IEC/PAS 61300-3-35

Edition 1.0
2002-07

Fibre optic interconnecting devices and passive components – Basic test and measurement procedures –

Part 3-35: Examinations and measurements – Fibre optic cylindrical connector endface visual inspection

PUBLICLY AVAILABLE SPECIFICATION

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public.

IEC-PAS 61300-3-35 has been processed by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document:

Draft PAS	Report on voting
86B/1677/PAS	86B/1701/RVD

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

Part 3-35: Examinations and measurements – Fibre optic cylindrical connector endface visual inspection

1 Scope

The purpose of this part of IEC 61300 is to quantitatively assess the endface quality of a polished fiber optic connector. The information is intended for use with other standards which set requirements for allowable surface defects such as scratches, pits and debris which may affect optical performance. In general, the methods described in this document apply to fibers contained within a ferrule, however portions are applicable to non-ferruled connectors. Those portions are identified where appropriate.

2 Normative references

The following normative document contains provisions which, through reference in this text, constitutes provisions of this part of IEC 61300.

IEC 61300-1 Ed. 1.0b: 1995, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 1: General and guidance 86B*

3 General description

Two methods are described: (A) Optical microscope and (B) CCD array camera with monitor. In method A, the required equipment is an optical microscope capable of direct illumination with a calibrated eyepiece reticle to measure the size of features in the image. In method B, an optical microscope is used in conjunction with a CCD array camera to project an image onto a video monitor at a known magnification. In both methods A and B, features are identified and measured by an operator.

3.1 Morphological Definitions of Defect Features

For purposes of this document the following defects shall apply for all measurement methods.

Scratches: permanent linear surface features derived from polishing or handling

Pits: permanent non-linear features caused by surface damage during polishing or handling.

Cracks: permanent fracture lines that may extend to the surface of the fiber

Surface debris: non-permanent features that can be removed by cleaning.

3.2 Measurement conditions

No restrictions are placed on the range of atmospheric conditions under which the test can be conducted. It may performed in controlled or uncontrolled environments

3.3 Pre-conditioning

No minimum pre-conditioning time is required.

3.4 Recovery

Since measurements are to be made at standard test conditions, no minimum recovery time is required.

4 Apparatus

The apparatus consists of the following elements.

4.1 Method A: Optical

The apparatus for method A (figure 1) consists of an optical microscope with the following features and capabilties:

– A suitable ferrule or connector plug holder and a positioning stage

– Minimum total magnification of 200X, where total magnification is defined as the product of the objective lens and eyepiece lens magnifications.

– Resolving power of 1,0 μm

The resolving power is determined by the numerical aperature of the objective lens and wavelength of the illuminating light as given in equation:

$$R = 0{,}61\lambda/NA$$

Where: R is the resolving power,
λ is the wavelength of the illuminating light, and
NA is the numerical aperature of the objective lens

– Direct axial illumination with an unpolarisedlight light source shall be used. A center wavelength is 0,56 μm is recommended. This can be achieved with a white light source

NOTE A center wavelength of 0,56 μm requires an NA of 0.34 to achieve the required resolution of 1,0 μm

– A calibrated eyepiece reticle capable of measuring features on the ferrule surface with linear dimensions of 1,0 μm or greater .

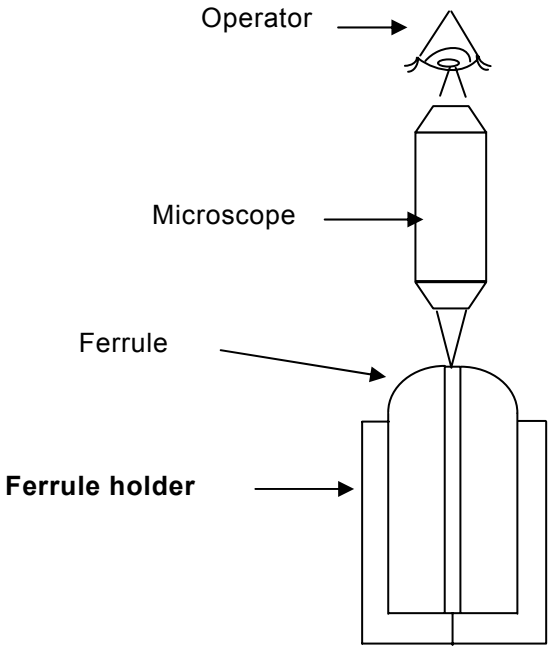


Figure 1 - Apparatus for Method A: Optical microsope

4.2 Method B: CCD Array Camera with Monitor

The apparatus for method B (figure 2) consists of an optical microscope, equipped as in method A, and a CCD array camera to project an image onto a video monitor. The total (electronic) magnification for such a system is the product of the optical magnification and the video magnification. The optical magnification is defined as the power of the objective lens multiplied times any video lens incorporated between the objective and CCD camera. Video magnification is defined as the ratio of the diagonal of the monitor divided by the diagonal of the camera chip size.

