

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2012 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.180.10

ISBN 978-2-8322-7193-3

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

CONTENTS	2
FOREWORD	4
1 Scope and object	6
2 Normative references	6
3 Method G1: Bend test for cable elements	6
3.1 Object	6
3.2 Sample	6
3.3 Apparatus	6
3.4 Procedure	7
3.5 Requirements	7
3.6 Details to be specified	7
4 Method G2: Ribbon dimensions and geometry – Visual method	7
4.1 Object	7
4.2 Sample	7
4.3 Apparatus	7
4.4 Procedure	7
4.4.1 General	7
4.4.2 Method 1	7
4.4.3 Method 2	8
4.5 Requirements	8
4.6 Details to be specified	8
4.7 Definitions of ribbon dimensions and geometry	8
4.7.1 General	8
4.7.2 Width and height	8
4.7.3 Basis line	8
4.7.4 Fibre alignment	8
5 Method G3: Ribbon dimensions – Aperture gauge	9
5.1 Object	9
5.2 Sample	9
5.3 Apparatus	9
5.4 Procedure	9
5.5 Requirement	10
5.6 Details to be specified	10
6 Method G4: Ribbon dimensions – Dial gauge (Test deleted)	10
7 Method G5: Ribbon tear (separability)	10
7.1 Object	10
7.2 Sample	10
7.3 Apparatus	10
7.4 Procedure	11
7.5 Requirements	11
7.6 Details to be specified	11
8 Method G6: Ribbon torsion	12
8.1 Object	12
8.2 Sample	12
8.3 Apparatus	12
8.4 Procedure	12

8.5	Requirements	12
8.6	Details to be specified	12
9	Method G7: Tube kinking	13
9.1	Object	13
9.2	Sample	13
9.3	Apparatus	13
9.4	Procedure	14
9.5	Requirements	14
9.6	Details to be specified	15
10	Method G8: Ribbon residual twist test	15
10.1	Object	15
10.2	Sample	15
10.3	Apparatus	15
10.4	Procedure	16
10.5	Requirements	16
10.6	Details to be specified	16
	Figure 1 – Cross-sectional drawing illustrating fibre ribbon geometry	9
	Figure 2 – Aperture gauge	10
	Figure 3 – Sample preparation	11
	Figure 4 – Separability procedure	12
	Figure 5 – Torsion test	13
	Figure 6 – Tube kinking test	15
	Table 1 – Examples of test apparatus dimensions	14

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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 60794-1-23 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This bilingual version (2019-07) corresponds to the monolingual English version, published in 2012-08.

This edition of IEC 60794-1-23 cancels and replaces the cable elements tests methods part of the second edition of IEC 60794-1-2 published in 2003. It constitutes a technical revision.

The main change with respect to the previous edition is that it has been decided to split the second edition of IEC 60794-1-2 into six new documents:

- IEC 60794-1-2, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*
- IEC 60794-1-20, *Optical fibre cables – Part 1-20: Generic specification – Basic optical cable test procedures – General & Definitions*

- IEC 60794-1-21, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical tests methods*
- IEC 60794-1-22, *Optical fibre cables – Part 1-22: Generic specification – Basic optical cable test procedures – Environmental tests methods*
- IEC 60794-1-23, *Optical fibre cables – Part 1-23: Generic specification – Basic optical cable test procedures – Cable elements tests methods*
- IEC 60794-1-24, *Optical fibre cables – Part 1-24: Generic specification – Basic optical cable test procedures – Electrical tests methods*

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

FDIS	Report on voting
86A/1451/FDIS	86A/1469/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.

The French version of this standard has not been voted upon.

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

A list of all the 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 publication will remain unchanged until the stability 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.

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.

OPTICAL FIBRE CABLES –

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

1 Scope and object

This part of IEC 60794 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.

The object of this part of IEC 60794 is to define test procedures to be used in establishing uniform requirements for the geometrical, material, mechanical, environmental properties of optical fibre cable elements.

Throughout the document the wording “optical cable” may also include optical fibre units, microduct fibre units, etc.

General requirements and definitions are given in IEC 60794-1-20 and a complete reference guide to test method of all types in the IEC 60794-1-2.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60794-3:2001, *Optical fibre cables – Part 3: Sectional specification – Outdoor cables*

3 Method G1: Bend test for cable elements

3.1 Object

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

3.2 Sample

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

3.3 Apparatus

The apparatus consists of:

- a) a mandrel having a smooth surface with diameter as stated in the detail specification;

b) an attenuation measuring apparatus (see IEC 60793-1-40).

3.4 Procedure

The element to be tested shall be loosely wound on the mandrel; 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.

3.5 Requirements

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

3.6 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.

4 Method G2: Ribbon dimensions and geometry – Visual method

4.1 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.

4.2 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.

4.3 Apparatus

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

4.4 Procedure

4.4.1 General

Either of the two following procedures may be used.

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

4.4.2 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.

NOTE 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.

4.4.3 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.

NOTE 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.

4.5 Requirements

Unless otherwise specified in the detail specification, the width, height and fibre alignment shall be in accordance with IEC 60794-3:2001, Table 1.

4.6 Details to be specified

The detail specification shall include the following:

- a) permissible maximum and minimum values;
- b) average values;
- c) number of samples tested.

4.7 Definitions of ribbon dimensions and geometry

4.7.1 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 fiber 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 4.7.3 and 4.7.4 in lieu of the fibre centres. In this case, the measurements shall be made on the same side of all fibres (e.g. top or bottom, left or right side).

4.7.2 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.

