IEC 62614

Edition 1.0 2010-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Fibre optics – Launch condition requirements for measuring multimode attenuation

Fibres optiques – Exigences des conditions d'injection pour la mesure de l'affaiblissement en multimodal

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: 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 corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

IEC 62614

Edition 1.0 2010-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Fibre optics – Launch condition requirements for measuring multimode attenuation

Fibres optiques – Exigences des conditions d'injection pour la mesure de l'affaiblissement en multimodal

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX

M

ICS 33.180.01

ISBN 978-2-88912-071-0

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTICS – LAUNCH CONDITION REQUIREMENTS FOR MEASURING MULTIMODE ATTENUATION

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 62614 has been prepared by IEC technical committee 86: Fibre optics.

This standard cancels and replaces IEC/PAS 62614, published in 2009. This first edition constitutes a technical revision.

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

FDIS	Report on voting
86/367/FDIS	86/368/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.

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.

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.

FIBRE OPTICS – LAUNCH CONDITION REQUIREMENTS FOR MEASURING MULTIMODE ATTENUATION

1 Scope

This International Standard describes the launch condition requirements used for measuring multimode attenuation in passive components and in installed cable plants.

In this standard, the fibre types that are addressed include category A1a (50 µm /125 µm) and A1b (62,5 µm /125 µm) multimode fibres, as specified in IEC 60793-2-10. The nominal test wavelengths detailed are 850 nm and 1 300 nm. This standard may be suitable for multimode attenuation measurements for other multimode categories and/or other wavelengths, but the source condition for other categories and wavelengths are not defined here.

The purpose of these requirements is as follows:

- to ensure consistency of field measurements when different types of test equipment are used;
- to ensure consistency of factory measurements when different types of test equipment are used;
- to ensure consistency of field measurements when compared with factory measurements.

This standard describes launch condition requirements for optical attenuation using sources with a controlled encircled flux (EF).

2 Normative references

The following referenced documents are indispensable for the application 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 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 61280-1-4, *Fibre optic communication subsystem test procedures – Part 1-4: General communication subsystems – Light source encircled flux measurement method*

IEC 61280-4-1:2009, *Fibre optic communication subsystem test procedures – Part 4-1: Installed cable plant – Multimode attenuation measurement*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE In this clause only specific terms and definitions for the purposes of this document are provided. For common fibre optic terms, reference is made to IEC/TR 61931.

3.1
coupled power ratio
CPR
difference, expressed in dB, between the power exiting a multimode fibre and the power exiting a single-mode fibre concatenated to the same multimode fibre with the same launching conditions

3.2
encircled flux
EF
fraction of cumulative near-field power to the total output power as a function of radial distance from the optical centre of the core

3.3
mode power distribution
MPD
relative mode power in each of the mode groups of a multimode fibre, often shown graphically

3.4
multimode attenuation
attenuation pertaining to multimode fibres and/or multimode fibre components, systems and subsystems

3.5
reference grade launch cord
launch cords constructed with a reference grade termination at the interface to the device under test

3.6
reference grade termination
connector plug with tightened tolerances terminated onto an optical fibre with tightened tolerances such that the expected loss of a connection formed by mating two such assemblies is less than or equal to 0,1 dB (an adapter, required to ensure this performance, may be considered to be part of the reference grade termination where required by the test configuration)

NOTE 1 As an example, the core diameter tolerance may need to be ± 0,7 µm (under consideration). Other fibre tolerances are also under consideration.

NOTE 2 This definition remains under study. When a more complete definition is available in another standard, this definition will be replaced by a reference to that standard.

4 Background on multimode launch conditions

There have been a wide range of launch conditions used for testing multimode fibre components and systems. Light sources, typically used in measuring attenuation, may produce varying modal distributions when launched into multimode fibre. These differing modal distributions, combined with the differential mode attenuation (DMA) inherent in most multimode components, commonly cause measurement variations when measuring attenuation of multimode components. For example, attenuation measurement variations can occur when two similar light sources or different launch cords are used.

Legacy (LED based) applications had a wide power budget which in most cases masked the variance in results between the factory and field measurement. As technology has evolved, the system requirements for attenuation have become more stringent. Demanding application requirements are driving the need for accurate and reproducible multimode attenuation measurements over a variety of field-test instruments. Attenuation measurement experiments, with different instruments having the same standards compliant set up, produce measurement variations that are induced by their differing launch conditions.

