IEC 60794-1-23

Edition 2.0 2019-10

INTERNATIONAL STANDARD

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Optical fibre cables – Part 1-23: Generic specification – Basic optical cable test procedures – Cable element test methods

Câbles à fibres optiques – Partie 1-23: Spécification générique – Procédures fondamentales d'essai des câbles optiques – Méthodes d'essai des éléments de câble

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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 60794-1-23 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 2012. It constitutes a technical revision.

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

a) addition of a new test method G9: Bleeding and evaporation (formerly known as method E15 in IEC 60794-1-21:2015);
b) addition of a new test method G10A: Stripping force stability of cabled optical fibres (formerly known as method E5A in IEC 60794-1-21:2015);
c) addition of a new test method G10B: Strippability of optical fibre ribbons (formerly known as method E5B in IEC 60794-1-21:2015);
d) addition of a new test method G10C: Strippability of buffered optical fibres (formerly known as method E5C in IEC 60794-1-21:2015);

e) addition of a new test method G11A: Tensile strength and elongation of buffer tubes (included in IEC 60811-501);

f) addition of a new test method G11B: Elongation of buffer tubes at low temperature (included in IEC 60811-505);

g) clarification of the sample preparation procedure in method G5: Ribbon tear (separability);

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

CDV	Report on voting
86A/1912/CDV	86A/1945/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.

A list of all parts in the IEC 60794 series, published under the general title *Optical fibre cables*, 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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OPTICAL FIBRE CABLES

Part 1-23: Generic specification – Basic optical cable test procedures – Cable element test methods

1 Scope

This part of IEC 60794 describes test procedures to be used in establishing uniform requirements for the geometrical, material, mechanical, environmental properties of optical fibre cable elements.

This document applies to optical fibre cables for use with telecommunication equipment and devices employing similar techniques, and to cables having a combination of both optical fibres and electrical conductors.

Throughout the document, the wording "optical cable" can also include optical fibre units, microduct fibre units, etc.

NOTE The environmental testing of optical fibre ribbon would be valuable for some applications. Useful information about suitable test methods can be found in the optical fibre standards IEC 60793-1-50, IEC 60793-1-51, IEC 60793-1-52, and IEC 60793-1-53.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60794-1-2, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures – General guidance*

IEC 60794-1-31:2018, *Optical fibre cables – Part 1-31: Generic specification – Optical cable elements – Optical fibre ribbon*

IEC 60793-1-32:2018, *Optical fibres – Part 1-32: Measurement methods and test procedures – Coating strippability*

IEC 60793-1-40, *Optical fibres – Part 1-40: Attenuation measurement methods*

IEC 60793-1-46, *Optical fibres – Part 1-46: Measurement methods and test procedures – Monitoring of changes in optical transmittance*

IEC 60811-401, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven*

3 Terms and definitions

No terms and definitions are listed in this document.

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 General requirements

IEC 60794-1-2 is the reference guide to test methods of all types. It shall be considered for general requirements and definitions.

5 Method G1: Bend test for optical cable elements

5.1 Object

The purpose of this test is to characterize cable elements for splicing purposes by determining the attenuation increase of an optical cable element (fibre, ribbon, core tube, breakout unit, etc.) when bent within a splice closure or similar device.

5.2 Sample

The length of the sample of optical cable element shall be sufficient to carry out the testing specified.

5.3 Apparatus

The apparatus consists of

a) a mandrel having a smooth surface with diameter as stated in the detail specification, and

b) an attenuation measuring apparatus for the determination of attenuation change (according to the test methods of IEC 60793-1-40 and IEC 60793-1-46).

5.4 Procedure

The element to be tested shall be wound on the mandrel at minimal tension; the number of turns shall be stated in the detail specification.

In order to measure the attenuation increase caused by bending, allowance should be made for the intrinsic attenuation of the fibre.

5.5 Requirements

Any increase in attenuation shall comply with the limits shown in the detail specification.

5.6 Details to be specified

The detail specification shall include the following:

a) optical test wavelength;

b) diameter of the mandrel;

c) number of turns;

d) apparatus and attenuation measuring technique;

e) temperature at which the evaluation shall be performed if different from room temperature.

6 Method G2: Ribbon dimensions and geometry – Visual method

6.1 Object

The purpose of this test is to determine the geometry of an optical fibre ribbon as defined by the parameters of width, height and fibre alignment, for the purpose of type testing to assume proper manufacturing process control. This test is not necessarily suitable for final product inspection and, unless otherwise specified, shall not be used for that purpose.

