

Polished Optical Fiber End Face

1. SCOPE

This specification covers the acceptable and the not acceptable conditions for polished optical fiber end faces on 1.25mm, 2.0mm, 2.5mm, MT, Mini-MT, and Attenuation product families.

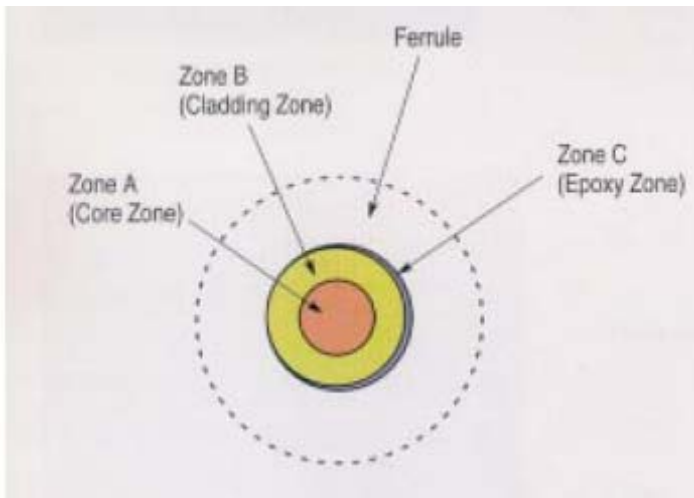
2. APPLICABLE DOCUMENTS

The following documents constitute a part of this specification to the extent specified herein Unless otherwise specified, the latest edition of the document applies.

2.1. Documents

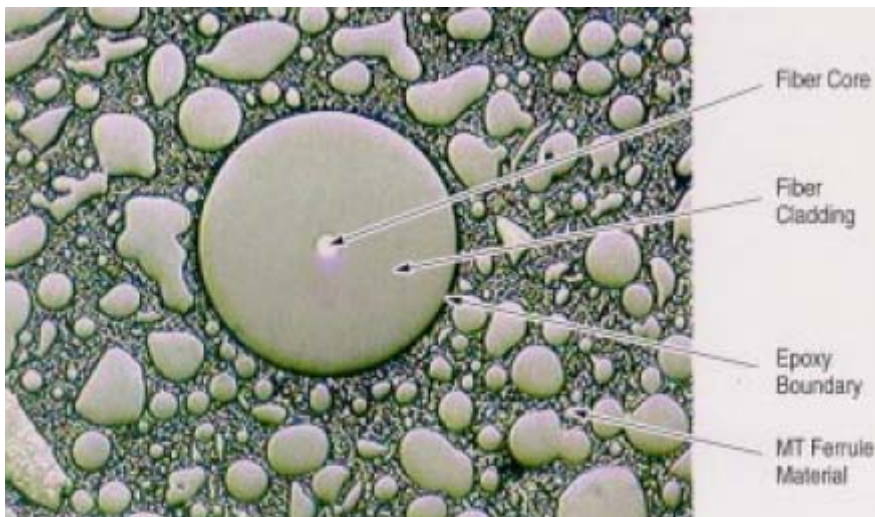
- A. 408-8922 Cleaning and Inspection for Physical Contact Fiber Optic Connectors
- B. 411-19471 Cleaning and Handling Fiber Optic Connector and Adapters

