IEC 61300-3-45

Edition 1.0 2011-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – Basic test and measurement procedures –
Part 3-45: Examinations and measurements – Attenuation of random mated multi-fibre connectors

Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures –
Partie 3-45: Examens et mesures – Affaiblissement dû à l'accouplement de connecteurs quelconques multifibres

IEC 61300-3-45:2011

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 It also gives information on projects, withdrawn and replaced publications.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 61300-3-45

Edition 1.0 2011-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – Basic test and measurement procedures –
Part 3-45: Examinations and measurements – Attenuation of random mated multi-fibre connectors

Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures –
Partie 3-45: Examens et mesures – Affaiblissement dû à l'accouplement de connecteurs quelconques multifibres

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX N

ICS 33.180.20

ISBN 978-2-88912-483-1

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 3-45: Examinations and measurements – Attenuation of random mated multi-fibre connectors

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 61300-3-45 Ed.1.0 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

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

FDIS	Report on voting
86B/3177/FDIS	86B/3215/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 list of all parts of IEC 61300 series, published under the general title, *Fibre optic interconnecting and passive components – Basic test and measurement procedures*, 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.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 3-45: Examinations and measurements – Attenuation of random mated multi-fibre connectors

1 Scope

The purpose of this part of IEC 61300 is to describe the procedure required to measure the statistical distribution and mean attenuation for random mated optical connectors with physical contact (PC) and angled physical contact (APC) polished 1-row multi-fibre rectangular ferrules as defined in the IEC 61754 series. This measurement method is applicable to cable assemblies.

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 61300-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 1: General and guidance*

IEC 61300-3-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-1: Examinations and measurements – Visual examination*

IEC 61300-3-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Fibre optic connector endface visual and automated inspection*

IEC 61754 (all parts), *Fibre optic connector interfaces*

3 General description

3.1 Test methods

Two test methods are described for measuring the attenuation of random mated optical connectors. Both provide an estimate of the expected average performance that a group of cable assemblies (including an adaptor, if applicable) selected from a batch will exhibit when used in an optical system. The cable assemblies, and any adaptors, must be chosen at random to ensure that the measurements provide a statistically unbiased estimate.

Method 1 describes the procedure using a sample of cable assemblies and adaptors specified in Table 1. In this case the plugs (with pins) are used as “reference” plugs and the plugs (without pins) are tested against them sequentially. The results, based on the number of measurements specified in Table 1, are recorded in the test matrix shown in Figures 3 to 5.

Method 1 is intended to be part of a design approval exercise that may involve one or more suppliers. Once approval is achieved, Method 2 would be relied on to maintain process control. However, in the event of a dispute, Method 1 shall act as the reference measurement method.

Method 2 describes a procedure for the measurement of a sample of cable assemblies specified in Table 2.

Three cable assemblies are selected from the sample as “reference” cable assemblies and pins are fitted. The other test cable assemblies (without pins) are tested against each of the three “reference cable assemblies” sequentially. This produces the number of measurements specified in Table 2 and the results are recorded in the test matrix shown in Figures 10 to 12.

It is recognised that the number of measurements required by Method 1 may be excessive for day-to-day routine checking of either in-house or supplier produced products. In this case, as indicated above, Method 2 may be an alternative option.

NOTE In this measurement method, the terms “reference” plug or “reference” cord are used to define those components chosen at random from a batch, against which a number of comparative measurements are made. It is not intended that the terms should imply specially chosen or manufactured components, such as those used, for example, in screen testing.

Table 1 – Sample size for Method 1

Connector (n-fibre connector)	Sample size		
	Cord and adaptors	Measurements	Fibres
2-fibre connector	15	210	420
4-fibre connector	12	132	528
8-fibre connector	10	90	720
10-fibre connector	10	90	900
12-fibre connector	10	90	1 080

Table 2 – Sample size for Method 2

Connector (n-fibre connector)	Sample size				
	Cord and adaptors			Measurements	Fibres
	Total	Reference	Test :N		
2-fibre connector	12	3	9	54	108
4-fibre connector	8	3	5	30	120
8-fibre connector	6	3	3	18	144
10-fibre connector	6	3	3	18	180
12-fibre connector	6	3	3	18	216

3.2 Precautions

The following test requirements shall be met.

a) Precautions shall be taken to ensure that the cladding modes do not affect the measurement. Cladding modes shall be stripped as a function of the fibre coating.

b) Precautions shall be taken to ensure that the position of the fibres in the test remains fixed between the measurement of P_1 and P_2 to avoid changes in attenuation due to bending losses.

c) The stability performance of the test equipment shall be ≤ 0,05 dB or 10 % of the attenuation to be measured, whichever is the lower value. The stability shall be maintained over the measurement time and operational temperature range. The required measurement resolution shall be 0,01 dB for both multimode and single mode.

d) To achieve consistent results, clean and inspect all connectors and adaptors prior to measurement. Visual examination shall be undertaken in accordance with IEC 61300-3-1 and IEC 61300-3-35.

