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INTERNATIONAL STANDARD

colour inside

AMENDMENT 1

Information technology – Implementation and operation of customer premises cabling – Part 3: Testing of optical fibre cabling

ISO/IEC 14763-3:2014-06/AMD1:2018-08(en)

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

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

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AMENDMENT 1

Information technology – Implementation and operation of customer premises cabling –
Part 3: Testing of optical fibre cabling

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

This amendment has been prepared by subcommittee SC 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This document has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

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.

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INTRODUCTION to the amendment

This document contains information for inspecting end faces of the different kinds of installed fibre optic cabling interfaces and connectors of test cords and recommendations for cleaning these interfaces, and replaces the normative Annex B and deletes the informative Annex H of ISO/IEC 14763-3:2014.

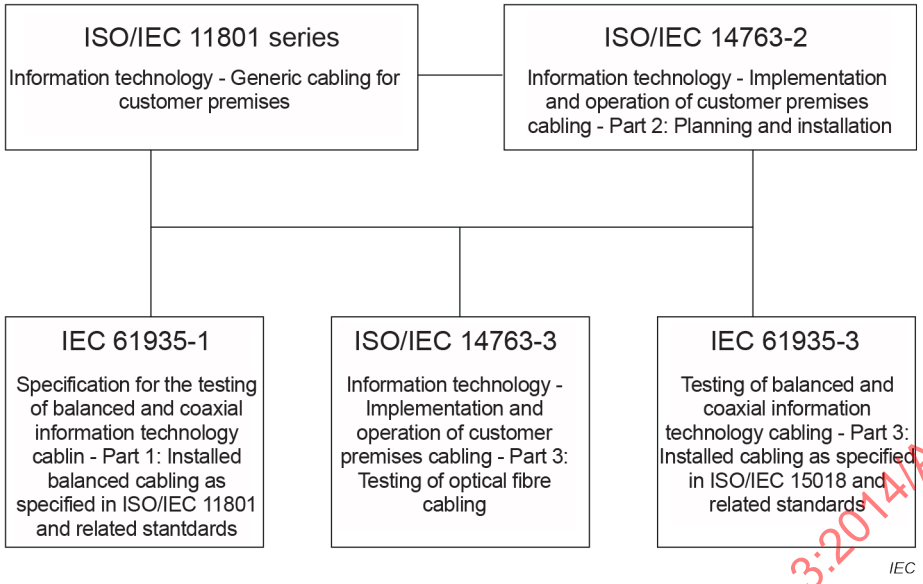
Additional information regarding channel and link testing is provided to Annex E.

Introduction

Replace paragraphs 1 to 3, including Figure 1, with the following:

This International Standard has been prepared in support of International Standard series ISO/IEC 11801.

Figure 1 below shows the inter-relationship between the ISO/IEC 11801 series and other International Standards and for cabling systems with related standards.



NOTE ISO/IEC 15018 has been replaced by ISO/IEC 11801-4.

Figure 1 – Relationship of related International Standards

ISO/IEC 14763-3 details the inspection and test procedures for optical fibre cabling,

a) designed in accordance with premises cabling standards including the ISO/IEC 11801 series, and

b) installed according to the requirements and recommendations of ISO/IEC 14763-2.

*In the NOTE, replace "*ISO/IEC 11801*" with "*ISO/IEC 11801-1*".*

1 Scope

*Replace "*ISO/IEC 11801, ISO/IEC 24764, ISO/IEC 24702 and ISO/IEC 15018*" with "*the ISO/IEC 11801 series*".*

2 Normative references

Replace the reference to ISO/IEC 11801 with the following new reference:

ISO/IEC 11801-1, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

Replace the reference to IEC 61300-3-35:2009 with the following new reference:

IEC 61300-3-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Visual inspection of fibre optic connectors and fibre-stub transceivers*

Clauses 3, 6, 8, 9, 10, E.1, F.1, G.1 and G.2

*Replace all instances of "*ISO/IEC 11801*" in these clauses with "*ISO/IEC 11801-1*".*

3.1 Terms and definitions

Add the following new terms and definitions:

3.1.25
defect
surface feature such as pits, chips and loose debris

3.1.26
loose debris
particles and debris on the surface that can be removed by cleaning

3.1.27
pit
permanent non-linear surface damage

3.1.28
scratch
permanent linear surface damage

3.2 Abbreviations

Add the following new abbreviation:

LC LC connector

Replace the existing MPO abbreviation with the following:

MPO Multi-fibre Push On connector (based on rectangular ferrule)

9.1.1.1 General

Add the following new paragraphs after the first paragraph:

According to ISO/IEC 11801-1, a channel does not include the connector on the equipment cords that interfaces with the network equipment. The optical attenuation limits specified for network equipment take into account the attenuation associated with the connections of the equipment to the installed cabling.