3. IDENTIFICATION (END FACE)



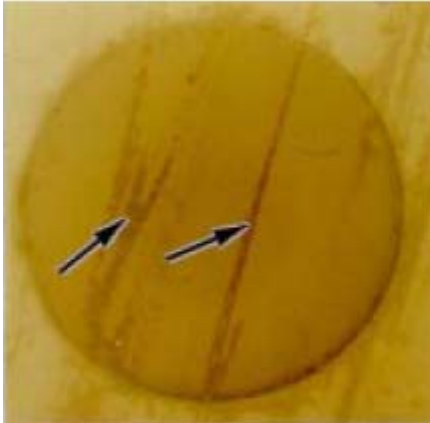
**End Face
(Not to Scale)**

Figure 1



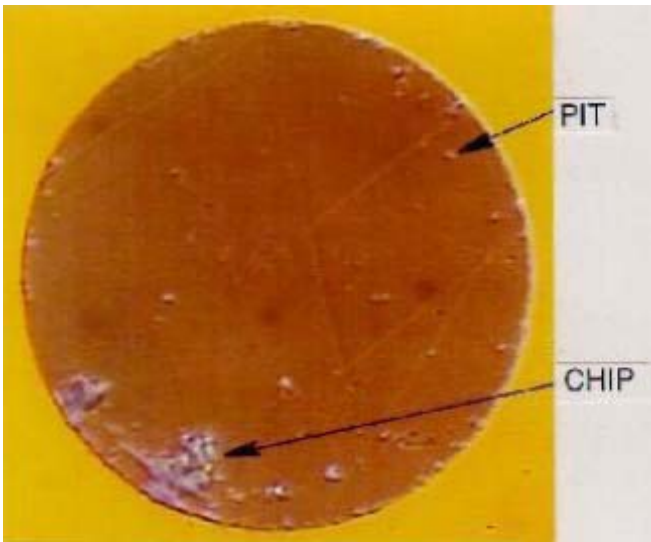
**MT Ferrule
EndFace
(Not to Scale)**

Figure 2



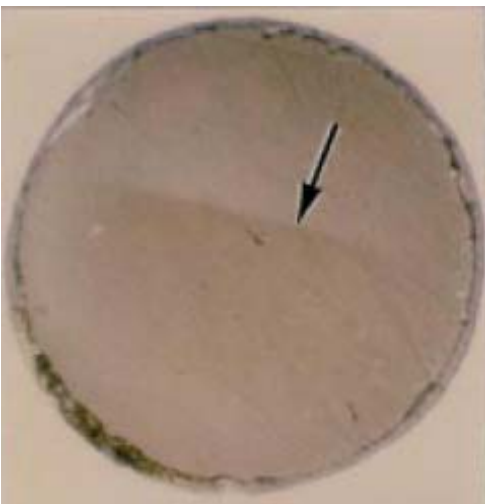
Scratches

Figure 3



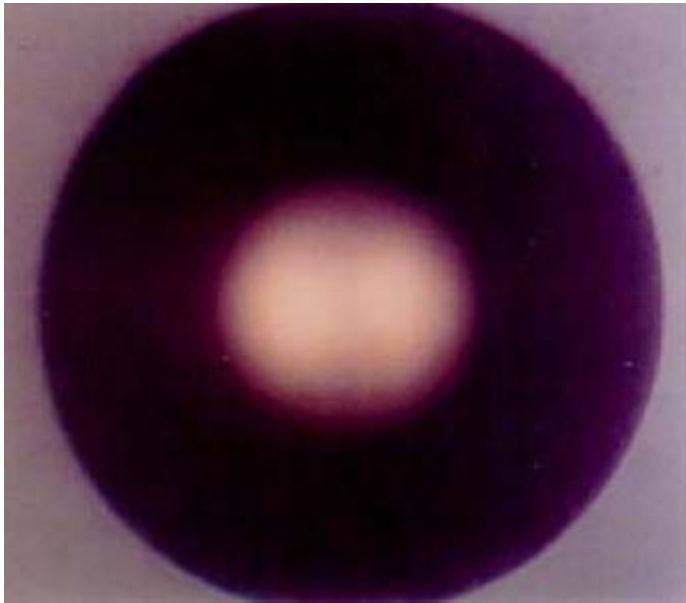
Pits, and Chips

Figure 4



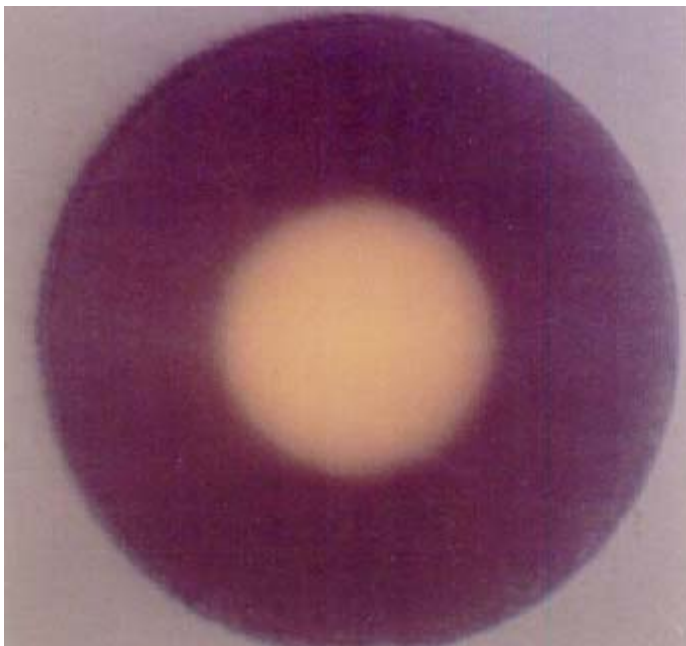
Cracks/Fractures

Figure 5



Incorrect Illumination
(Backlighting)

Figure 6



Correct Illumination
(Backlighting)

Figure 7

4. DEFINITIONS FOR FIBER END FACE FINISH AND FERRULE SURFACE

4.1. Fiber End Face Finish Definitions

- A. Backlighting – Illumination of the fiber core under examination by launching light into the opposite end of the cable assembly, Figures 6 and 7.
- B. Chip – Damage to the end face surface where the native material is missing.
- C. Cladding – The portion of the fiber outside the core, Figure 1.
- D. Core – The center of the fiber that carries the transmitted light, Figure 1.
- E. Crack – A structural defect that penetrates into the fiber, Figure 5.
- F. End Face – The polished surface of the ferrule and fiber, Figure 1.
- G. Epoxy – The adhesive material used to bond the fiber to the ferrule, Figure 1 and 2.
- H. Ferrule – The component used to hold and align the optical fiber, Figure 1 and 2.
- I. Fiber – A thin strand of glass or plastic that serves as the transmission medium for carrying light, Figure 2.
- J. Pit – Any circular surface defects that generally have a round appearance, Figure 4.
- K. Scratch – Any linear surface defect, Figure 3.
- L. Contamination – Particulate material, oily films, alcohol residue, epoxy that is removable by cleaning.

