Fiber Optic Connections for PDV

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A Continuing Education

with

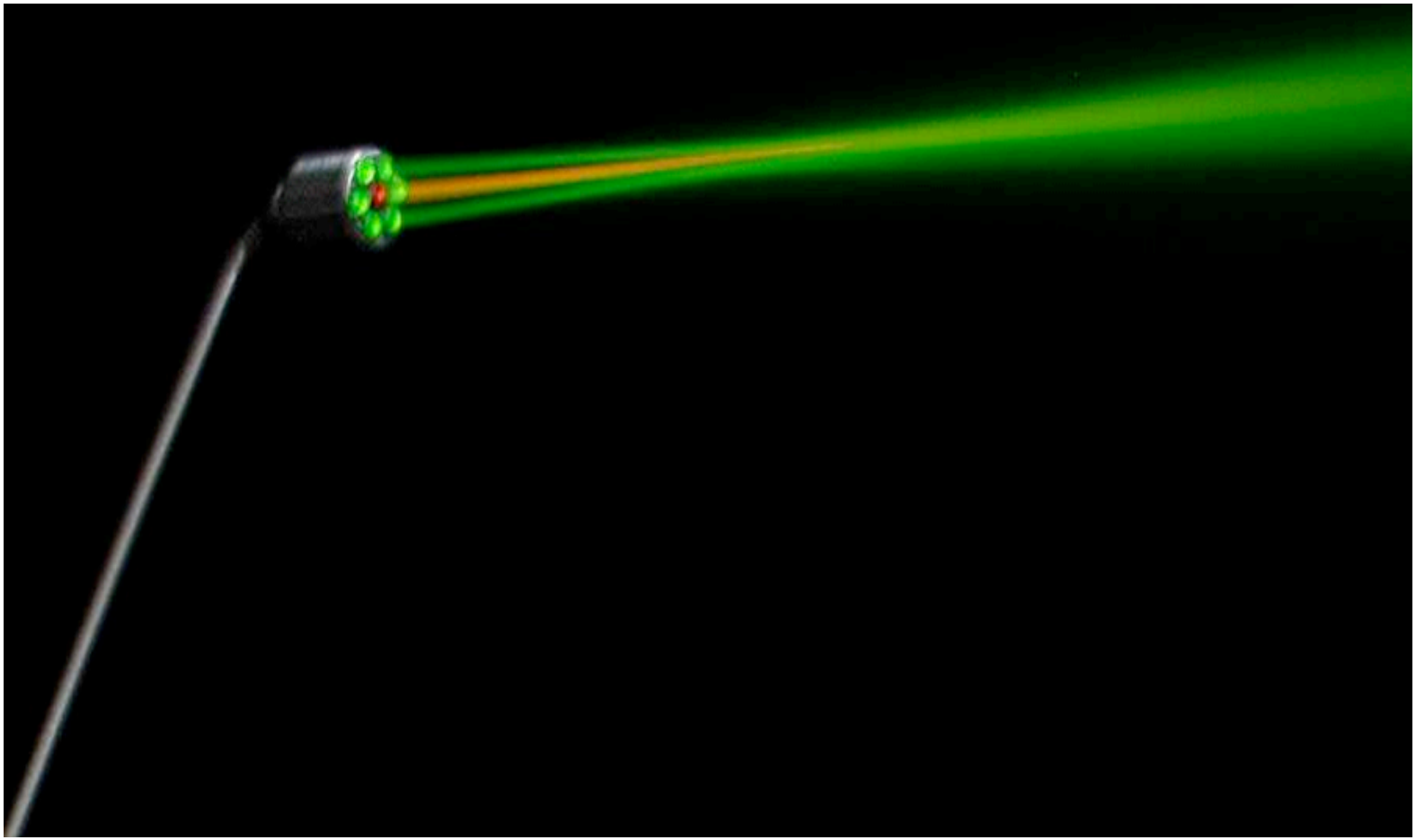
Immense Support from PDV Experimenters

David Holtkamp, Paulo Rigg, Brian Jensen, David Esquibel, Tom Graves, Dale Turley, Robert Malone, Vincent Romero, Adam Iverson, Brian Hollander, Araceli Rutkowski, John Hollabaugh, Brian Cata, Irene Cata, Gary Gonzales, Jason Young, Richard Thompson, Alfred Meidinger, Bart Briggs, Matt Brigg, Leonard Tabaka, Patrick Rodriguez, Brent Frogget

Fiber Optic Torch

New Item

taking pre-orders now



Excellent Probes Give Excellent Data

Good Probes Give Good Data

Bad Probes Give Bad Data

Excellent Probes

Plus
Bad Connectors

equals

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This talk covers the following topics:

- **Basic Theory of PC Polish for connectors**
- **Fusing Fiber Optics verses FC/APC connectors**
- **Types or Kinds of FC/APC connectors**
- **Types of connector feed thru's**
- **Testing of connectors**