The testing of a channel utilizes the customer's equipment cords at both ends of the channel and these cords are left in place after testing. The channel test method is normally used to measure the attenuation of a channel at the time of service implementation or maintenance.

The channel and link test method requires a new reference for any change of connection at the light source and/or the power meter between tests since the connection between source and connected cord should never be disturbed after a reference measurement has been taken.

Inspect and clean when necessary the connector interfaces of the source, the launch test cord, the tail test cord and substitution test cord.

Allow sufficient time for light source stabilization in accordance with light source manufacturer's recommendations.

9.1.1.2 Enhanced three-test-cord attenuation measurement test method of installed channels

Replace 9.1.1.2 with the following:

9.1.1.2 Channel test method

The procedure for channel testing is as follows.

a) Connect the launch test cord (LTC) to the light source (LS) at one end and to the equipment (EQP) cord at the other end. Connect equipment cord to the power meter (PM). Allow sufficient time for the light source stabilization in accordance with light source manufacturer's recommendations. (See Figure 8). Since this reference measurement is carried out with a near end EQP cord, the defect of near end EQP cord may not be found. When this test method is used, the quality of the near end EQP cord shall comply with the requirement.

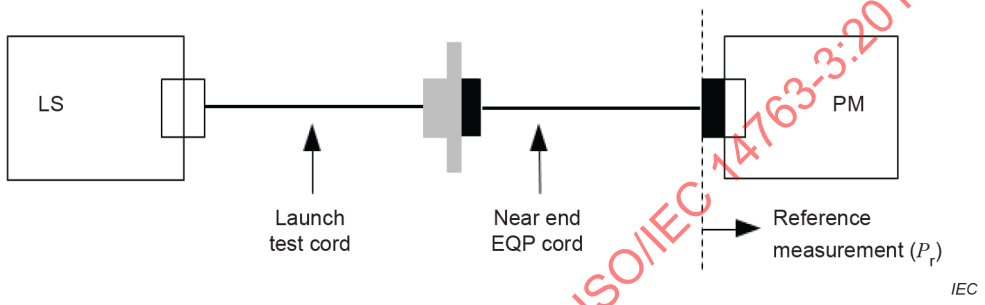


Figure 8 – Connection of LS – LTC – Near end EQP cord – PM for reference setting

b) The reference measurement, P_r, shall be recorded in watts (W) or decibel-milliwatts (dBm).

c) The near end EQP cord is disconnected from the power meter and the LTC-EQP cord combination is reconnected to the fixed cable of the channel under test.

d) At the far end of the channel, connect the far end EQP cord to the power meter, see Figure 20).

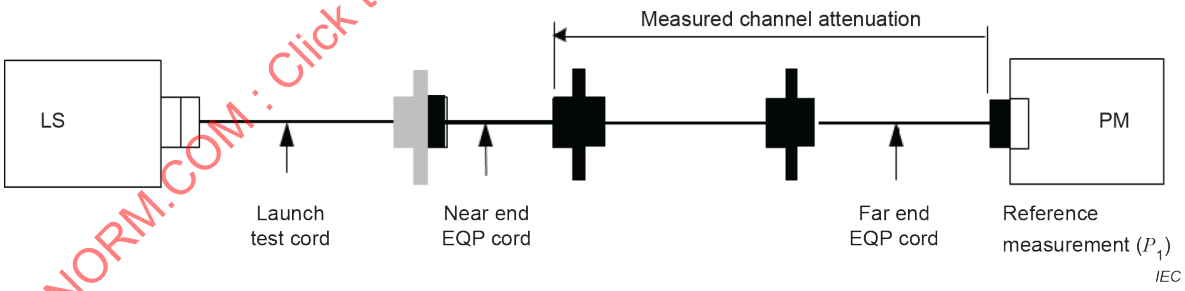


Figure 20 – Connections to channel test for attenuation measurement

e) The power P_1 is measured directly at the far end EQP cord. The measurement, P_1, shall be recorded in watts (W) or decibel-milliwatts (dBm).

f) The attenuation of the channel is:

$$A = P_r - P_1 \quad \text{(dB)} \tag{1}$$

where P_1 and P_r are expressed in dBm.

