ENGINEERING TECHNICAL WHITE PAPER

Inspection Criteria for Polished XO20 Terminus Connector Endfaces

1. PRODUCT DESCRIPTION

Any fiber optic connector that will use XiOptics's XO20 Terminus optical terminus system.

1.1 PURPOSE

This specification is intended to provide a guide and specific criteria for the inspection of polished end- faces of fiber optic connectors to ensure no excess contaminants or defects are exhibited on the optical connectors delivered by XiOptics.

1.2 SCOPE

This specification is to be used to inspect the quality of the polished end-face for any fiber optic connector that will be used in XiOptics interconnects. This specification should be used for single fiber and multiple fiber connectors with single mode or multimode fiber. This specification should be used as a supplement to, not a substitute for XiOptics's customer's requirements. The fiber end-face surface should be examined with a 200X minimum optical microscope or video inspection system after the connector has been cleaned per the manufacturer's cleaning procedures.

CAUTION!! Before viewing any fiber optic connector end-face make sure that the fiber is disconnected from any light emitting sources such as LED's and LASER's.

2. GENERAL

2.1 CHANGE INFORMATION

2.1.1 CHANGE CLASSIFICATION

The change(s) shall be incorporated in all products hereafter manufactured.

2.1.2 CHANGES COVERED BY REISSUE

ISSUE CHANGE DESCRIPTION

- Initial Release

2.1.3 REFERENCES

ISSUE REFERENCES

1 99-2411 2 2000-1066

2.2 ASSOCIATED DOCUMENTS

2.2.1 INFORMATION FURNISHED BY XiOptics TECHNOLOGIES

Refer to DCC for the latest issue of the following:

DOCUMENT NO. TITLE

Customer Care Processes Bulletin 1

2.2.2 INDUSTRY STANDARDS

Not Applicable.

2.2.3 PRINCIPLE DRAWING

Not Applicable.

2.3 TECHNICAL ASSISTANCE

For technical assistance, contact XiOptics Engineering & Environmental through specialist@xioptics.com .

2.4 ACRONYMS / DEFINITIONS

2.4.1 ACRONYMS

DCC Document Control Center LED Light Emitting Diode MM Multi-Mode Fiber SM Single Mode Fiber

2.4.2 DEFINITIONS

The following definitions are applicable to this specification:

Fiber Optic Connector

Connector Ferrule: Structure that permanently contains the fiber or fibers in position and includes features with precise dimensions that contribute to the fiber alignment when mated. The ferrule material is usually ceramic but can be plastic, silicon, glass or metal. Fiber Cladding: Outer ring of glass within optical fiber that surrounds the core; typically 125 mm in diameter. Fiber Core: Center area of optical fiber in which light is transmitted, typically 8.3 and 62.5 microns in diameter for single mode fiber and multimode fiber respectively.

Fiber Surface Defect and Contaminant Definitions

CAUTION!! Before viewing any fiber optic connector end-face make sure that the fiber is disconnected from any light emitting sources such as LED’s and LASER’s.

Chips: Large divots or inclusions in the fiber face (>10 mm in diameter).

Crack: Fractures caused by fiber preparation, termination or polishing procedures. Cracks usually look like lines across the face of the connector from one point on the outside diameter to another point on the outside diameter.

Epoxy Ring: The circular ring of epoxy surrounding the fiber caused by the space between the internal diameter of the ferrule and the fiber diameter.

Fixed Contaminate/Particulate: Any contaminant that cannot be removed by cleaning procedures.

Loose Contaminate/Particulate: Any loose contaminant such as dirt, dust fibers, film or flakes that can be removed by cleaning procedures.

Pits/Blemishes: Small areas of glass removed from the fiber end-face (<2 mm in diameter).

Protrusion Contaminant: A fixed contaminant that is embedded in the glass and extends beyond the surface of the fiber as viewed using an interferometer lens.

Residues: Residues from cleaning fluids such as alcohol, water, adhesive and index matching oils, gels or greases.