6.2 Sample

The number of samples to be tested shall be specified in the detail specification. The selected samples shall be statistically independent and representative of the ribbon population tested.

6.3 Apparatus

The apparatus consists of a microscope or profile projector with appropriate magnification.

6.4 Procedure

6.4.1 General

Either of the two procedure methods described in 6.4.2 and 6.4.3 may be used.

For the specified number of samples, all dimensions shall be measured as average as well as maximum and minimum values.

Care should be taken that the preparation of the sample does not change the structure of the fibre ribbon and represents an undisturbed image of the fibre cladding and ribbon cross-section.

6.4.2 Method 1

The sample is prepared by cutting it perpendicular to the axis of the ribbon and placing it in a curable resin or in a tool which holds the ribbon. If necessary, the sample shall be ground and polished to prepare a smooth perpendicular end face. The prepared sample is secured with its end face perpendicular to the optical path and measured by means of a microscope or profile projector.

6.4.3 Method 2

Place the ribbon in a ribbon fibre holder and remove 20 mm to 25 mm of the fibre coating and matrix material with the ribbon hot sheath stripping tool and wipe the stripped portion of the fibres clean with an alcohol-moistened pad. Adjust the position of the ribbon in the ribbon fibre holder and cleave the fibres at a distance of 250 μm to 500 μm from the stripped edge of the ribbon. Cut and polish the other end of the ribbon, and illuminate it with a collimated light source. Align and measure the cleaved end of the ribbon under microscope.

6.5 Requirements

Unless otherwise specified in the detail specification, the width, height and fibre alignment shall be in accordance with IEC 60794-1-31:2018.

6.6 Details to be specified

The detail specification shall include the following:

a) permissible maximum and minimum values;

b) limits for average values;

c) number of samples tested.

6.7 Definitions of ribbon dimensions and geometry

6.7.1 General

The following definitions apply to a fibre ribbon cross-section as shown in Figure 1. The figure illustrates an example for a 4-fibre ribbon, where a is the diameter of a coloured fibre.

NOTE In consideration of the precision of fibre geometric attributes and the relatively larger precision of ribbon geometry requirements, it is acceptable for glass core/glass cladding fibres to use the edge of the cladding for the measurements of 6.7.3 and 6.7.4 in lieu of the fibre centres. In this case, the measurements can be made on the same side of all fibres (e.g. top or bottom, left or right side).

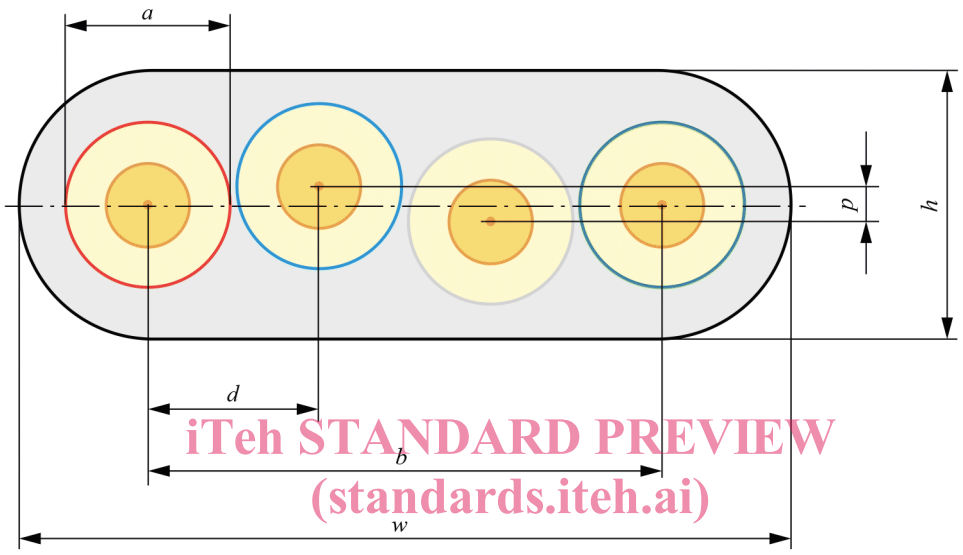

Figure 1 – Cross-sectional drawing illustrating fibre ribbon geometry

6.7.2 Width and height

The width w and height h of the ribbon are the dimensions of the minimum rectangular area enclosing the ribbon cross-section.

