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INTERNATIONAL STANDARD

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

Fibres optiques –
Partie 1-33: Méthodes de mesures et procédures d'essai – Résistance à la corrosion sous contrainte

IEC 60793-1-33:2017-08(en-fr)

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OPTICAL FIBRES –

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

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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- withdrawn,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.

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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.

3 Terms and definitions

No terms and definitions are listed in this document.

[1] Numbers in square brackets refer to the Bibliography.

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

4 Overview of test methods

The following test methods are available:

– Dynamic n_d value by axial tension, see Annex A.

– Dynamic n_d value by two-point bending, see Annex B.

– Static n_s value by axial tension, see Annex C.

– Static n_s value by two-point bending, see Annex D.

– Static n_s value by uniform bending, see Annex E.

5 Reference test methods

At the time of this revision, no agreement could be reached in maintaining method A only as RTM in using it with some fibres equipped with modern coatings. Method A or B should be used to resolve disputes because they may be completed in a duration practical for dispute resolution.

6 Apparatus

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

7 Sampling and specimens

7.1 General

These measurements are statistical in nature. A number of specimens or samples from a common population are tested, each under several conditions.

Failure stress or time statistics for various sampling groups are used to calculate the stress corrosion susceptibility parameters.

7.2 Specimen length

Specimen length is contingent on the test procedure used. See Annexes A, B, C, D, and E for the length required for each test method. For tensile tests, the length ranges from 0,5 m to at most 5 m. For two-point bending tests, the actual length tested is less than 1 cm and for uniform bending tests, about 1 m.

7.3 Specimen preparation and conditioning

All of the test methods shall be performed under constant environmental conditions. Unless otherwise specified in the detail specification, the nominal temperature shall be in the range of 20 °C to 23 °C with a tolerance of ±2 °C for the duration of the test. Unless otherwise specified in the detail specification, the nominal relative humidity (RH) shall be in the range of 40 % to 60 % with a tolerance of ±5 % for the duration of the test.

Unless otherwise specified, all specimens shall be pre-conditioned in the test environment for a minimum period of 12 h.

A method for extrapolating such stress corrosion susceptibility parameters to service environments different from the default environment specified above has not been developed.

It has been observed that the value of n produced by these tests can change after even brief exposure of the fibre to elevated temperature and humidity. A guide for the use of these methods is documented in IEC TR 62048 [18].

The observed value of stress corrosion susceptibility parameter, n, may differ between fatigue test methods, if not performed in the same effective measuring time and effective glass area under test (see Annex H). Care should be taken in the choice of test method. This should be agreed between the customer and supplier.

8 Procedure

See Annexes A, B, C, D, and E for the individual test methods.

Each of several samples (consisting of a number of specimens) is exposed to one of a number of stress conditions. For static fatigue tests, a constant stress is applied from sample to sample and time to failure is measured. For dynamic fatigue tests, the stress rate is varied from sample to sample, and the failure stress is measured.

The following is an overview of the procedures common to all methods:

- complete pre-conditioning;
- divide the specimens into sample groups;
- apply the specified stress conditions to each sample group;
- measure time or stress at failure;
- complete calculations.

9 Calculations

The calculations for each individual test method are found in Annexes A, B, C, D, and E.

10 Results

The following information shall be reported with each test:

- fibre identification;
- test date;
- stress corrosion susceptibility parameter;
- test method.

The following information shall be provided upon request:

- specific information as required by the test method;
- relative humidity and ambient temperature;
- any special pre-conditioning.

Clauses A.5, B.5, C.5, D.5, and E.5 have results that apply to each specific method.

11 Specification information

The detail specification shall specify the following information:

– information to be reported;
– any deviations to the procedure that apply;
– failure or acceptance criteria.

Annex A
(normative)

Dynamic n value, n_d, by axial tension

A.1 General

This method is designed for determining the dynamic stress corrosion susceptibility parameter (dynamic n value, n_d) of optical silica-based fibre at specified constant strain rates.

This method is intended only to be used for those optical fibres of which the median fracture stress is greater than 3 GPa at the highest specified strain rate. For fibres with median fracture stress less than 3 GPa, the conditions herein have not demonstrated sufficient precision.

This method is intended to test fatigue behaviour of fibres by varying the strain rate. The test is applicable to fibres and strain rates for which the logarithm of fracture stress versus the logarithm of strain rate behaviour is linear.

A.2 Apparatus

A.2.1 General

Clause A.2 describes the fundamental requirements of the equipment used for dynamic fracture stress testing. There are several configurations that meet these requirements. Examples are presented in Figures A.1 to A.3. Unless otherwise specified in the detail specification, use a gauge length of 500 mm for tensile test specimens.

