IEC 61745

Edition 2.0 2017-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

(standards.iteh.ai)

Procédure d'analyse d'image d'extrémité pour l'étalonnage de dispositifs d'essais de géométrie des fibres optiques

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.180.01

ISBN 978-2-8322-4614-6

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 General information and preparation for calibration	11
4.1 Geometrical parameters of optical fibres	11
4.2 Description of geometry test sets	11
4.3 Calibration standard requirements	12
5 Calibration.....	12
5.1 General.....	12
5.2 Rationale for calibration of geometry test sets.....	12
5.2.1 General	12
5.2.2 Verification of calibration state.....	13
5.3 Calibration procedure.....	14
5.3.1 General advice and organization.....	14
5.3.2 Test requirements.....	14
5.3.3 Calibration standard requirements	14
5.3.4 Determination of calibration factors.....	14
5.4 Check calibration procedure.....	16
5.5 Spatial linearity	16
5.6 Calibration of core/cladding concentricity error measurement.....	17
5.7 Calibration of non-circularity measurement.....	17
6 Evaluation of uncertainties	17
6.1 General.....	17
6.2 Evaluation of uncertainty in test set calibration	18
6.2.1 General	18
6.2.2 Uncertainty in scaling factor.....	18
6.2.3 Uncertainty in offset correction factor	19
6.3 Evaluation of uncertainty in fibre measurement.....	20
6.3.1 General	20
6.3.2 Determination of $u_{Op,I,F}$	21
6.3.3 Determination of $u'_{I,F}$	21
6.4 Evaluation of uncertainty in chromium mask measurement.....	21
6.4.1 General	21
6.4.2 Determination of $u_{Op,I,C}$	21
6.4.3 Determination of $u'_{I,C}$	21
6.5 Summary	22
7 Documentation	22
7.1 Records	22
Annex A (normative) Mathematical basis for measurement uncertainty calculations	23
A.1 General.....	23
A.2 Type A evaluation of uncertainty	23
A.3 Type B evaluation of uncertainty	23
A.4 Determining the combined standard uncertainty.....	24
A.5 Reporting	25

Annex B (informative) Derivation of calibration factors	26
B.1 Derivation of scaling factors	26
B.2 Derivation of correction offset factor	27
Annex C (informative) Examples for the determination of calibration factors	29
C.1 Example of determination of scaling factor	29
C.2 Example of determination of offset correction factor	29
Annex D (informative) Calculation of uncertainties	30
D.1 General	30
D.1.1 Overview	30
D.1.2 Examples of type B evaluation of uncertainty	30
D.2 Combining sources of uncertainty	30
D.2.1 General	30
D.2.2 Example of combining several sources of uncertainty	31
D.3 Student's t distribution	31
Annex E (informative) Worked examples for the determination of uncertainties	33
E.1 General	33
E.2 Example of determination of scaling factor uncertainty	33
E.3 Example of determination of correction offset uncertainty	33
E.4 Example of determination of fibre measurement uncertainty	34
E.5 Example of determination of chromium mask measurement uncertainty	34
Annex F (informative) Generation of working standards	35
F.1 Generation of working standards	35
F.1.1 General	35
F.1.2 Measurement conditions	35
F.2 Procedure for generation of working standards	35
F.2.1 In the case where the infant artefact is a fibre	35
F.2.2 In the case where the infant artefact is a chromium-on-glass artefact	35
Annex G (informative) Estimation of uncertainty in the measurement of core/cladding concentricity error	36
G.1 Method of estimating uncertainty in concentricity error measurement	36
G.1.1 General	36
G.1.2 Determination of u	36
G.1.3 Determination of u_{OP}	36
G.1.4 Determination of CB	36
G.1.5 Determination of u_{CB}	38
G.2 Correcting for concentricity bias	38
Annex H (informative) Estimation of uncertainty in the measurement of non-circularity	39
H.1 Method of estimating uncertainty in non-circularity measurement	39
H.2 Determination of u	39
H.3 Determination of u_{OP}	39
H.4 Determination of NCB	39
H.4.1 General	39
H.4.2 Method A: uncalibrated artefact	40
H.4.3 Method B: calibrated artefact	40
H.5 Determination of u_{NCB}	40
Bibliography	41
Figure 1 – Example of a calibration chain and the accumulation of uncertainties	13

Figure B.1 – Representation of a grid calibration mask	26
Figure B.2 – Representation of an annulus calibration mask	27
Figure B.3 – Derivation of correction offset	28
Table D.1 – Values of t for specified confidence level	32
Table G.1 – Measured values for angular positions	37

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 61745:2018](https://standards.iteh.ai/catalog/standards/sist/41bf3c54-5b18-4275-92e0-9c1796aa1c8c/sist-en-61745-2018)

<https://standards.iteh.ai/catalog/standards/sist/41bf3c54-5b18-4275-92e0-9c1796aa1c8c/sist-en-61745-2018>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**END-FACE IMAGE ANALYSIS PROCEDURE FOR THE CALIBRATION
OF OPTICAL FIBRE GEOMETRY TEST SETS**

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61745 has been prepared by IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition, published in 1998, and constitutes a technical revision.