6.7.3 Basis line

The basis line is that line in the cross-section of an optical fibre ribbon crossing the fibre centres of the first fibre (fibre 1) and the last fibre (fibre n) of the fibre ribbon, as shown in Figure 1 as dotted line. This line is used as the reference plane for the fibre alignment measurements.

6.7.4 Fibre alignment

6.7.4.1 Horizontal fibre separation

The horizontal separation of fibres is the distance of the orthogonal projection of two fibre centres on the basis line in the fibre ribbon cross-section.

Two horizontal separation parameters can be distinguished:

a) centre-centre distance d between adjacent fibres;

b) centre-centre distance b between the extreme fibres.

6.7.4.2 Planarity

The planarity p of the fibre ribbon structure is the sum of the maximum positive and absolute value of the maximum negative vertical separation of the fibres.

The vertical separation of the fibres is the orthogonal distance from the fibre centre to the basis line. The vertical separation is positive for fibres "above" the basis line and negative for fibres "below" the basis line.

7 Method G3: Ribbon dimensions – Aperture gauge

7.1 Object

The purpose of this test is to verify the functional performance of a ribbon. In order to ensure functional performance, the dimensions of edge bonded ribbons may be controlled and verified for final inspection purposes with an aperture gauge. The intent is to verify that the end portion of a ribbon can be inserted into and would be reasonably aligned to the guide slots of commercial stripping tools.

7.2 Sample

Unless otherwise specified in the detail specification, five representative ribbon samples, each with a minimum length of 50 mm, shall be taken from the ribbon to be tested.

7.3 Apparatus

An aperture gauge, as shown in Figure 2 shall be used to assess the overall dimensions of a ribbon. The values for ribbon width (w) and ribbon height (h) of Figure 2 shall be the nominal ribbon dimensions as established using method G2 in an appropriate quality assessment scheme.

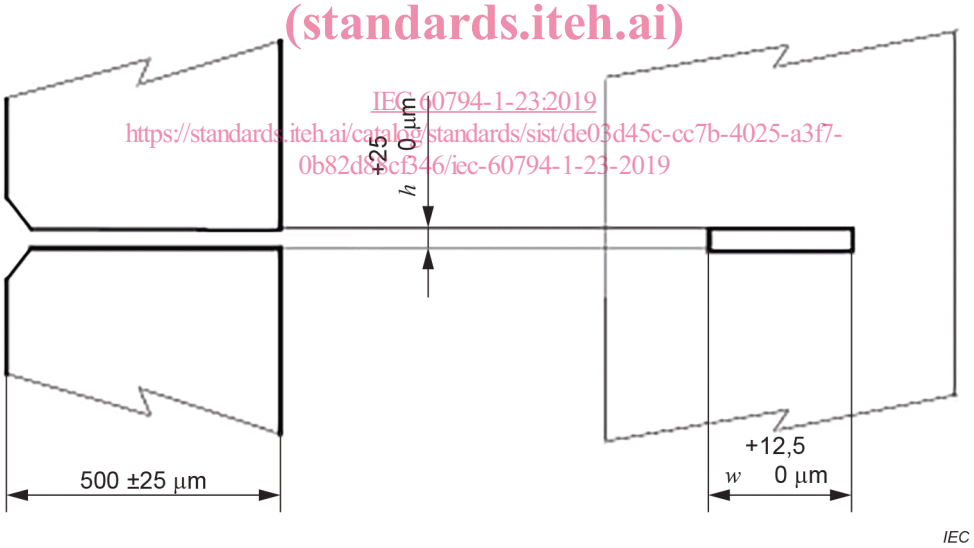

Figure 2 – Aperture gauge

7.4 Procedure

The ribbon sample to be tested is held in the middle, and a 10 mm end portion is inserted through the aperture gauge.

7.5 Requirement

It shall be possible for the 10 mm ribbon end portion to be freely inserted through the aperture gauge without mechanical damage to the sample.

7.6 Details to be specified

The detail specification shall include the following:

a) dimensions of the aperture gauge;

b) number of samples to be tested.

8 Method G4: Ribbon dimensions – Dial gauge (obsoleted method)

9 Method G5: Ribbon tear (separability)

9.1 Object

The purpose of this test is to assure sufficient tear resistance for ribbons where the fibres are not required to be separable, or to assure sufficient separability of the fibres for ribbons where the fibres are required to be separated. The intention of this test is to be able to tear by hand without damage.