4.2. Ferrule Surface Definitions

- A. White Mark – Irregular circular white mark appearing on the surface of MT / Mini-MT ferrules.

NOTE

This mark is ferrule material lacking pigment.

- B. Shiny Mark – These marks are irregular, may look like a smear, and are usually bright or shiny in appearance.

NOTE

This has been shown to be aluminum or other soft metal transferred to the fiber or ferrule when the end face was inadvertently rubbed against aluminum tooling.

5. INSPECTION CRITERIA

The end face criterion within this specification is inclusive of single and multi-fiber ferrules. Each individual fiber of a multi fiber ferrule must meet the limits of acceptability defined within this specification.

5.1. Inspection Method

- Inspection of fiber optic end faces must be performed in an environment consistent with fiber optic assembly manufacturing environments.
- The end face shall be cleaned prior to inspection with a lint-free cloth. If necessary, 99% alcohol can be used to clean the end face. Reference 411-19471 and 408-8922.
- Fiber end face shall be inspected using a video inspection system with a 20X primary objective lens with N/A 0.3, or a direct view optical microscope at 200X with a 20X primary objective lens.
- Endfaces that require inspection of diameters greater than 250um (Zone E) must switch to 5X primary objective.

- Endfaces that are angled (APC) must have the appropriate angled adapter attached to the microscope.
- Proper back lighting must be used to see fractures (Figure 7). If the fiber is not sufficiently backlit, the core may not appear uniform (Figure 6). Correct this condition by holding the opposite end in line with the light source.

5.2. Limits of Acceptability (Refer to Paragraphs 5.4. through 5.12.)

- Refer to the following sections for the limits of acceptability:
- Single Fiber – Single-Mode, Plastic or Ceramic Round Ferrule, see section 5.4.
- Single Fiber – Single-Mode, APC Ferrule, see section 5.5.
- Single Fiber – Multi-Mode, Plastic or Ceramic Round Ferrule, see section 5.7.
- Single Fiber – 100/140 Multi-Mode, Plastic or Ceramic Round Ferrule, see section 5.8.
- Escon Cable Assemblies, see section 5.9.
- Attenuators, see section 5.10.
- Single-Mode MT and Mini-MT (Including Low Loss), see section 5.11.
- Multi-Mode MT and Mini-MT (Including Low Loss), see section 5.12.

5.3. Inspection Overlay Example (refer to Paragraph 5.13.)

5.4. LIMITS OF ACCEPTABILITY FOR SINGLE FIBER

Applicable to: Single Mode: Plastic or Ceramic Round Ferrule

Zone A (0 - 25 microns)	Acceptance Criteria
Scratches	No Scratches.
Pits	No Pits.
Chips	No Chips.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone B (25- 120 microns)	Acceptance Criteria
Scratches	No scratches greater than 3µm in width. 1 scratch less than or equal to 3µm in width are acceptable 3 scratches less than or equal to 1µm in width are acceptable
Pits	No Pits greater than 1µm in diameter. Any number of Pits less than 1µm in diameter are acceptable.
Chips	No Chips.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone C (120- 130 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. Any number of Scratches less than 3µm in width are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. Any number of Pits less than 5µm in diameter are acceptable.
Chips	No Chips greater than or equal to 5µm in diameter. Any number of Chips less than 5µm in diameter are acceptable.
Crack / Fracture	No Crack or Fractures.
Contamination	No Contamination.
Zones A, B, and C (0-130 microns)	No surface defects other than described above are acceptable. Shiny marks accepted as defined above per criteria for Scratches/Pits.
Zone D (130-250 microns)	No Cracks or Loose Contaminants are acceptable.