If P_1 and P_r are expressed in W, then the measured attenuation can be calculated as follows:

$$A = -10\lg(P_1/P_r) \quad \text{(dB)} \qquad (2)$$

The channel testing is carried out in one direction only.

For this method, the measurement uncertainties at 95 % confidence level are as follows.

SMF: ± 0,16 dB for fibre length < 2 km.

MMF: ± 0,19 dB when measured attenuation ≤ 1,4 dB.

MMF: ± 0,14 × measured attenuation when measured attenuation > 1,4 dB.

NOTE Measurement uncertainties are determined using IEC TR 61282-14 and representative system data. See IEC TR 61282-14 for more details.

9.1.1.3 Test method for links using the one-test-cord reference method

Replace the subclause title with the following:

9.1.1.3 Link test method using the one-cord method and enhanced-three-test-cord reference method

Annex B (normative) Visual inspection criteria for connectors

Replace Annex B with the following:

Annex B
(normative)

Visual inspection and cleaning of optical fibre cabling interfaces

B.1 Specified optical fibre cabling interfaces

The different international cabling standards specify the following optical fibre cabling interfaces:

a) LC connector simplex and duplex connectors both in multimode and single-mode PC and single mode APC configuration and adapters;

b) MPO connectors (male and female) in multimode PC and single-mode APC configuration and adapters.

Since different configurations are possible, Annex B explains the visual inspection criteria and cleaning recommendations for each configuration of the LC and MPO cabling interface.

B.2 The inspection equipment

The inspection equipment that shall be used is specified in IEC 61300-3-35.

All possible connectors in multimode and single-mode fibre configurations specified in structured cabling standards shall be inspected with a low-resolution microscope.

Low resolution means that the microscope shall have a field of view of at least 250 microns. The fibre shall be maximum 50 % of the image on the microscope in the vertical axis.

The capability of the microscope for detecting 2 µm targets and the correct field of view can be determined by use of, for example, a chrome on glass artefact with 2 µm targets and a 250 µm circle. The user should contact the equipment supplier for such an artefact. Other artefacts that determine the capability of the microscopes to detect 2 µm defects/scratches may be used.

There are different types of microscopes available on the market.

Direct viewing microscopes are in general lower cost. Very important with this type of equipment is that the microscope shall contain a built-in laser safety filter.

The laser filter is to control the energy which is directed into the eye from active sources in the cabling. When direct viewing is used one should ensure that no laser or equipment with lasers is active on the cabling. See IEC 60825-2 for regulations regarding laser safety of optical fibre communication systems.

Video microscopes contain a lens which transfers via a camera the magnified image on a display. Video microscopes provide more laser safety than direct viewing microscopes.

Low resolution microscopes as specified in IEC 61300-3-35 with automated analysis are available on the market.

All microscope systems show system-to-system variability and a 100 % match between inspection results of multiple microscopes according to IEC 61300-3-35 is not achievable at this moment. This is even the case when microscopes of the same brand and type are compared.

NOTE Some microscopes are available with floodlight (side illumination); these are particular handy when inspecting MPOs for dirt.

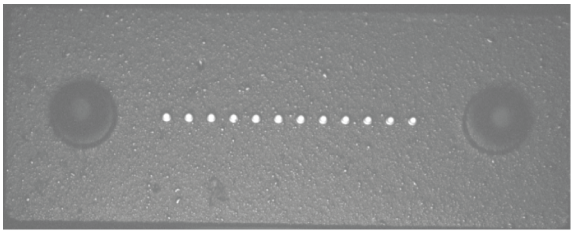


Figure B.1 – Normal illumination of male MPO

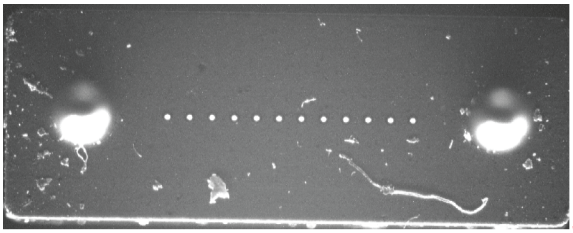


Figure B.2 – Same ferrule with floodlight

B.3 Return loss requirements for cabling interfaces

B.3.1 General

Cabling interfaces have 3 major sets of requirements:

a) multimode 20 dB for cylindrical (LC) and rectangular ferrules (MPO);

b) single-mode 35 dB PC for cylindrical ferrules only (LC);

c) single-mode 60 dB APC for cylindrical (LC) and rectangular ferrules (MPO).

