



March 2024

Reliability and Testing of Fiber Optics Interconnect

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SENKO

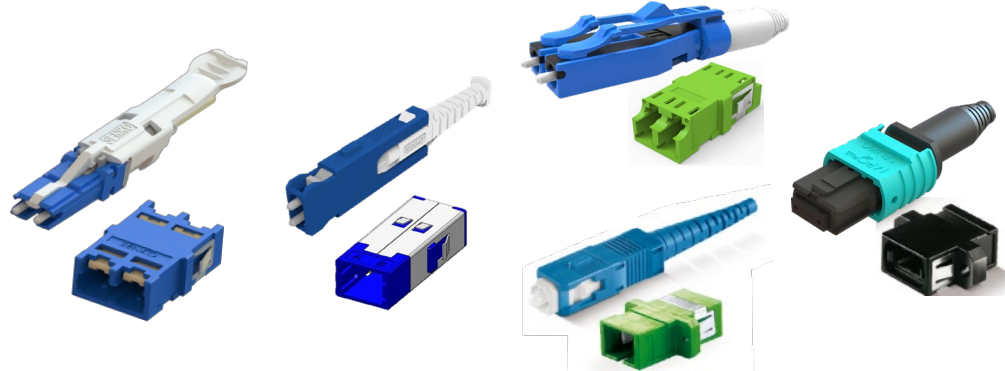


Markets for Fiber Optic Interconnect



Fiber Optic Typical Connectors Product Offering

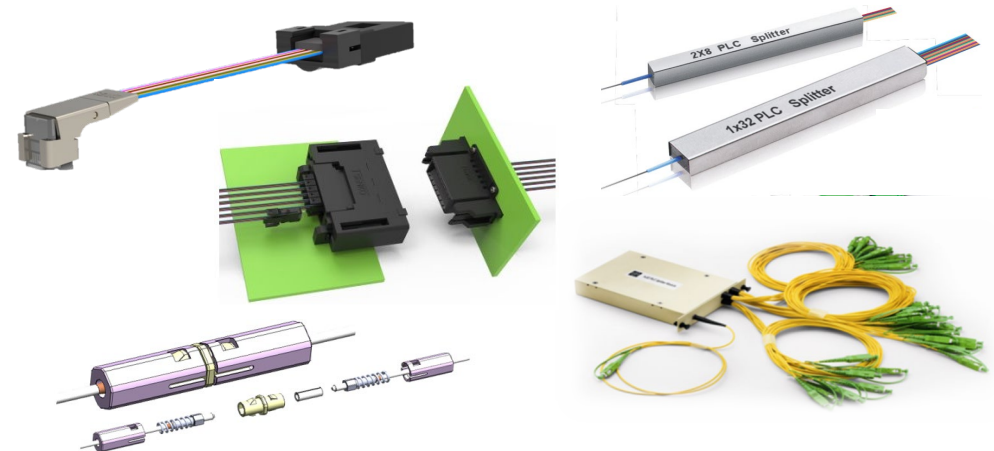
Indoor Connectors



Outdoor Connectors

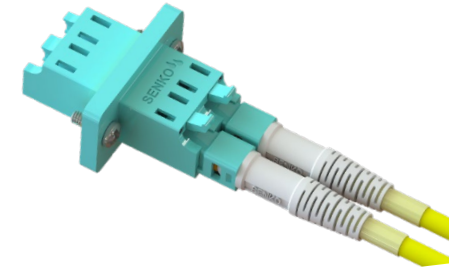


Other Interconnect Solutions



Inspection & Clean

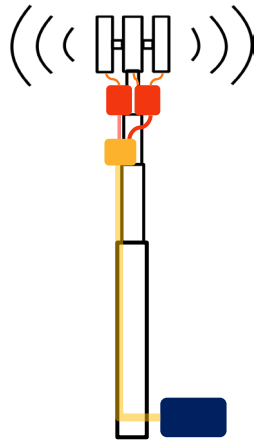




FTTA & FTTH Solutions

Product Overview

Macro Cell



- Hybrid
- High Power
- Simple installation

RRU connectivity Remote Radio Unit



- ✓ Connectors go into RRU / equipment
- ✓ One-stop shop
- ✓ Small footprint connectors for RRUs



Hybrid Trunk / Break-out



- ✓ Outdoor rated connectors
- ✓ Hybrid connectors
- ✓ Plug & Play IP Fan Out Kits

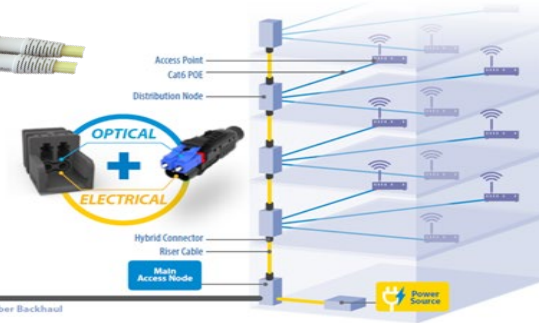
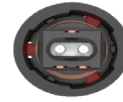


BBU connectivity Baseband Unit



- ✓ High Density solutions
- ✓ Passive Device – WDM, AWG
- ✓ Beyond 100G -

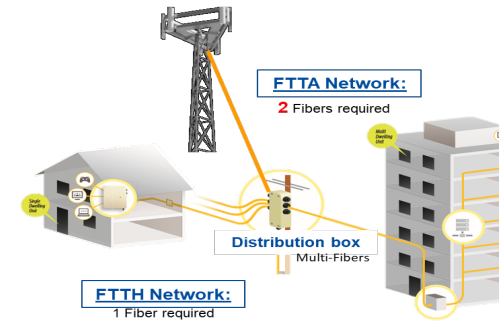
Small Cell/DAS



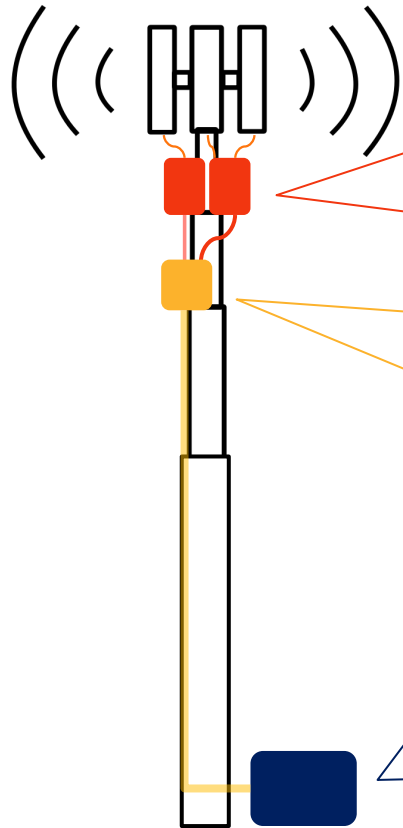
FTTH



Wireline and Wireless convergence:

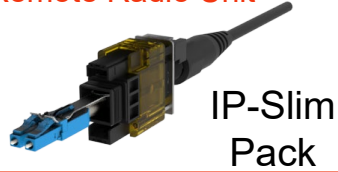


Macro Cell Network Connectors



RRU connectivity Remote Radio Unit

- ✓ Connectors go into RRU / equipment
- ✓ One-stop shop
- ✓ Small footprint connectors for RRUs



Hybrid Trunk / Break-out

- ✓ Outdoor rated connectors
- ✓ Hybrid connectors
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BBU connectivity Baseband Unit