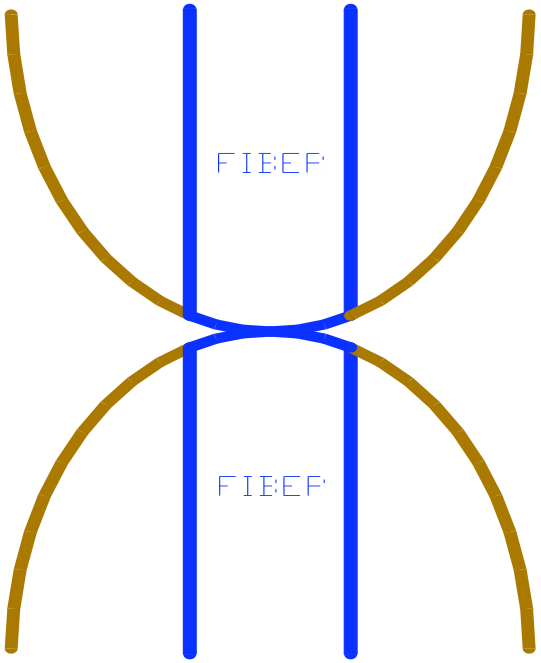
FC/PC Connectors:
The FC/PC connector is one of the original 2.5mm ferrule technology designs. Starting out as the **FC connector** (**sometimes known as face contact**), the FC/PC connector (**PC is sometimes referred to as physical contact**) is an improvement of the original design. The radiused ferrule end face of the FC/PC connector allows the optical fibers to touch, thus eliminating the air gap that usually results with the original FC design. With the optical fibers in contact the attenuation decreases and the amount of light reflected back (Return Loss) to the source also decreases. A typical FC connector has a return loss of about -14 dB where an FC/PC connector will have a return loss of -30dB. Using special polishing techniques an **FC/PC connector can be made to have Super PC (-40 dB) or Ultra PC (-50 dB) return loss characteristics**.

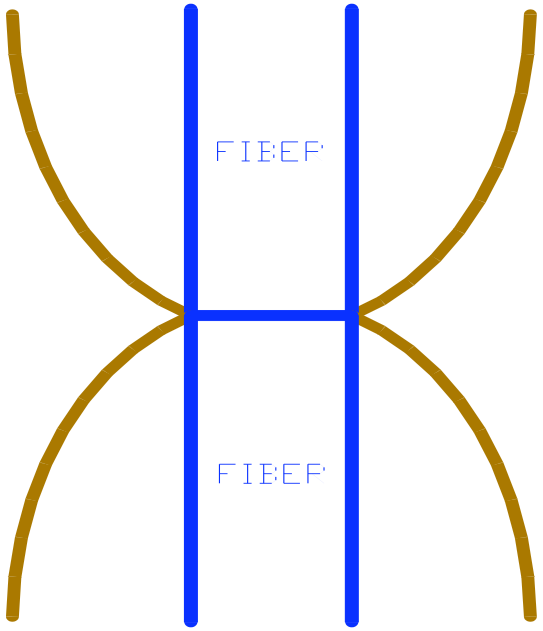
FC/PC is always narrow key and wide slot

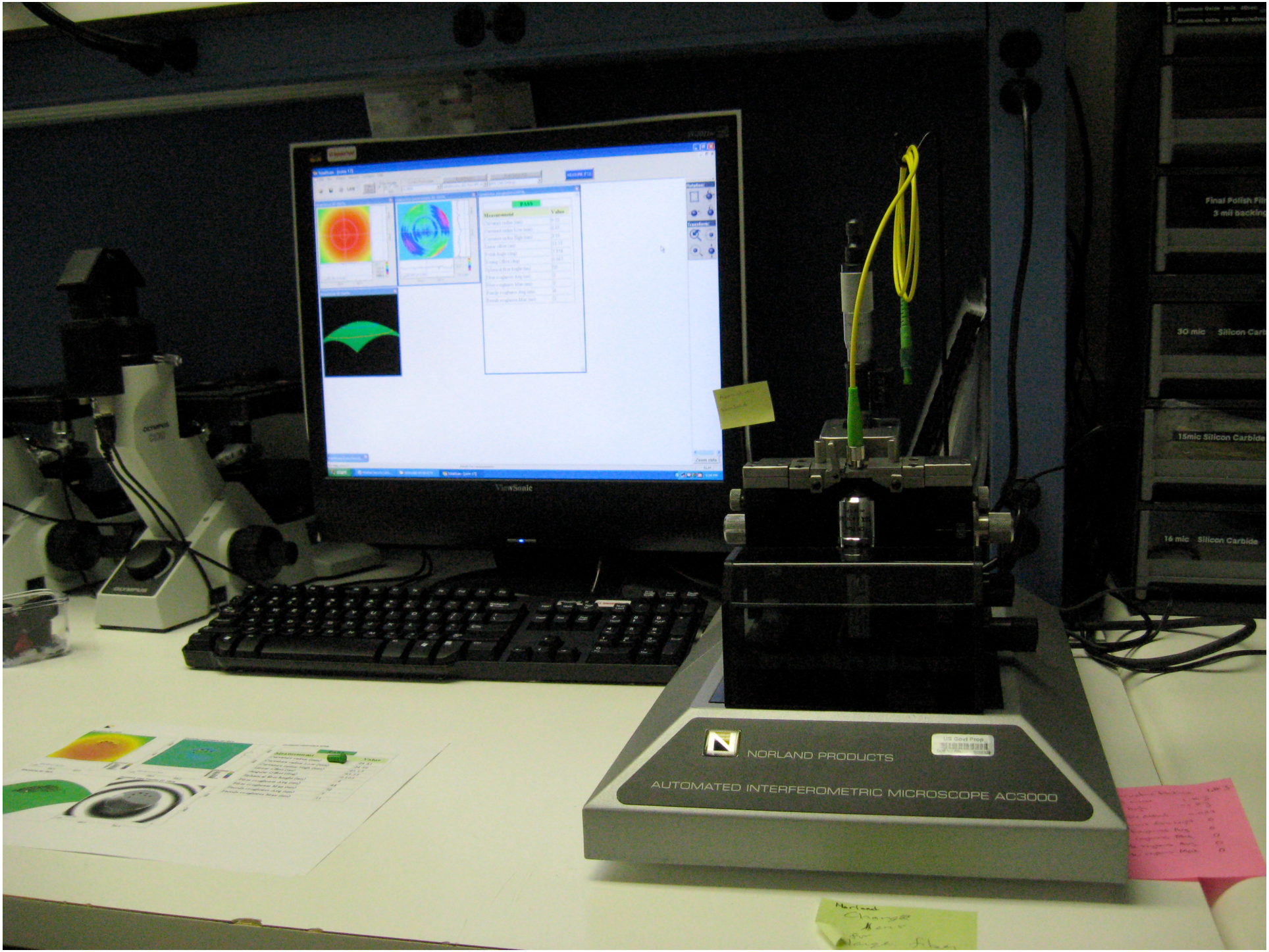
The FC/APC (Angled Physical Contact) connector provides return loss better than -60dB and has a tight-fit key **configuration to improve performance. This ensures a minimum insertion loss and a maximum return loss. The FC/APC connector is intended for CATV & Telecommunication network applications.**