The requirements of the system with respect to magnification resolution and contrast are the same as for method A. Linear dimensions may be made with an intermediate lens reticle or a a calibrated grid on the video monitor.

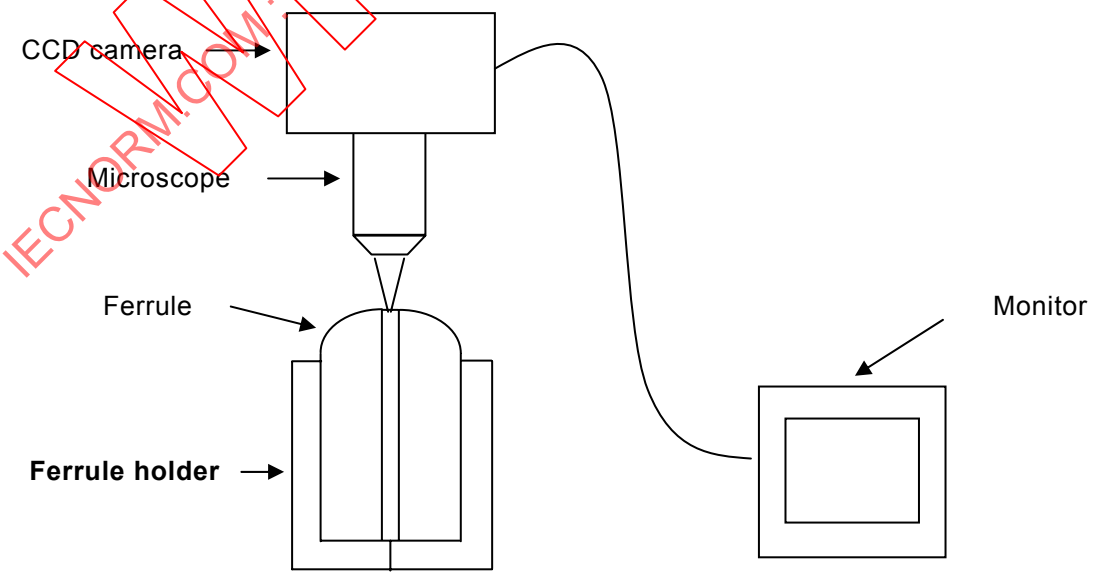


Figure 2 - Apparatus for Method B: CCD Array camera with Monitor

5 Procedure

5.1 Measurement Regions

For purposes of setting requirements on endface quality, the polished endface of a connector is divided into measurement regions defined as follows:

Table 1 - Measurement Regions for polished connectors

ZONE	DIAMETER
A: Core Zone	0-25 μm
B: Cladding Zone	25-120 μm
C: Epoxy Zone	120-130 μm
D: Contact Zone	130-250μm

For purposes of measurements the zone boundaries are determined as follows:

5.1.1 Adjust the microscope or microscope and video magnifications to a minimum of 200X and a maximum that will project a field of view of at least 300μm. Attach the ferrule or connector plug in the ferrule holder so that the portion of the ferrule or plug closest to the endface is held within the holder with a contact length at least twice the ferrule diameter for cylindrical ferrule or 5,0 mm for rectangular and ferruless connectors.

5.1.2 Locate the center of the fiber. This is done by locating the fiber edge in four positions 90° apart. Position the holder so that the fiber axis is parallel to and coincident with the axis of the microscope.

5.1.3 The diameters of measurment regions in table 1 of paragraph 3.1 are centered on the fiber center as located in 3.1.2

5.2 With the settings of 3.1.1.1, manually scan each of the regions of table 1 and record the number and size of each defect feature defined in paragraphs 1.3 and 2.1.

