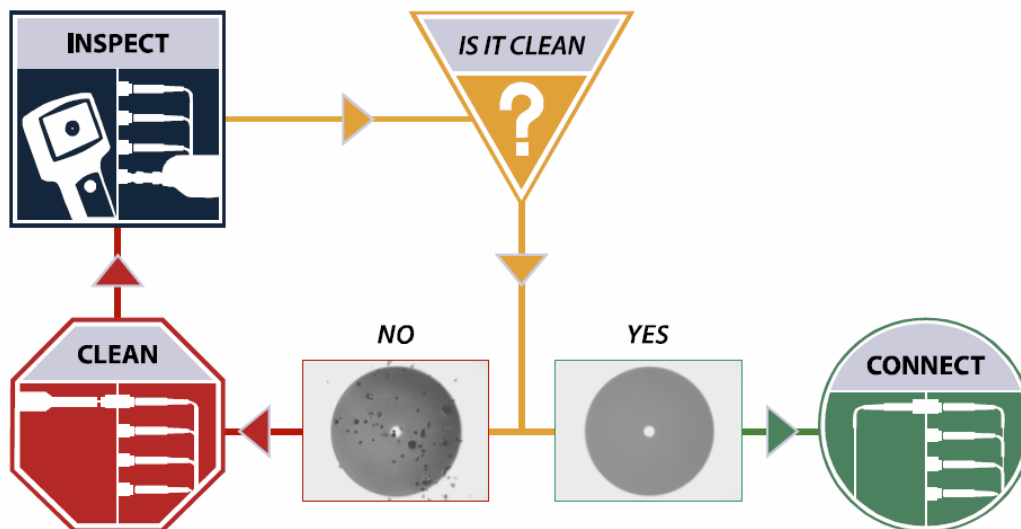


Inspect Before You Connectsm

Follow the simple “**INSPECT BEFORE YOU CONNECT**” process to ensure fiber end faces are clean prior to mating connectors.



Fiber Optic Cleaning and Connecting

When cleaning and connecting fiber optic cables never look directly into the end of the fiber. Power off both the Head End and Remote units while connecting and cleaning. Remember light is also coming from the unit at the other end of the fiber.

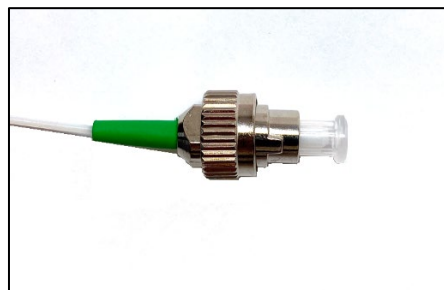
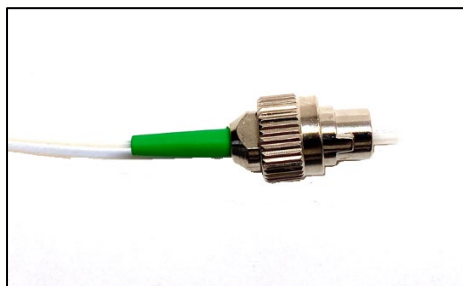
This product is supplied with angle-polished connectors (APC) and these must not be confused with standard flat, spherical, or "super" polished connectors (UPC). These connector types are not interchangeable and mating one with the other will damage both the cable and the equipment.

The specification of the optical connector is critical to the performance of the complete fiber optic link.



Ensure that all mating connectors are matched types. All Optical Zonu RF over Fiber equipment uses APC connectors. All SFP/SFP+ Transceiver modules use UPC connectors.

Minimum Bend Radius of a simplex patch cable is typically 30 mm (1.2 inches). At this radius there will be only a very small increase in loss due to the bend ($\sim 0.05\text{dB}$). A smaller bend radius will increase the optical loss.



Note: fiber will be yellow indicating a single mode fiber but the connector end will be green indicating an angle cut connector (APC).

Only connect SC/APC cable to SC/APC modules, FC/APC cable to FC/APC modules, SC/UPC cable to SC/UPC modules and LC/UPC cable to LC/UPC modules.

