

© Copyright SEK. Reproduction in any form without permission is prohibited.

**Optofibrer –
Del 1-33: Mätning och provning –
Spänningsskorrosion (mekanisk påkänning)**

*Optical fibres –
Part 1-33: Measurement methods and test procedures –
Stress corrosion susceptibility*

Som svensk standard gäller europastandarden EN 60793-1-33:2017. Den svenska standarden innehåller den officiella engelska språkversionen av EN 60793-1-33:2017.

Nationellt förord

Europastandarden EN 60793-1-33:2017

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 60793-1-33, Second edition, 2017 - Optical fibres - Part 1-33: Measurement methods and test procedures - Stress corrosion susceptibility**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 60793-1-33, utgåva 1, 2004, gäller ej fr o m 2020-09-20.

ICS 33.180.10

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a mätning, säkerhet och provning och för utförande, skötsel och dokumentation av elprodukter och elanläggningar.

Genom att utforma sådana standarder blir säkerhetsfordringar tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK Svensk Elstandard

Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 60793-1-33

November 2017

ICS 33.180.10

Supersedes EN 60793-1-33:2002

English Version

**Optical fibres - Part 1-33: Measurement methods and test
procedures - Stress corrosion susceptibility**
(IEC 60793-1-33:2017)

Fibres optiques - Partie 1-33: Méthodes de mesure et
procédures d'essai - Résistance à la corrosion sous
contrainte
(IEC 60793-1-33:2017)

Lichtwellenleiter - Teil 1-33: Messmethoden und
Prüfverfahren - Spannungskorrosionsempfindlichkeit
(IEC 60793-1-33:2017)

This European Standard was approved by CENELEC on 2017-09-20. 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

European foreword

The text of document 86A/1803/FDIS, future edition 1 of IEC 60793-1-33:2017, prepared by IEC/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 60793-1-33:2017.

The following dates are fixed:

- latest date by which this document has (dop) 2018-06-20
to be implemented at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2020-09-20

This document supersedes EN 60793-1-33:2002.

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

The text of the International Standard IEC 60793-1-33:2017 was approved by CENELEC as a European Standard without any modification.

CONTENTS

FOREWORD	5
INTRODUCTION	7
1 Scope	8
2 Normative references	8
3 Terms and definitions	8
4 Overview of test methods	9
5 Reference test methods	9
6 Apparatus	9
7 Sampling and specimens	9
7.1 General	9
7.2 Specimen length	9
7.3 Specimen preparation and conditioning	9
8 Procedure	10
9 Calculations	10
10 Results	10
11 Specification information	11
Annex A (normative) Dynamic n value, n_d , by axial tension	12
A.1 General	12
A.2 Apparatus	12
A.2.1 General	12
A.2.2 Support of the specimen	13
A.2.3 Stressing application	14
A.2.4 Fracture force measurement	14
A.2.5 Strain rate control	14
A.2.6 Stress rate characterization	15
A.3 Test sample	15
A.3.1 Sample size	15
A.3.2 Sample size (optional)	15
A.4 Procedure	15
A.5 Calculations	16
A.5.1 Fracture stress	16
A.5.2 Fracture stress at a given strain rate	16
A.5.3 Dynamic (tension) stress corrosion susceptibility parameter, n_d	17
A.6 Results	17
Annex B (normative) Dynamic n value, n_d , by two-point bending	19
B.1 General	19
B.2 Apparatus	19
B.2.1 General	19
B.2.2 Stepper motor control	19
B.2.3 Stepper motor-driven movable platen	19
B.2.4 Stationary platen	19
B.2.5 Platen velocity	19
B.2.6 Fibre fracture detecting system	19
B.3 Test sample	20
B.4 Procedure	20

B.5 Calculations	21
B.5.1 Fracture stress	21
B.5.2 Dynamic (two-point bending) stress corrosion susceptibility parameter, n_d	21
B.5.3 Results	22
Annex C (normative) Static n value, n_s , by axial tension	24
C.1 General.....	24
C.2 Apparatus	24
C.2.1 General	24
C.2.2 Gripping the fibre at both ends.....	24
C.2.3 Stressing the fibre	24
C.2.4 Measuring time to fracture	24
C.3 Test sample	24
C.4 Procedure	24
C.5 Calculations	25
C.5.1 Fracture stress	25
C.5.2 Static (tension) stress corrosion susceptibility parameter, n_s	25
C.5.3 Simple median.....	25
C.6 Results	25
Annex D (normative) Static n value, n_s , by two-point bending	27
D.1 General.....	27
D.2 Apparatus	27
D.2.1 Test equipment.....	27
D.2.2 Fibre fracture detection.....	27
D.3 Test sample	27
D.4 Procedure	27
D.5 Calculations	27
D.5.1 Fracture stress	27
D.5.2 Static (two-point bending) stress corrosion susceptibility parameter, n_s	28
D.6 Results	28
Annex E (normative) Static n value, n_s , by uniform bending	29
E.1 General.....	29
E.2 Apparatus	29
E.2.1 General	29
E.2.2 Support of the sample.....	29
E.2.3 Stressing the fibre	29
E.2.4 Measuring time to fracture	29
E.3 Test sample	29
E.4 Procedure	29
E.5 Calculations	30
E.5.1 Fracture stress	30
E.5.2 Static (uniform bending) stress corrosion susceptibility parameter, n_s	30
E.6 Results	30
Annex F (informative) Considerations for dynamic stress corrosion susceptibility parameter calculations	31
F.1 Specimen size and sample size	31
F.1.1 Specimen size	31
F.1.2 Sample size.....	31