- ✓ High Density solutions
- ✓ Passive Device – WDM, AWG
- ✓ Beyond 100G -



RRU Connectivity: IP-RC/CD2

IP-R Connector Rapid Connection



FEATURES

- IP-67 rated
- Field Installable
- Conduit option available



APPLICATION

- FTTA/Wireless
- For Ericsson RRU
- Any Outside plant equipment

CD2 Connector Plug & Receptacle

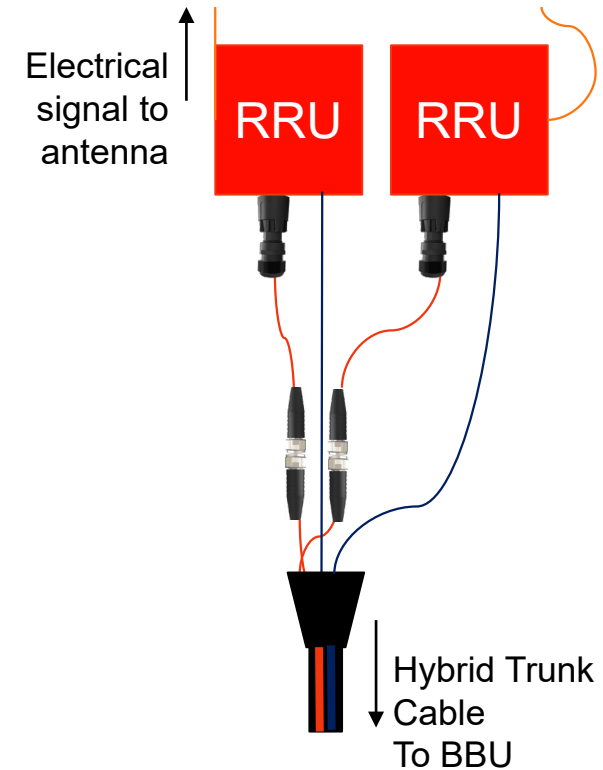


FEATURES

- Metallic Connection.
- Supply as a component kit.
- Inline connection without adapter

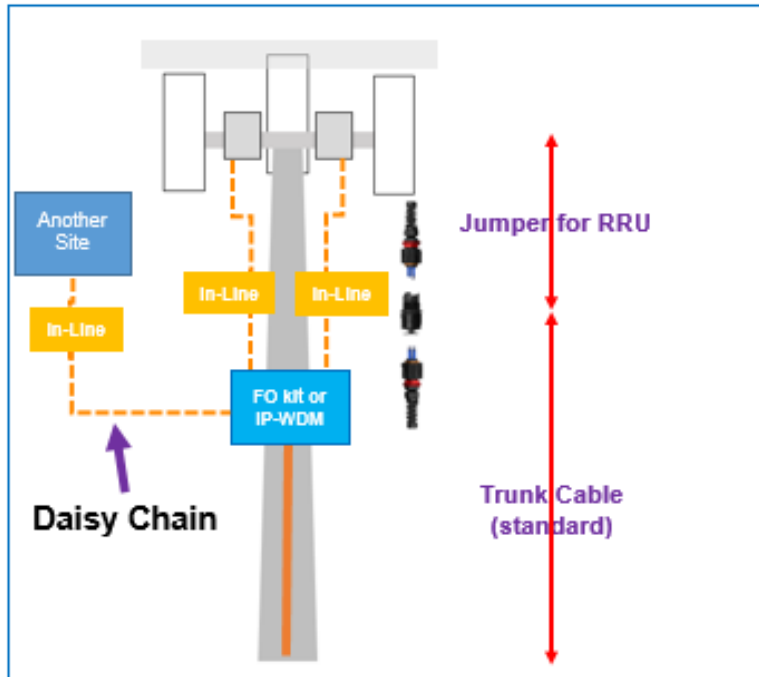
APPLICATION

- FTTA/Wireless
- For Ericsson/Nokia radio network
- Any Outside plant equipment – Inline application

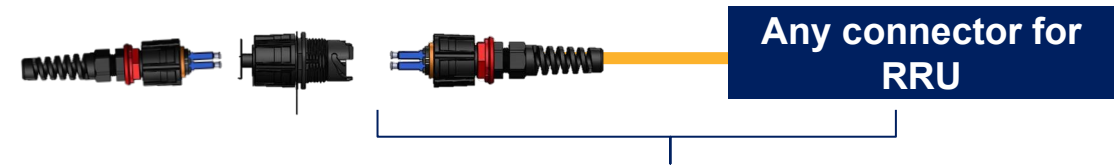


IP-LC In-Line Adapter

IP-LC/MPO In-Line Adapter:



In-Line Adapter + Connector

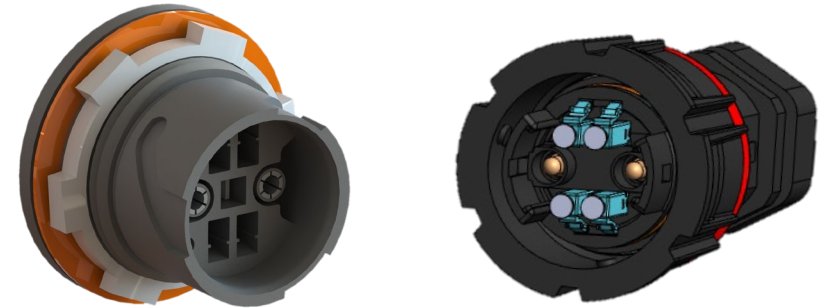
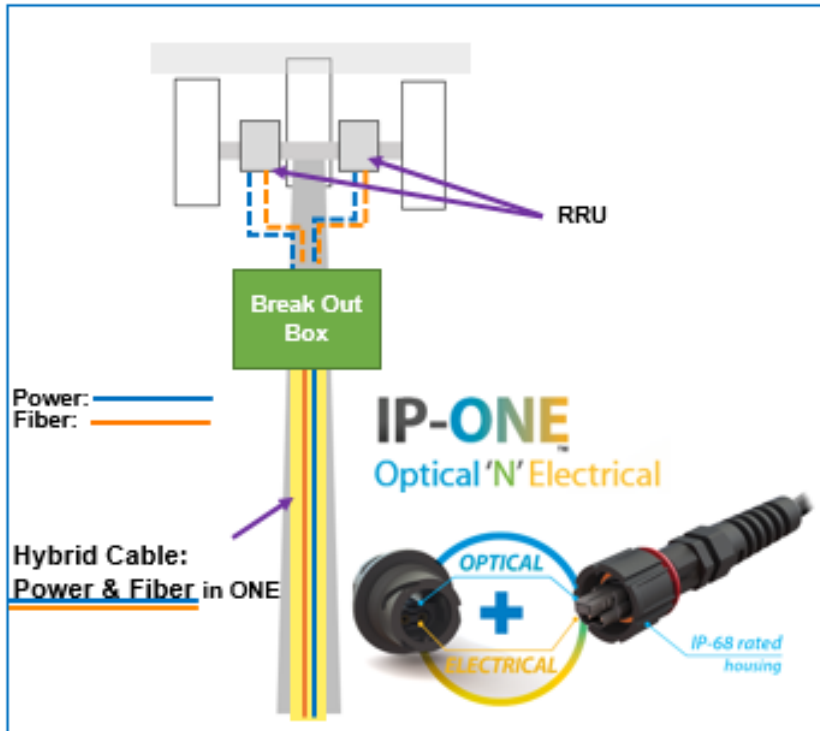