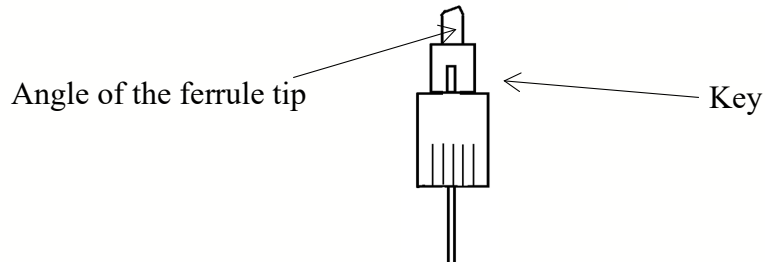
To connect SC/APC, locate the connector key. Align key and keyway then gently push the plug into the adapter until a click is heard and the connector locks. To disconnect SC/APC just pull the “square” collar back. Replace the dust caps on both the receptacle and the cable plug.

To connect FC/APC optical connectors, remove the dust caps and align the white ceramic center ferrule on the cable connector with the mating receptacle. There is a key (lug) on the side of the ferrule, which must match the key (gap) in the receptacle shroud. When they are aligned, gently push the plug home and finger tighten the knurled collet nut onto the threaded receptacle. To disconnect, unscrew the knurled collet on the plug and gently withdraw the plug. Replace the dust caps on both the receptacle and the cable plug. (Keep in mind Minimum Bend Radius of Fiber Optic Cable is 50 mm.)

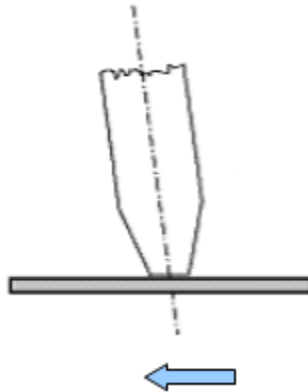


Handling and Cleaning Fiber Optic Connectors

- Optical connectors **MUST** be cleaned before use. Most performance issues are due to dirty fibers. For details read the cleaning instruction which accompanies the connector cleaning kit you use.
- Minimum radius curvature is typically 30 mm (1.2 inches) – make sure fiber is not pinched or sharply bent.
- Always keep the connector with the plastic cover.
- Never touch the fiber tip.
- Optical Zonu RF over Fiber Transceivers use a variety of angle cut optical connectors: SC FC LC/APC. They must mate only with their corresponding connectors and adaptors. The plastic boot color on the cable side of the connector is **GREEN** indicating the connector is angle cut APC.
- Optical Zonu SFP/SFP+ Transceivers use a variety of non-angle-polished optical connectors: SC FC LC/UPC. They must mate only with their corresponding connectors and adaptors. The plastic boot color on the cable side of the connector is **BLUE** indicating the connector is non-angle (or “flat”) polished UPC.
- Always clean both sides of the mating surfaces. For blind connectors use either a special tool OR clean the connector to be inserted very well.
- **Dry cleaning**, no special solutions or cleaner, is the preferred method. Solvents might attack epoxy and some optical cleaners for lenses may leave residues. If a cleaner is used, only reagent-grade 99% **isopropyl alcohol** should be used. Never use cotton **swabs** or cloth, as it will leave threads behind. As a last step, clean and dry the end of the ferrule with a dry lint-free wipe, or surface, before insertion.
- If a tool is used, follow the manufacturer’s direction explicitly.
- If possible, use a “Figure 8” motion and ensure that the tip of the ferrule is always parallel to the cleaning pad.
- The APC **GREEN** connectors are all angle-cut. The angle of the angle-cut connector is very slight. They have a slope of only about 8 degrees. The figure below shows the relation of the key to the angle of the tip.



- Note: If the key to the connector is facing up, then the slope will be as shown above. All APC connectors (SC FC LC) have this trait. High on the right sloping down to the left with the Key as shown.
- If a dispenser like Cletop is used, push the lever down to expose the cleaning surface. Begin by twisting back and forth, and then with the key facing left, pull down.



Key is facing into this diagram.



CLETOP (and others) make dispensers for cleaning cable connectors as is shown below.



Lint Free Wipes: If a handheld lint free wipe is used, using your finger to push the wipe against the end of the ferrule will be adequate.