PC POLISH CONCEPT

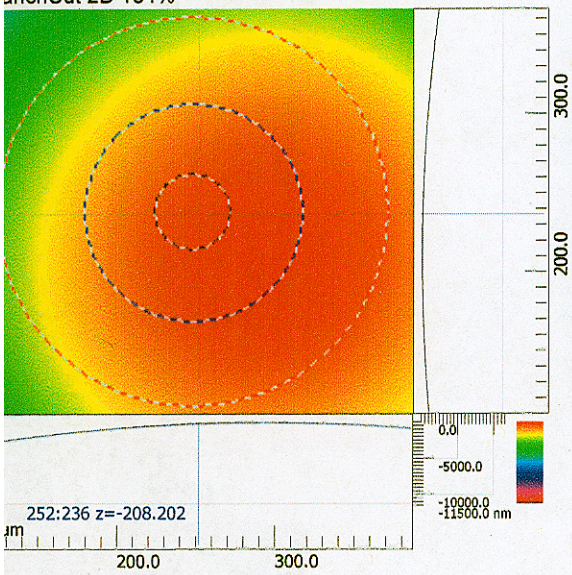
- On Connection:
  - Fibers meet in intimate optical contact. No air gap.
  - Fibers compress until ferrules contact.
  - Ferrules take majority of compressive force.



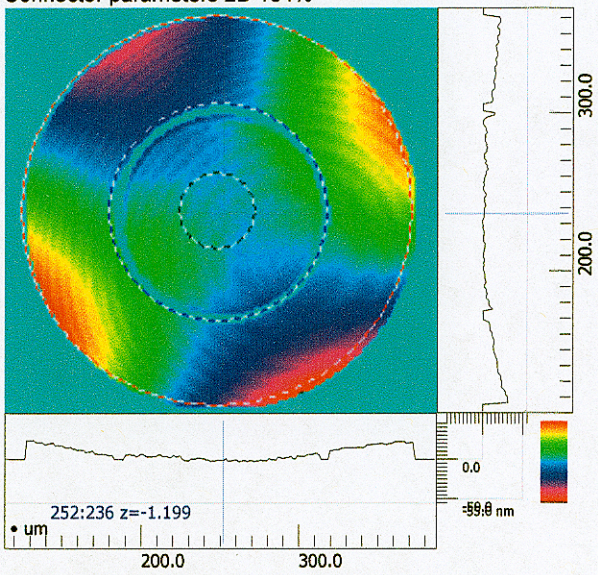



NORLAND PRODUCTS
AUTOMATED INTERFEROMETRIC MICROSCOPE AC3000
ViewSonic
Final Polish Fil
3 mil backing
30 mic Silicon Carb
15mic Silicon Carbide
16 mic Silicon Carbide