Experts have concluded that the launch condition should be expressed at the interface between the test instrument launch cord and the terminated fibre to be tested. That is, the launch condition should be based in part on the measured near field at the output of the launch cord. The key to making reproducible loss measurements across various sources is to narrowly constrain the range of power distribution at large radii so that all compliant sources produce closely agreeing loss measurement results. This is because the variation in the allowed power distribution at large radii across different sources translates directly into variability of loss measurements. Smaller power variations enable more reproducible loss measurements.

5 Test source launch

5.1 General

The source launch conditions are described at the output of the reference grade launch cord. It is expected that the source and launch cord, as supplied, have been verified by the test equipment manufacturer to produce the specified launch measured according to IEC 61280-1-4. For reference grade fibre, core diameter tolerances of ± 0,7 µm have been evaluated with some success. Variance of other parameters, such as numerical aperture and core concentricity, need more study.

5.2 Encircled flux

The EF is determined from the near field measurement of the light coming from the end of the reference grade launch cord in accordance with IEC 61280-1-4.

The measured near field result is a function of the near field profile, $I(r)$, of radius, r, away from the optical centre of the core, and the edge of the near field profile, R, which is used to generate the EF function as

$$EF(r) = \frac{\int_0^r xI(x)dx}{\int_0^R xI(x)dx} \quad (1)$$

5.3 Encircled flux template illustration

An illustration of an EF template is shown in Figure 1. A target EF value for a set of particular radial control points is defined. Upper and lower limit of EF values for a set of particular radial control points may also be defined. A compliant launch is a launch that falls within the template at the particular radial control points.

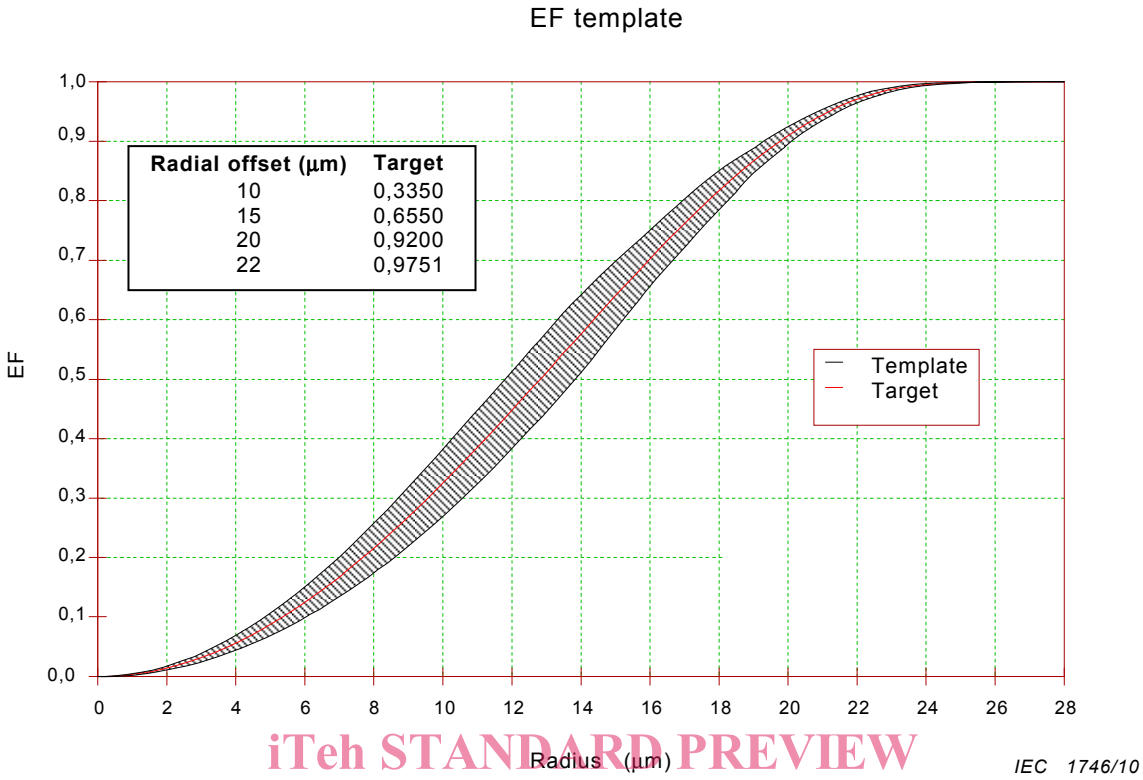

Figure 1 – EF template illustration

5.4 Encircled flux target for attenuation measurement

For the purposes of this standard, the EF requirement is defined as a target EF value for a set of particular radial control points for each of four combinations of fibre core diameter and wavelength, as tabulated in Table 1 through Table 4.

