

# TECHNICAL REPORT



---

## Optical fibres – Measurement methods – Microbending sensitivity

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE

T

---

ICS 33.180.10

ISBN 978-2-83220-500-6

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references .....	6
3 General properties of microbending loss.....	7
4 General considerations.....	7
4.1 Launch condition for multimode fibres .....	7
4.2 Sample lengths .....	7
4.3 Winding tension.....	7
4.4 Relaxation time .....	8
4.5 Material used for fixed roughness.....	8
4.6 Drum materials.....	8
4.7 Drum material for temperature cycling .....	8
5 Test procedures .....	8
5.1 Method A: expandable drum .....	8
5.1.1 General .....	8
5.1.2 Apparatus.....	8
5.1.3 Procedure.....	9
5.1.4 Calculations.....	9
5.2 Method B: fixed diameter drum.....	10
5.2.1 General .....	10
5.2.2 Apparatus.....	10
5.2.3 Procedure.....	12
5.2.4 Calculations.....	12
5.3 Method C: plate test .....	13
5.3.1 General .....	13
5.3.2 Apparatus.....	13
5.3.3 Procedure.....	14
5.3.4 Calculations.....	14
5.4 Method D: basketweave .....	15
5.4.1 General .....	15
5.4.2 Apparatus.....	15
5.4.3 Procedure.....	16
5.4.4 Calculations or interpretation of results.....	17
6 Results .....	17
Annex A (informative) Representative results with method B.....	19
Bibliography.....	24
Figure 1 –Set-up for expandable drum method used in an optical fibre testing facility .....	9
Figure 2 – Standard winding/prooftester can be used for preparing the sample .....	11
Figure 3 –Example of a possible set-up in temperature cycling .....	11
Figure 4 – Alternative wire mesh set-up used in an optical fibre testing facility.....	12
Figure 5 – Microbend-inducing equipment.....	13
Figure 6 – Quartz drum with basketwoven fibre.....	15

Figure 7 – Basketweave example as used in an optical fibre testing facility .....	16
Figure 8 – Example of temperature cycle inside chamber.....	17
Figure A.1 – Example of temperature cycling of 10 different unshifted single-mode fibres (wavelength 1 310 nm).....	20
Figure A.2 – Example of temperature cycling of 10 different unshifted single-mode fibres (wavelength 1 550 nm).....	20
Figure A.3 – Microbending repeatability for fibre N° 1 with winding tension 1 N.....	21
Figure A.4 – Ribbon set-up .....	21
Figure A.5 – Losses at 1 310 nm for different ribbons .....	22
Figure A.6 – Losses at 1 625 nm for different ribbons .....	22
Table A.1 – Used instrument and values for single-mode fibres .....	19
Table A.2 – Multimode fibre test results .....	23

# INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

## **OPTICAL FIBRES – MEASUREMENT METHODS – MICROBENDING SENSITIVITY**

### 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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 62221, which is a technical report, 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, and constitutes a technical and editorial revision.

The main changes with respect to the previous edition are listed below:

- a) updates related to B6 (bend-insensitive) category single-mode fibres;
- b) inclusion of a definition for microbending and general properties;
- c) expansion of general considerations;

- d) more details given for each method;
- e) addition of an Annex A.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86A/1460/DTR	86A/1470/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

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

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.

A bilingual version of this publication may be issued at a later date.

**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 FIBRES – MEASUREMENT METHODS – MICROBENDING SENSITIVITY**

### **1 Scope**

IEC 62221, which is a technical report, describes four methods (A, B, C and D) for the measurement of microbending sensitivity of optical fibres.

These four methods are distinguished by the equipment being used for measurements and their applications:

- method A using an expandable drum and applies to category A1 and class B fibres;
- method B using a fixed diameter drum and applies to category A1 and class B fibres;
- method C using a plate and applied loads and applies to category A1 and class B fibres;
- method D using a "basketweave" wrap on a fixed diameter drum, and applies to category A1 and class B fibres

Methods A and B may also be used to measure the microbending sensitivity of optical fibre ribbons.

Methods A and C offer the capability to measure the microbending sensitivity over a wide range of applied linear pressure or loads. Method B may be used to determine the microbending sensitivity for a fixed linear pressure.

Methods A, B and D can also be used at different temperatures (temperature cycling) provided special low thermal expansion materials (e.g. quartz drums) are used.

The results from the four methods can only be compared qualitatively. These methods are considered characterization type tests.

It shall be understood that the microbend results from any method, could have significant variation between laboratories.

These methods do not constitute a routine test used in the general evaluation of optical fibre. This parameter is not generally specified within a detail specification.

### **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 60793-1-1:2008, *Optical fibres – Part 1-1: Measurement methods and test procedures – General and guidance*

IEC 60793-1-22:2001, *Optical fibres – Part 1-22: Measurement methods and test procedures – Length measurement*

IEC 60793-1-40:2001, *Optical fibres – Part 1-40: Measurement methods and test procedures – Attenuation*

IEC 60793-1-46:2001, *Optical fibres – Part 1-46: Measurement and test procedures – Monitoring of changes in optical transmittance*

IEC 62614, *Fibre optics – Launch condition requirements for measuring multimode attenuation*