Scratch: Usually caused be small contaminants in the polishing materials. Appears white in color. Severe scratches or a large number of scratches may affect insertion loss and back reflection.

Ferrule Surface

The same defects indicated above for fiber surface can be exhibited in the ferrule surface. Cracks and chips are the most common types of defects found on the ferrule surface.

Black Marks/Surface Scratches: Marks or scratches on the surface of the ferrule due to the manufacturing process.

Voids/Pin Holes: A pore or hole in the ferrule material.

3. QUALITY CONTROL REQUIREMENTS

The following defects that can be found on the end-face of a polished optical connector are described and the regions these defects are allowed and disallowed. Refer to Figure 3.5.1 for region identification. Figure 3.5.2 is a summary of the following requirements and defects.

3.1 FIXED/PROTRUDING CONTAMINANTS

Fixed contaminants on the surface of the connector ferrule fiber may cause separation of the fiber end-faces during mating. This type of contaminant can be caused by assembly (excess epoxy), polishing, testing or cleaning procedures and may be difficult to remove by standard cleaning procedures but may be removed by additional polishing XiOptics's requirements and recommendation for re-polishing should be followed.

Fiber Type	Requirement
Single Mode	No fixed contamination/particulate is allowed in region A. One fixed contaminant allowed in each region B and C. (See Figure 3.5.2).
Multimode	No fixed contamination/particulate is allowed in region A. One fixed contaminant allowed in each region B and C. (See Figure 3.5.2).
Corrective Action	Contaminant must be removed by cleaning or re-polishing the connector end-face. If the contaminant cannot be removed by cleaning or re-polishing then the connector shall be removed and the fiber re-terminated. (Consult manufacturer's recommended cleaning and re-polishing procedures)

Fiber Type Requirement

Single Mode No fixed contamination/particulate is allowed in region A. One fixed contaminant allowed in each region B and C. (See Figure 3.5.2). Multimode No fixed contamination/particulate is allowed in region A. One fixed contaminant allowed in each region B and C. (See Figure 3.5.2).

Corrective Action

Cleaning or re-polishing the connector end-face must remove contaminant. If the contaminant cannot be removed by cleaning or re-polishing then the connector shall be removed and the fiber re- terminated. (Consult XiOptics's recommended cleaning and re-polishing procedures, Customer Care Processes Bulletin 1)

3.2 FREE-FLOATING/LOOSE CONTAMINANTS

Free-floating or loose particles on the surface of the connector ferrule fiber may cause separation of the fiber end-faces during mating or blockage of light transmission through the connection. This type of contaminant is usually caused by debris accumulation on an unprotected connector end and can usually be removed by re-cleaning the connector. XiOptics's cleaning procedures should be followed.

Fiber Type Requirement

Single Mode No floating contamination/particulate is allowed in regions A, B, C or D. Multimode No floating contamination/particulate is allowed in regions A, B, C or D.

Corrective Action

Contaminant may be removed by blowing micro-filtered compressed air across the fiber face. If the air does not remove the debris, then the connector must be re-cleaned. If the contaminant remains after three cleaning attempts, then the contaminant is considered fixed and re-polishing may be necessary. Follow the procedures in Fixed Contaminant Requirements (Consult XiOptics's recommended cleaning procedures, Customer Care Processes Bulletin 1).