5.3 Visual requirements

The following example visual examination criteria are based in part on those in level 2 and level 3 optical interface standards IEC 61XXX-X

Table 2 - Visual requirements for polished connectors, single mode non-dispersion shifted fiber, RL ≥ 50 dB

ZONE	REQUIREMENT[1]		
	scratches	pits	debris
A: Core Zone (Dia = 0-25 μm)	none ≥ 1μm	none ≥ 1μm	none ≥ 1μm
B: Cladding Zone (Dia = 25-120 μm)	3 ≥ 1μm No length limit	none ≥ 1μm	none ≥ 1μm
C: Epoxy Zone[2] (Dia = 120-130 μm)	no limit	No limit	No loose particles
D: Contact Zone[2] (Dia = 130-250μm)	no limit	no limit	No loose particles

NOTE 1 For scratches, the requirement refers to width. For pits it refers to the maximum diameter

NOTE 2 Lower RL performance grades are less restrictive in zone A

NOTE 3 No cracks are allowed in the fibre area, diameter = 120 μm.

NOTE 4 If containination is present, it must be removed by cleaning. Otherwise the product is rejected.

NOTE 5 There are no requirements for the area outside the contact zone since defects in this area have no influence on the performance.

6 Details to be specified

– Type of system used

– Description of lenses in system: Magnification, NA, resolution

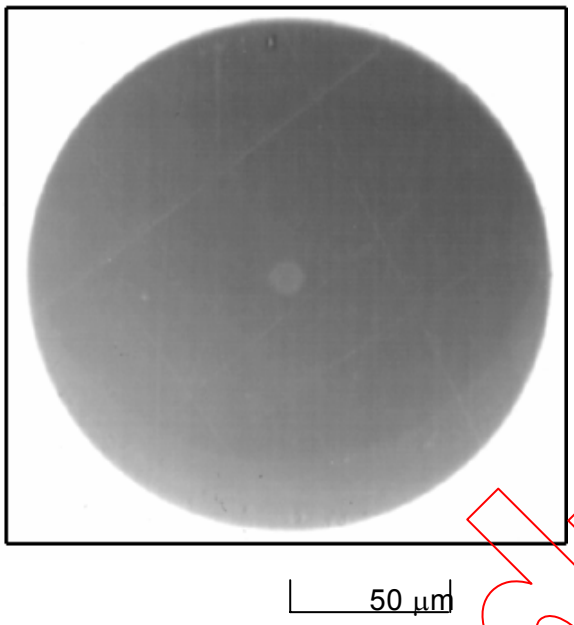
– Illumination type and center wavelength

– Optical Magnification, electronic magnification, video magnification

Appendix A

Examples of inspected end-faces with defects

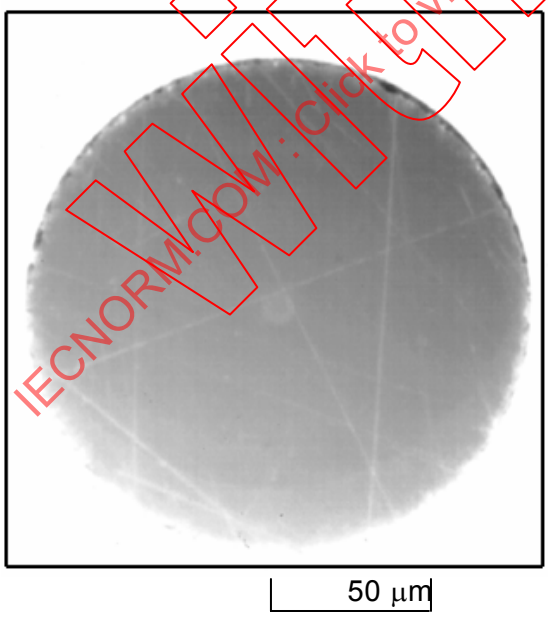
The following examples are taken with a microsope with minimum resolution of 1,0 μm



Rejected

Observed defects :

1 scratch in core zone

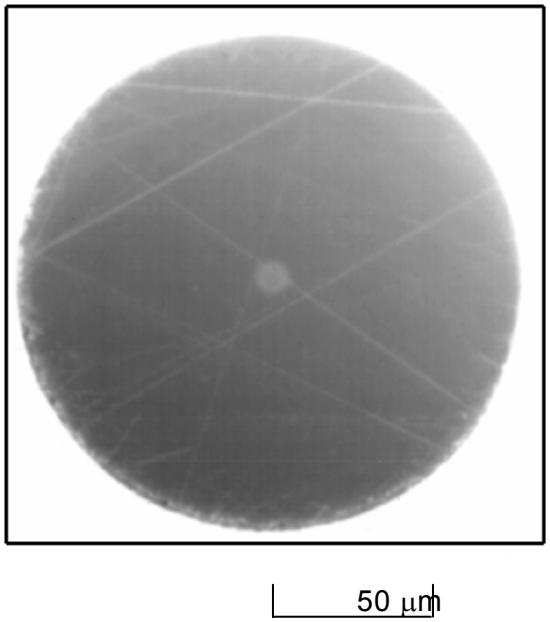


Rejected

Observed defects :

