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Optična vlakna - 1-22. del: Merilne metode in postopki preskušanja - Merjenje dolžine

Optical fibres - Part 1-22: Measurement methods and test procedures - Length measurement

Lichtwellenleiter - Teil 1-22: Messmethoden und Prüfverfahren - Längenmessung

Fibres optiques - Partie 1-22: Méthodes de mesure et procédures d'essai - Mesure de la longueur

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en

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Fibres and cables

oSIST prEN IEC 60793-1-22:2023

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IEC SC 86A : FIBRES AND CABLES				
Secretariat:		SECRETARY:		
France		Mr Laurent Gasca		
OF INTEREST TO THE FOLLOWING COMMITTEES:		PROPOSED HORIZONTAL STAN	NDARD:	
		Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.		
FUNCTIONS CONCERNED:				
EMC		QUALITY ASSURANCE	SAFETY	
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Attention IEC-CENELEC p The attention of IEC Natio CENELEC, is drawn to the for Vote (CDV) is submitted	nal Committees, members of fact that this Committee Draft d for parallel voting.	s.iteh.ai)	ELEC PARALLEL VOTING	
Attention IEC-CENELEC p The attention of IEC Natio CENELEC, is drawn to the for Vote (CDV) is submitted The CENELEC members a CENELEC online voting sys	parallel voting nal Committees, members of fact that this Committee Draft d for parallel voting. re invited to vote through the stem.	S.iteh.ai	ELEC PARALLEL VOTING	

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TITLE:

Optical fibres - Part 1-22: Measurement methods and test procedures - Length measurement

PROPOSED STABILITY DATE: 2027

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57	INTERNATIONAL ELECTROTECHNICAL COMMISSION				
58					
59	OPTICAL FIBRES –				
60 61 62	Part 1-22: Measurement methods and test procedures – Length measurement				
63	FOREWORD				
64 65 66 67 68 69 70 71	 The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations. 				
72 73 74	2) The formal decisions or agreements of the 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 National Committees.				
75 76 77	3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.				
78 79 80 81	4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.				
82 83	4) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.				
84 85	 Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights. 				
86 87	4c24c61a9075/osist-pren-iec-60793-1-22-2023 International Standard IEC 60793-1-22 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.				
88 89	This second edition cancels and replaces the first edition published in 2001. This edition constitutes a technical revision.				
90 91	This edition includes the following significant technical changes with respect to the previous edition:				
92	a) Inclusion of category C single mode fibres in Table 1				
93	b) Inclusion of a new informative Annex F on Brillouin frequency shift test method				
94	The text of this standard is based on the following documents:				
	FDIS Report on voting				
	86A/687/FDIS 86A/726/RVD				
95 96 97	Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.				

⁹⁸ This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

Annexes A, B, C, D and E form an integral part of this standard.

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- 101 IEC 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
- 105 The committee has decided that the contents of this publication will remain unchanged 106 until XXXX. At this date, the publication will be
- 107 reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- 110 amended.
- 111
- 112

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114

- Publications in the IEC 60793-1 series concern measurement methods and test procedures as they apply to optical fibres.
- 117 Within the same series several different areas are grouped, as follows:
 - IEC 60793-1-20 to Measurement methods and test procedures for dimensions IEC 60793-1-29:
 - IEC 60793-1-30 to IEC Measurement methods and test procedures for mechanical charac-60793-1-39: teristics
 - IEC 60793-1-40 to Measurement methods and test procedures for transmission and IEC 60793-1-49: optical characteristics
 - IEC 60793-1-50 to Measurement methods and test procedures for environmental IEC 60793-1-59: characteristics.
 - IEC 60793-1-60 to Measurement methods and test procedures for polarization-IEC 60793-1-69: maintaining fibres.

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119	OPTICAL FIBRES –
120	Part 1-22: Measurement methods and test procedures –
121	Length measurement
122	

123 **1 Scope**

124 This part of IEC 60793 establishes uniform requirements for measuring the length and elongation 125 of optical fibre (typically within cable).

126 The length of an optical fibre is one of the most fundamental values and shall be known for the 127 evaluation of transmission characteristics such as losses and bandwidths.

In addition, informative Annex F has been added to determine the tensile strain applied to a
 fibre. It uses Brillouin reflectometry (BOTDR) or so-called Brillouin analysis (BOTDA), which
 are single-sided and double-sided methods respectively.

131 **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.

135 IEC 60793-1-40, Optical fibres – Part 1-40: Measurement methods and test procedures – 136 Attenuation

- IEC 60793-1-42, Optical fibres Part 1-42: Measurement methods and test procedures –
 Chromatic dispersion
- 139 IEC 60794-1-1, Optical fibre cables Part 1-1: Generic specification General

3 Terms and definitions

- 141 For the purposes of this document, the following terms and definitions apply.
- ISO and IEC maintain terminological databases for use in standardization at the followingaddresses:
- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

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150 **4 Overview of method**

This standard gives five methods for measuring length, which are presented in the following table 1.

153

Table 1 – Measurement methods

Method	Characteristics covered	Fibre category(ies) covered
A Delay measuring	Length	All A1, B, and C
B Backscattering	Length	All A1, B, and C
C Fibre elongation ^a	Fibre elongation °	A1, B1 ^b , and C
D Mechanical	Length	All
E Phase shift	Length	All A1, B, and C

^a The measurement of fibre elongation, method C, is part of several measurement methods for fibres and fibre optic cables, such as those in IEC 60794-1-1.