For each of these 3 sets, Annex B shows the requirements, and the cleaning recommendations both as free connector (channel) and connector inside an adapter (link).

B.3.2 Multimode cylindrical and rectangular ferrules (20 dB return loss)

B.3.2.1 General requirements

The following inspection zones and requirements shall be followed when the end faces of multimode connectors are inspected. The inspection shall be carried out in accordance with IEC 61300-3-35.

The contact zones of all connector types shall be inspected for dirt and loose particles, for MPO cabling interfaces the contact zone is the complete ferrule end face. This inspection becomes very easy when microscopes with very low resolution with floodlight are used, see Figure B.1 and Figure B.2. Inspection for dirt shall always be followed by low-resolution inspection of the polished fibres for scratches and defects according to Table B.1. Scratches and defects are counted separately.

The inspection requirements of IEC 61300-3-35 apply. For the convenience of the user, Table B.1 contains the requirements of IEC 61300-3-35:2015 (which is the current standard at the time of publication of this document). At the time of inspection, users of this document shall verify if Table B.1 is in line with the requirements of the then valid IEC 61300-3-35.

Table B.1 – Inspection requirements for cabling interfaces with 20 dB return loss

Zone (diameter)	**Scratches** (maximum number of a given dimension)	**Defects** (maximum number of a given dimension)
A: core 0 µm to 65 µm	No limit ≤ 3 µm None[a] > 3 µm	3 ≤ 5 µm None[a] > 5 µm
B: cladding 65 µm to 115 µm	No limit ≤ 5 µm None[a] > 5 µm	10 ≤ 5 µm None[a] > 5 µm

NOTE 1 Outside the core and cladding zone there are only cleanliness requirements.

The recommended inspection area for cylindrical ferrules is limited to 250 µm diameter. Ten particles of ≤ 5µm diameter are allowed. There are no requirements for the area outside the 250 µm zone. Cleaning loose debris beyond this region is recommended good practice.

For rectangular ferrules, it is recommended to inspect the entire ferrule surface for cleanliness.

Ten particles of ≤ 10 µm diameter are allowed.

NOTE 2 For multiple-fibre rectangular-ferrule connectors, the criteria apply to all fibres in the array.

NOTE 3 The zone size for multimode fibres has been set at 65 µm to accommodate both 50 µm and 62,5 µm core size fibres. This is done to simplify the grading process.

[a] None detected with low resolution microscope capable of detecting 2 µm defects/scratches.

When dirt (loose contamination) is found, the ferrule end face shall be cleaned.

The cleaning methods as described are recommended.

B.3.2.2 Cleaning procedure for LC multimode cabling interface

Figure B.3 and Figure B.4 show the cleaning procedure for LC multimode cabling interface.

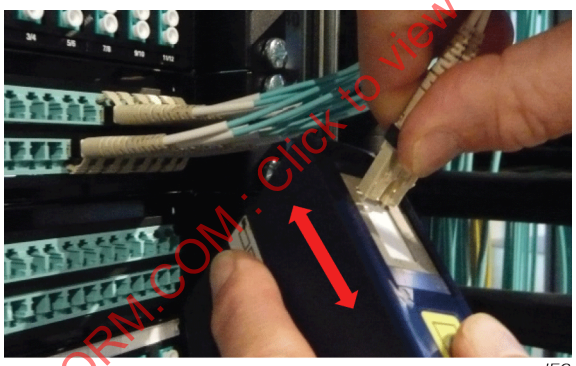


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Figure B.3 – Example of multimode LC channel interface

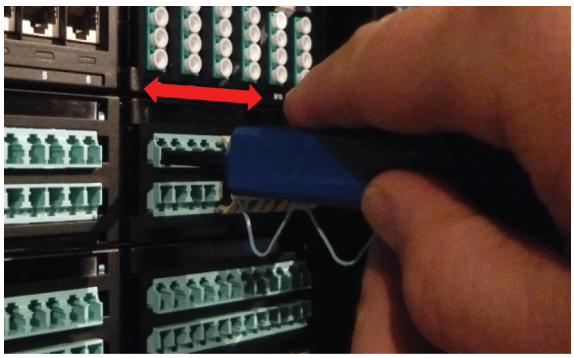

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Figure B.4 – Example of multimode LC link interface

a) Dry cleaning is preferred. In general, two strokes on the tape in the cassette or two push/clicks of the pen cleaner are sufficient to remove the loose contaminant.

b) When dirt is difficult to remove, use of an appropriate cleaning liquid (quick evaporating) is allowed when it is followed by dry cleaning. Otherwise a residue might be left behind on connector surface.