Table 1 – EF target for 50 µm core fibre at 850 nm

Radial offset µm	Target
10	0,335 0
15	0,655 0
20	0,919 3
22	0,975 1

Table 2 – EF target for 50 µm core fibre at 1 300 nm

Radial offset µm	Target
10	0,336 6
15	0,656 7
20	0,918 6
22	0,972 8

Table 3 – EF target for 62,5 µm fibre at 850 nm

Radial offset µm	Target
10	0,210 9
15	0,439 0
20	0,692 3
26	0,935 0
28	0,978 3

Table 4 – EF target for 62,5 µm fibre at 1 300 nm

Radial offset µm	Target
10	0,211 9
15	0,440 9
20	0,694 5
26	0,935 7
28	0,978 2

5.5 Harmonization of multimode launch conditions to eliminate wavelength bias

Efforts were taken to harmonize the expected component losses at 850 nm and 1 300 nm wavelengths for a given fibre core diameter. This was accomplished by adjustment of the 850 nm and 1 300 EF targets to produce comparable extrinsic component losses. An example of matching the attenuation characteristics at the two wavelengths is illustrated in Figure 2. This elimination of bias provides an opportunity to ensure dual wavelength compliance of a passive component or short cable plant link using a single source condition.

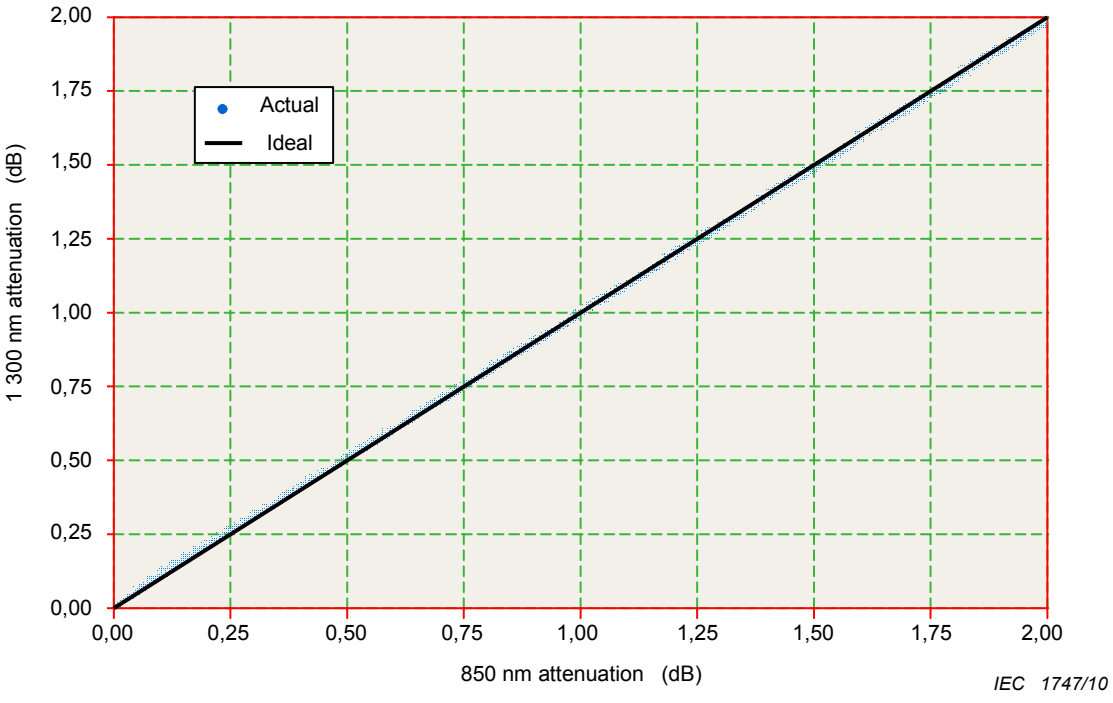

Figure 2 – Wavelength comparison