IEC 61300-3-35

Edition 3.0 2022-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures –
Partie 3-35: Examens et mesures – Examen visuel des connecteurs fibroniques et des émetteurs-récepteurs à embase fibrée

IEC 61300-3-35:2022-09(en-fr)

Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2022 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 Secretariat
3, rue de Varembé
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.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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.

IEC Products & Services Portal - products.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

IEC 61300-3-35

Edition 3.0 2022-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures –
Partie 3-35: Examens et mesures – Examen visuel des connecteurs fibroniques et des émetteurs-récepteurs à embase fibrée

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.180.20

ISBN 978-2-8322-5713-5

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.

AVA Documents
Document Sharing Hub

® Registered trademark of the International Electrotechnical Commission
Marque déposée de la Commission Electrotechnique Internationale

Full document details: IEC 61300-3-35 2022

CONTENTS

FOREWORD 4
1 Scope 6
2 Normative references 6
3 Terms, definitions and abbreviated terms 6
3.1 Terms and definitions 6
3.2 Abbreviated terms 7
4 Apparatus 7
4.1 General 7
4.2 Method A: Direct view optical microscopy 8
4.3 Method B: Video microscopy 8
4.4 Method C: Automated analysis microscopy 9
4.5 Requirements of validation 9
4.6 Minimum requirements for standard field of view microscope 9
4.7 Minimum requirements for large field of view microscope 9
5 Inspection procedure 9
Annex A (normative) Visual requirements for connector end faces 12
A.1 Requirements 12
A.2 Visual inspection requirements for multimode PC and APC polished connectors 12
A.3 Visual requirements for single-mode PC polished connectors, RL ≥ 26 dB, and single-mode transceivers using a fibre-stub interface 13
A.4 Visual requirements for single-mode PC polished connectors, RL ≥ 35 dB 13
A.5 Visual requirements for single-mode PC polished connectors, RL ≥ 45 dB 14
A.6 Visual requirements for single-mode angle polished (APC) connectors 14
Annex B (informative) Examples of defects and scratches 15
Annex C (normative) Validation procedure 16
C.1 Validation artefact 16
C.2 Validation procedure 16
Annex D (informative) Recommended cleaning method 17
D.1 Inspection procedure for cleanliness 17
D.2 Cleaning procedure rectangular ferrules (on cable) 17
D.3 Cleaning procedure for cylindrical ferrules 19
D.4 Cleaning procedure for adaptor and receptacle of rectangular ferrules 20
Annex E (informative) Examples of large field of view images 21
Bibliography 23

Figure 1 – Flowchart of inspection procedure 10
Figure B.1 – Example 1 of defects and scratches 15
Figure B.2 – Example 2 of defects and scratches 15
Figure D.1 – Flowchart of dry only cleaning/inspection sequence 17
Figure D.2 – Flowchart of dry-wet cleaning/inspection sequence 17
Figure D.3 – Dry cleaning of connector on cable 18
Figure D.4 – Moisten the tape 19
Figure D.5 – Wiping action 19

AVA Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

Figure D.6 – cleaning of cylindrical ferrule 19
Figure D.7 – Moisten the tape 20
Figure D.8 – 2 Strokes on wet tape 20
Figure D.9 – Insert click cleaner 20
Figure D.10 – Clean pins 20
Figure D.11 – Rotate stick 20
Figure E.1 – Example of typical contaminations 21
Figure E.2 – Example of typical contaminations 21
Figure E.3 – Example of typical contaminations 22
Figure E.4 – Example of typical contaminations 22

Table A.1 – Visual requirements for multimode PC and APC polished connectors 12
Table A.2 – Visual requirements for single-mode PC polished connectors, RL ≥ 26 dB, and single-mode transceivers using a fibre-stub interface 13
Table A.3 – Visual requirements for single-mode PC polished connectors, RL ≥ 35 dB 13
Table A.4 – Visual requirements for single-mode PC polished connectors, RL ≥ 45 dB 14
Table A.5 – Visual requirements for single-mode angle polished (APC) connectors 14

Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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.