^b This measurement is applicable unreservedly to type B single-mode fibres. For type A1 multimode fibres, take particular care when interpreting the results because the results of this measurement may be influenced by interfering modal effects, for example, due to the occurrence of non-longitudinal stresses on the fibre. Application of the measurement to A2 to A4 multimode fibres is under consideration.

^c In addition, informative Annex F has been added to determine the tensile strain applied to a fibre. It uses Brillouin reflectometry (BOTDR) or so-called Brillouin analysis (BOTDA), which are single-sided and doublesided methods respectively.

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Information common to all measurements is contained in clauses 2 to 8. Information on specific
 application appears in annexes A, B, C, D, and E for methods A, B, C, D and E, respectively.

157 4.1 Method A – Delay measuring

The delay measuring method applies to measurements of the fibre length by the measurement of the propagation time of an optical pulse or a pulse train on the basis of a known value of the group index of the fibre.

Alternatively, this method is suitable for measuring the group index of a fibre of known length. Therefore, in practice this fibre length measurement method is calibrated against a known length of fibre of the same type.

164 **4.2 Method B – Backscattering**

165 The backscattering method, which is a single-sided measurement, uses an optical time domain 166 reflectometer (OTDR), and measures the optical power backscattered from different points in 167 the fibre to the beginning of the fibre.

168 **4.3 Method C – Fibre elongation**

This measurement method describes a procedure for determining the fibre elongation. It does not measure absolute strain, but instead measures the changes in strain from one loading condition to another.

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4.4 Method D – Mechanical length

This measurement method describes a procedure for determining the fibre length by winding a fibre around a fixed diameter calibrated wheel that rotates. The length is determined by the number of revolutions of the wheel.

176 4.5 Method E – Phase shift

The phase shift method describes a procedure for determining the fibre length. The length is determined from the phase shift that occurs when a predetermined modulation frequency f_{max} is applied.

180

181 **4.6 Reference test method**

The reference test method (RTM), which shall be the one used to settle disputes, varies depending on whether the fibre is cabled or not, such as

- 184 uncabled fibre: method D;
- 185 length of fibre within cable: method B;
- 186 elongation of fibre within cable: method C;
- 187 elongation of uncabled fibre: method C;

188 **5** Apparatus

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

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- 191 6 Sampling and specimens /catalog/standards/sist/6bb6861c-4a14-4bd3-be74-4c24c61a9075/osist-pren-iec-60793-1-22-2023
- See the appropriate annex A, B, C, D or E for specific requirements. General requirementsfollow.
- Prepare a flat end face, perpendicular to the fibre axis, at the input and output ends of each specimen for measurements based on optical delay measurements.

196 7 Procedure

197 See the appropriate annex A, B, C, D or E for specific requirements.

198 8 Calculations

199 See the appropriate annex A, B, C, D or E for specific requirements.

200 9 Results

- 201 The following information shall be provided with each measurement:
- 202 date and title of measurement;
- 203 identification and description of specimen, including whether fibre or cable;
- 204 specimen length, or elongation;
- 205 measurement method used: A, B, C, D or E;
- 206 other results, as required by the appropriate annex, A, B, C, D or E.

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- 207 The following information shall be available upon request:
- 208 description of measurement apparatus arrangement;
- 209 type and wavelength of measurement source;
- 210 launch conditions;
- 211 details of computation technique;
- 212 date of latest calibration of equipment.

213 See annexes A, B, C, D and E for any additional information that shall be available upon 214 request.

10 Specification information

- 216 The detail specification shall specify the following information:
- 217 type of fibre (or cable) to be measured;
- 218 failure or acceptance criteria;
- 219 information to be reported;
- 220 deviations to the procedure that apply.
- 221

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(A.1)

222 Annex A (normative)
224
225 Requirements specific to method A – Delay measuring
227
228

229 A.1 General

Use this method to measure the length of optical fibre by itself, or installed in cable. If the specimen is a fibre in a cable, determine the value of group index *N* under conditions applicable to the specimen under measurement (for example, tension, temperature). This is done by inverting equation (A.1) and the measurements on a specimen with a known length.

234 A.2 Principle

An optical pulse travelling through an optical fibre with length *L* and average group index *N* experiences a travelling/delay time, Δt :

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238 where

239 Δt is the time delay;

240 N is the average group index;

241 C is the velocity of light in vacuum

241 C is the velocity of light in vacuum.

If *N* is known, the measurement of Δt gives *L*. On the other hand, the measurement of Δt gives the value of *N* when *L* is known.

A.3 Apparatus

245 A.3.1 Two techniques

- There are two techniques for measuring the propagation time of an optical pulse:
- 247 time measurement of the transmitted pulse (Δt measured);
- 248 time measurement of the reflected pulse ($2\Delta t$ measured).
- 249 See figures A.1 and A.2 for two different arrangements corresponding to the two techniques 250 applying a sampling oscilloscope.
- Instead of the sampling oscilloscope, backscattering equipment, or a counter with separate start/stop gate and averaging capability (for example, at least 10⁴ counts), can be used.