- Jumper for RRU**
- ✓ Various length
 - ✓ Various connector configurations

Benefits:

- Standardize trunk cable configuration.
- Reduce cost by eliminating a distribution box
- Future proof, scalable as needed

Fiber/Copper Hybrid Connectors

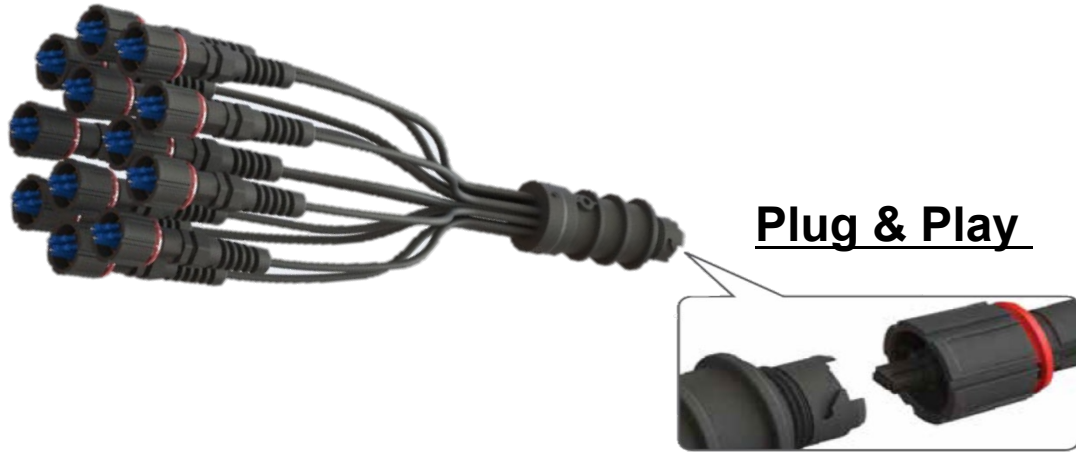


4F + 2x6AWG

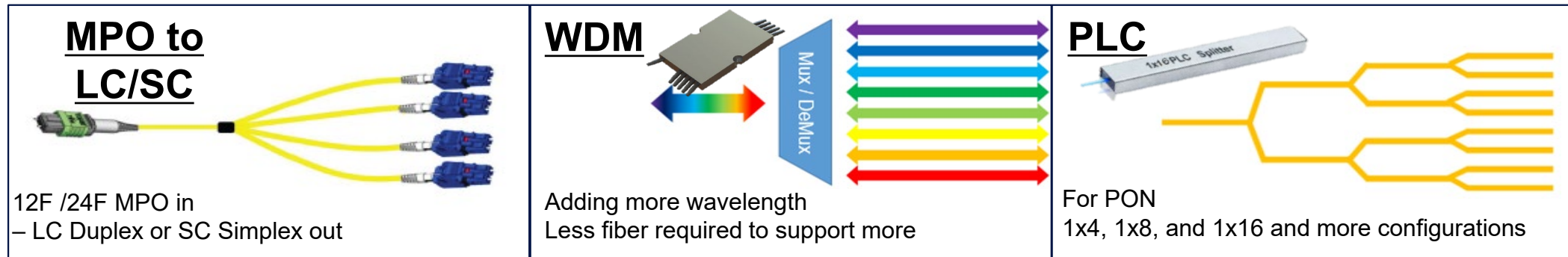
Benefits:

- Save cost by simplifying cabling structure
- Save time by simplifying installation process

Outdoor Plug & Play Fan-Out Kit Series

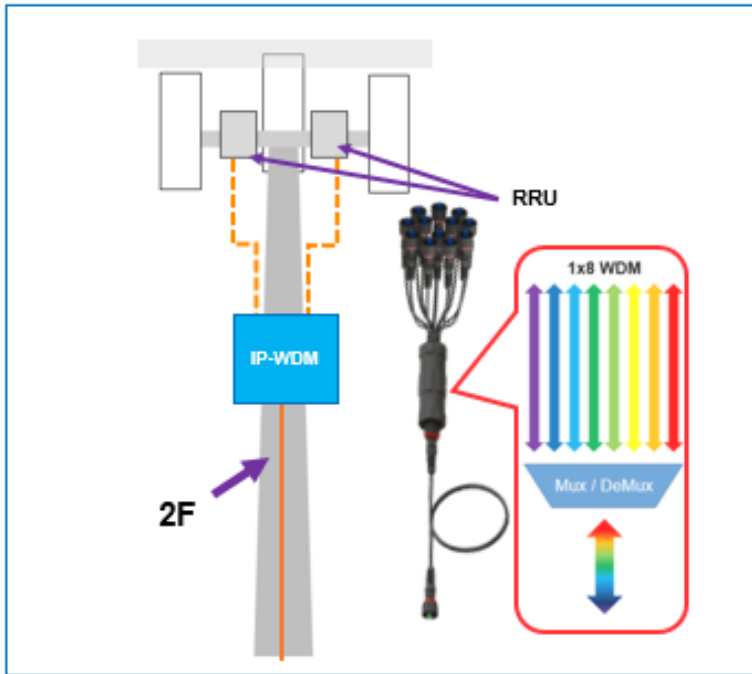


- ✓ **Save Space**
Eliminating the need of breakout box
- ✓ **Save Time**
Quick and **Simple Installation**