Put a drop of cleaning fluid on the tape of the cassette, use two strokes on the wet tape followed by two strokes on the dry tape. This is a recommended cleaning method when simple dry cleaning is not sufficient.

This cleaning procedure is in general the same for all types of cabling interface.

B.3.2.3 Cleaning procedure for MPO cabling interface

Figure B.5 and Figure B.6 show the cleaning procedure for the MPO multimode cabling interface.

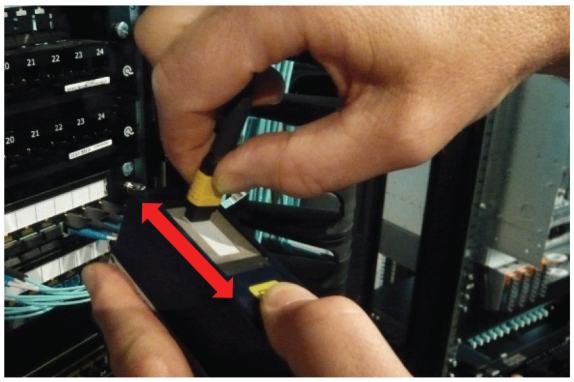

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Figure B.5 – Example of MPO channel interface

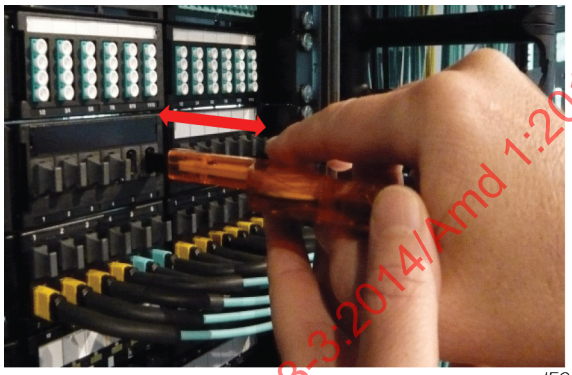

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Figure B.6 – Example of MPO link interface

Special attention should be given to cleaning of male MPO channel interfaces because the pins prohibit the use of female MPO cassette cleaners. It is recommended to use special MPO male cassettes available on the market which allow cleaning of the fibres between the pins or one should use an MPO generic cleaner that works for male and female connector types.

It is recommended to inspect the entire ferrule surface of the MPO connector for loose contaminants by means of a microscope with very low resolution with floodlight illumination. Due to the ferrule surface structure of the MPO connector it is more difficult to differentiate between loose particles and the ferrule surface. Use of the floodlight illumination solves this as loose contamination appears as white particles on a dark surface (see Figure B.1 and Figure B.2).

NOTE The floodlight illumination inspection is in addition to inspecting core/cladding defects.

B.3.3 Single mode PC cylindrical ferrules (35 dB return loss)

B.3.3.1 General requirements

The following inspection zones and requirements shall be followed when the end faces of multimode connectors are inspected. The inspection shall be carried out in accordance with IEC 61300-3-35.

Inspection for dirt shall always be followed by low-resolution inspection of the polished fibres for scratches and defects according to Table B.1. Scratches and defects are counted separately.

The inspection requirements of IEC 61300-3-35 apply. For the convenience of the user, Table B.2 contains the requirements of IEC 61300-3-35:2015 (which is the current standard at the time of publication of this document). At the time of inspection, users of this document shall verify if Table B.2 is in line with the requirements of the then valid IEC 61300-3-35.

Table B.2 – Inspection requirements for cabling interfaces with 35 dB return loss

Zone (diameter)	**Scratches** (maximum number of given dimension)	**Defects** (maximum number of as given dimension)
A: core 0 µm to 15 µm	1 ≤ 3 µm None[a] > 3 µm	None[a]
B: cladding 15 µm to 115 µm	No limit ≤ 5 µm None[a] > 5 µm	10 ≤ 3 µm None[a] > 3 µm
NOTE Outside the core and cladding zone there are only cleanliness requirements. The recommended inspection area for cylindrical ferrules is limited to 250 µm. Ten particles of ≤ 5 µm diameter are allowed. There are no requirements for the area outside the 250 µm zone. Cleaning loose debris beyond this region is recommended. Ten particles of ≤ 5 µm diameter are allowed.		
[a] None detected with low resolution microscope capable of detecting 2 µm defects/scratches.		