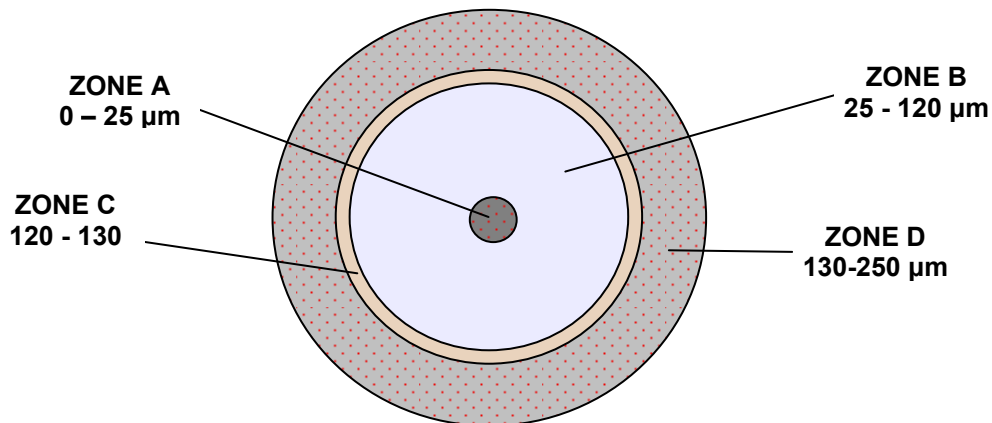


Figure 8

5.5. Limits of Acceptability for APC Cable Assemblies

Zone A (0 - 25 microns)	Acceptance Criteria
Scratches	No Scratches greater than 1µm in width are acceptable Scratches less than or equal to 1µm in width are acceptable
Pits	No Pits.
Chips	No Chips.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone B (25- 120 microns)	Acceptance Criteria
Scratches	Scratches less than or equal to 1µm in width are acceptable No Scratches greater than 3µm in width are acceptable 3 scratches greater than 1 µm or less than or equal to 3µm in width are acceptable
Pits	No Pits greater than 1µm in diameter. Any number of Pits less than 1µm in diameter are acceptable.
Chips	No Chips.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone C (120- 130 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. Any number of Scratches less than 3µm in width are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. Any number of Pits less than 5µm in diameter are acceptable.
Chips	No Chips greater than or equal to 5µm in diameter. Any number of Chips less than 5µm in diameter are acceptable.
Crack / Fracture	No Crack or Fractures.
Contamination	No Contamination.
Zones A, B, and C (0-130 microns)	No surface defects other than described above are acceptable. Shiny marks accepted as defined above per criteria for Scratches/Pits.
Zone D (130-250 microns)	No Cracks or Loose Contamination are acceptable.
Zone E (>250 microns)	No Loose Contaminants are acceptable. Chips of maximum diameter 125µm are acceptable on the outer circumference of the ferrule tip.

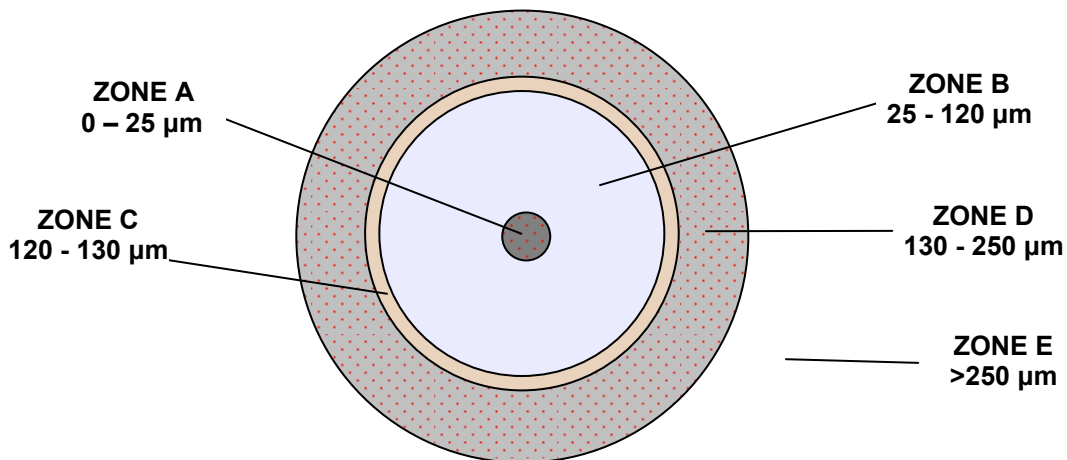


Figure 9

5.6. Limits of Acceptability for Single Fiber

Applicable to Multi-Mode: Plastic or Ceramic Round Ferrule

Zone A (0 - 65 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. 3 Scratches greater than 2µm and less than 3µm in width are acceptable. Any number of Scratches less than or equal to 2µm in width are acceptable.
Pits	No Pits greater than or equal to 3µm in diameter. 5 Pits less than 3µm are acceptable.
Chips	No Chips.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone B (25- 115microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. 3 Scratches greater than 2µm and less than 3µm in width are acceptable. Any number of Scratches less than 2µm are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. Any number of Pits less than 5µm in diameter are acceptable.
Chips	2 Chips less than or equal to 5µm in diameter are acceptable.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone C (115- 135 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 5µm in width. Any number of Scratches less than 5µm in width are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. Any number of Pits less than 5µm in diameter are acceptable.
Chips	No Chips greater than or equal to 10µm in diameter. 3 Chips less than 10µm in diameter are acceptable.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zones A, B, and C (0-135 microns)	No surface defects other than described above are acceptable. Shiny Marks accepted as defined above per criteria for Scratches/Pits
Zone D (135-250 microns)	No Cracks or Loose Contaminants are acceptable.