anchCut 2D 184%



Connector parameters 2D 184%

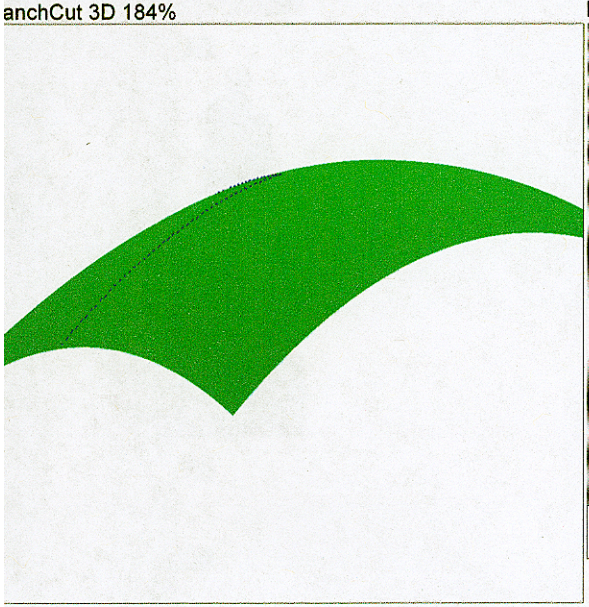


Connector parameters HTML

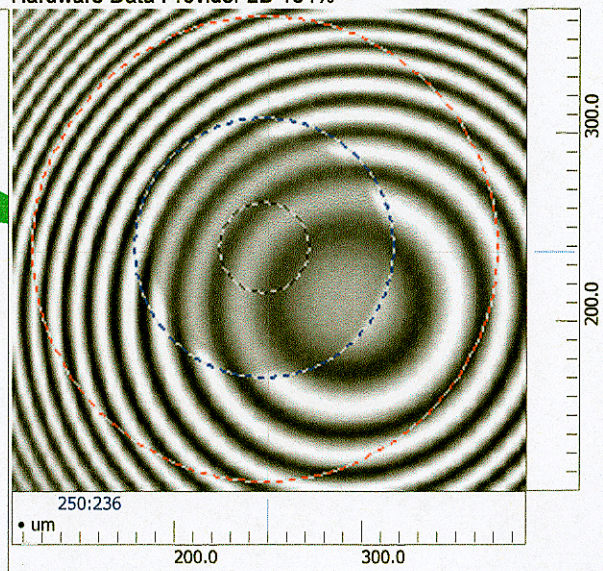
FAIL

Measurement	Value
Curvature radius (mm)	5.43
Curvature radius Low (mm)	5.25
Curvature radius High (mm)	5.61
Linear offset (um)	48.24
Polish Angle (deg)	8.280
Keying Offset (deg)	0.425
Spherical fiber height (nm)	25
Fiber roughness Avg (nm)	5
Fiber roughness Max (nm)	6
Ferrule roughness Avg (nm)	20
Ferrule roughness Max (nm)	23