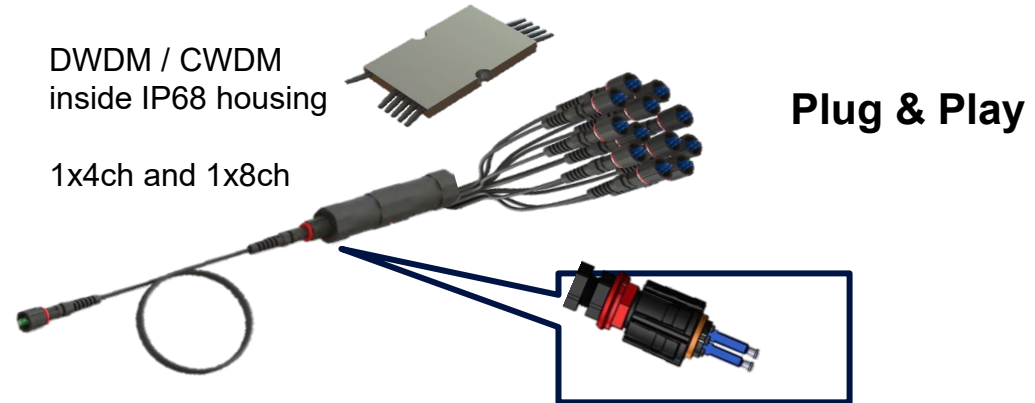


IP-WDM Plug& Play

Where fiber count is limited



IP-CWDM / DWDM Outside Plant Ruggedized

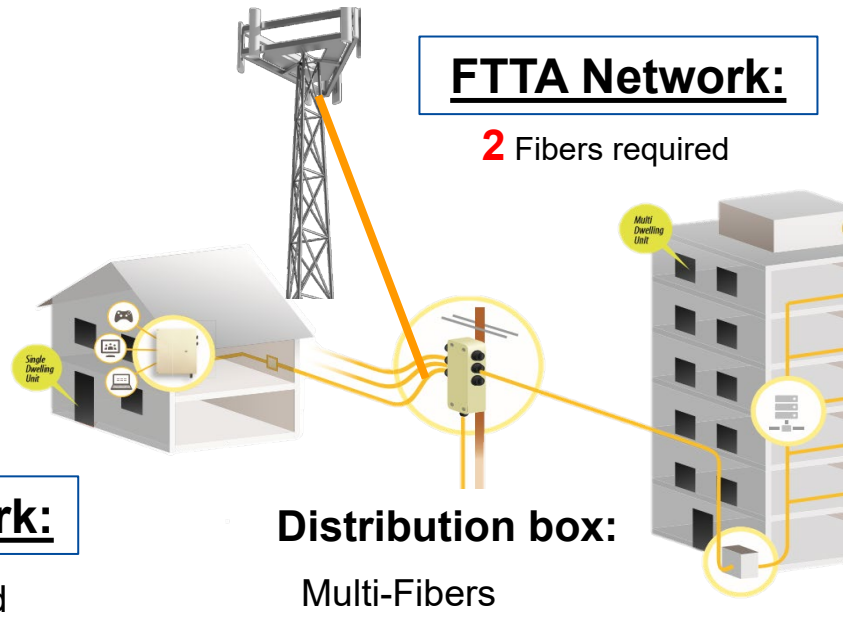


Benefits:

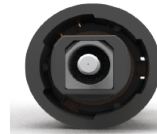
- Less fiber required on trunk cable
- Eliminate the need of a distribution box
- Simple and quick plug & play

IP-9: Small for Wireline / Wireless

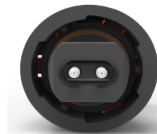
Wireline and Wireless convergence:



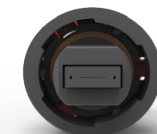
IP-9 Series:



Single Fiber- SC/ SC
field installable



Duplex Fiber
SN- 2x LC ferrule



Multi-Fiber
MT ferrule

Benefits:

- One footprint for 1-fiber, 2-fibers and 12 fibers
- Save investment for closure / terminal
- Configuration to be flexible / Shorten LT.



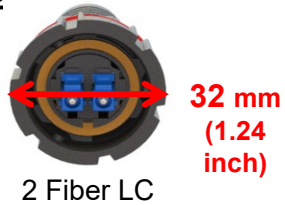
IP Family Interconnect

- ✓ Various sizes and configurations available
- ✓ Make any custom configuration by changing an inner clip

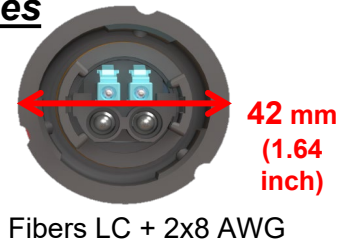
IP-9 series



IP-16 series



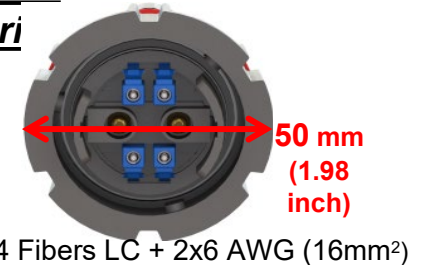
IP-21 series



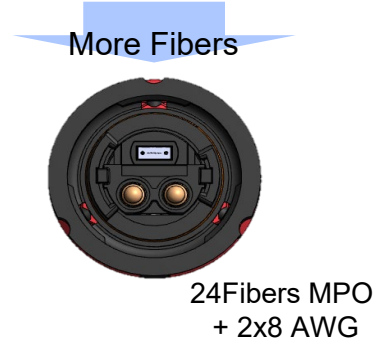
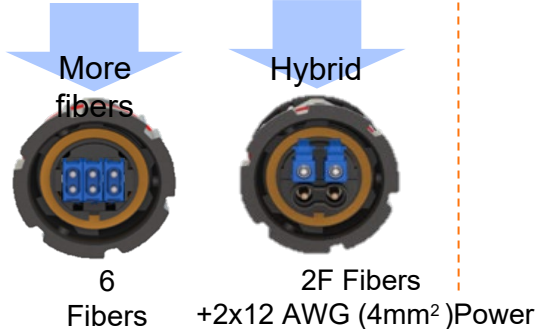
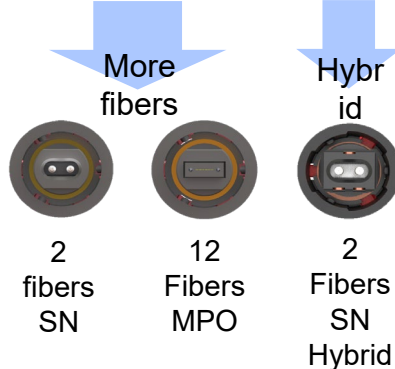
IP-PLUS
= Optimized for Fiber

IP-ONE
= Fiber + Power

IP-25 series



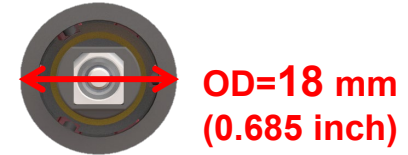
Utilize same housing and Change Inner CLIPs to make various configuration



IP-9: ONE footprint hardened connectors

FEATURES:

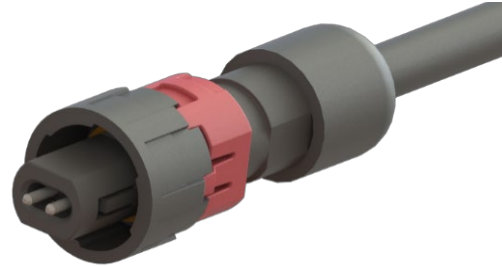
- One footprint for 1-fiber, 2-fibers and 12 fibers
- The smallest hardened connector series
- Safe lock ring feature



1
Fiber
SC *SC Field Installable*

SC (2.5mm) ferrule
3.0-5.0mm Round Cable

SC Field
Installable



2
Fibers

2x LC ferrule
Max 5.5 mm Cable



12
Fibers

MT ferrule (up to 12F)
3.0-5.5mm Round Cable

ONE footprint for SFP, BiDi, QSFP

One adapter cutout for multiple scenarios:

SFP

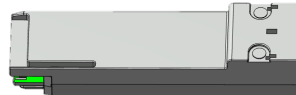


2
Fibers



Duplex Fiber
SN- 2x LC ferrule

BiDi SFP

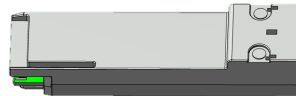


1
Fiber



Single Fiber- SC/ SC
field installable

QSFP



8
Fibers



Multi-Fiber
MT ferrule

Connector Environment

When inflated
tire pressure is
32psi



When **mated**
connector pressure is
45,000psi

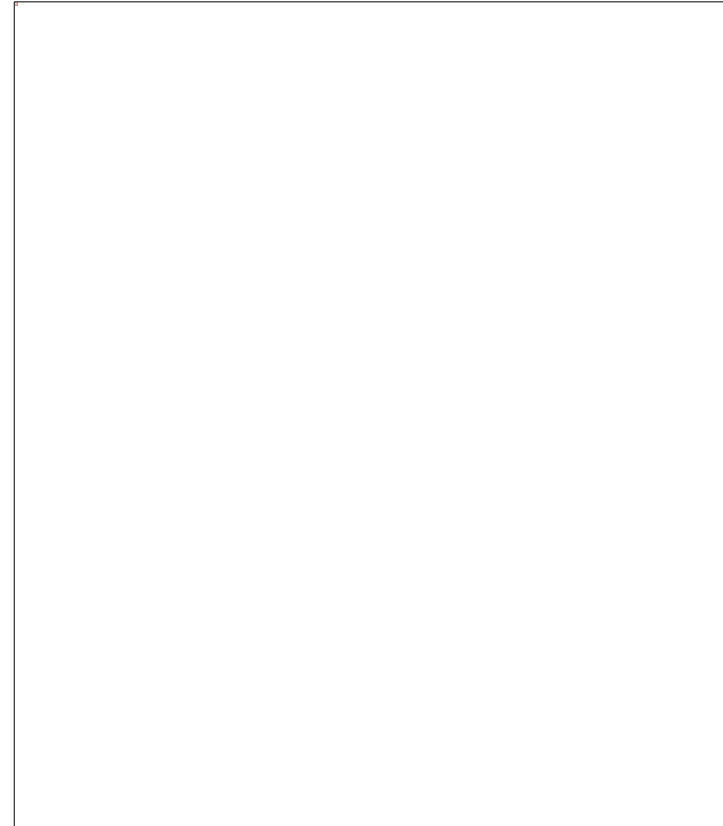


1400x

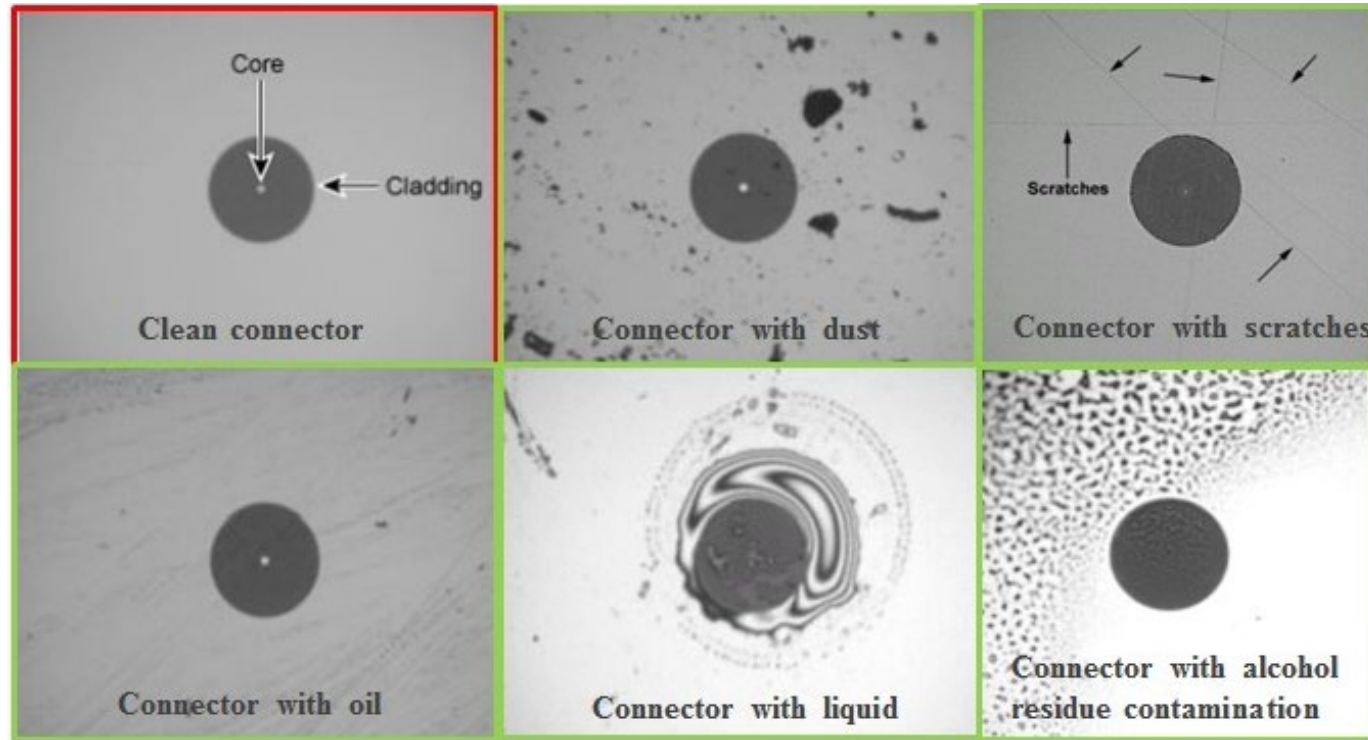


Connector Assurance

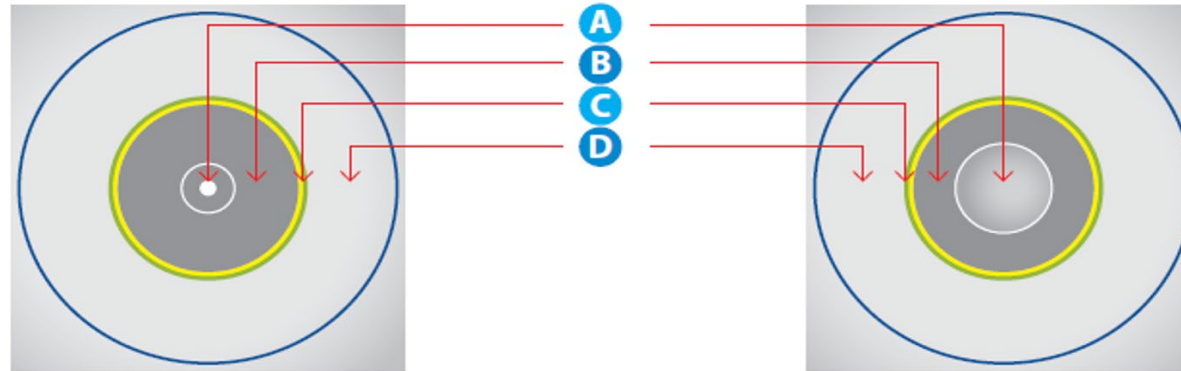
- General requirements
- Service life testing
- Extended service life testing
- Reliability assurance program



Visual Endface Testing



Visual Endface per IEC 61300-3-35



Zone	Diameter for single mode	Diameter for multimode
A: Core	0 μm to 25 μm	0 μm to 65 μm
B: Cladding	25 μm to 120 μm	65 μm to 120 μm
C: Adhesive	120 μm to 130 μm	120 μm to 130 μm
D: Contact	130 μm to 250 μm	130 μm to 250 μm

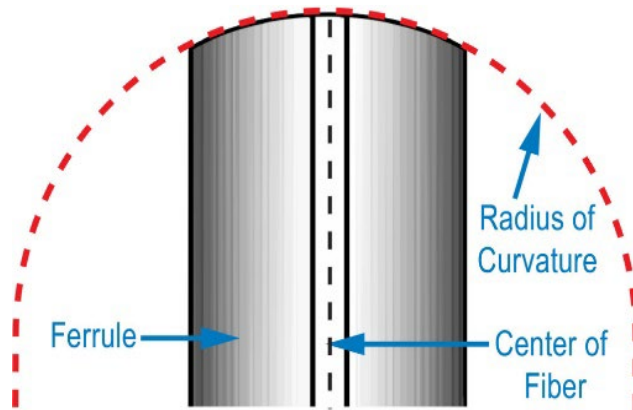
Note 1: All data above assumes a 125 μm cladding diameter.

Note 2: Multimode core zone diameter is set at 65 μm to accommodate all common core sizes in a practical manner.