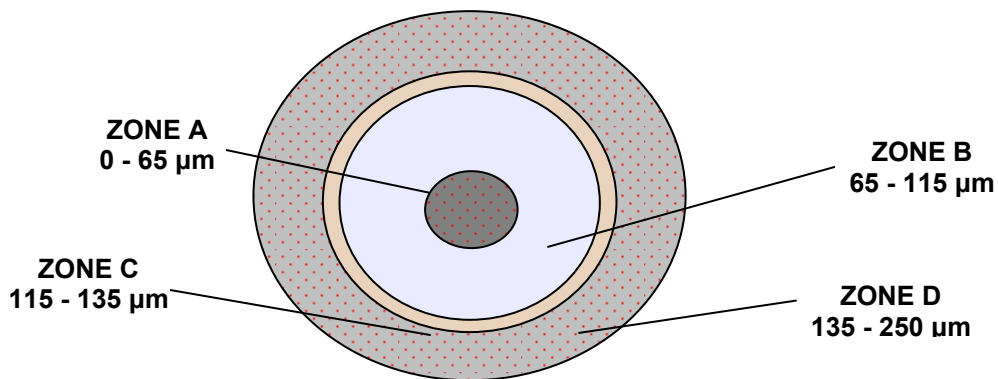


Figure 10

5.7. Limits of Acceptability for Single Fiber

Applicable to: Multi-Mode: Ceramic Round Ferrule Terminated with 100/140 Fiber

Zone A (0 - 100 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. 3 Scratches greater than 2µm and less than 3µm in width are acceptable. Any number of Scratches less than or equal to 2µm in width are acceptable.
Pits	No Pits greater than or equal to 3µm in diameter. 5 Pits less than 3µm are acceptable.
Chips	No Chips.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone B (100- 130microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. 3 Scratches greater than 2µm and less than 3µm in width are acceptable. Any number of Scratches less than 2µm are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. Any number of Pits less than 5µm in diameter are acceptable.
Chips	2 Chips less than or equal to 5µm in diameter are acceptable.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone C (130- 150 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 5µm in width. Any number of Scratches less than 5µm in width are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. Any number of Pits less than 5µm in diameter are acceptable.
Chips	No Chips greater than or equal to 10µm in diameter. 3 Chips less than 10µm in diameter are acceptable.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zones A, B, and C (0-150 microns)	No surface defects other than described above are acceptable. Shiny Marks accepted as defined above per criteria for Scratches/Pits
Zone D (150-250 microns)	No Cracks or Loose Contaminants are acceptable.

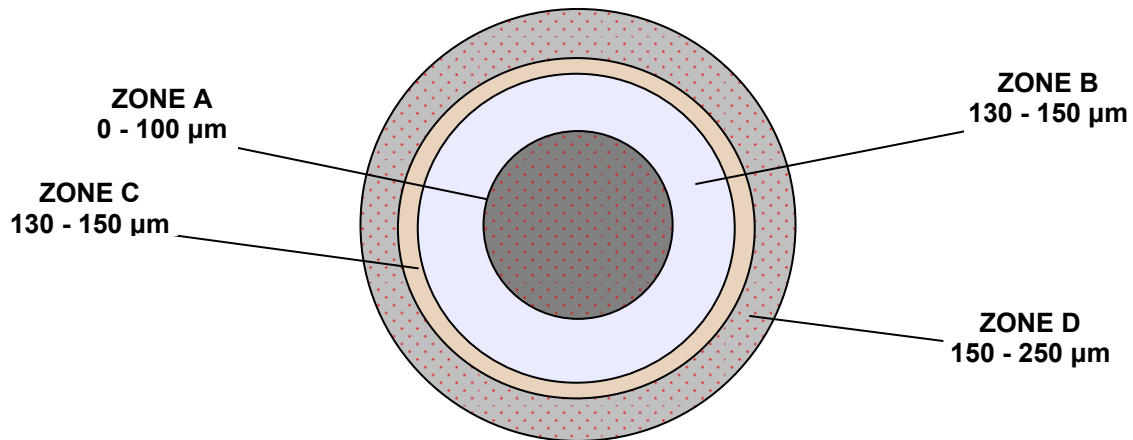


Figure 11

5.8. Limits of Acceptability for ESCON Cable Assemblies

Zone A (0 – 65 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 1µm in width. 1 Scratch less than 1µm is acceptable.
Pits	No Pits greater than or equal to 1µm in diameter. 1 Pit less than 1µm in diameter is acceptable.
Chips	No Chips.
Crack / Fracture	No Crack or Fractures.
Contamination	No Contamination.
Zone B (65- 120 microns)	Acceptance Criteria
Scratches	No Scratches greater than 3µm in width. 3 Scratches greater than 2µm and less than 3µm in width are acceptable. Any number of Scratches less than or equal to 2µm in width as long as Loss requirements are met.
Pits	No Pits greater than or equal to 5µm in diameter. 3 Pits less then or equal to 5µm in diameter are acceptable.
Chips	No Chips greater than 5µm in diameter. 2 Chips less then or equal to 5µm in diameter are acceptable.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination
Zone C (120 – 130 microns)	Acceptance Criteria
Scratches	Any number of Scratches are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. Any number of Pits less than 5µm in diameter as long as they do not pass into Zone B.
Chips	No Chips greater than 5µm in diameter. Any number of Chips less than 5µm in diameter as long as they do not pass into Zone B.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination
Zones A, B, and C (0-130 microns)	No surface defects other than described above are acceptable. Shiny Marks accepted as defined above per criteria for Scratches/Pits
Zone D (130 – 250 microns)	No Cracks or Contaminants are acceptable. No voids greater than 1.0mm, No Epoxy is acceptable.