NOTE A cladding mode stripper usually comprises a material having a refractive index equal to or greater than that of the fibre cladding.

4 Apparatus

4.1 Source (S)

The source consists of an optical emitter, the means to connect to it and associated drive electronics. In addition to meeting the stability and power level requirements, the source shall have the following characteristics:

– Centre wavelength, as detailed in the performance and product standard;
– Spectral width, filtered light emitting diode (LED) ≤ 150 nm full width half maximum (FWHM);
– Spectral width, laser diode (LD) < 10 nm FWHM.

For multimode fibres, broadband sources such as an LED shall be used.

For single mode fibres either an LED or LD may be used.

NOTE The interference of modes from a coherent source will create speckle patterns in multimode fibres. These speckle patterns give rise to speckle or modal noise and are observed as power fluctuations, since their characteristic times are longer than the resolution time of the detector. As a result, it may be impossible to achieve stable launch conditions using coherent sources for multimode measurements. Consequently, lasers, including optical time domain reflectometer (OTDR) sources, should be avoided in favour of LEDs or other incoherent sources for measuring multimode components.

4.2 Launch conditions (E)

The launch condition shall be specified in accordance with IEC 61300-1.

4.3 Detector (D)

The detector consists of an optical detector, the means to connect to it and associated electronics. The connection to the detector will be an adaptor that accepts a connector plug of the appropriate design. The detector shall capture all light emitted by the connector plug.

In addition to meeting the stability and resolution requirements, the detector shall have the following characteristics:

– Linearity of multimode, ≤ ±0,25 dB (over –5 dBm up to –60 dBm);
– Linearity of single mode, ≤ ±0,1 dB (over –5 dBm up to –60 dBm).

NOTE The power meter linearity should be referenced to a power level of –23 dBm at the operational wavelength.

Where the connection to the detector is broken between the measurement of P_1 and P_2, the measurement repeatability shall be within 0,05 dB or 10 % of the attenuation to be measured, whichever is the lower value. A large sensitive area detector may be used to achieve this.

The precise characteristics of the detector shall be compatible with the measurement requirements. The dynamic range of the power meter shall be capable of measuring the power level exiting from the device under test (DUT) at the wavelength being measured.

5 Procedure

5.1 Method 1

a) Randomly select the sample number of cable assemblies specified in Table 1. Sequentially label the plugs under test as shown in Figures 3 to 5.

b) Randomly select the sample size of adaptors as specified in Table 1. Sequentially label the adaptors under test as shown in Figures 3 to 5.

c) Set up the measurement system as shown in Figure 1, with cord 1as the "reference" cord and with plug 1 as the "reference" plug. Measure power $P_{1\text{-}1}$ to $P_{1\text{-}n}$ for all fibres in the cord.

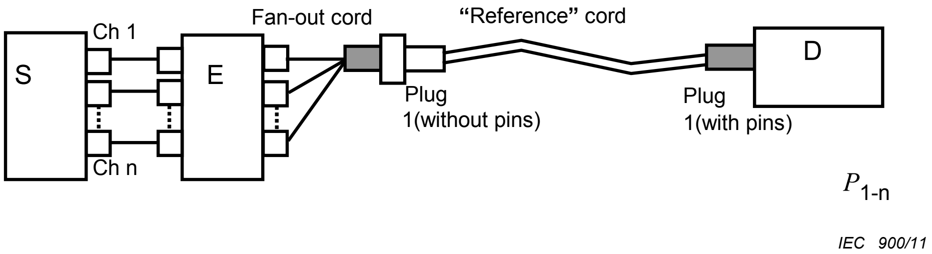

Figure 1 – "Reference" cord measurement – Method 1

d) Connect test cord 2 and adaptor 1 to the system and mate plug 1 (with pins) to plug 2 (without pins) as shown in Figure 2. Measure the power $P_{2\text{-}1}$ to $P_{2\text{-}n}$ for all fibres in the cord.

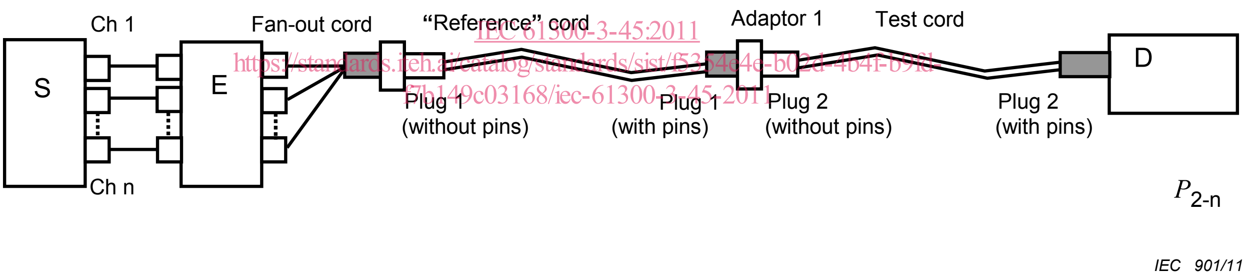

Figure 2 – Test cord measurement – Method 1

e) Calculate the attenuation of the mated plug pair 1 (with pins) / 2 (without pins) with adaptor 1, using Equation (1):

$$\text{Attenuation} = [-10 \log (P_{2\text{-}i}/P_{1\text{-}i})] - (A \times L)\ \text{dB} \qquad (1)$$

Where

i is fibre number of Test cord.

