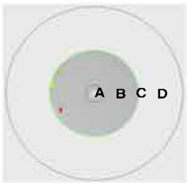
Inspecting & Diagnosing Fiber Optic Connections

1. Visual Inspection Scope

This phase of inspection must be carried out prior to all cable testing. Minor defects or scratches are acceptable while major ones are not. The critical area is the core zone which can tolerate only the smallest of imperfections. Note: most failures are due to lack of proper end-face cleaning while baked-on contamination, scratches / defects require end face re-polishing to restore the end face to passing visual inspection.

1



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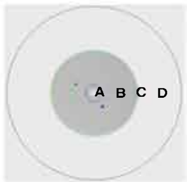


Zone	IEC 61300-3-35 Recommended Acceptance Criteria Multimode Polished Connectors	
	Scratches	**Defects**
Core	No limit ≤ 3 µm None > 3 µm	4 ≤ 5 µm None > 5 µmm
Cladding	No limit ≤ 5 µm None > 5 µm	No limit < 2 µm 5 from 2 µm to 5 µm
Adhesive	No limit	No limit
Contact	No limit	None ≥ 10 µm

There are 3 major ZONES (A/B/D) on the end face that are used to define the level of impact contamination may have on signal performance. Particles closer to Zone A (Core) will have more impact than farther out.

Image 1: Three (3) defects in the cladding zone. Those highlighted in red are over 5 um in diameter causing a failure condition.

Image 2: One (1) fine scratch and two (2) particles that are smaller than 5 um in the cladding zone resulting in an acceptable signal.

⚠ *Always be sure laser sources are turned off before you begin the inspection or cleaning process.*

2. Visual Fault Locator

When cleaning is not the issue, optical continuity can be verified using a Visual Fault Locator. The light used in fiber systems is invisible infrared light (IR) beyond the range of the human eye. By injecting the light from a visible source, such as an LED, laser or incandescent bulb, one can visually trace the fiber from transmitter to receiver to ensure orientation and continuity.

One of the best uses for these devices is to trace fibers for identification or to determine correct connections. To trace fibers using the fiber optic tracer or VFL, connect the fiber to the output connector of the unit. The light output will be visible to the eye at the other end of the fiber.

Continuity test

Break in fiber

⚠ *Always use caution - avoid looking directly at the VFL inspection laser.*

Fiber can pass visible laser light, but still be failing cables or fibers due to signal loss.
In this case, there is a need to measure the loss with a Power Meter or OTDR.

3. Power Meter Testing

The most basic fiber optic measurement is optical power from the end of a fiber. This measurement is the basis for loss measurements as well as the power from a source or presented at a receiver. Power Meter Testing simulates the way the cable will function with an actual link. The test source mimics the transmitter, the power meter the receiver. Results are displayed on a meter readout in "dB." Optical loss is measured in "dB" while optical power is measured in "dBm".

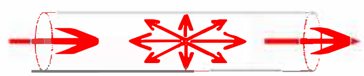
Network Type	Wavelength, nm	Power Range, dBm	Power Range, W
Telecom	1310, 1550	+3 to -45 dBm	50 nW to 2mW
Datacom	650, 850, 1300	0 to -30 dBm	1 to 100uW
CATV, DWDM	1310, 1550	+20 to -6 dBm	250 uW to 10mW

Optical power levels typical of fiber optic communication systems

Know the appropriate power meter light source for your application.
Multimode Fiber - 850 or 1300nm --- Singlemode Fiber - 1310 or 1550 nm.

4. Optical Time-Domain Reflectometer (OTDR)

Unlike sources and power meters which measure the loss of the fiber optic cable directly , the OTDR "sees" individual details such as link lengths as well as the locations and levels of loss and reflectance. In fiber, light is scattered in all directions, including some scattered back toward the source. The OTDR uses this "backscattered light" to make measurements along with reflected light from connectors or cleaved fiber ends. OTDRs are most effective when testing long cables (800+ feet) or runs with splices.



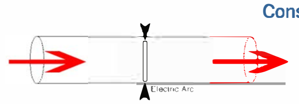
Fiber optic signal path demonstrating (Rayleigh backscatter) or light reflected back from points along the fiber. The OTDR uses this as the basis for measurement.

For most users, factory repair is the best option.
However, depending on the level of experience with fiber, technical competency, and available equipment, accurate testing and quality splices can be made in the field.

1. Fusion Splicing

Pros: Low loss, low back reflection, lower per splice cost

Cons: Requires expensive equipment and skilled technical ability



The small size of the fusion splice and the development of automated fusion-splicing machines have made electric arc fusion (arc fusion) one of the most popular splicing techniques in commercial applications.

2. Mechanical Splicing

Pros: Minimal tooling and technical training required

Cons: Greater loss & back reflection, higher per splice cost

Mechanical splices use an alignment fixture to mate the fibers and either a matching gel or epoxy to minimize back reflection. relying on tight dimensional tolerances in the fibers to minimize loss. Mechanical splices are more commonly used with multimode fiber and for connectorization rather than splicing.

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