B.3.3.2 Cleaning procedure for the LC single-mode cabling interfaces

Figure B.7 and Figure B.8 show the cleaning procedure for the LC single-mode cabling interface.

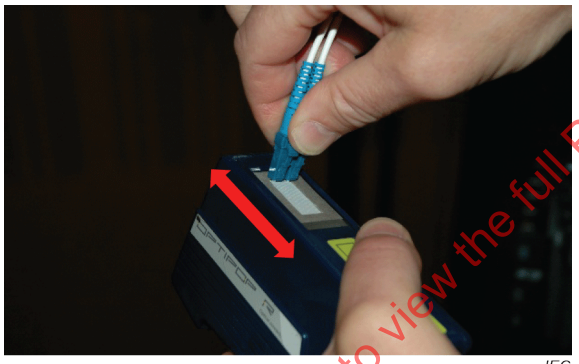

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Figure B.7 – Example of single-mode LC channel interface

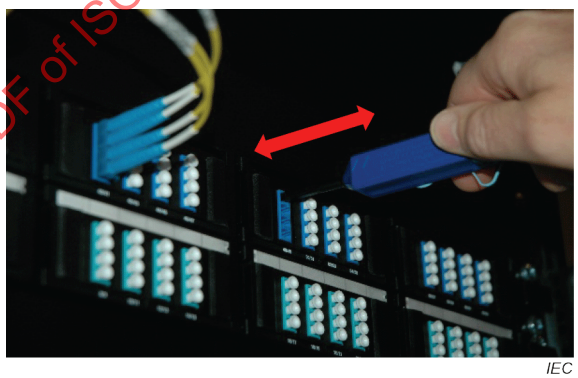

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Figure B.8 – Example of single-mode LC link interface

The single-mode LC cabling interfaces have the same shape as the multimode LC cabling interfaces. The distinct difference is the colour: blue for the single-mode LC connector housing and beige or aqua for the multimode connector housing.

B.3.4 Single-mode APC cylindrical and rectangular ferrules (60 dB return loss)

B.3.4.1 General requirements

The single-mode angled polished LC and MPO cabling interfaces are used in applications where very high return loss is required. Angled polished connectors are in general used in telecommunication applications or as connection to the telecommunication networks.

The angled polished LC and MPO cabling interfaces have the same shape as the multimode LC cabling interfaces. The distinct difference is the colour: green for the angled polished single-mode LC and MPO connector housing and beige or aqua for the multimode connector housing.

The following inspection zones and requirements shall be followed when the end faces of single-mode angle polished cylindrical connectors are inspected. The inspection shall be carried out in accordance with IEC 61300-3-35.

For ferrules of MPO connectors it is recommended to inspect first the entire ferrule end face for loose particles and dirt and not only the fibre area. This inspection becomes very easy when microscopes with very low resolution with floodlight are used, see Figure B.1 and Figure B.2. Inspection for dirt shall always be followed by low-resolution inspection of the polished fibres for scratches and defects according to Table B.1. Scratches and defects are counted separately.

The inspection requirements of IEC 61300-3-35 apply. For the convenience of the user, Table B.3 contains the requirements of IEC 61300-3-35:2015 (which is the current standard at the time of publication of this document). At the time of inspection, users of this document shall verify if Table B.3 is in line with the requirements of the then valid IEC 61300-3-35.

Table B.3 – Inspection requirements for cabling interfaces with 60 dB return loss

Zone (diameter)	**Scratches** (maximum number of a given dimension)	**Defects** (maximum number of a given dimension)
A: core 0 µm to 15 µm	4 ≤ 3 µm	None[a]
B: cladding 15 µm to 115 µm	No limit ≤ 5 µm None[a] > 5 µm	5 ≤ 3 µm 10 > 3 µm
NOTE 1 Outside the core and cladding zone there are only cleanliness requirements. The recommended inspection area for cylindrical ferrules is limited to 250 µm. Ten particles of ≤ 5 µm diameter are allowed. There are no requirements for the area outside the 250 µm zone. Cleaning loose debris beyond this region is recommended. For rectangular ferrules, it is recommended to inspect the entire ferrule surface for cleanliness. Ten particles of ≤ 10 µm are allowed. NOTE 2 For multiple-fibre rectangular-ferrule connectors, the criteria apply to all fibres in the array.		
[a] None detected with low resolution microscope capable of detecting 2 µm defects/scratches.		