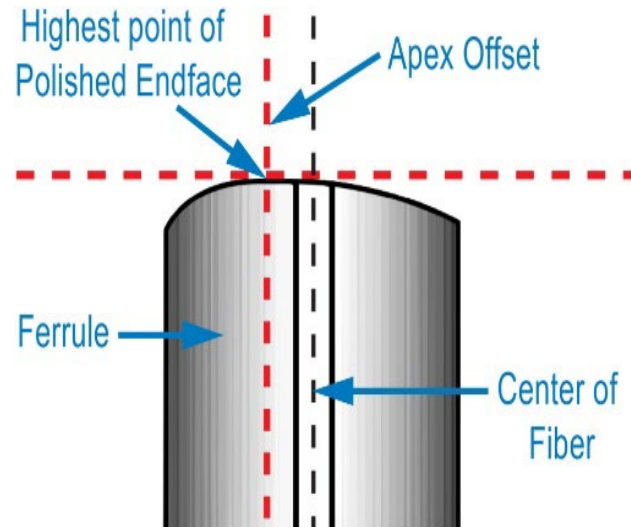
Note 3: A defect is defined as existing entirely within the inner-most zone which it touches.

Interferometry Testing Ceramic Ferrule

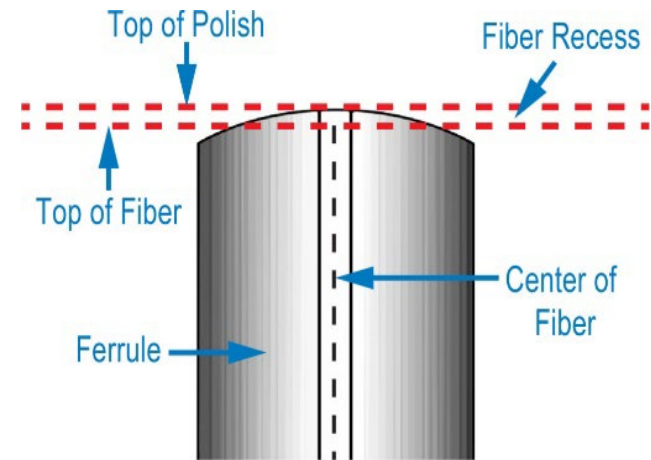
Radius of Curvature (ROC), mm



Apex Offset, μm



Fiber Height, nm



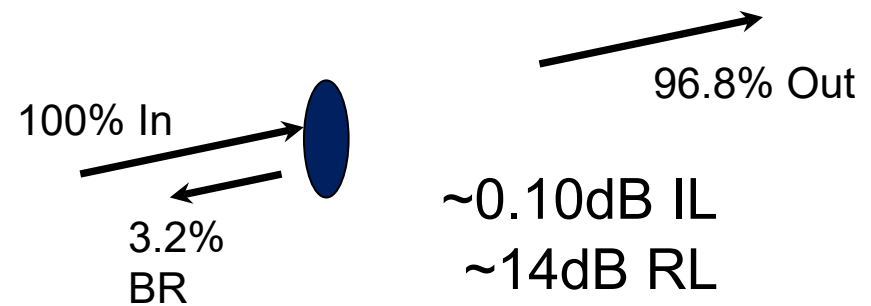
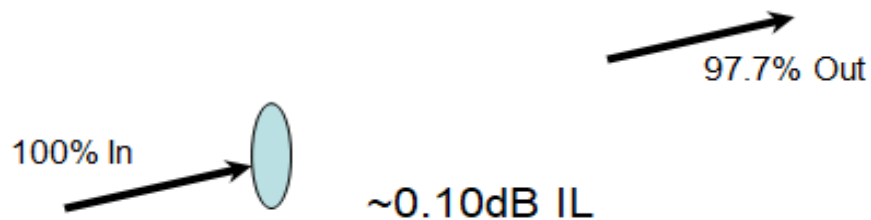
Optical Losses

$$\text{Insertion Loss (IL)} = -10 \log_{10} (P_o / P_{in})$$

where: P_o = Output Power P_{in} = Input Power

$$\text{Return Loss (RL)} = -10 \log_{10} (P_r / P_{in})$$

where: P_r = Reflected Power P_{in} = Input Power



Optical Testing

Fiber

1-3 dB
Multimode fiber, 1 km

0.2-0.47 dB
Single-mode fiber, 1 km



Splices

0.01-0.10 dB
Fusion splice

0.1-0.3 dB
Mechanical splice



Connectors

0.1-0.5 dB
Normal connector

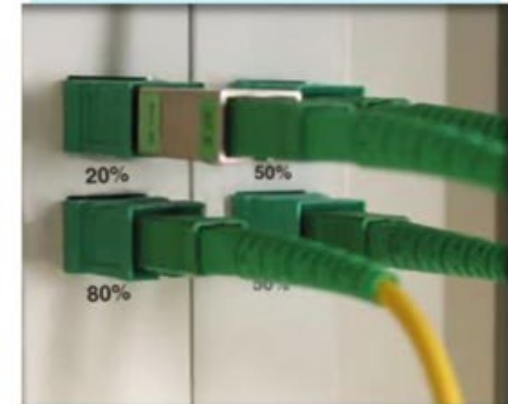
0.5-5.0 dB
Dirty connector



Other

3.4 dB
1:2 splitter

19.2 dB
1:64 splitter



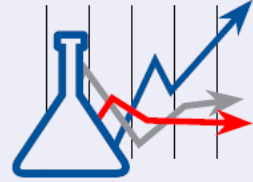
GR-326-CORE



General Requirements

Tests include:

- Intermateability test
- Fungus rating test
- Flammability test



Service Life Testing

Tests include:

- Environmental (Thermal Age, Thermal Cycle, Humidity Age, etc.)
- Mechanical test (Flex, Twist, Proof, Cable Impact, Vibration & Durability)
- Transmission with Applied Tensile Load



Extended Service Life & Reliability Tests

Tests include:

- Extended Thermal Age, Thermal Cycle and Humidity Age
- Dust Particles
- Salt Fog/Spray
- Airborne Contaminant
- Ground water immersion

Environmental Testing

Thermal Aging



Thermal Cycle



Humidity Aging



Dry-out Step



Humidity/
Condensation
Cycle



Post Condensation
Thermal Cycle



Mechanical Testing

Vibration Test



Flex Test



Twist Test



Proof Test



Impact Test



Durability Test



TWAL

(Transmission With Applied Load)



Exposure Testing



Airborne
contaminants



Ground Water Test



Corrosion Test



Salt spray



Dust

Material Testing



Intermateability



Flammability



Fungus

Testing Laboratories



- Independent 3rd party test lab
- ISO:17025 accredited testing lab for GR-326/TPR9409
- Testing capabilities covers TIA and IEC Requirements