IEC 61300-3-35 has been prepared by subcommittee SC 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) adding of a statement that visual inspection is not a substitute for optical qualification such as attenuation and return loss measurement;
b) adding of some terms and definitions;
c) adding requirements for SM 35 dB connectors;

AVA Documents Document Sharing Hub

Full document details: IEC 61300-3-35 2022

d) adding of a sentence in Clause 5 concerning the susceptibility of the methods to system variability and variability within systems from same supplier;

e) removal of inspection requirements for zones C and D;

f) insertion of a generic cleanliness specification for whole rectangular ferrule and 250 µm area around every fibre;

g) adding a cleaning recommendation for rectangular and cylindrical ferrules;

h) outer edge of inspection zone B has changed from 115 µm to 110 µm to meet manufacturing tolerances of fixture for microscopes;

i) change that defects that are partly in core are only to be judged for the part they are in the core. The remainder of the defect is considered to be located in the cladding.

j) adding a statement that a connector cannot be rejected by just failing visual inspection. Meeting the specified optical performance determines the use of this connector.

The text of this International Standard is based on the following documents:

Draft	Report on voting
86B/4643/FDIS	86B/4665/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 61300 series, published under the general title *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

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

1 Scope

This part of IEC 61300 is concerned with the observation and classification of debris, scratches and defects. The inspection requirements are based on IEC TR 62627-05. Advice for cleaning of contamination from fibres/ferrule is found in IEC TR 62627-01 and a recommendation is given in Annex D. IEC TR 62572-4 provides the cleaning method for a stub for optical transceivers. Visual inspection is in addition to, and does not replace measurement of performance parameters such as attenuation and return loss, or end face parameters. The dimensions specified are chosen such that they can be easily estimated. Not only the zones A and B on the fibre are inspected for defects and scratches but the whole contact area (where the two fibres/ferrules meet when mated) needs to be inspected for contamination (this is up to 250 µm diameter for cylindrical ferrules and the whole ferrule surface for rectangular ferrules).

The objectives of this document are the following:

- specify the minimum criteria for a microscope to be compliant to this document;
- specify the procedure and criteria for inspecting fibre-optic end faces for cleanliness to determine if the end faces are fit for use. All connector optical interfaces (IEC 61755 series and IEC 63267 series) are based on physical contact between fibre cores;
- provide quantitative criteria for the analysis of end face images.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60825-2, *Safety of laser products – Part 2 Safety of optical fibre communication systems (OFCSs)*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

3.1.1
defect
permanent non-linear surface feature on the fibre or ferrule end face within the regions of interest, which includes, but it not limited to, pits, chips, edge chipping, and/or non removable foreign material

Note 1 to entry: Some fibre types have structural features potentially visible on the fibre end face. Fibres that use microstructures to contain the light signal, such as photonic band-gap and hole-assisted fibres, can have an engineered or random pattern of structures surrounding the core. These features are not defects.

Note 2 to entry: Scratches are excluded from this definition.

3.1.2
defect size
diameter of the smallest circle that can encompass the entire defect

3.1.3
debris
unwanted material or particulates of any kind on the surface of fibre or ferrule end face within the regions of interest that is removeable using standard cleaning methods

Note 1 to entry: Multiple cleaning methods are described in IEC TR 62627-01.

3.1.4
scratch
permanent surface feature on the fibre end face where the width of the damaged area is smaller than or equal to one fifth of its length

3.1.5
reliably detectable
sufficiently clear and visible so that a typical technician of average training would recognize a feature at least 98 % of the time

3.2 Abbreviated terms

APC angled physical contact

DUT device under test

FOV field of view

LFOV large field of view

MM multimode

PC physical contact

RL return loss

SFOV standard field of view

SM single-mode

4 Apparatus

4.1 General

One of the objectives of this document is to specify the minimum criteria (see 4.5 and 4.6) a microscope shall meet to be compliant to this document.

Three types of microscopes are described:

a) method A microscope: direct view optical microscope as described in 4.2;

b) method B microscope: video microscope as described in 4.3;

c) method C microscope: automated analysis microscope as described in 4.4.

Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

For each type, there are optical/hardware requirements to be met and procedures to be followed. As these processes are in support of the inspection criteria defined in Clause 5, all three are expected to result in a "pass" or "fail".

The minimum optical requirements for all types of microscopes to be compliant with this document are given in 4.5 and 4.6.

The microscopes described in this document, with the exception of large field of view (LFOV), are capable of being used for inspection for contamination (cleanliness) prior mating in the field and factory and after polishing SM and MM, single-fibre and multifibre connectors in the factory.

LFOV microscopes can be used for inspection of contamination of the entire ferrule surface of multifibre connectors in the field and in the factory.