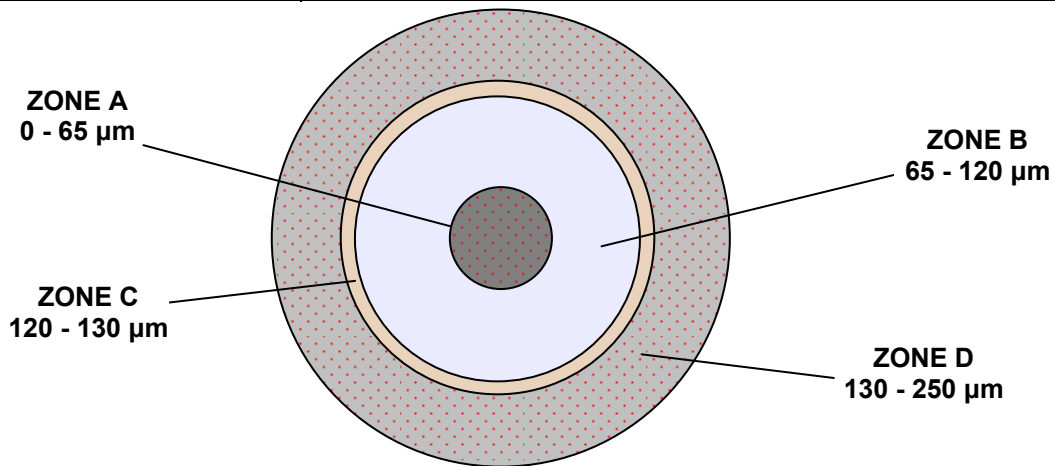


Figure 12

5.9. Limits of Acceptability for Attenuators

Applicable to: Singlemode polished endfaces

Zone A (0 - 25 microns)	Acceptance Criteria
Scratches	No Scratches.
Pits	No Pits.
Chips	No Chips.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone B (25- 120 microns)	Acceptance Criteria
Scratches / Polish Lines	No Scratches greater than or equal to 2μm in width. 3 Scratches less than 2μm in width are acceptable.
Pits	No Pits greater than 3μm in diameter. 5 Pits less than 3μm in diameter are acceptable.
Chips	No Chips.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone C (120- 130 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3μm in width. Any number of Scratches less than 3μm in width are acceptable.
Pits	No Pits greater than 5μm in diameter. Any number of Pits less than 5μm in diameter are acceptable.
Chips	No Chips greater than 5μm in diameter. Any number of Chips less than 5μm in diameter are acceptable.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone D (130- 250 microns)	Acceptance Criteria
Scratches	No Scratches greater than 10μm in width. Any number of Scratches less than 10μm in width are acceptable.
Pits	No Pits greater than 10μm in diameter. Any number of Pits less than 10μm in diameter are acceptable.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Contamination.
Zone E (250 microns– 2.5mm) For Internal Endface only	Acceptance Criteria
Scratches	No Scratches greater than 30μm in width. Any number of Scratches less than 30μm in width are acceptable.
Pits	No Pits greater than 30μm in diameter. Any number of Pits less than 30μm in diameter are acceptable.
Crack / Fracture	No Cracks or Fractures.
Contamination	No Particles greater than or equal to 80μm are acceptable. 10 Particles less than or equal to 30μm in size are acceptable. 2 Particles between 30μm and 80μm are acceptable.