GR 326
(FOC TPR 9409)
Optical Connectors



GR 910
Attenuators



GR 1081
Field Install Connectors



GR 1221/1209
PLC Splitters

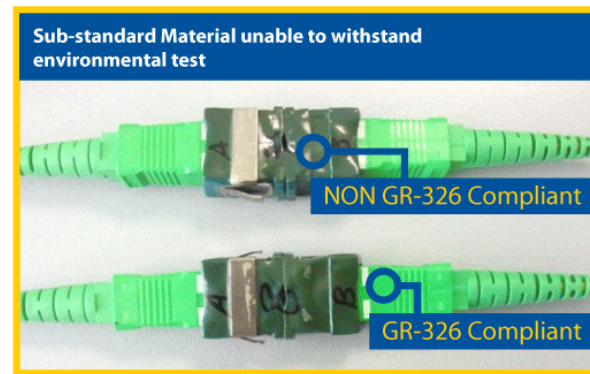
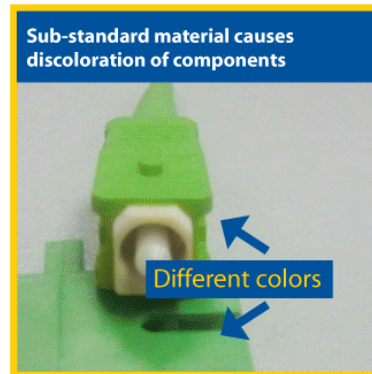
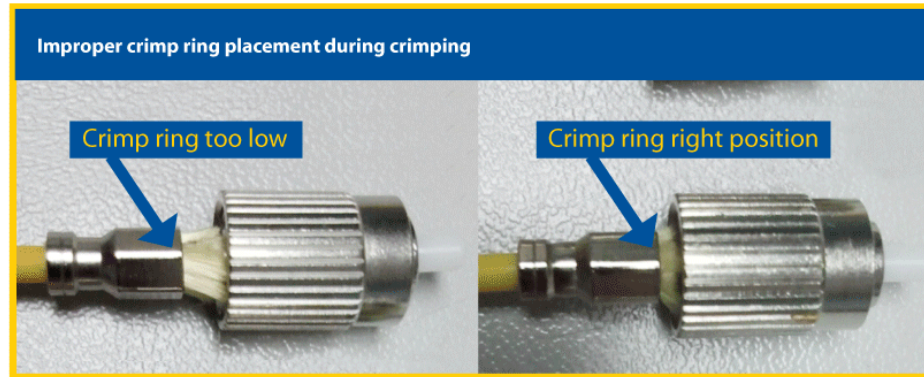
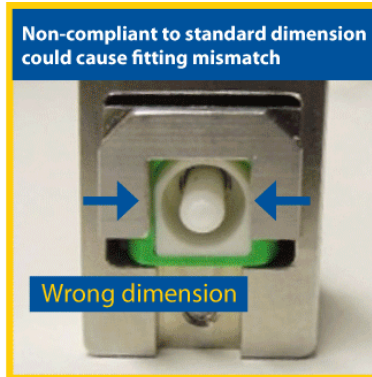


GR 1435 (TPR 9431)
Multi fiber Optical Connectors

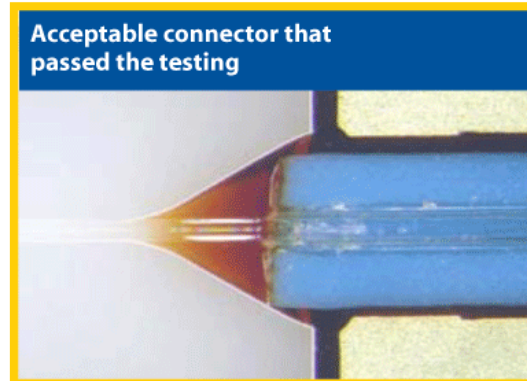
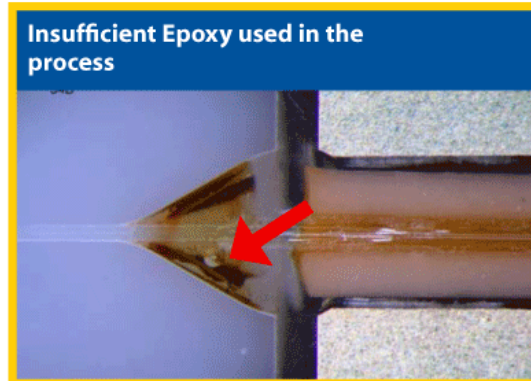
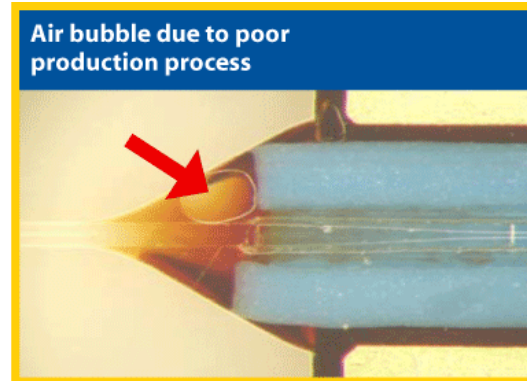
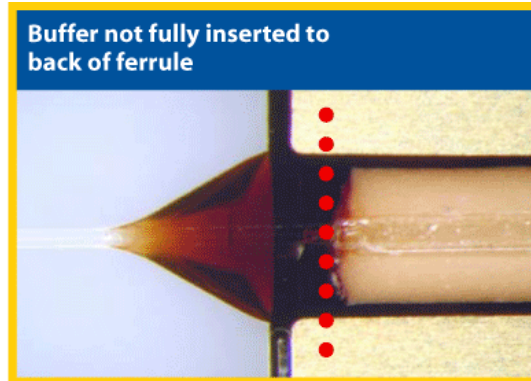
Possible Material Defects