Figure 3.5.1 Inspection regions

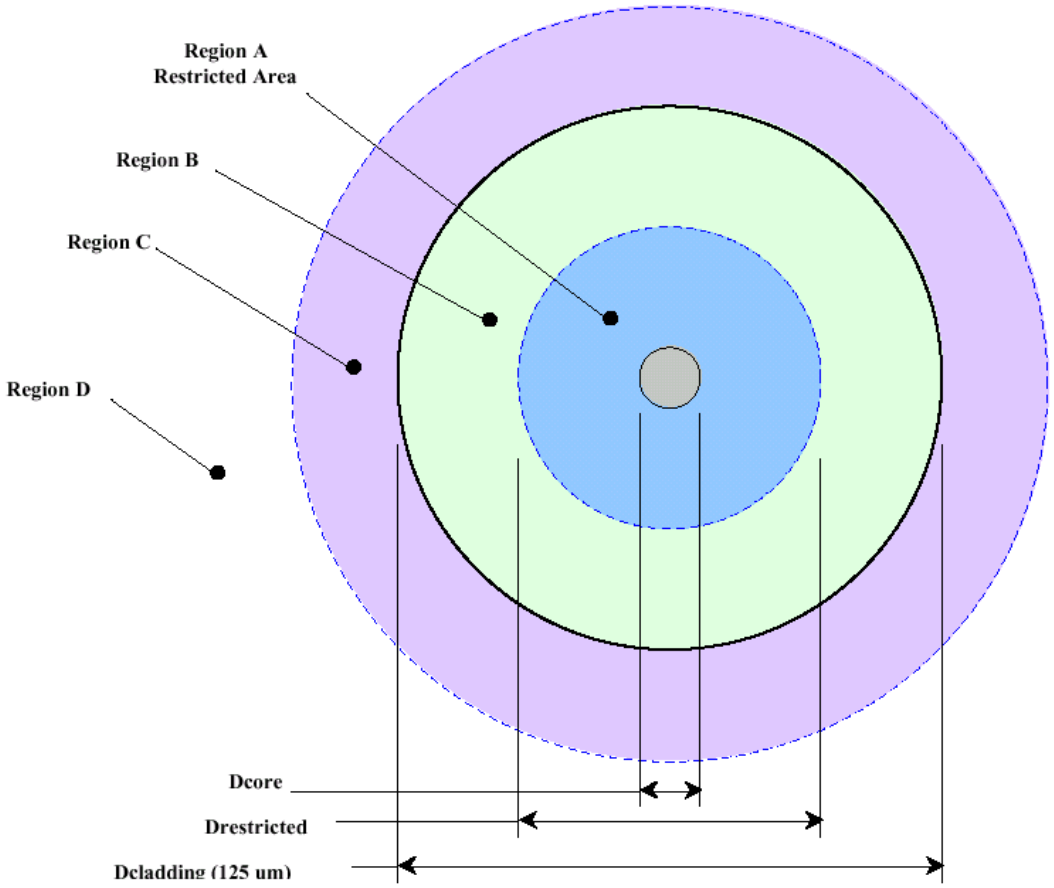


Figure 3.5.2 Multimode