The simplest way to clean connectors is to use lint free wipes. Dry cleaning is recommended. If 99% **isopropyl alcohol** is used to clean the connector, be sure to use a dry wipe as a final cleaning step. The wipes can be handheld, or the operator can fold the lint free wipes into 4~6 layers, and lay it flat on a table. He then holds the connector “vertically” straight and cleans the end face in figure 8 motion.

F.I.S. has a cleaner whose top surface (not shown) has a lint free wipe which comes from an internal spool.



- Hold the connector between your thumb and forefinger.
- Clean the connector using firm pressure by swiping in a figure 8.
- Do not swipe over the same space twice.

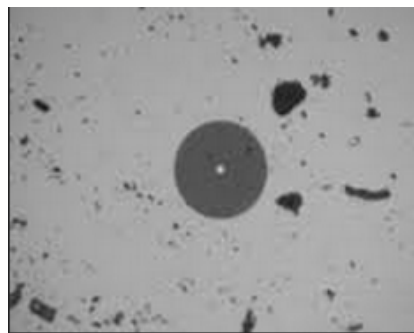
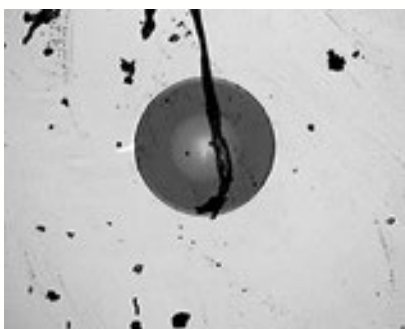
Viewing Optical Connectors

To be sure that the optical connector is clean, there are instruments which allow you to safely examine the end of the connector.



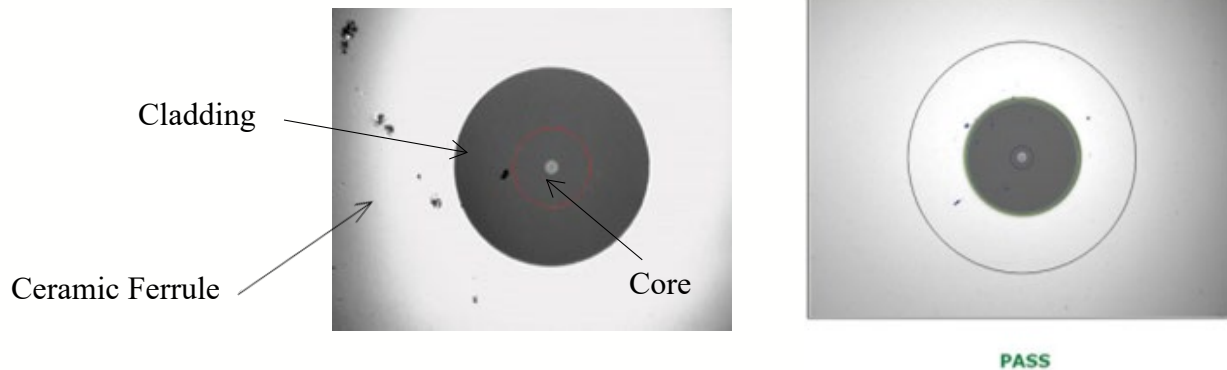
Care must be taken to use the correct APC adaptor with the viewer (note your fiber should have a **GREEN** connector if it is APC; and a **BLUE** connector, if it is UPC). For proper viewing, every connector type requires a different tip which mates with the end of the connector.

Here are two very dirty optical fiber connectors:





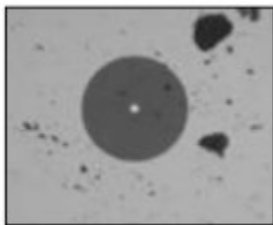
Here are two cleaner connectors:



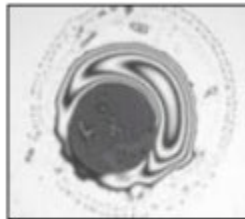
At the center of the connector ferrule is the fiber. It consists of the core surrounded by the cladding. The core carries the majority of the light's power.

It is this region, and the region near the core, which needs to be very clean. The connector on the left has a small black bit of dirt near the core which could compromise the performance slightly.