F.2	Numeric algorithm for calculation of dynamic stress corrosion susceptibility parameter, n_d	32
F.3	Complete method to calculate fracture stress.....	33
Annex G (informative)	Considerations for static stress corrosion susceptibility parameter calculations	35
G.1	Homologous method	35
G.2	Maximum likelihood estimate	35
Annex H (informative)	Considerations on stress corrosion susceptibility parameter test methods.....	36
H.1	General.....	36
H.2	Crack growth	36
H.3	Types of stress corrosion susceptibility test methods	37
H.4	Comparison of n value obtained with different methods.....	37
H.5	Conclusion.....	38
Bibliography.....		40
Figure A.1 – Schematic of translation test apparatus		12
Figure A.2 – Schematic of rotational test apparatus		13
Figure A.3 – Schematic of rotational test apparatus with load cell		13
Figure A.4 – Representation of dynamic fatigue graph		18
Figure B.1 – Schematic of two-point bending unit.....		22
Figure B.2 – Schematic of possible dynamic fatigue (two-point bending) apparatus		23
Figure B.3 – Schematic of dynamic fatigue data.....		23
Figure C.1 – Schematic of possible static fatigue (tension) apparatus		26
Figure D.1 – Possible test equipment schematic		28
Figure E.1 – Schematic of possible static fatigue (uniform bending) apparatus		30
Figure H.1 – COST 218 round robin results of fracture strength versus "effective" time-to-fracture for dynamic and static axial tension, dynamic and static two-point bending and static mandrel test methods		38
Figure H.2 – COST 218 round robin results of fracture strength versus "effective" time-to-fracture for dynamic and static axial tension, dynamic and static two-point bending and static mandrel test methods		39
Table F.1 – 95 % confidence interval for n_d		32

INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL FIBRES –**Part 1-33: Measurement methods and test procedures –
Stress corrosion susceptibility****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 60793-1-33 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

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

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

- a) removal of RTM;
- b) changes to scope.

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

FDIS	Report on voting
86A/1803/FDIS	86A/1824/RVD

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.

A list of all parts of 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 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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

Annexes F, G, and H are for information only.

OPTICAL FIBRES –

Part 1-33: Measurement methods and test procedures – Stress corrosion susceptibility

1 Scope

This part of IEC 60793 contains descriptions of the five main test methods for the determination of stress corrosion susceptibility parameters.

The object of this document is to establish uniform requirements for the mechanical characteristic of stress corrosion susceptibility for silica-based fibres. Dynamic fatigue and static fatigue tests are used to determine the (dynamic) n_d value and (static) n_s value of stress corrosion susceptibility parameters. Currently, only the n_d -value is assessed against specification. Measured values greater than 18 per this procedure reflect the n_d -value of silica, which is approximately 20. Higher values will not translate to demonstrable enhanced fatigue resistance.

Silica fibre mechanical tests determine the fracture stress and fatigue properties under conditions that model the practical applications as closely as possible. The following test methods are used for determining stress corrosion susceptibility:

- A: Dynamic n_d value by axial tension;
- B: Dynamic n_d value by two-point bending;
- C: Static n_s value by axial tension;
- D: Static n_s value by two-point bending;
- E: Static n_s value by uniform bending.

These methods are appropriate for category A1, A2 and A3 multimode, class B single-mode fibres and class C intraconnecting single-mode fibres.

These tests provide values of the stress corrosion parameter, n , that can be used for reliability calculations according to IEC TR 62048 [18]¹.

Information common to all methods is contained in Clauses 1 to 10, and information pertaining to each individual test method appears in Annexes A, B, C, D, and E.

Annexes F and G offer considerations for dynamic and static stress corrosion susceptibility parameter calculations, respectively; Annex H offers considerations on the different stress corrosion susceptibility parameter test methods.

2 Normative references

There are no normative references in this document.

¹ Numbers in square brackets refer to the Bibliography.