For methods A and B, visual gauge tools should be used to facilitate the estimation procedure. For method A, an eyepiece reticule should be used. For method B, a transparent overlay should be used.

WARNING – All methods are susceptible to system variability: methods A and B are operator and equipment hardware dependent. Method C is less operator dependent but exhibits from software irregularities and variations in hardware and, in case of field use, operator handling differences can cause a variation in results that might appear even when equipment from the same brand is compared. Method C has an inherent uncertainty when defects or scratches are located near test limits, as described in Annex A tables.

4.2 Method A: Direct view optical microscopy

This method uses an optical microscope in which a primary objective lens forms a first image that is then magnified by an eyepiece that projects the image directly to the user's eye. It shall have the following features and capabilities:

- a suitable ferrule or connector adapter;
- a light source and focussing mechanism;
- a built-in laser safety filter;
- a means to compare dimension of defects or scratches observed in the image with a sufficient reliability (i.e. eyepiece reticule with certified dimension according the magnification).

Laser safety is of particular concern when using direct view microscopes, as any energy in the optical path is directed into the eye of the observer. When method A is used, the user shall ensure there is no laser active on the link prior to inspection. IEC 60825-2 shall be used for laser safety of optical fibre communication systems.

4.3 Method B: Video microscopy

This method uses an optical microscope in which a lens system forms an image on a sensor that, in turn, transfers the image to a display. The user views the image on the display. It shall have the following features and capabilities:

- a suitable ferrule or connector adapter;
- a light source and focussing mechanism;
- a means for creating an image (display);
- a means to estimate surface dimensions defects and/or scratches observed in the image (e.g. overlay with certified dimension according the image on the screen).

Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

4.4 Method C: Automated analysis microscopy

This method uses an optical microscope in which a digital image is acquired or created and is subsequently analysed via an algorithmic process. The purpose of such a system is to reduce the effects of human subjectivity in the analysis process. It shall have the following features and capabilities:

- a suitable ferrule or connector adapter;
- a light source and focussing mechanism;
- a means for acquiring and creating a digital image;
- algorithmic analysis of the digital image;
- a means to compare the analysed image to programmable acceptance criteria.

4.5 Requirements of validation

Microscope systems for methods A, B and C shall be validated for use as compliant with this document. This validation shall be conducted with a purpose-built validation artefact that can serve to validate a system's ability to detect surface defects or scratches of relevant size and/or the required system response. Such (an) artefact(s) shall be provided with instructions on its use and shall be manufactured in a method such that it can be measured in a traceable manner. The related validation procedure is found in Annex C.

4.6 Minimum requirements for standard field of view microscope

This requirement for the standard field of view microscope (SFOV) is a minimum total magnification offering a field of view of at least 250 µm (for methods B and C, this dimension shall be measured in the vertical, or most constrained axis) capable of detecting defects of 2 µm in diameter and scratches of 3 µm wide in the whole field of view.

The minimum requirements for systems for methods A, B and C are as follows:

- particle size detection: 2 µm diameter;
- scratch detection: 3 µm wide.

4.7 Minimum requirements for large field of view microscope

Microscopes with large field of view are only capable of being used for cleanliness inspection of the complete ferrule of single-mode (SM) and multimode (MM) array type connectors like MPO. This requirement is a minimum total magnification offering a LFOV of at least 6,4 mm × 2,5 mm and capable of detecting debris of 10 µm in diameter in the whole field of view.

The minimum requirement for very large field of view systems for methods A,B and C is 10 µm diameter for particle size detection.