Bulkhead Connectors



Fiber optic connector with dust



liquid solvent residue



connector with dry residue



There are Instruments to clean the bulkhead connectors without opening the units.

Below shows an instrument to clean SC bulkhead connectors, as well as cleaning sticks, which fit the end of the connector.



However, it is not recommended to use these. Rather, at the head end it is easiest to turn off the power and remove the cover. The SC/APC connectors can be unplugged from the bulkhead connector and cleaned as usual.

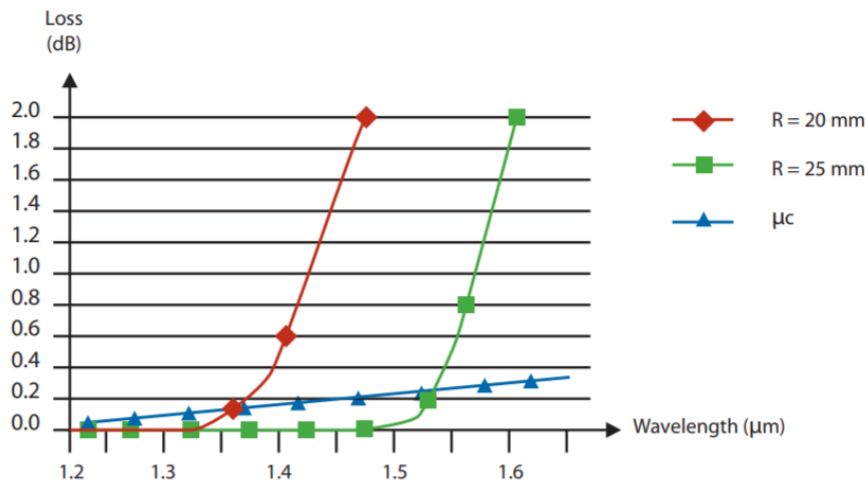
Reminders

- Never touch the end face of an optical fiber connector.
- Always Install dust caps on unplugged fiber connectors.
- Store unused dust caps in a re-sealable bag to prevent dust accumulating.
- Do not re-use optic cleaning swabs or lens paper (lint free wipes).
- Make sure all solvent residues are removed when using a wet cleaning.

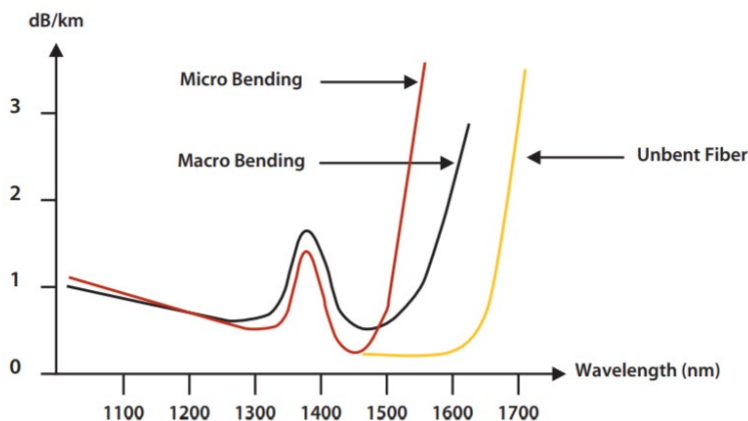
Fiber Insertion Loss Troubleshooting Tip

Micro bending and Macro bends are common problems in installed fiber cable installations, because they can induce signal power losses. During installation if fiber Insertion loss showing a significantly higher Insertion Loss at 1550 than at 1310 it indicates the likely presence of a stress point on the fiber, somewhere in the cable assembly most likely a fiber bend that

exceeds operating bend radius, or a fiber “pinch” or microbend somewhere within the product. The higher the stress (larger the bend), the higher the Insertion Loss @ 1550 compared to 1310.