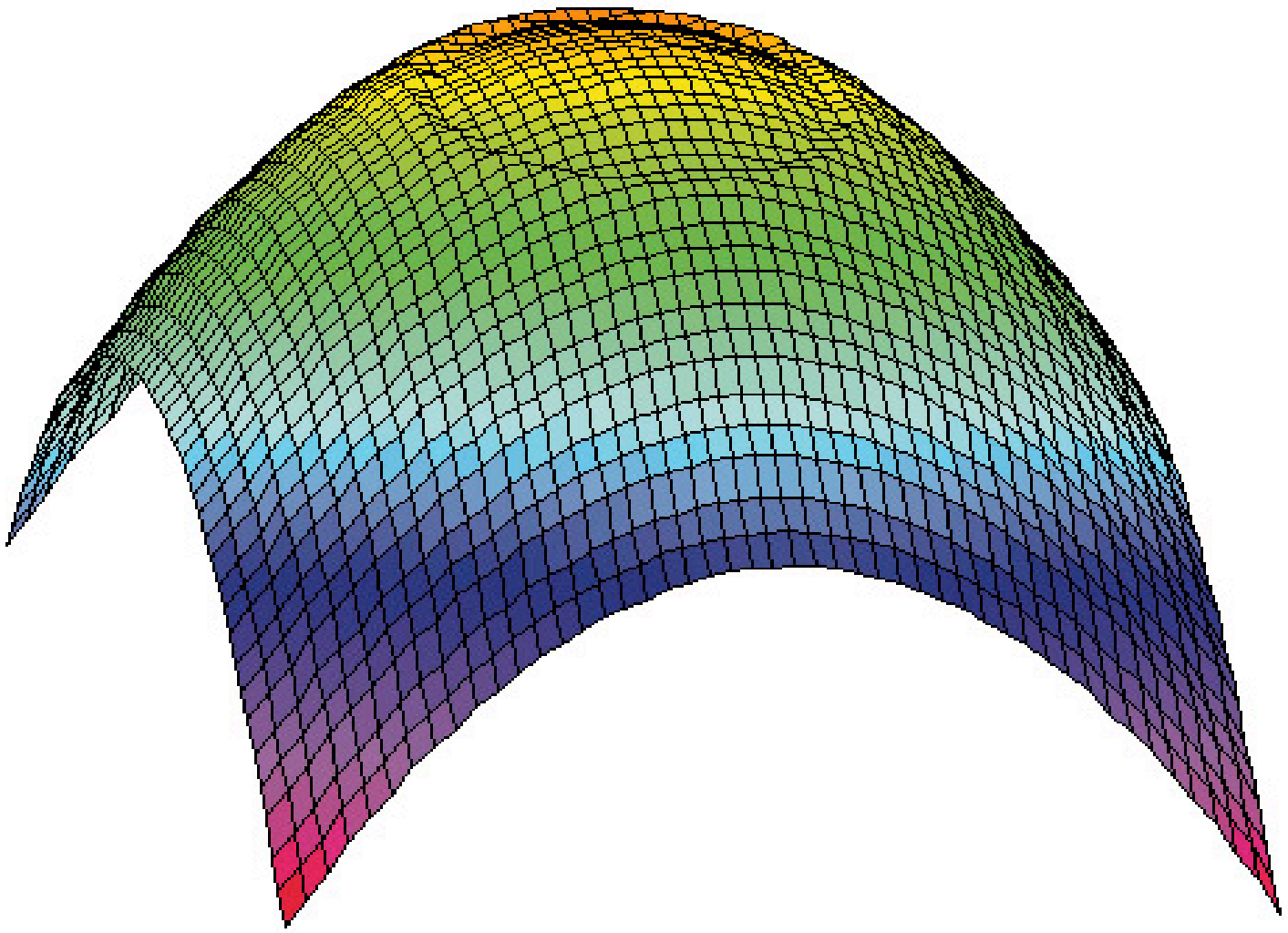
anchCut 3D 184%



Hardware Data Provider 2D 184%

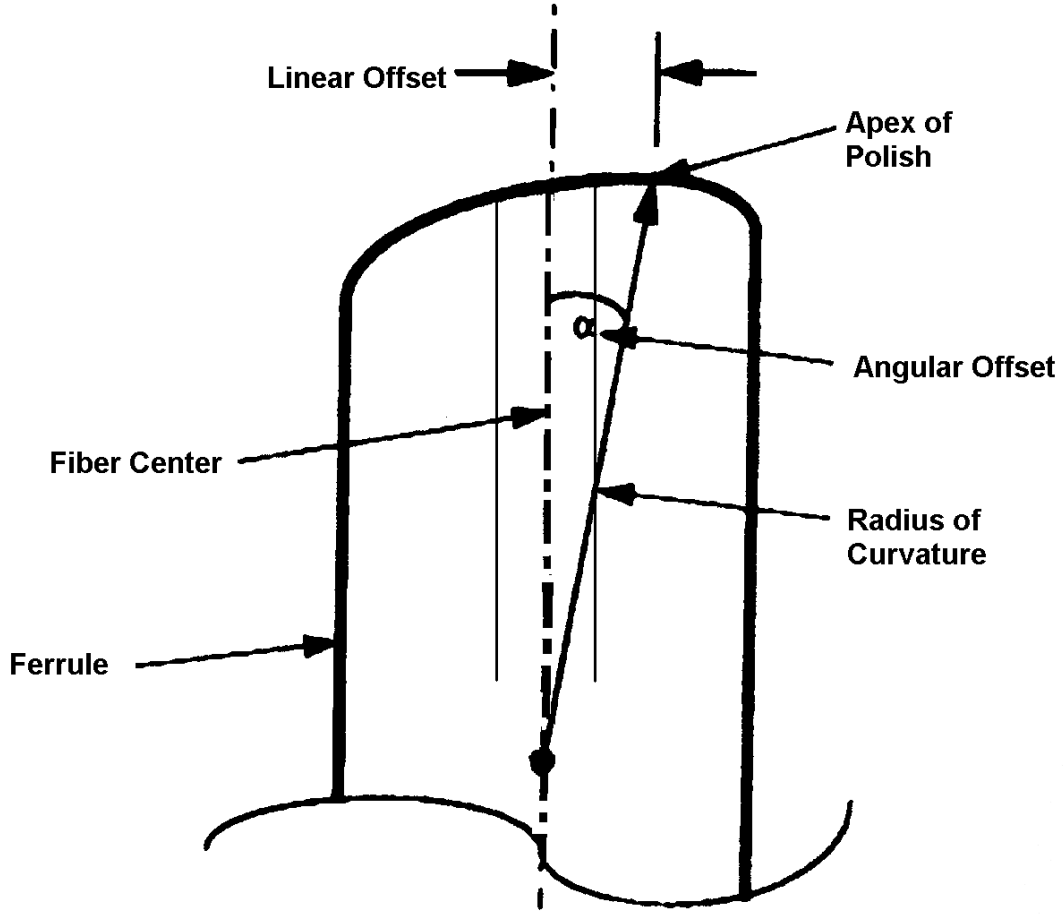


3D MEASUREMENT



OFFSET OF POLISH

Distance from center of fiber to highest point of ferrule



Fusing Fiber Optics verses FC/APC connectors:

- 9/125 Single mode fiber
  - TIA/EIA-568-B.3 **Fiber loss in cables**

    inside plant cable MAX LOSS 1550nm 1.0 dB/km

    outside plant cable MAX LOSS 1550nm 0.5 dB/km

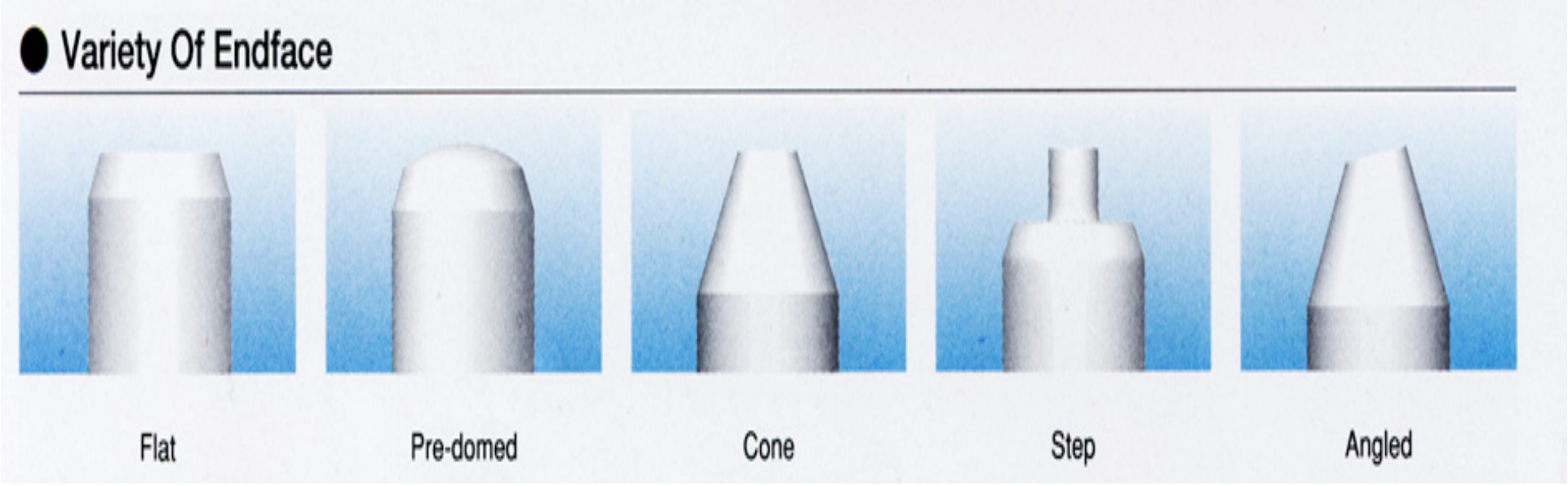
- Fusion or mechanical splicing:
  - ANSI/EIA/TIA-455-34 Method A
  - Attenuation not to exceed -0.3dB should be -0.03
  - Back reflection: better than -75dB

- **FC/APC connector could have results as good as fusing**

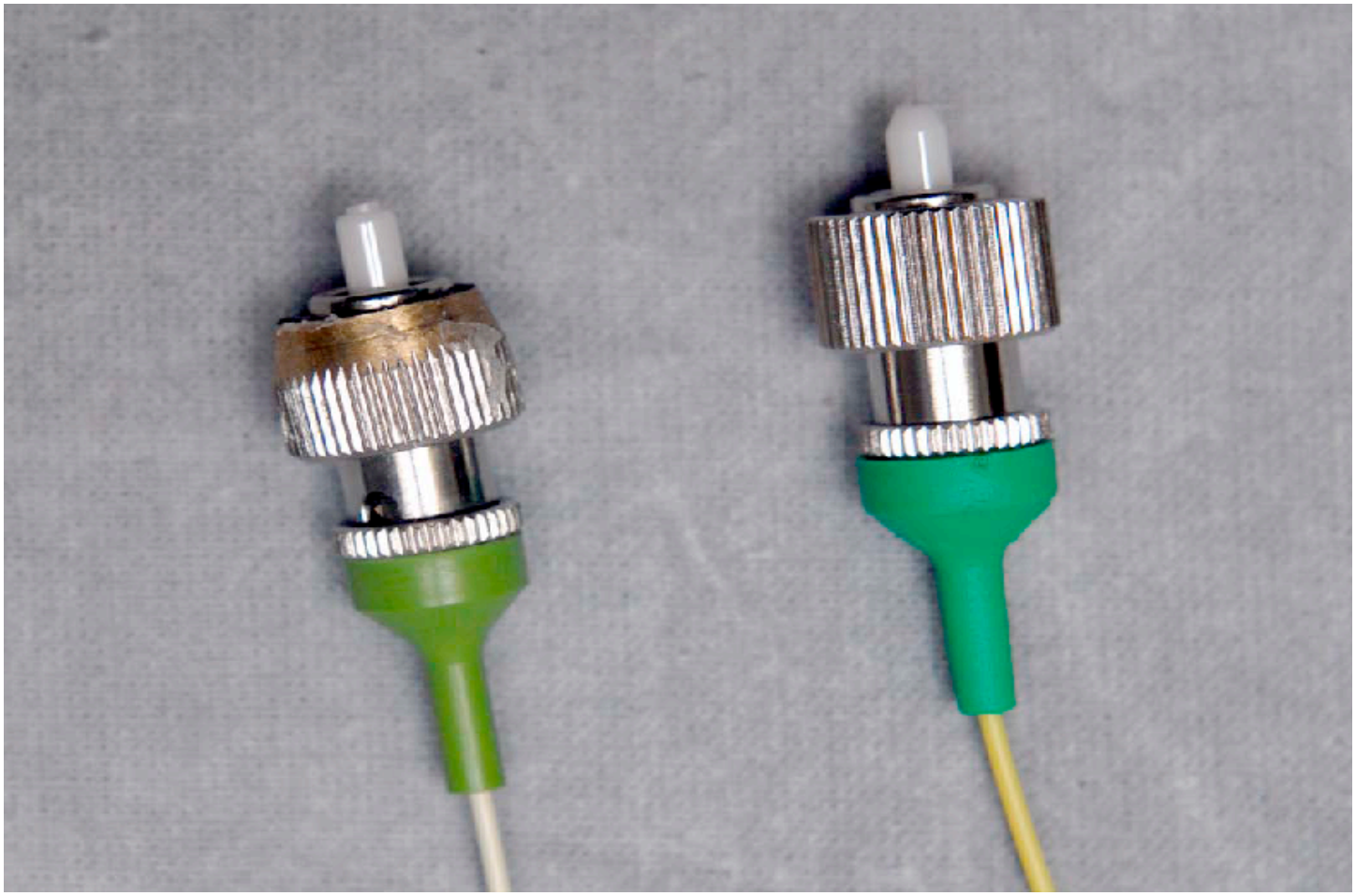
  Attenuation: < -0.3dB typically -0.03dB