5 Inspection procedure

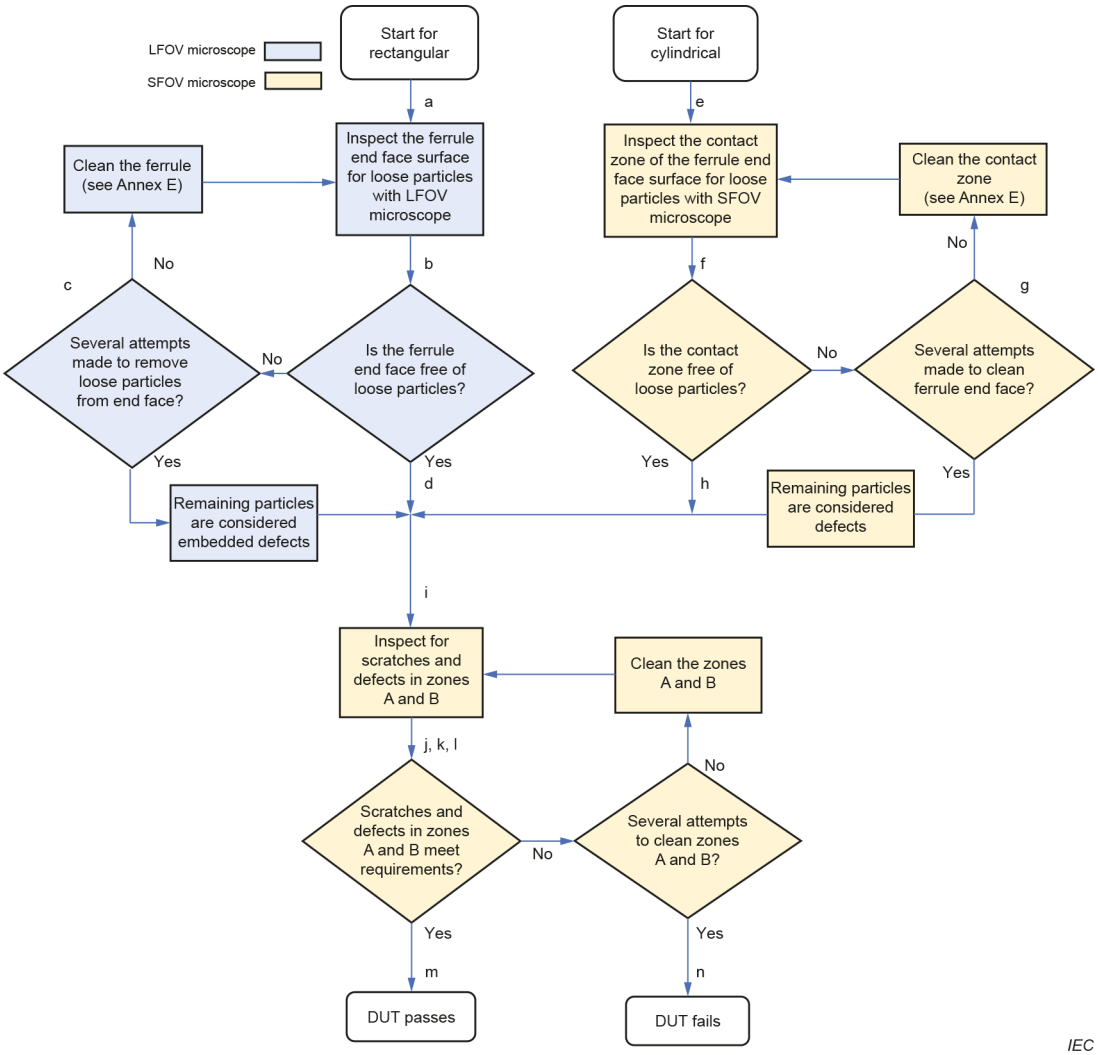
The inspection for cleanliness of ferrules shall take place prior to any other inspection of the polished parts of the end faces. For cylindrical ferrules, at least an area of 250 µm diameter shall be inspected and cleaned when necessary. Cylindrical ferrules should be inspected and cleaned beyond the 250 µm area.

For rectangular ferrules, the entire ferrule surface (6,4 mm × 2,5 mm) shall be inspected for cleanliness and cleaned when necessary. Use of inspection equipment with LFOV and oblique illumination eases the detection of contamination on the rectangular ferrules.

Documents
Document Sharing Hub
Full document details: IEC 61300-3-35 2022

SFOV may also be used for cleanliness inspection of the entire rectangular ferrule surface. It requires scrolling over the entire 6.4 × 2.5 mm ferrule surface. During the scrolling action, care should be taken not to miss any part of ferrule surface and maintain ferrule surface in focus.

The flowchart in Figure 1 shows the procedure to be employed.



NOTE Letters a, b, … to n correspond to procedure in Clause 5.

Figure 1 – Flowchart of inspection procedure

The following cleanliness for rectangular ferrules shall apply.

a) Using a LFOV microscope as defined in 4.7, focus the microscope so that a crisp image of the ferrule end face of rectangular ferrules can be seen.

b) Inspect the entire end face for contamination. For APC ferrules, only the angled area needs to be inspected; the small flat non-angled area, if present, does not require inspection.