B.3.4.2 Cleaning procedure for the LC/APC single-mode cabling interfaces

Figure B.9 and Figure B.10 show the cleaning procedure for the LC/APC single-mode cabling interface.

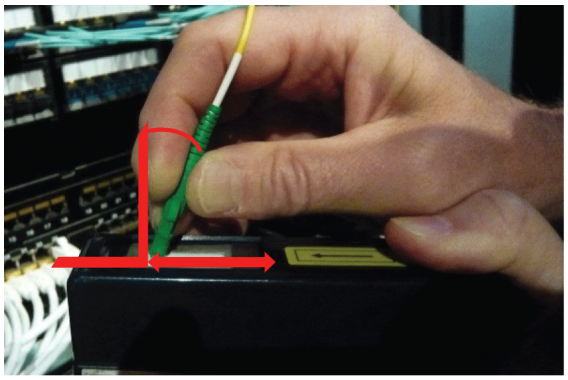

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Figure B.9 – Example of single-mode LC/APC channel interface

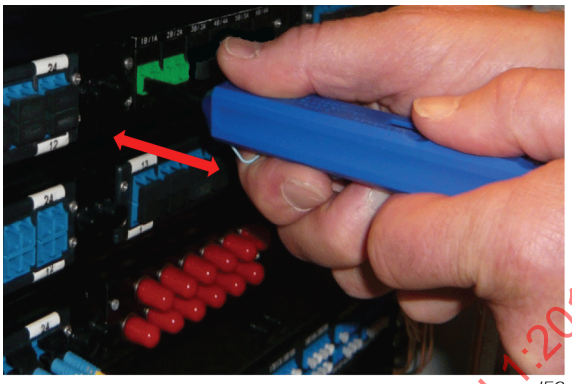

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Figure B.10 – Example of single-mode LC/APC link interface

NOTE The angle of the connector is exaggerated for indicating purposes.

Cleaning of the angled LC is slightly more complex than of the LC PC connector because the ferrule front face is under an 8° angle. When the LC/APC channel cabling connector is cleaned, it is recommended to clean a single connector and not a duplex connector which allows a tilt of the connector such that the ferrule surface is in complete planar contact with the cleaning cloth.

For cleaning the LC/APC link cabling interface, neither the plug nor the cleaning probe can be tilted. Repeated push and click operations might be needed for effective cleaning.

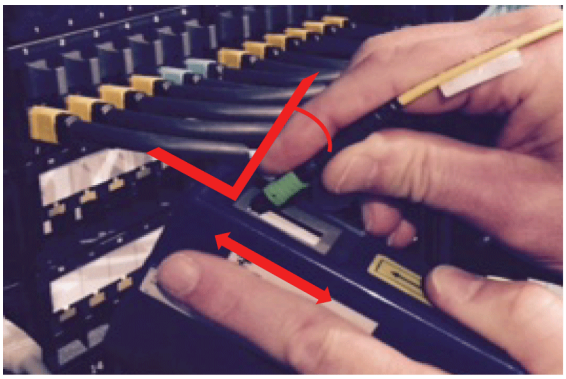
B.3.4.3 Cleaning procedure for single-mode (SM) MPO/APC cabling interface

Special attention should be given to cleaning of male MPO channel interfaces because the pins prohibit the use of female MPO cassette cleaners. It is recommended to use special MPO male cassettes available on the market which allow cleaning of the fibres between the pins or one should use an MPO generic cleaner that works for male and female connector types.

Cleaning of the angled MPO is slightly more complex than of the regular MPO connector because the ferrule front face is under an 8° angle.

It is recommended to inspect the entire ferrule surface of the MPO connector for loose contaminants by means of a microscope with very low resolution with floodlight illumination. Due to the ferrule surface structure of the MPO connector it is more difficult to differentiate between loose particles and the ferrule surface. Use of the floodlight illumination solves this as loose contamination appears as white particles on a dark surface.

Figure B.11 and Figure B.12 show the cleaning procedure for the single-mode MPO/APC cabling interface.