The effects of micro and macro bending on a fiber



Typical attenuation coefficients for bent and unbent fiber

Appendix – Courtesy of Bicsi®

Also see: <https://www.camplex.com/Portals/0/Documents/Data%20Sheets/BICSI-Ensuring%20Fiber%20Optic%20System%20Performance.pdf>

Fiber Optic Connector



- The **BODY** houses the ferrule to secure the fiber in place.
- The **FERRULE** is a small cylinder used to mount the fiber and acts as the alignment mechanism. The end of the fiber is located at the end of the ferrule.
- The **FIBER** comprises 2 layers: the **CLADDING** and the **CORE**.
 - The **CLADDING** is a glass layer surrounding the core, which prevents the signal in the core from escaping.
 - The **CORE** is the critical center layer of the fiber and the conduit that light passes through.
- Fiber connectors have extremely tight tolerances with the potential to make a low-loss connection. To achieve this potential, they must be handled and mated properly.

Anatomy of Fiber Connectors

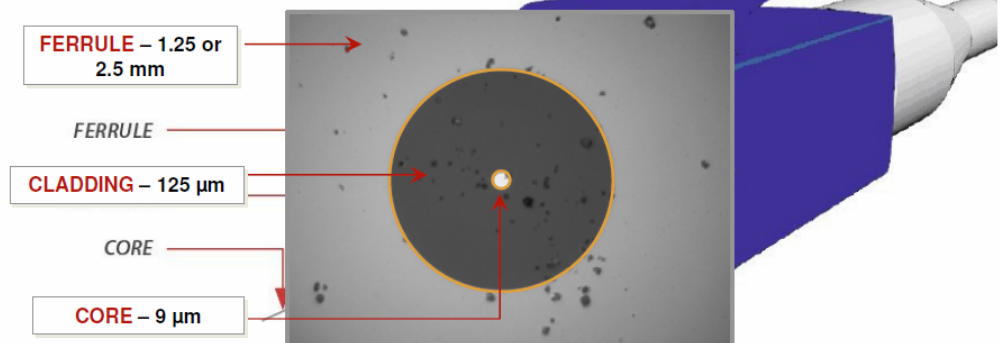
Light is transmitted and retained in the **CORE** of the optical fiber by *total internal reflection*.

The fiber connector endface has 3 major areas – the core, the cladding and the ferrule. Particles closer to the core will have more impact than those farther out.

A

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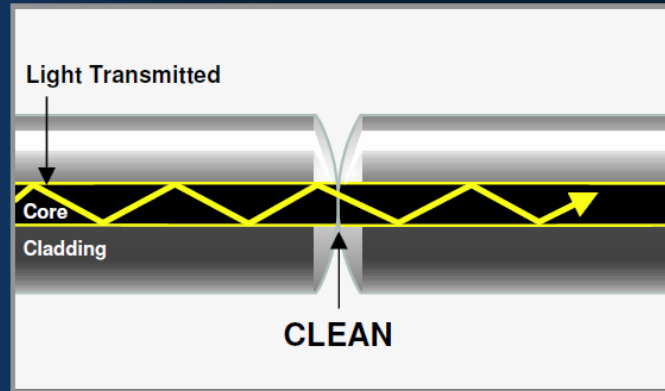
Fiber End Face View



What Makes a GOOD Fiber Connection?

The 3 basic principles that are critical to achieving an efficient fiber optic connection are “The 3 Ps”:

- Perfect Core Alignment
- Physical Contact
- Pristine Connector Interface



Today's connector design and production techniques have eliminated most of the challenges to achieving core alignment and physical contact.

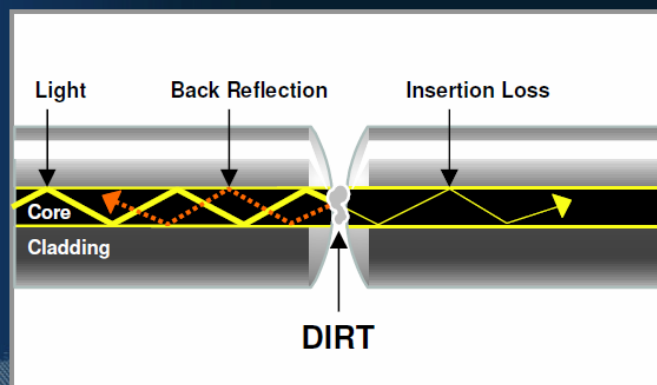
Bicsi

What Makes a BAD Fiber Connection?

Today's connector design and production techniques have eliminated most of the challenges to achieving Core Alignment and Physical Contact.