   A maximum of 10 particles between 10 µm and 25 µm are the recommended limit. There is no limit for particles below 10 µm, and no particles larger than 25 µm should appear. The defect size is the diameter of the smallest circle that can encompass the entire defect.

c) All loose particles should be removed; several attempts at cleaning may be required. Debris remaining after cleaning shall be considered as a defect(s). Consult IEC TR 62627-01:2016, Annex E of this document, and IEC TR 62572-4 for recommendations on cleaning methods for connectors and transceivers.

Documents
Document Sharing Hub
Full document details: IEC 61300-3-35 2022

d) If the rectangular ferrule end face meets the limits for cleanliness, the inspections of zones A and B of all fibres of the rectangular ferrule against the requirements of the relevant table in Annex A can start.

The following cleanliness for cylindrical ferrules shall apply.

e) Using a microscope as defined in 4.6, focus the microscope so that a crisp image of the cylindrical ferrule end face can be seen.

f) Inspect the 250 µm diameter central zone of the end face for contamination. A maximum of 10 particles between 5 µm and 10 µm are the recommended limit in the ring between 135 µm to 250 µm diameter. There is no limit for particles smaller than 5 µm, and no particles larger than 10 µm should appear.

g) All loose particles shall have been removed, and any remaining particles shall be considered as defects. Debris remaining after cleaning shall be considered as defects. Consult IEC TR 62627-01:2016, Annex E of this document, and IEC TR 62572-4 for recommendations on cleaning methods for connectors and transceivers.

h) If the cylindrical ferrule end face meets the limits for cleanliness, the inspection of zones A and B of the fibre against the requirements in the relevant table in Annex A can start.

The visual inspection of zones A and B for cylindrical and rectangular ferrules is as follows.

i) Focus the microscope so that a crisp image of the fibres can be seen.

j) Locate all defects and scratches (see Annex B for examples of defects and scratches) within the zones specified in the relevant table in Annex A. Classify and count defects and scratches within zones A and B.

k) If a defect or scratch is found in both the zones A and B, classify the part of the scratch or defect only for zone A that falls in zone A and only for zone B that falls in zone B.

l) Once all defects and scratches have been classified and counted, the results shall be totalled and compared with the appropriate acceptance criteria (Table A.1 to Table A.5).

m) If the scratches and defects are less than or equal to the criteria, then the DUT passes.

n) If the scratches and defects are greater than the criteria and several attempts at cleaning have been made, the DUT fails.

If a connector fails after executing the inspection procedure and no loose debris is present, the connector shall be tested against its optical performance specification (typically attenuation and/or return loss). If the connector meets the specified optical performance, the connector is suitable for use.

Consult IEC TR 62627-01:2016, Annex E of this document, and IEC TR 62572-4 for recommendations on cleaning methods for connectors and transceivers.

NOTE It is possible than an optical assembly that has not been verified to be clean pass an optical performance test but have reduced performance in the future due to debris migration towards the fibre core. It is possible an optical assembly with debris on the end face become damaged and potentially damage the mating connector.

Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022

Annex A
(normative)

Visual requirements for connector end faces

A.1 Requirements

The normative inspection requirements for various connector end face types and performance grades are specified in Clauses A.2 to A.6. These define the allowable defects and scratches for single-mode and multimode connectors, with PC and APC polished interfaces.

NOTE The IEC 63267 series and IEC 61755 series optical connector interfaces are under development. After publication of both interfaces, the inspection requirements will be normatively placed in the IEC 63267 series and IEC 61755 series, while the content of this Annex A will become informative by means of revision or amendment.

A.2 Visual inspection requirements for multimode PC and APC polished connectors

Measurements of scratch width using inspection methods A and B are subject to significant variability due to the subjectivity and human-dependence inherent to these methods. When method A or B is used, the specified dimensions of defects and scratches may be estimated in order to be classified and counted. Additionally, when method C is used, as described in IEC TR 63367, machine imaging and processing systems have intrinsic limitations that also result in variability in scratch width measurement. As a result, it is commonplace to obtain different values for defect diameter and scratch width and pass/fail conditions when connector end face features are measured across different equipment or repeatedly on the same equipment and when using methods A, B, and C.

The zone size for multimode fibres has been set at 65 µm to accommodate both 50 µm and 62,5 µm diameter core fibres. This has been done to simplify the grading process. Table A.1 shows the requirements for allowed defects and scratches for MM connectors.