2 scratches in core zone

4 scratches in cladding zone

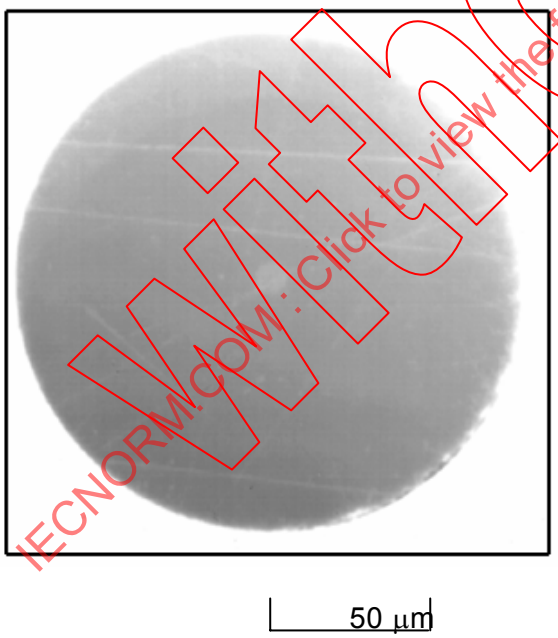


Rejected

Observed defects:

3 scratches in core zone

7 scratches in cladding zone

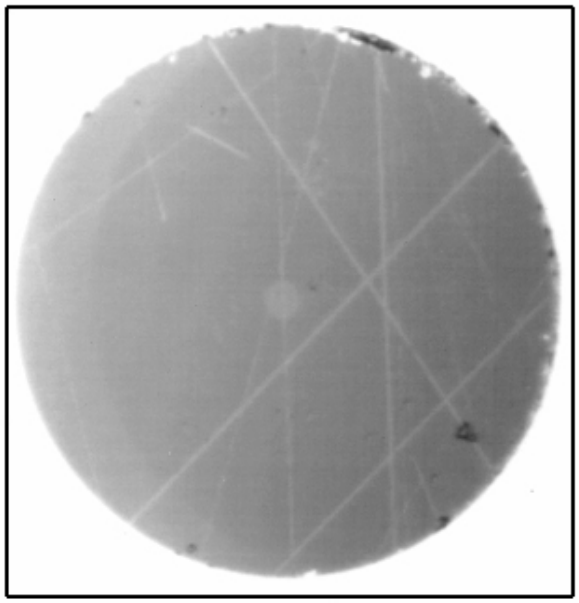


Rejected

Observed defects:

2 scratches in core zone

6 scratches in cladding zone



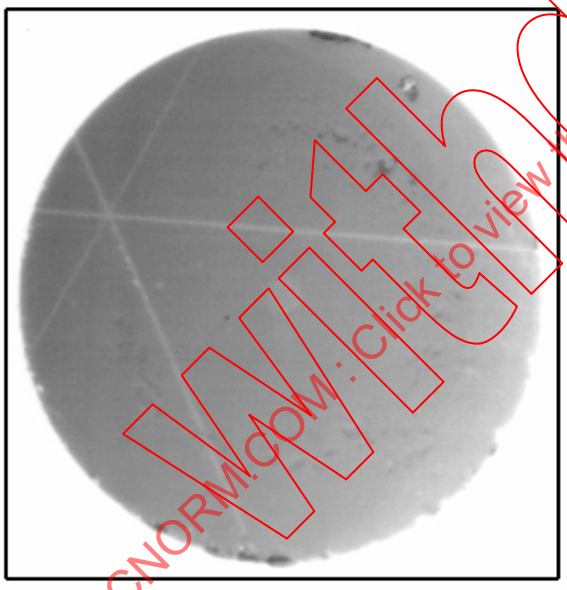
Rejected

Observed defects:

1 pit > 1um

2 scratches in core zone

7 scratches in cladding zone



Rejected

Observed defects:

2 pits > 1 um in cladding zone