SLOVENSKI STANDARD
SIST EN 61744:2006

01-marec-2006

Nadomešča:
SIST EN 61744:2004

Umerjanje pribora za preskušanje kromatične disperzije (IEC 61744:2005)

Calibration of fibre optic chromatic dispersion test sets

Kalibrierung von Prüfaufbauten zur Bestimmung der chromatischen Dispersion

Etalonnage des ensembles d'essai de la dispersion chromatique des fibres optiques

Ta slovenski standard je istoveten z: **EN 61744:2005**

ICS:

33.140	Posebna merilna oprema za uporabo v telekomunikacijah	Special measuring equipment for use in telecommunications
33.180.01	Sistemi z optičnimi vlakni na splošno	Fibre optic systems in general

SIST EN 61744:2006 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61744

December 2005

ICS 33.180.01

Supersedes EN 61744:2001

English version

Calibration of fibre optic chromatic dispersion test sets
(IEC 61744:2005)

Etalonnage des ensembles d'essai
de la dispersion chromatique
des fibres optiques
(CEI 61744:2005)

Kalibrierung von Prüfaufbauten
zur Bestimmung der chromatischen
Dispersion
(IEC 61744:2005)

This European Standard was approved by CENELEC on 2005-09-01. 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 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.

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

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

Ref. No. EN 61744:2005 E

Foreword

The text of document 86/236/FDIS, future edition 2 of IEC 61744, prepared by IEC TC 86, Fibre optics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61744 on 2005-09-01.

This European Standard supersedes EN 61744:2001.

The principal change is the addition of reference to wavelength in vacuum. This reference is critical for accurate production, measurement and sale of products in the emerging market applications of fibre optics such as dense wavelength division multiplexing (DWDM) systems.

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)	2006-07-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2008-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61744:2005 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61315	NOTE	Harmonized as EN 61315:1997 (not modified).
IEC 61746	NOTE	Harmonized as EN 61746:2005 (not modified).
IEC 60793-1-1	NOTE	Harmonized as EN 60793-1-1:2003 (not modified).
ISO 9000	NOTE	Harmonized in the EN ISO 9000 series (not modified).
ISO 10012	NOTE	Harmonized as EN ISO 10012 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60050-731	- [1]	International Electrotechnical Vocabulary (IEV) Chapter 731: Optical fibre communication	-	-
IEC 60825-1	- [1]	Safety of laser products Part 1: Equipment classification, requirements and user's guide	EN 60825-1 + corr. February	1994 [2] 1995
IEC 62129	- [3]	Calibration of optical spectrum analyzers	-	-
ISO 9000	Series	Quality management and quality assurance standards	EN ISO 9000	Series
BIPM/IEC/IFCC/ ISO/IUPAC/ IUPAP/OIML	1995	Guide to the Expression of Uncertainty in Measurement (GUM)	-	-
ISO/IEC 17025	- [1]	General requirements for the competence of testing and calibration laboratories	EN ISO/IEC 17025	2005 [2]

[1] Undated reference.

[2] Valid edition at date of issue.

[3] At draft stage.

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI
IEC
61744

Deuxième édition
Second edition
2005-09

Etalonnage des ensembles d'essai de la dispersion chromatique des fibres optiques

Calibration of fibre optic chromatic dispersion test sets

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CODE PRIX
PRICE CODE XA

Pour prix, voir catalogue en vigueur
For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CALIBRATION OF FIBRE OPTIC CHROMATIC DISPERSION 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.
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International Standard IEC 61744 has been prepared by IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2001. This edition constitutes a technical revision. The principal change is the addition of reference to wavelength in vacuum. This reference is critical for accurate production, measurement and sale of products in the emerging market applications of fibre optics such as dense wavelength division multiplexing (DWDM) systems.

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

FDIS	Report on voting
86/236/FDIS	86/240/RVD

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.

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.

0 Introduction

0.1 Chromatic dispersion in optical fibres

Chromatic dispersion is the variation with optical light wavelength of the light propagation delay time in a length of fibre. This variation can cause bandwidth limitation in the fibre when used to transmit communication signals. For a more detailed explanation, refer to Annex C and IEC 60793-1-1.