endface examples

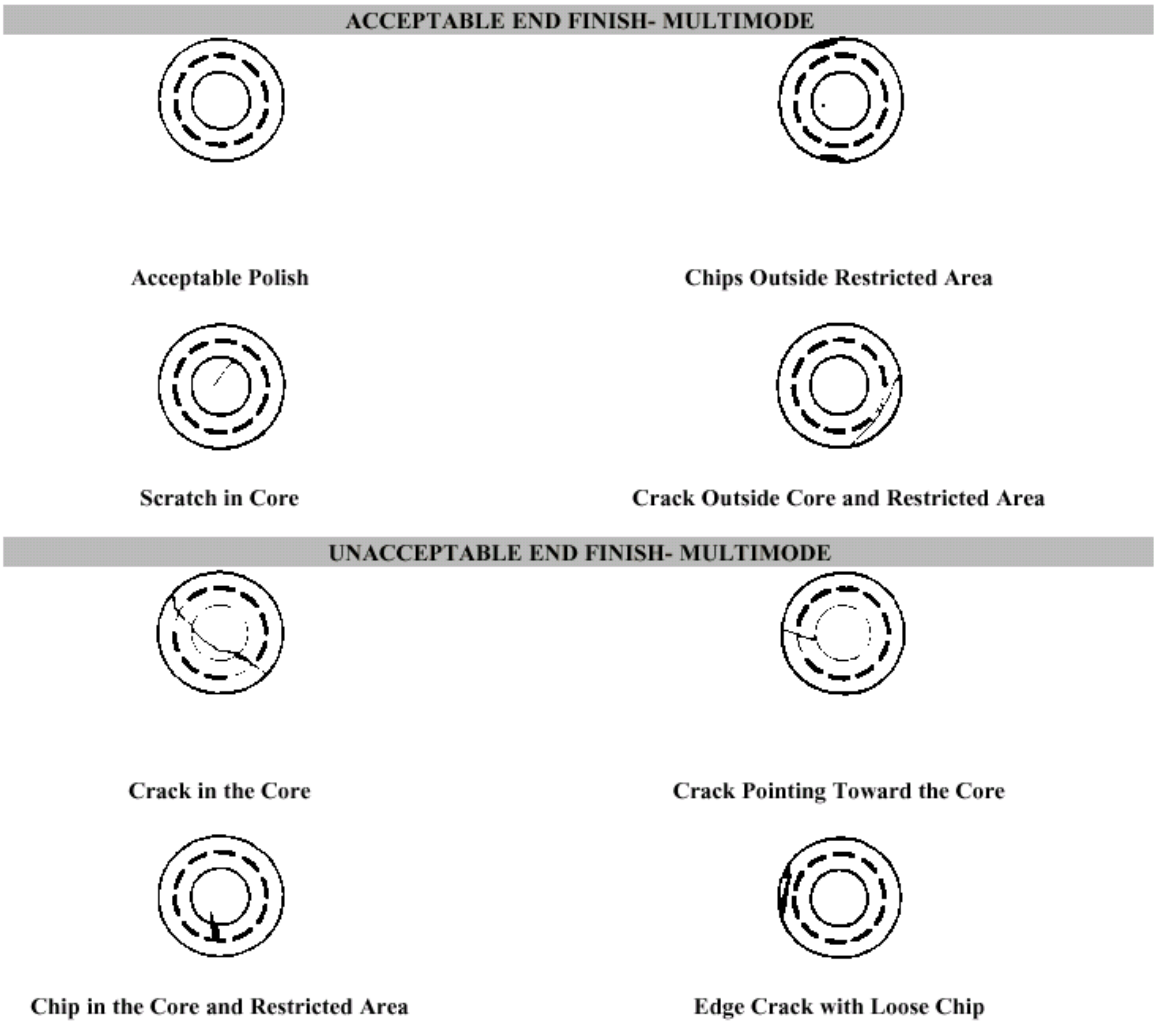
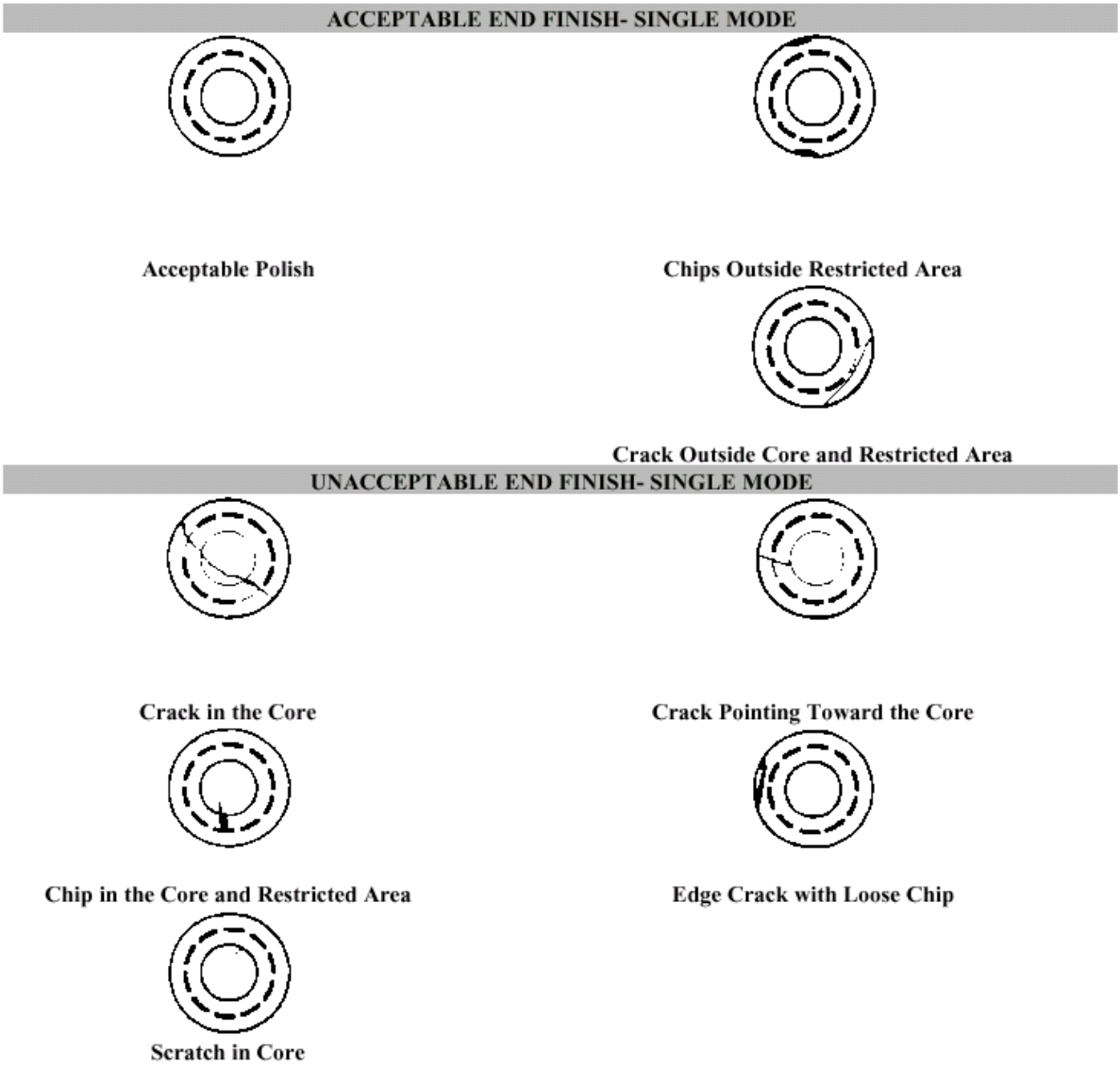