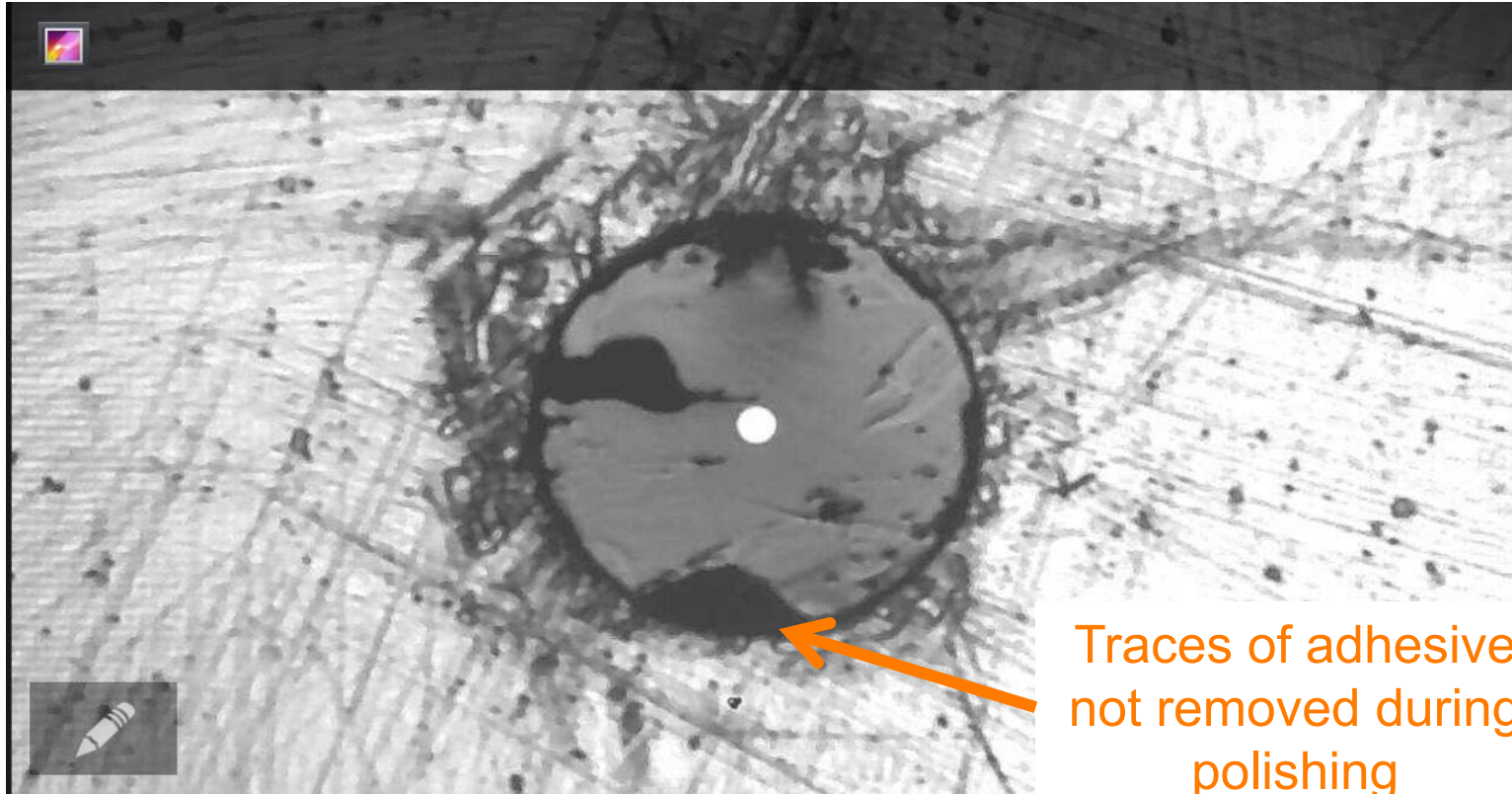
Possible Factory Assembly Defects



Possible Factory Termination Defects



Possible Visual Defects



Traces of adhesive
not removed during
polishing

Possible Installation Mistakes



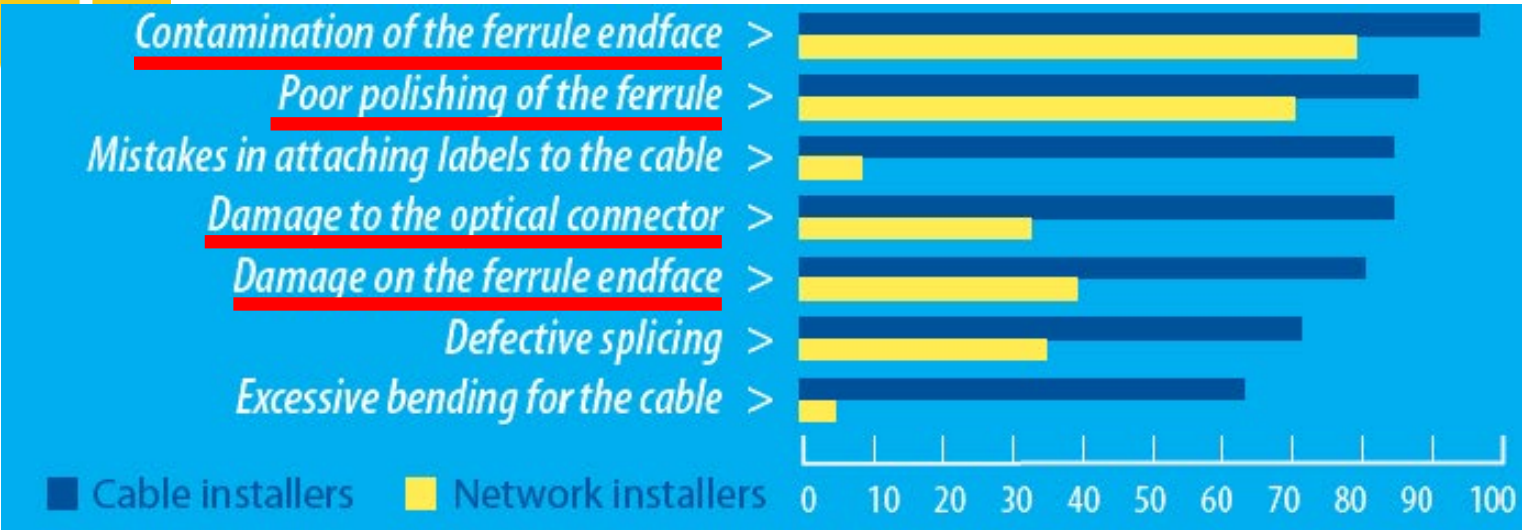
Possible Cable Defects



Cleaning, Inspection, Test & Maintenance



Importance of Maintenance & Cleaning



In a recent study, 98% of installers (blue) and 80% of network owners (yellow) reported that issues with connector contamination was the greatest cause of network failure.

Source of data NTT

- Proper manufacturing
- Proper cleaning
- Proper testing



Clean, Inspect, and Test

- Best Practice Handouts
- Performance Verification Reports
- Standards Compliance Documentation
- Application Based Technical Support
- On-site, Hands-on Training support
- How To Training Videos
- Innovative New Products
- Cost Savings Calculators

YOUR OPTICAL POWER BUDGET #1 ENEMY: ENDFACE CONTAMINATION

REAL WORLD TEST OF CONTAMINATION'S IMPACT ON YOUR OPTICAL POWER BUDGET

Advice On For Getting Optimal Performance In Your Network:

- Always inspect both ends of the connector pair before testing.
- Be proactive and clean away contaminants before mating a connector pair to avoid embedding dirt into ferrule surface.
- Invest on optical cleanliness using quality component including ferrules, connectors, adapters and cabling.



Industry Best Practices Cleaning: LC Fiber Connectors (SCK-SS-125A)

51 Views • Jan 19, 2020

SENKO Advanced Components

Best Practices

Best Practice for Inspect & Clean Multimode MPO Connectors
Featuring SMART PROBE 2 Inspection Scope

This process is applicable to:

- Both MPO connectors residing in an adapter and for unmated trunk cables
- Both male (with guide pins) and female (no guide pins) MPO connectors
- Multiple fiber arrays including **12, 16, 24, 32, 48** and **72** fiber count MPO multimode connectors
- Both 12 fiber array (centered key) and 16 fiber (offset key) MPO connectors

Part Number	Description
SCK-VW3000-01	SENKO SMART PROBE 2 WiFi Inspection Scope
SCK-SPT2-MPO-PC-F	MPO Flat Polish In Adapter Inspection Tip
SCK-SS-MPO	SENKO SMART CLEANER MPO Endface Cleaner (12, 24, 48 & 72 Fiber)
SCK-SS-MPO-2	SENKO SMART CLEANER 16F MPO Endface Cleaner (16 & 32 Fiber)
7777-1	MPO Adapter for 12, 24, 48 and 72 Fiber MPO Connectors (centered key)
7W7-1	MPO Adapter for 16 and 32 Fiber MPO connectors (offset key)

SENKO SMART PROBE 2 WiFi Inspection Scope

MPO Adapter

SENKO SMART CLEANER MPO Endface Cleaner

1 Best Practice for Inspect & Clean Multimode MPO Connectors

Product Overview

Cleaning

Smart Clean



Gel Cleaner

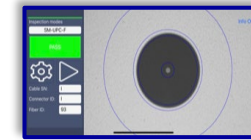


CLETOP / OPTIPOP



Inspection

Smart Probe[™]
for Fiber Inspection



WiFi inspection scope
capable of doing IEC
61300-3-35 surface
analysis

Test tool



Visual Fault Locators
for single fiber and
MT connector



Wide range of light
sources for >12
wavelengths (λ)



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Advanced Components

Growing Together
www.senko.com