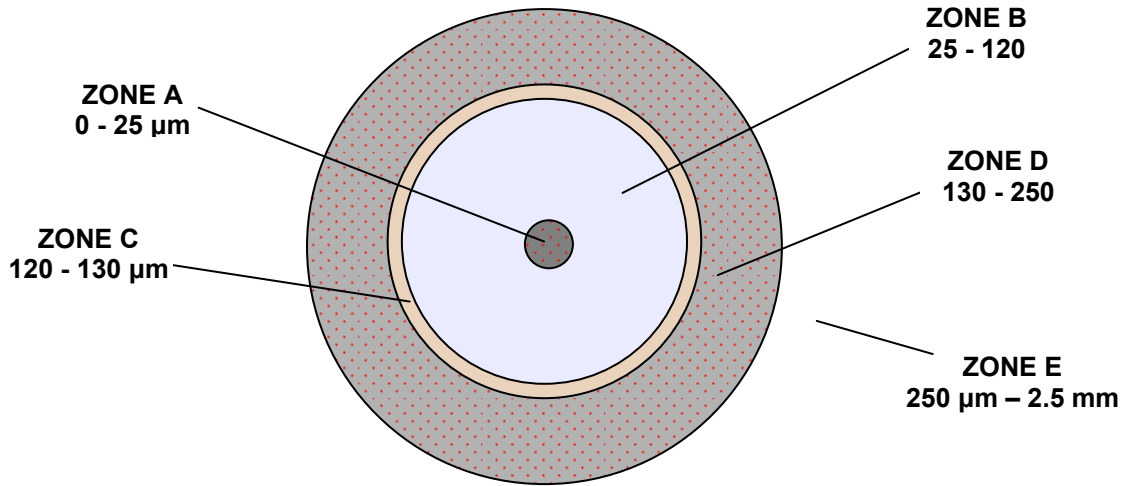


Figure 13

5.10. Limits of Acceptability for **Singlemode MT and Mini MT**

*Applicable to: **Singlemode, Multi-fiber product family.***

Zone A (0 - 25 microns)	Acceptance Criteria
Scratches (MT)	No Scratches.
Scratches (Mini MT)	Any number of scratches less than or equal to 1µm in width.
Pits	No Pits.
Chips	No Chips.
Zone B (25- 115 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. 3 Scratches greater than 2µm and less than 3µm in width are acceptable. Any number of Scratches less than or equal to 2µm in width are acceptable.
Pits	No Pits greater than or equal to 3µm in diameter. Any number of Pits less than 3µm in diameter are acceptable.
Chips	No Chips.
Zone C (115- 125 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. Any number of Scratches less than 3µm in width are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. Any number of Pits less than 5µm in diameter are acceptable.
Chips MT only	Any number of Chips less than 10µm in diameter, which do not cross the Zone B boundary, are acceptable.
Chips Mini MT only	Any number and size of chips contained within Zone C boundary are acceptable.
Zones A, B, and C (0-125 microns)	No surface defects other than described above are acceptable.

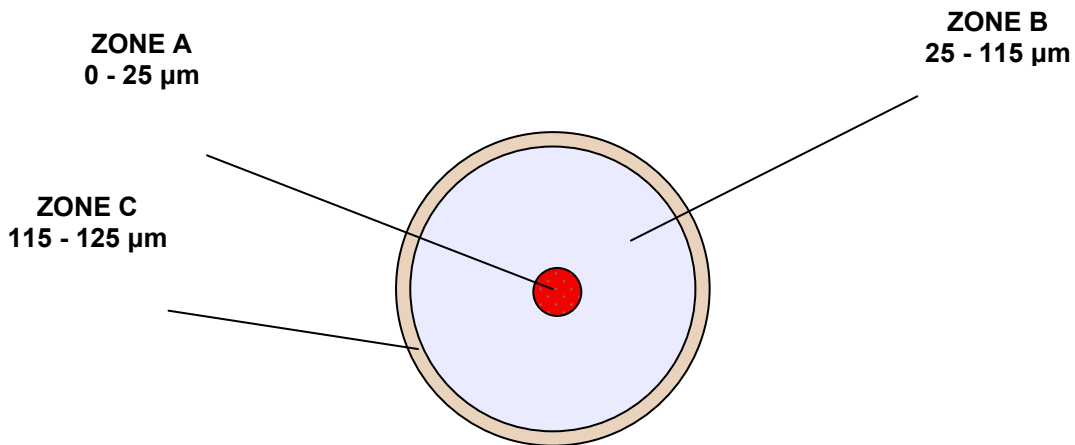


Figure 14

5.11. Limits of Acceptability for Multimode MT and Mini-MT

Applicable to: Multimode, Multi-fiber product family.

Zone A (0 - 65 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. 3 Scratches greater than 2µm and less than 3µm in width are acceptable. Any number of Scratches less than or equal to 2µm in width are acceptable.
Pits	No Pits greater than or equal to 3µm in diameter. Any number of Pits less than 3µm in diameter are acceptable.
Chips	No Chips.

Zone B (65- 115 microns)	Acceptance Criteria
Scratches	No Scratches greater than or equal to 3µm in width. 3 Scratches greater than 2µm and less than 3µm in width are acceptable. Any number of Scratches less than or equal to 2µm in width are acceptable.
Pits	No Pits greater than or equal to 5µm in diameter. 3 Pits greater than 3µm and less than 5µm in width are acceptable. Any number of Pits less than 3µm in diameter are acceptable.
Chips	No Chips.

Zone C (115- 125 microns)	Acceptance Criteria
Scratches	Any number of Scratches any size are acceptable.
Pits	Any number of Pits less than 10µm in width, which do not cross the Zone B are acceptable.
Chips MT only	Any number of Chips less than 10µm in width, which do not cross the Zone B boundary, are acceptable.
Chips Mini MT only	Any number and size of chips contained within Zone C boundary are acceptable.
Zones A, B, and C (0-125 microns)	No surface defects other than described above are acceptable.