  Back reflection 8^{O} connector typically > -75dB

- **Types or kinds of FC/APC connectors**
  - Die Cast Nickel plated Zinc housing
  - Glass composite body housing
  - Plastic interbody
  - Zorconia Ferrule
  - Pre-polished verses Pre-angled
  - Wide or Narrow Key
  - Wide or Narrow slot - Feed thru
  - APC bulkhead's are not a standard



Purchased a Laser with this (left) connector
It was modified to fit into a feedthru to avoid the heads on a screw
Loss was 25% ALL APC connectors are a Green boot



Types of FC/APC connectors

- **ALL FC/PC are narrow key with wide slot**
- **FC/APC are narrow key and narrow slot**
  except Molex Japan Institute Standard (JIS)

- **Glass composite inter-body with Die cast nickel plated Zinc threaded nut (everybody but 3M)**

  Nickel flakes off with use and contaminates ferrule Unable to clean off. Needs to be repolished

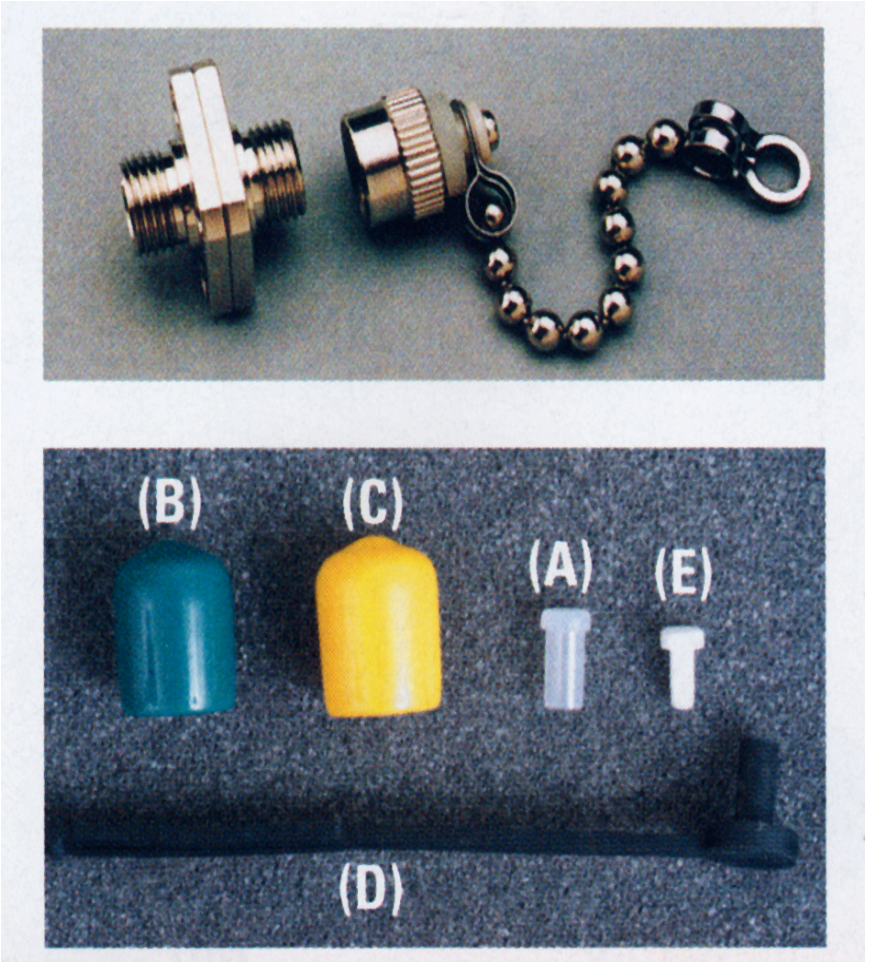
- **Glass composite inter-body and threaded nut (3M only)**