Table A.1 – Visual requirements for multimode PC and APC polished connectors

Zone (diameter)	**Defects** (diameter)	**Scratches** (width)
A: core zone 65 µm	< 2 µm: no limit ≥ 2 µm and ≤ 5 µm: maximum 4 > 5 µm: none	< 3 µm: no limit ≥ 3 µm and ≤ 4 µm: maximum 4 > 4 µm: none
B: cladding zone 65 µm to 110 µm	≤ 25 µm: no limit > 25 µm: none	No limit
NOTE 1 See Figure B.1 and Figure B.2 as examples. NOTE 2 For multiple-fibre rectangular-ferrule connectors, the criteria apply to all fibres in the array.		

Documents
Document Sharing Hub
Full document details: IEC 61300-3-35 2022

A.3 Visual requirements for single-mode PC polished connectors, RL ≥ 26 dB, and single-mode transceivers using a fibre-stub interface

Measurements of scratch width using inspection methods A and B are subject to significant variability due to the subjectivity and human-dependence inherent to these methods. When method A or B is used, the specified dimensions of defects and scratches may be estimated in order to be classified and counted. Additionally, when method C is used, as described in IEC TR 63367, machine imaging and processing systems have intrinsic limitations that also result in variability in scratch width measurement. As a result, it is commonplace to obtain different values for defect diameter and scratch width and pass/fail conditions when connector end face features are measured across different equipment or repeatedly on the same equipment and when using methods A, B, and C.

Table A.2 shows the requirements for allowed defects and scratches for SM connectors with 26 dB return loss.

Table A.2 – Visual requirements for single-mode PC polished connectors, RL ≥ 26 dB, and single-mode transceivers using a fibre-stub interface

Zone (diameter)	**Defects** (diameter)	**Scratches** (width)
A: core zone 25 µm	< 2 µm no limit ≥ 2 µm and ≤ 3 µm maximum 1 > 3 µm none	< 3 µm no limit ≥ 3 µm and ≤ 4 µm maximum 2 > 4 µm none
B: cladding zone 25 µm to 110 µm	≤ 25 µm no limit > 25 µm none	No limit

A.4 Visual requirements for single-mode PC polished connectors, RL ≥ 35 dB

Measurements of scratch width using inspection methods A and B are subject to significant variability due to the subjectivity and human-dependence inherent to these methods. When method A or B is used, the specified dimensions of defects and scratches may be estimated in order to be classified and counted. Additionally, when method C is used, as described in IEC TR 63367, machine imaging and processing systems have intrinsic limitations that also result in variability in scratch width measurement. As a result, it is commonplace to obtain different values for defect diameter and scratch width and pass/fail conditions when connector end face features are measured across different equipment or repeatedly on the same equipment and when using methods A, B, and C.

Table A.3 shows the requirements for allowed defects and scratches of SM connectors for 35 dB return loss.

Table A.3 – Visual requirements for single-mode PC polished connectors, RL ≥ 35 dB

Zone (diameter)	**Defects** (diameter)	**Scratches** (width)
A: core zone 25 µm	< 2 µm no limit ≥ 2 µm and ≤ 3 µm maximum 1 > 3 µm none	< 3 µm no limit Maximum 1 ≥ 3 µm and ≤ 4 µm None > 4 µm
B: cladding zone 25 µm to 110 µm	≤ 25 µm no limit > 25 µm none	No limit

Documents
Document Sharing Hub
Full document details: IEC 61300-3-35 2022

A.5 Visual requirements for single-mode PC polished connectors, RL ≥ 45 dB

Measurements of scratch width using inspection methods A and B are subject to significant variability due to the subjectivity and human-dependence inherent to these methods. When method A or B is used, the specified dimensions of defects and scratches may be estimated in order to be classified and counted. Additionally, when method C is used, as described in IEC TR 63367, machine imaging and processing systems have intrinsic limitations that also result in variability in scratch width measurement. As a result, it is commonplace to obtain different values for defect diameter and scratch width and pass/fail conditions when connector end face features are measured across different equipment or repeatedly on the same equipment and when using methods A, B, and C.

Table A.4 shows the requirements for allowed defects and scratches of SM connectors for 45 dB return loss.