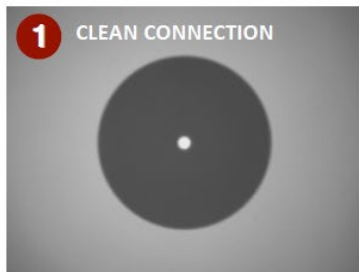
What remains challenging is maintaining a **Pristine End-face**. As a result, **CONTAMINATION** is the #1 source of troubleshooting in optical networks.

- A single particle mated into the core of a fiber can cause significant **back reflection**, **insertion loss** and even **equipment damage**.



Bicsi

Contamination and Signal Performance



Back Reflection = **-67.5 dB**
Total Loss = **0.250 dB**



Back Reflection = **-32.5 dB**
Total Loss = **4.87 dB**

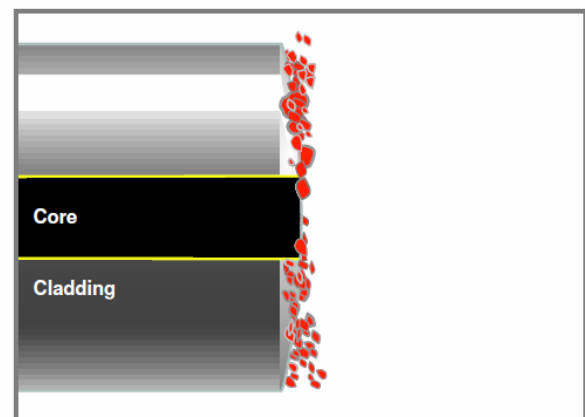
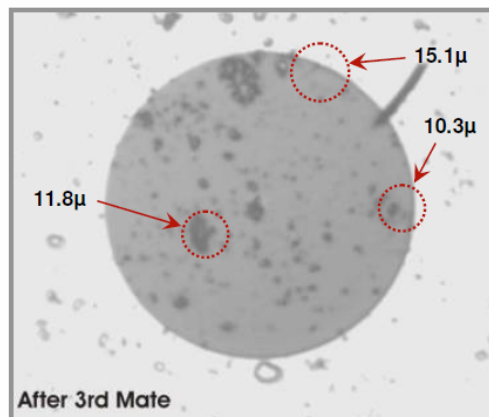
Fiber Contamination and Its Effect on Signal Performance



Clean Connection vs. Dirty Connection

OTDR trace illustration of the significant decrease in signal performance after mating dirty connectors

Illustration of Particle Migration

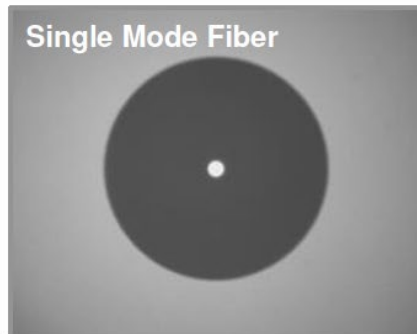


Actual fiber end face images of particle migration

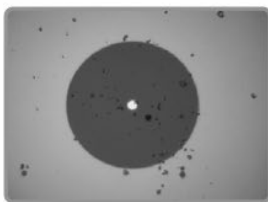
- Each time the connectors are mated, particles around the core are displaced, causing them to migrate and spread across the fiber surface.
- Particles larger than 5μm usually explode and multiply upon mating.
- Large particles can create barriers ("air gaps") that prevent physical contact.
- Particles less than 5μm tend to embed into the fiber surface, creating pits and chips.

Types of Contamination

Fiber end faces **should be free of any contamination or defects**, as shown below:



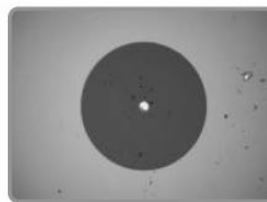
Common types of contamination and defects include the following:



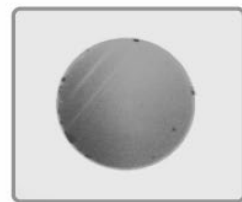
Dirt



Oil



Pits & Chips



Scratches

REMEMBER:

Inspect Before You Connectsm

Follow the simple “**INSPECT BEFORE YOU CONNECT**” process to ensure fiber end faces are clean prior to mating connectors.