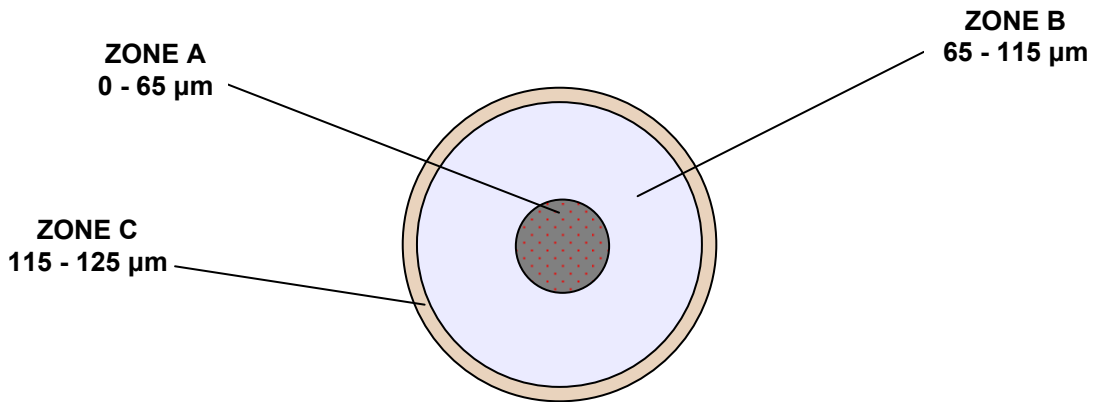
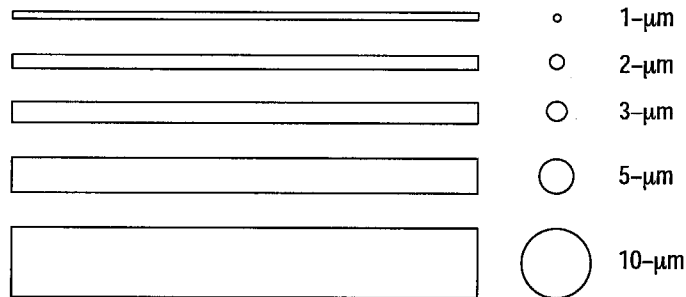
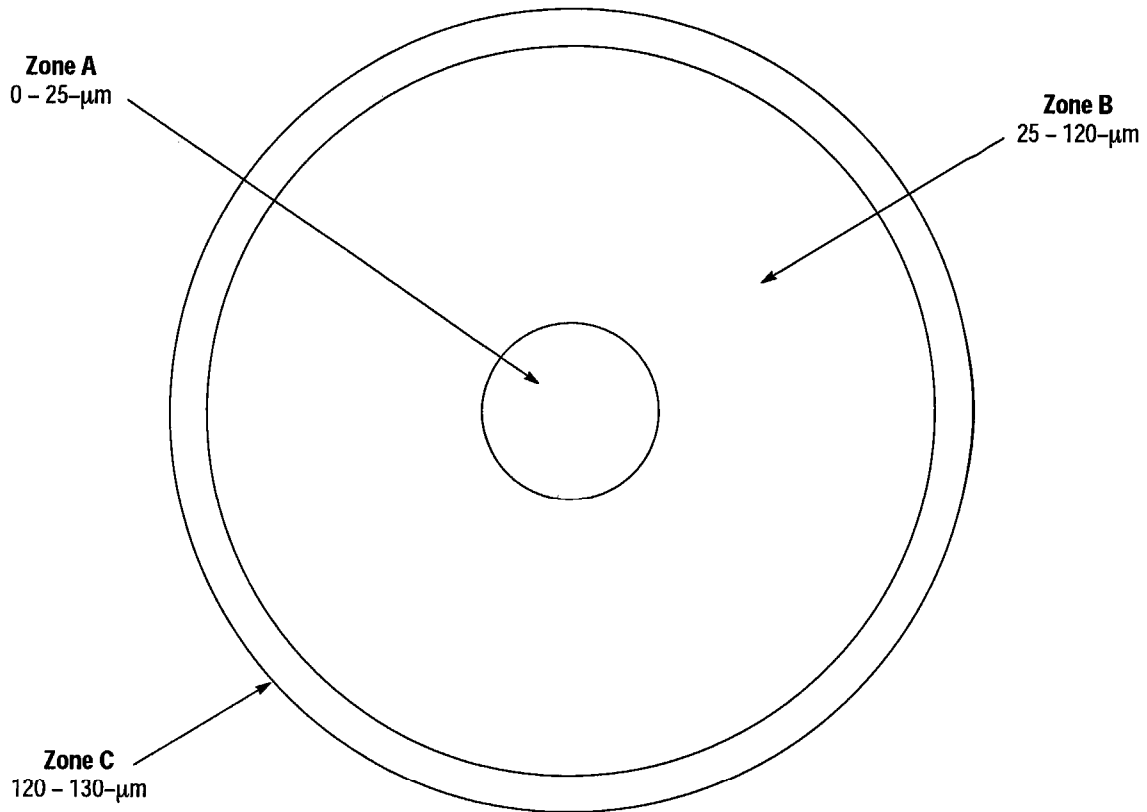


Figure 15

5.12. Singlemode Inspection Overlay

Figure 17 is to be used only for image sizes measuring 10.54 centimeters across the cladding. Copies made must be a 1:1 ratio.



NOTE

Figure 17 is drawn to scale. Printing may cause slight size variations.

Figure 16