0.2 Chromatic dispersion (CD) test sets

CD test sets are used to measure the chromatic dispersion properties of optical fibres and typically comprise an optical source of known wavelength(s), a fibre light input coupling and output coupling means, optical detection means, and electronic or optical means of determining the optical delay or dispersion at the source wavelength. There are several variants each requiring slightly different calibration techniques. Refer to Annex C for further details.

In general, all CD test sets produce an output of fibre delay or dispersion versus the light wavelength, typically in graphical form. Thus, wavelength constitutes the 'x-axis' and delay or dispersion the 'y-axis'.

0.3 Overview of calibration procedures described in this standard

The requirement to calibrate the CD test set, traceable to known standards, is essential for quality control in fibre optic production, fibre research and similar activities. This standard describes the detailed procedures used to establish calibration of a CD test set.

Calibration of a CD test set is established by applying known artefacts or standards (themselves calibrated to reference standards) to the CD test set, measuring its response and adjusting (correcting) the CD test set to achieve results that match the standards used. In this way the CD test set results will be brought to close agreement with other CD test sets also calibrated in the manner described in this standard.

Primarily the artefacts or standards used are as follows:

a) wavelength artefact(s) used to calibrate the light source wavelength(s) used by the CD test set. This is to establish the correct excitation wavelength for the system (the 'x-axis') in order that the correct delay or dispersion (the 'y-axis') be determined subsequently;

b) delay or dispersion artefact(s) used to calibrate the delay or dispersion response of the CD test set (the 'y-axis').

Calibration can only be carried out using these artefacts. After a calibration has been completed, a calibration period is defined over which the CD test set is deemed to remain calibrated. At the end of this period, it would be necessary to establish if the CD test set calibration requires updating (changing); this can be performed using the artefact described above, or by use of a known standard fibre (reference fibre) whose chromatic dispersion is known. This is referred to as calibration checking. The fibre forms a stable source of known dispersion and may be used as a simple dispersion artefact.

If it is found that the calibration has not changed within the required uncertainty limits, then it is possible to simply extend the calibration period again by a defined amount.

If, however, it is found that the CD test set measurement results have changed significantly compared to the user requirements (i.e. the test set has drifted), then calibration using the artefacts (if not already carried out at this time) should be carried out and the calibration renewed.

The above rationale ensures that the CD test set calibration is only ever performed using known standards (artefacts), but that if the CD test set is sufficiently stable over the calibration period selected, then a simple check of calibration can suffice to ascertain this and to (justify) allow the extension of the calibration period. The extension can be repeated indefinitely over many calibration periods, provided the CD test set continues to remain within uncertainty limits over the entire set of calibration periods.

In order to be considered calibrated and in conformance with this standard, a CD test set must have its calibration adjusted based on comparison to artefacts for the primary parameters of wavelength and delay [dispersion]. In all cases, this calibration of primary parameters is necessary, but may or may not be sufficient, to ensure calibration of the CD test set to the required uncertainty.

In addition, it may be necessary to also confirm or compensate the calibration state of a CD test set using a calibrated reference fibre. The CD test set calibration compensation is explained more fully in Annex D. It should be noted that use of a calibrated reference fibre alone is not sufficient to ensure calibration of a CD test set.

It should also be noted that if a calibrated CD test set undergoes calibration compensation using a calibrated reference fibre, the scope and extent of its calibration is limited to the conditions used at the time of calibration compensation (i.e. wavelength, fibre type, loss regime, etc.) Care should be exercised that test sets calibrated and compensated in this manner are used only within the appropriate limits of their calibration extent. The adjustments required to effect compensation on one set of wavelengths for one fibre type may increase the uncertainty of measurement of other fibre types with different minimum dispersion wavelengths.