Table A.4 – Visual requirements for single-mode PC polished connectors, RL ≥ 45 dB

Zone (diameter)	**Defects** (diameter)	**Scratches** (width)
A: core zone 25 µm	< 2 µm no limit ≥ 2 µm and ≤ 3 µm maximum 1 > 3 µm none	< 3 µm no limit ≥ 3 µm none
B: cladding zone 25 µm to 110 µm	≤ 25 µm no limit > 25 µm none	No limit

A.6 Visual requirements for single-mode angle polished (APC) connectors

Measurements of scratch width using inspection methods A and B are subject to significant variability due to the subjectivity and human-dependence inherent to these methods. When method A or B is used, the specified dimensions of defects and scratches may be estimated in order to be classified and counted. Additionally, when method C is used, as described in IEC TR 63367, machine imaging and processing systems have intrinsic limitations that also result in variability in scratch width measurement. As a result, it is commonplace to obtain different values for defect diameter and scratch width and pass/fail conditions when connector end face features are measured across different equipment or repeatedly on the same equipment and when using methods A, B, and C.

Table A.5 shows the requirements for allowed defects and scratches for SM APC connectors.

Table A.5 – Visual requirements for single-mode angle polished (APC) connectors

Zone (diameter)	**Defects** (diameter)	**Scratches** (width)
A: core zone 25 µm	< 2 µm no limit ≥ 2 µm and ≤ 3 µm maximum 1 > 3 µm none	< 3 µm no limit ≥ 3 µm and ≤ 4 µm maximum 4 > 4 µm none
B: cladding zone 25 µm to 110 µm	≤ 25 µm no limit > 25 µm none	No limit
NOTE For multiple-fibre rectangular-ferrule connectors, the criteria apply to all fibres in the array.		

Documents
Document Sharing Hub
Full document details: IEC 61300-3-35 2022

Annex B
(informative)

Examples of defects and scratches

Examples of defect and scratches are shown in Figure B.1 and Figure B.2.

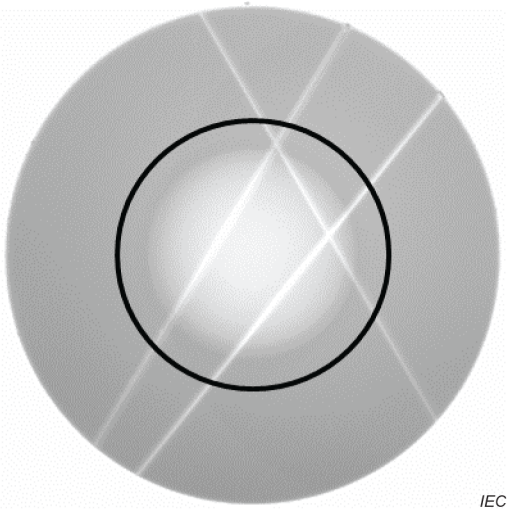


Figure B.1 – Example 1 of defects and scratches

Test requirements:	Multimode PC polished connectors, RL ≥ 20 dB (see Table A.1)
Result:	Accepted, observed scratches are within the acceptance parameters of Table A.1
Reason:	3 scratches ≤ 4 µm in the core zone of 65 µm.

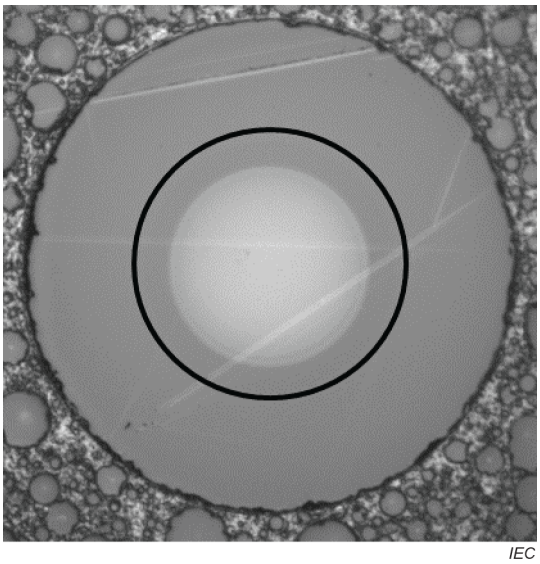


Figure B.2 – Example 2 of defects and scratches

Test requirements:	Multimode PC multi-fibre rectangular connectors (see Table A.1).
Result:	Accepted.
Reason:	2 scratches observed in core zone 65 µm acceptable according to Table A.5 and 1 scratch and 1 defect observed in cladding zone are within the acceptance parameters of Table A.1.

AVA Documents
Document Sharing Hub

Full document details: IEC 61300-3-35 2022