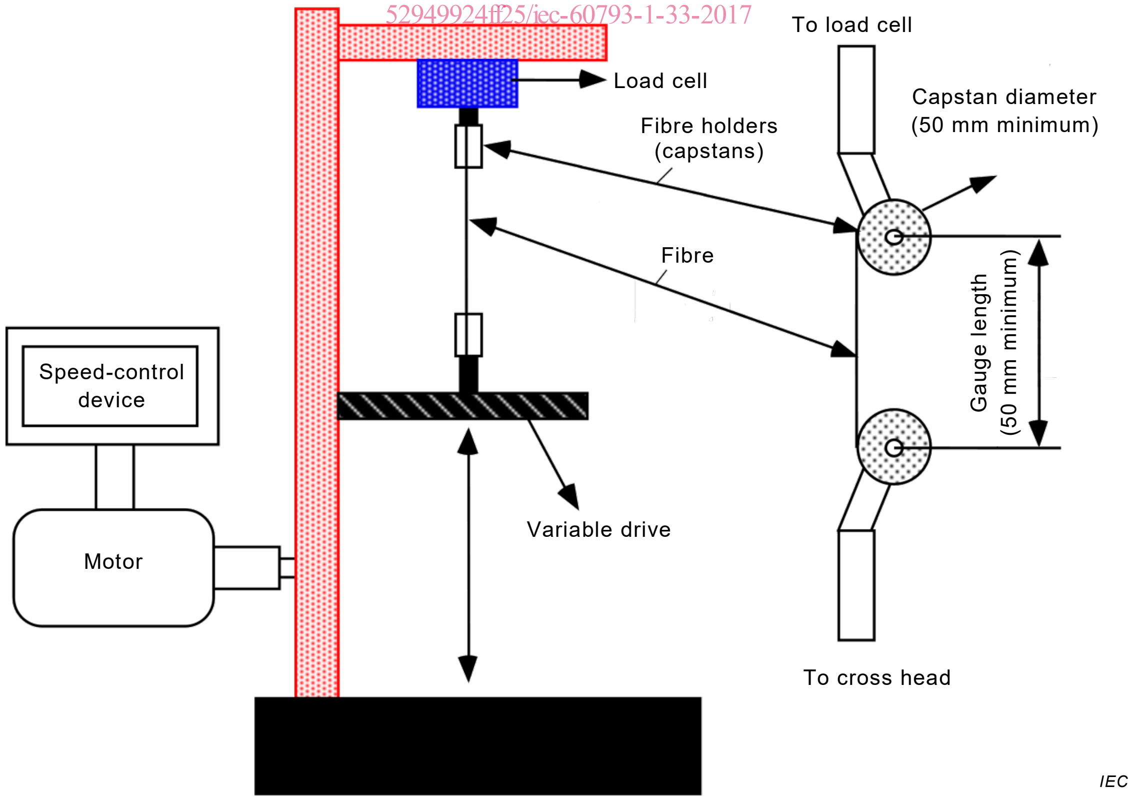

Figure A.1 – Schematic of translation test apparatus

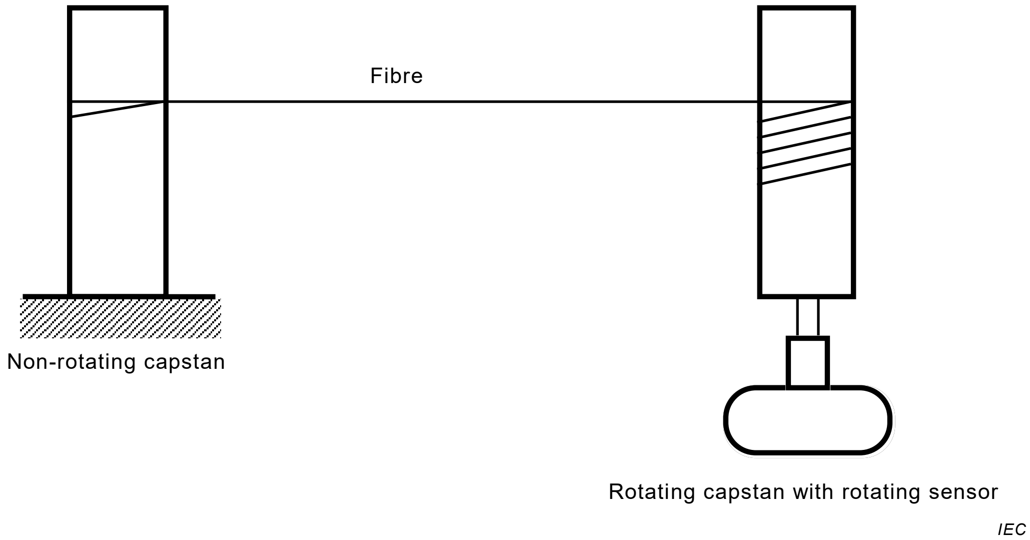

Figure A.2 – Schematic of rotational test apparatus

Figure A.3 – Schematic of rotational test apparatus with load cell

A.2.2 Support of the specimen

Grip the fibre length to be tested at both ends and subject the fibre to tension until fracture occurs in the gauge length section of the fibre. Minimize the fibre fracture at the grip – a sensitive aspect of this method – by providing a surface friction that prevents excessive slippage.

Do not include breaks that occur at the grip in the sample or use them in the calculations.

Use a capstan, optionally covered with an elastomeric sheath, to grip the fibre. Wrap a section of the fibre that will not be tested around the capstan several times and secure it at the end with, for example, an elastic band or masking tape. Apply sufficient fibre length at the grip in order to avoid slippage inside the coating (coating type depending aspect [19]). Wrap the fibre with no crossovers. The gauge length is the length of fibre between the axes of the gripping capstans before it is stretched.