A is fibre attenuation per km;

L is length of fibre in km.

NOTE The product $A \times L$ may be ignored for both single mode and multimode [50/125 µm and 62,5/125 µm] where the cord length is small, i.e. < 10 m.

f) Record the attenuation results for each fibre into an appropriate matrix format.

NOTE An example of record table (for 4 fibre connectors) is shown in Figure 13.

g) Keeping plug 1 (with pins) and adaptor 1 as the "reference" configuration, replace test cord 2 by test cord 3 and mate plug 3 (without pins) with plug 1 (with pins).

h) Measure the power $P_{3\text{-}1}$ to $P_{3\text{-}n}$ and record the attenuation results for each fibre.

i) Repeat steps g) and h) until all the plugs (without pins) of the remaining test cable assemblies have been tested against the “reference” plug 1 (with pins).

j) After step i) has been completed, replace the “reference” plug and adaptor so that plug 2 (with pins) and adaptor 2 are the “reference” configuration.

k) Measure the attenuation for all plugs against “reference” plug 2 (with pins) and adaptor 2.

l) Continue this process until all allocated plugs have been used as “reference” plugs.

“Reference” Configuration		**Test cord and labelling** Plug (without pins)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Plug 1 (with pins)	Adaptor 1	-														
Plug 2 (with pins)	Adaptor 2		-													
Plug 3 (with pins))	Adaptor 3			-												
Plug 4 (with pins)	Adaptor 4				-											
Plug 5 (with pins)	Adaptor 5					-										
Plug 6 (with pins)	Adaptor 6						-									
Plug 7 (with pins)	Adaptor 7							-								
Plug 8 (with pins)	Adaptor 8								-							
Plug 9 (with pins)	Adaptor 9									-						
Plug 10 (with pins)	Adaptor 10										-					
Plug 11 (with pins)	Adaptor 11											-				
Plug 12 (with pins)	Adaptor 12												-			
Plug 13 (with pins)	Adaptor 13													-		
Plug 14 (with pins)	Adaptor 14														-	
Plug 15 (with pins)	Adaptor 15															-

IEC 902/11

Figure 3 – Test matrix and labelling for measuring Method 1 (2-fibre connector)

"Reference" configuration		Test cord and labelling Plug (without pins)											
		1	2	3	4	5	6	7	8	9	10	11	12
Plug 1 (with pins)	Adaptor 1	-											
Plug 2 (with pins)	Adaptor 2		-										
Plug 3 (with pins)	Adaptor 3			-									
Plug 4 (with pins)	Adaptor 4				-								
Plug 5 (with pins)	Adaptor 5					-							
Plug 6 (with pins)	Adaptor 6						-						
Plug 7 (with pins)	Adaptor 7							-					
Plug 8 (with pins)	Adaptor 8								-				
Plug 9 (with pins)	Adaptor 9									-			
Plug 10 (with pins)	Adaptor 10										-		
Plug 11 (with pins)	Adaptor 11											-	
Plug 12 (with pins)	Adaptor 12												-

IEC 903/11

Figure 4 – Test matrix and labelling for measuring Method 1 (4-fibre connector)

"Reference" configuration		Test cord and labelling Plug (without pins)									
		1	2	3	4	5	6	7	8	9	10
Plug 1 (with pins)	Adaptor 1	-									
Plug 2 (with pins)	Adaptor 2		-								
Plug 3 (with pins)	Adaptor 3			-							
Plug 4 (with pins)	Adaptor 4				-						
Plug 5 (with pins)	Adaptor 5					-					
Plug 6 (with pins)	Adaptor 6						-				
Plug 7 (with pins)	Adaptor 7							-			
Plug 8 (with pins)	Adaptor 8								-		
Plug 9 (with pins)	Adaptor 9									-	
Plug 10 (with pins)	Adaptor 10										-

IEC 904/11

Figure 5 – Test matrix and labelling for measuring Method 1 (8, 10, 12-fibre connector)

5.2 Method 2

a) Randomly select the sample number of cable assemblies specified in Table 2.

b) Choose three cable assemblies at random and sequentially label the plugs of each cord as "reference" plugs. Sequentially label the plugs of the remaining cable assemblies as test plugs. Sequentially label three adaptors 1 to 3 (as shown in Figures 10 to 12).

c) Set up the measurement system as shown in Figure 6, with "reference" cord 1 so that the plug 1 (with pins) is the "reference" plug. Measure power $P_{1\text{-}1}$ to $P_{1\text{-}n}$ for all fibres in the cord.