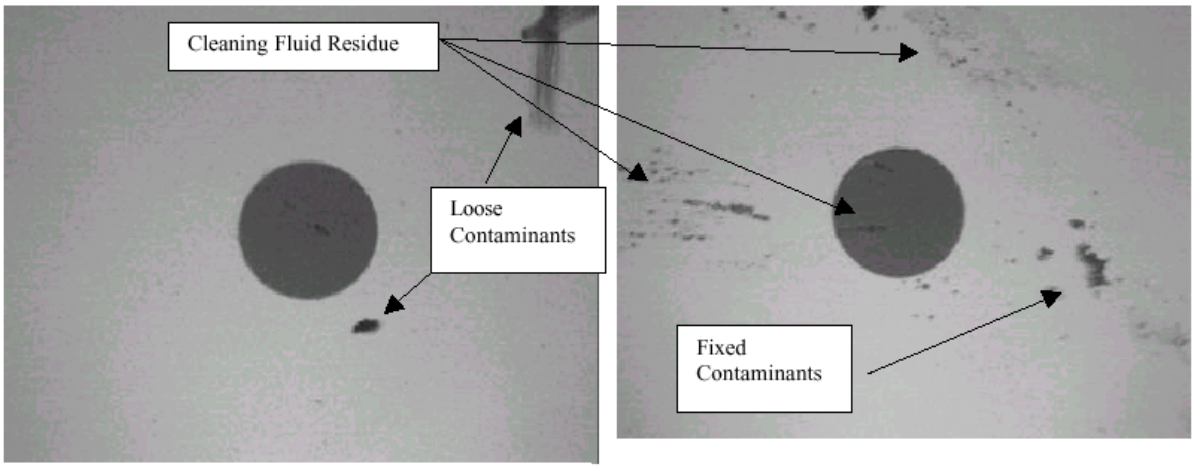
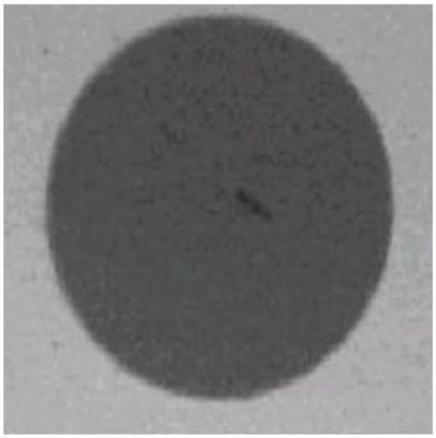