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NOTE The angle of the connector is exaggerated for indicating purposes.

Figure B.11 – Example of SM MPO/APC channel interface

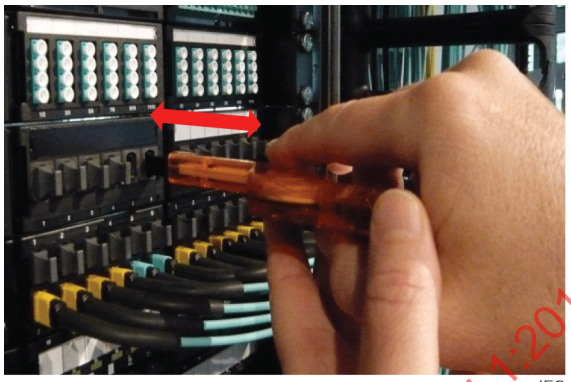

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Figure B.12 – Example of SM MPO/APC link interface

Annex D (normative) Inspection and testing of test and substitution test cords

Replace title of Annex D with the following:

Annex D (normative) Inspection and testing of launch test cords, tail test cords and substitution test cords

D.1 General requirements

Add, below c), the following new paragraph:

Prior to start of the attenuation measurement the performance of the reference cords shall be verified in agreement with Annex D.

Figure D.1 – Measurement of substitution test cord attenuation

Replace the title of Figure D.1 with following:

Figure D.1 – Measurement of launch test cord, tail test cord and substitution test cord interface attenuation

E.1 Reference methods for link attenuation

Replace the second sentence in the first paragraph with the following:

The enhanced three-test-cord reference method is to be used for measuring the attenuation of permanent links.

E.2 One-test-cord reference method for link attenuation

Replace Clause E.2 with the following:

E.2 One-test-cord method link attenuation

E.2.1 General

The one-cord test method may only be applied in the following specific circumstances:

a) the interface to the cabling under test is the same as the interface on the power meter; and

b) where the cabling under test has simplex interfaces (or interfaces that can be tested as such).

E.2.2 Test method

Inspect and clean when necessary the connector interfaces of the source and the launch test cord.

a) Allow sufficient time for light source stabilization in accordance with light source manufacturer's recommendations.

b) Connect the launch test cord (LTC) to the light source (LS) and to the power meter (PM). (See Figure E.1.)

c) Never disconnect the launch test cord connector from the light source.

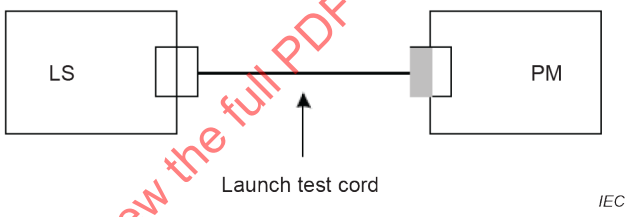

Figure E.1 – Connection of LS – LTC – PM for reference setting

d) Set the reference to 0,0 dB or record the reference measurement (P_r) in dBm or watts.

e) Connect the launch test cord to the near end of the link. Connect the tail test cord (TTC) to the far end of the link. (See Figure E.2.)

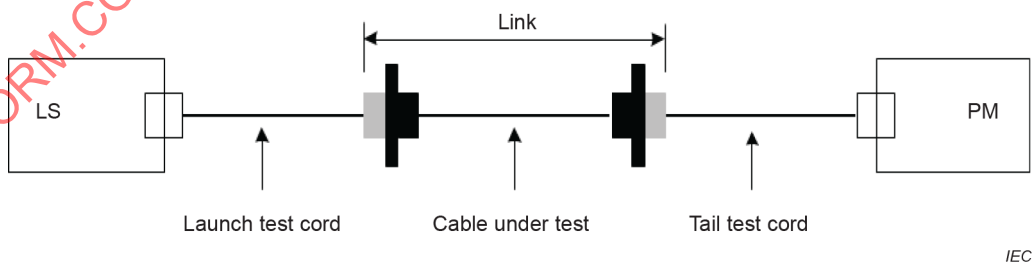

Figure E.2 – Connections to link for attenuation measurement

f) Measure and record the attenuation (P_1) of the link under test in dB.

For this method, the measurement uncertainties at 95 % confidence level are as follows.

SMF: ± 0,24 dB for fibre length < 2 km.

MMF: ± 0,27 dB when measured attenuation ≤ 1,9 dB.