In this document, the reference medium for wavelength and the velocity of light is assumed to be in normal air. However, since the velocity of light in air (or rather, the refractive index of air) is dependent on barometric pressure, humidity and temperature, it is sometime advantageous to reference the velocity of light in vacuum, and hence define the refractive index =1,0000000. This leads to a slight shift in the wavelength scale of the order of 0,3 nm to 0,4 nm depending on the wavelength value, between the so-called “wavelength in air” (as assumed in this document) and the wavelength in vacuum, also called “vacuum wavelength”.

Vacuum wavelength is typically used where very accurate dispersion control is required such as in long-haul or submarine fiber cable systems. CD test sets for measuring fibers used in these applications are typically calibrated to vacuum wavelength, e.g. using a wavemeter, or by mathematical correction of results obtained with an internal air wavelength calibration.

In order that the user be familiar with the conversion from air wavelength and the mathematical corrections involved, an informative annex, Annex E, is provided.

CALIBRATION OF FIBRE OPTIC CHROMATIC DISPERSION TEST SETS

1 Scope

This International Standard provides standard procedures for the calibration of optical fibre chromatic dispersion (CD) test sets. It also provides procedures to perform calibration checking on CD test sets whereby an extension to the test set calibration period may be obtained.

This standard is applicable to all types of CD test sets, with the exception that measurements on multimode optical fibres are excluded.

The purpose of this standard is to define a standard procedure for calibrating optical fibre chromatic dispersion (CD) test sets. The detailed calibration steps used vary according to the measurement technique used in the CD test set.

Whilst it is acknowledged that chromatic dispersion also occurs in multimode fibre and this fibre may be measured on many CD test sets, this standard will restrict discussion to single mode fibre measurements only.

The purpose of the procedures outlined in this standard is to focus manufacturers and users of CD test sets toward the reduction of measurement uncertainty in chromatic dispersion determination in optical fibres under all applicable conditions. The procedures apply to calibration laboratories and to the manufacturers or users of CD test sets for the purpose of

a) calibrating CD test sets;

b) setting specifications of CD test sets;

c) extending the calibration period of an already calibrated CD test set.

Use of the procedures also allows correct evaluation of CD test set uncertainty, relative and traceable to appropriate (for example, national) standards.

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 60050-731, *International Electrotechnical Vocabulary (IEV) – Chapter 731: Optical fibre communication*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide* [1)]

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1) A consolidated edition 1.2 exists (1998) that includes IEC 60825-1 (1993) and its Amendment 1 (1997) and Amendment 2 (2001).

IEC 62129, *Calibration of optical spectrum analyzers* [2)]

ISO 9000 (all parts), Quality management and quality assurance standards

BIPM/IEC/IFCC/ISO/IUPAC/IUPAP/OIML:1995, *Guide to the Expression of Uncertainty in Measurement (GUM)*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms and definitions

For the purposes of this document, the terms and definitions contained in IEC 60050(731) and the following definitions apply.

3.1
accredited calibration laboratory
calibration laboratory authorized by the appropriate national standards laboratory to issue calibration certificates with a minimum specified uncertainty, which demonstrate traceability to national standards

3.2
adjustment

modifying the hardware or firmware of a CD test set with the intention of making the measurement result of the CD test set equal to that of a national standard or a similar calibrated CD test set. This has the effect of correcting all subsequent measurements on that CD test set

3.3
artefact
device, instrument or equipment used in the process of calibrating a CD test set, for both wavelength and delay [dispersion]. The artefact is a means of transferring calibration of these parameters to a CD test set

3.4
calibration
process by which the relationship between the values indicated by the infant CD test set and known values of the calibration standard is established under specified conditions

NOTE The intention of calibration is to bring all CD test sets into substantial agreement with a suitable national standards laboratory. This may be performed by first comparing the relevant parameter of a measurement artefact with that produced by the CD test set, followed by transfer of that result, either by adjustment of the CD test set or by documentation of a calibration factor(s) in a calibration certificate. The pertaining environmental conditions and instrument state are usually recorded. Calibration includes estimation of all uncertainties. The use of reference fibres is for calibration checking only.

3.5
calibration chain
unbroken chain of transfers from a primary standard to the CD test set via reference standards, intermediate and/or working standards (see Figure 1)

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2) To be published.