FC/APC	Die cast Nickel Plated ZINC	Die cast Nut	Glass composite nut	Glass composite interbody	Feed Thru Narrow slot 2.02mm	Feed Thru Wide Slot 2.14mm	Pre-angled & Pre-polished	Pre-angled FLAT
Molex	x	x				x	x	
Corning	x	x		x	x			x
3M			x	x	x		x	x
AMP	x	x		x	x			x
FIS	x	x			x		x	
Seiko	x	x			x			x

Reference: Jim Inman Engineer @ Fiber Instrument Sales

Cleaning the FC/APC connector

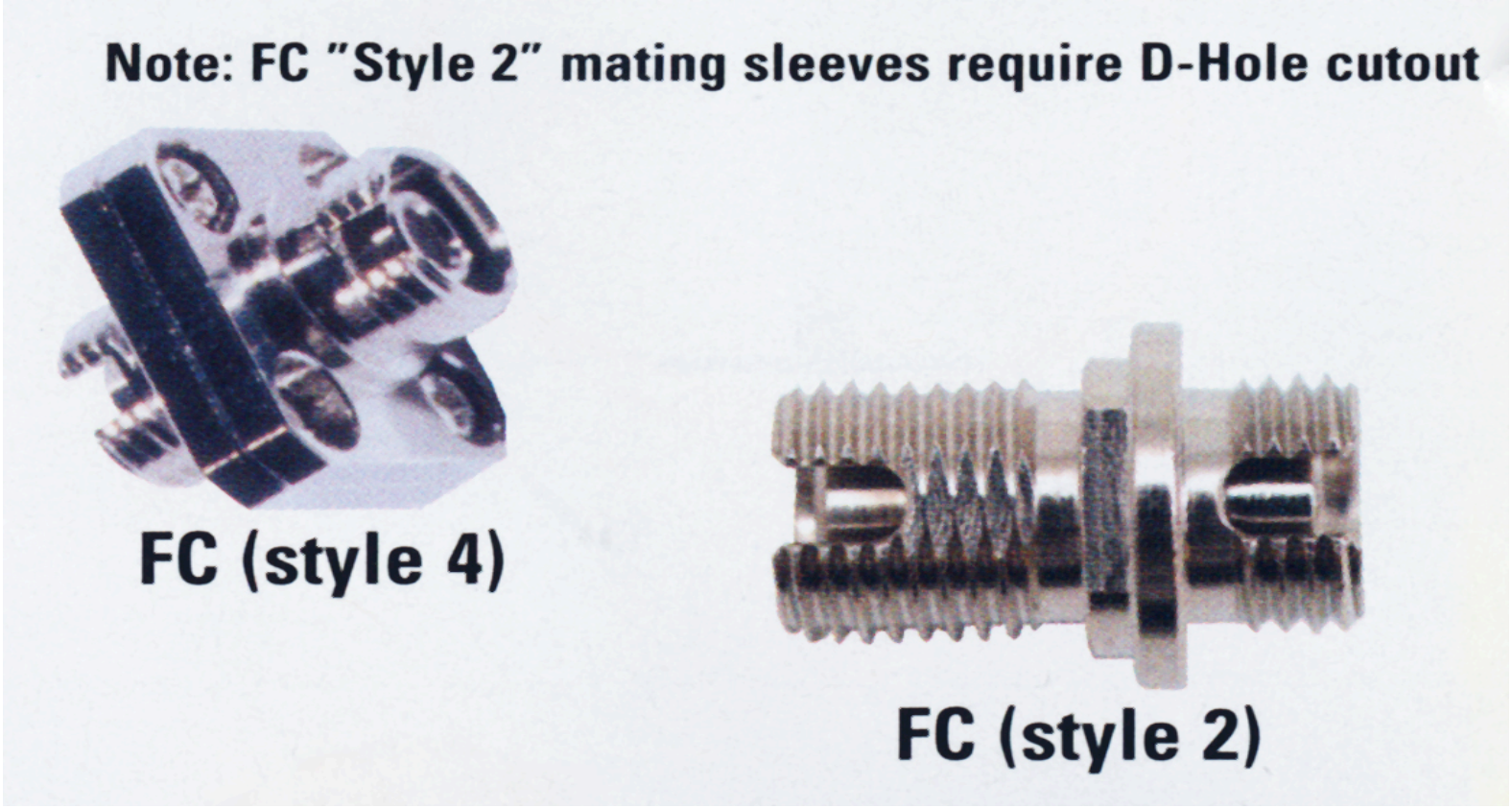
- **Clean every single time and check with microscope**
- **High power laser will burn plastic caps**
- **Static cling on ferrules attracts dirt**
- **Dirt can attract on both ends**
- **Turn off Laser when cleaning and viewing in microscope**



APC Feed Thru's

Wide Slot Narrow Slot

Brass insert Ceramic insert



Testing FC/APC connectors

Clean every single time and check with microscope

- Microscope (Video microscope is safer)
- Alcohol & wipes
- Connector cleaner
- Interferometer
- Laser source
- Radiometer
- Back Reflection meter

Conclusion

Clean	Clean	Clean
Inspect	Inspect	Inspect

"ANY" Flaw = Repolish & Reclean & Recheck

Never Force the fiber connection

"Luke, never use the force"

News Release

Seiko is now Seikoh Giken

Best not to mismatch Brand of connectors