4.7.3 Basis line

The basis line is given in the cross-section of an optical fibre ribbon as the straight line crossing the fibre centres of the first fibre (fibre 1) and the last fibre (fibre n) of the fibre ribbon.

4.7.4 Fibre alignment

4.7.4.1 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;

4.7.4.2 Planarity

The planarity p of the fibre ribbon structure is the sum of the maximum positive and absolute values 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.

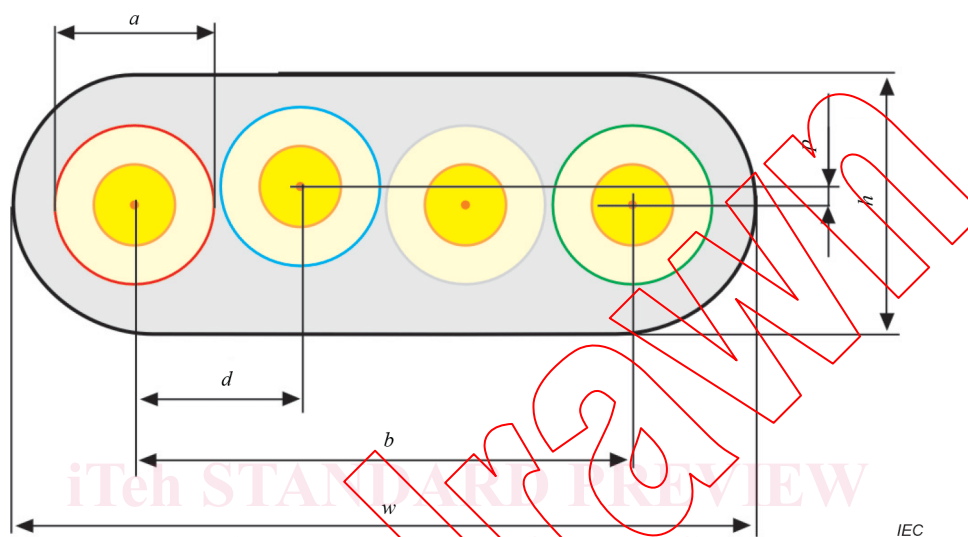


Figure 1 – Cross-sectional drawing illustrating fibre ribbon geometry

5 Method G3: Ribbon dimensions – Aperture gauge

5.1 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. This method is under consideration for encapsulated ribbons.

5.2 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.

5.3 Apparatus

An aperture gauge, as shown in Figure 2, having an aperture based on the dimensions shown in IEC 60794-3:2001, Table 1, may be used to assess the overall dimensions of a ribbon.

5.4 Procedure

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

5.5 Requirement

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

5.6 Details to be specified

The detail specification shall include the following:

- a) dimensions of the aperture gauge;
- b) number of samples to be tested.

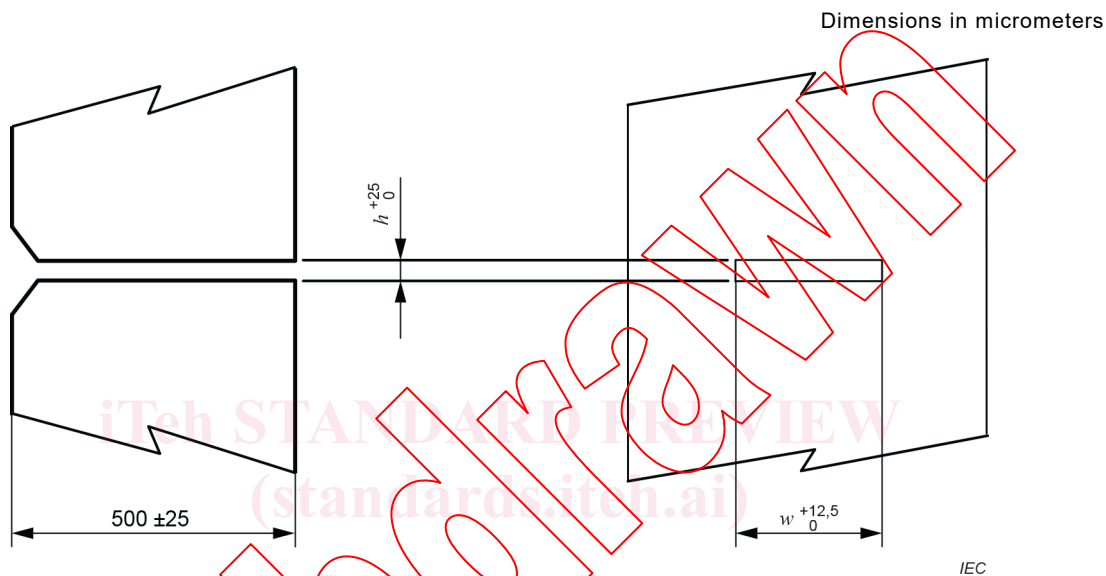


Figure 2 – Aperture gauge

6 Method G4: Ribbon dimensions – Dial gauge (Test deleted)

7 Method G5: Ribbon tear (separability)

7.1 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

7.2 Sample

For an n fibre ribbon, $n/2$ specimens, each with a minimum length of 100 mm, are taken from lengths of approximately 1 m each from the fibre ribbon.

The fibres to be tested are separated with a knife or other suitable method on a suitable length for clamping (see Figure 3) for x samples (x , typically 3 to 5, to be specified in the detail specification). One fibre is separated from the other fibres in the ribbon. For x more samples, two fibres are separated from the other fibres in the ribbon, etc. up to $n/2$ fibres.

7.3 Apparatus

The apparatus consists of:

- a) a tensile strength measuring apparatus with suitable clamping devices;