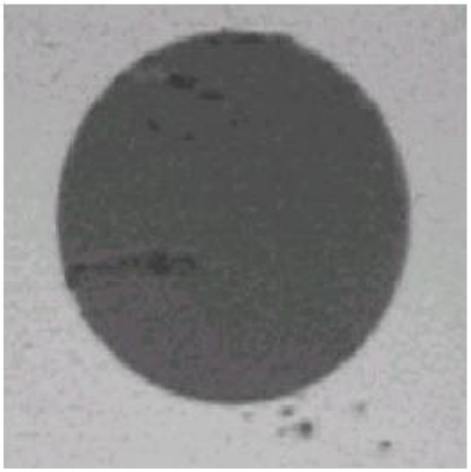
Figure 3.5.2 Single-mode endface examples continued



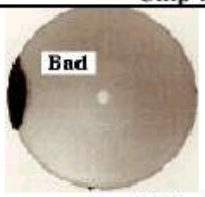
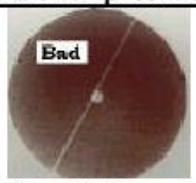
Contamination examples



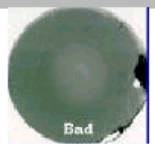
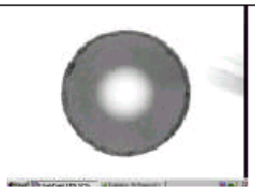




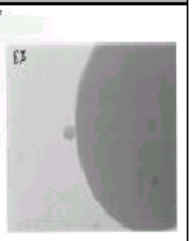
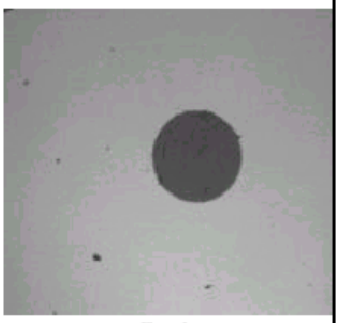
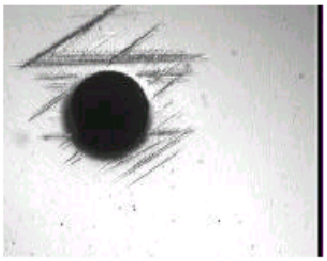
Chips scratches and blemishes

	ACCEPTABLE	UNACCEPTABLE
CHIPS	 On the fiber ceramic border	  Chip too large
		  Chip too large
SCRATCHES	 Scratch tangent to core	  Wide scratch in restricted area
	 Scratch tangent to core	  Scratch/chip too wide
		 Scratch in core
BLEMISHES / VOIDS	 One small void	

Defect comparison examples

DEFECT	ACCEPTABLE	UNACCEPTABLE
CHIPS	 Chip out of restricted area and small	  Large Chip  Chip in restricted area
SCRATCHES	 Light scratching in the core  Light scratching in the core	 Scratch exceeds size limit  Deep Scratch
CRACKS		 Core crack
EPOXY RING		

Voids pinholes and surface roughness

DEFECT	ACCEPTABLE	UNACCEPTABLE	
PIN HOLES EPOXY FILLED VOID CHIP- FILLED WITH EPOXY			
	Defect less than 10 um diameter	Defect too large in diameter	Diameter ok Defect runs into fiber edge
SURFACE ROUGHNESS /SCRATCHES			
	Good	Excessive scratches	

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