9.2 Sample

A number of samples of fibre ribbon, as specified in the detail specification, typically 3 to 5, shall be selected from the ribbon or ribbons to be tested. The length of each sample shall be sufficient to provide the number of test specimens as detailed below.

For an n fibre ribbon, n/2 specimens are taken from each of the samples above. Each specimen shall be 100 mm minimum length, consistent with Figure 3.

Prepare the n/2 specimens involving increasing numbers of fibres to be separated as a ribbon unit. That is, a specimen for fibre 1; a specimen for fibres 1 to 2; a specimen for fibres 1 to 3; etc.

The fibres to be tested are separated with a knife or other suitable method on a suitable length for clamping, per Figure 3.

For the first sample, the preparation of the test sequence shall be to separate one fibre from the other fibres in the ribbon in the first specimen. Then, separate a unit of two fibres from the next specimen. Then, units of three, four, etc. fibres are separated in the other specimens, up to a unit of n/2 fibres in the last specimen.

Do the same preparation for all the other samples.

NOTE If n is an odd number, replace n/2 with (n-1)/2 in the above description.

Dimensions in millimetres

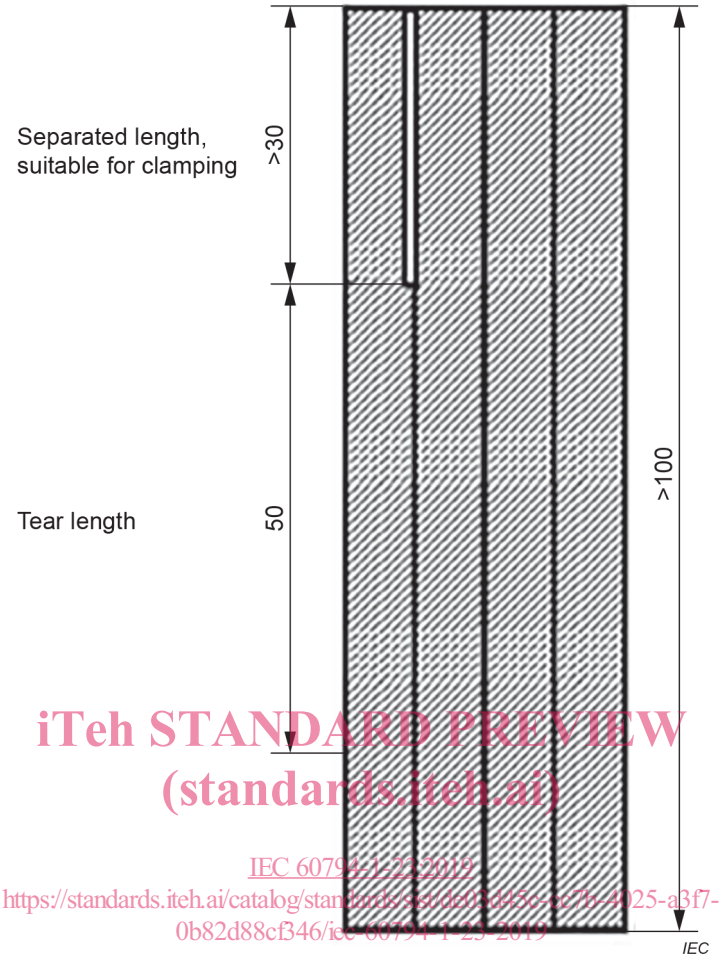

Figure 3 – Sample preparation for ribbon separability test

9.3 Apparatus

The apparatus consists of

a) a tensile strength measuring apparatus with suitable clamping devices and suitable force recording functions, and

b) a microscope with at least 100 × magnification.

9.4 Procedure

The specimen is inserted into the strength measuring apparatus, as shown in Figure 4. The fibres to be tested are torn at a speed of approximately 100 mm/min to 500 mm/min. The force to tear the fibres on a minimum length of 50 mm is continuously recorded.

In the case where fibres are required to be separated, the primary coating of the separated fibre(s) shall be visually inspected by means of a microscope.

The procedure is repeated for the specimens involving separation of fibre 1, fibres 1 to 2, fibres 1 to 3, etc. up through fibres 1 to n/2.