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

- a) removal of the limitation of single mode optical fibre geometry test sets to include multimode;
- b) addition of a new annex as mathematical basis.

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

CDV	Report on voting
86/510/CDV	86/516/RVC

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.

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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 61745:2018](#)

<https://standards.iteh.ai/catalog/standards/sist/41bf3c54-5b18-4275-92e0-9c1796aa1c8c/sist-en-61745-2018>

INTRODUCTION

In the research and production environments, there exists a range of test methods for characterizing the geometry of optical fibres. Furthermore, each test method may determine one or more of the many parameters required for complete geometrical characterization. IEC 61745 describes the calibration of test sets that perform end-face image analysis, also known as "near-field" or "grey-scale" analysis. The principles, however, may be applied to test sets of a different type.

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

[SIST EN 61745:2018](#)

<https://standards.iteh.ai/catalog/standards/sist/41bf3c54-5b18-4275-92e0-9c1796aa1c8c/sist-en-61745-2018>

END-FACE IMAGE ANALYSIS PROCEDURE FOR THE CALIBRATION OF OPTICAL FIBRE GEOMETRY TEST SETS

1 Scope

This document describes the calibration of test sets that perform end-face image analysis, also known as "near-field" or "grey-scale" analysis. The principles, however, can be applied to test sets of a different type.

The procedures outlined are performed by calibration laboratories and by the manufacturers or users of geometry test sets, for the purpose of calibrating geometry test sets and for evaluating the uncertainties in measurements made on calibrated test sets. The calibration of fibre coating or cable measurement test sets is not covered by this document.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purpose of this International Standard, the following definitions apply.

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

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

3.1

accredited calibration laboratory

calibration laboratory authorized by an appropriate national organization to issue calibration certificates that demonstrates traceability to national standards

3.2

artefact

object that is measured on or used to calibrate a geometry test set

EXAMPLE An optical fibre and a chromium-on-glass pattern are examples of artefacts.

3.3

calibration

set of operations that establish, under specified conditions, the relationship between the values of quantities indicated by a measuring instrument and the corresponding values realized by standards

Note 1 to entry: The results of a calibration permit either the assignment of measurand values to the indications or the determination of corrections with respect to the indications.

Note 2 to entry: A calibration may also determine other metrological properties such as the effects of influence quantities.

Note 3 to entry: The result of a calibration may be recorded in a document, called a "calibration certificate" or a "calibration report".

3.4 calibration chain

chain of transfers from a national standard to the geometry test set through intermediate or working standards

Note 1 to entry: See $U = k \times u$.

3.5 calibration checking

establishing that a geometry test set that has been previously calibrated but has reached its calibration due date remains within specified uncertainty limits

Note 1 to entry: If the geometry test set has drifted outside these limits, then re-calibration is required. Otherwise, the re-checking period can be extended for a stated period.

Note 2 to entry: The test set may be checked using a working standard.

3.6 calibration standard

artefact that is calibrated against a reference standard and is used to calibrate test sets

Note 1 to entry: The artefact may be a fibre or a chromium-on-glass pattern.

Note 2 to entry: Proper use of a calibration standard ensures traceability.

Note 3 to entry: The term includes the reference standard, the transfer standard and the working standard(s), in descending order of metrological uncertainty.

3.7 combined standard uncertainty

combination of a number of individual standard uncertainties

Note 1 to entry: The term "accuracy" should be avoided in this context.

Note 2 to entry: In calibration reports and technical data sheets, the combined standard uncertainty in the geometry test set measurement is reported as an overall expanded uncertainty with the applicable confidence level, for example 95,5% or 99,7 %.

3.8 confidence level

estimation of the probability that the true value of a measured parameter lies within a given range (expanded uncertainty)

3.9 correction offset

number that is added to or subtracted from the measurement result of a test set to correct for a known physical effect

3.10 coverage factor

k

factor used to calculate the expanded uncertainty, U , from the standard uncertainty, u

3.11 expanded uncertainty

U

range of values within which the measurement parameter, at the stated confidence level, can be expected to lie

Note 1 to entry: It is equal to the coverage factor, k , times the combined standard uncertainty u

$$U = k \times u$$

(1)