

## Fiber Optic Testing

When you're installing a fiber optic network, one of the most important steps in the operation is testing the newly installed and terminated optical fiber cables, to be sure that they're functioning properly. Before the testing and certification of a fiber network can begin, there are a couple of points you'll need to have covered, to ensure that the job is accurately and successfully completed.

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- Be well acquainted with the particular components and configuration of the network you'll be testing.
- Determine which tools and testing equipment you'll need for the job, and know exactly how to use them *before* you arrive at the test site.

There are two basic categories in which typical indoor-plant fiber optic cables are tested: Continuity, and End-to-End Optical Loss.

### **Continuity**

Because a broken fiber within a cable means interrupted data transmission, it's very important to evaluate the *continuity* of cables, in order to find out whether or not any fibers have signal-inhibiting flaws.

In Continuity tests, a pocket-sized, light emitting instrument – known as a **fiber optic tracer** or **visual fault locator** – is attached to each cable's fiber optic connector, and sends light signals into one end of the cable. If the light is detectable at the other end of the cable, that's an indication that the fiber has no breaks in it, and is fit for use. On the other hand, if the far end of the cable is not visibly lit, that's a sign that a break or some other imperfection in the fiber is preventing it from transmitting signals.

Cables aren't the only fiber optic network components to be checked for their transmission ability: **connectors** are put to the test as well. Installers are able to inspect fiber optic connectors with special **microscopes**, making sure that they are smoothly polished and able to provide an effective connection.

## Optical Loss

Optical loss testing enters the equation when it comes time measure the difference between the starting amount of optical power that is sent into a cable's transmitting end, and the amount that actually makes it to the receiving end. In order to evaluate Optical Loss, three types of test equipment are needed: a power meter, a test source, and a reference cable or two.

When measuring end-to-end optical loss, the installation technician begins by connecting the cable being tested to a **reference cable**. Next, a **test source** is used to send a light signal into the transmitting end of the **test cable**, and the amount of optical power that reaches the far end of the attached **reference cable** is measured with a **power meter**. This measurement gives the *optical loss* – or amount of power lost during end-to-end transmission – of the tested cable.



Whether you're installing network cables or testing them, visit [CableOrganizer.com](http://CableOrganizer.com) and check out our incredible inventory of fiber optic supplies. From optical fiber cables by Corning to CertiFiber and SimpliFiber testers from Fluke Networks, we have everything you need to get your fiber optic job done!

## OTDR (Optical Time Domain Reflectometer) Testing

As we mentioned earlier, OTDRs are always used on OSP cables to verify the loss of each splice. But they are also used as troubleshooting tools. Let's look at how an OTDR works and see how it can help testing and troubleshooting.

### How OTDRs Work

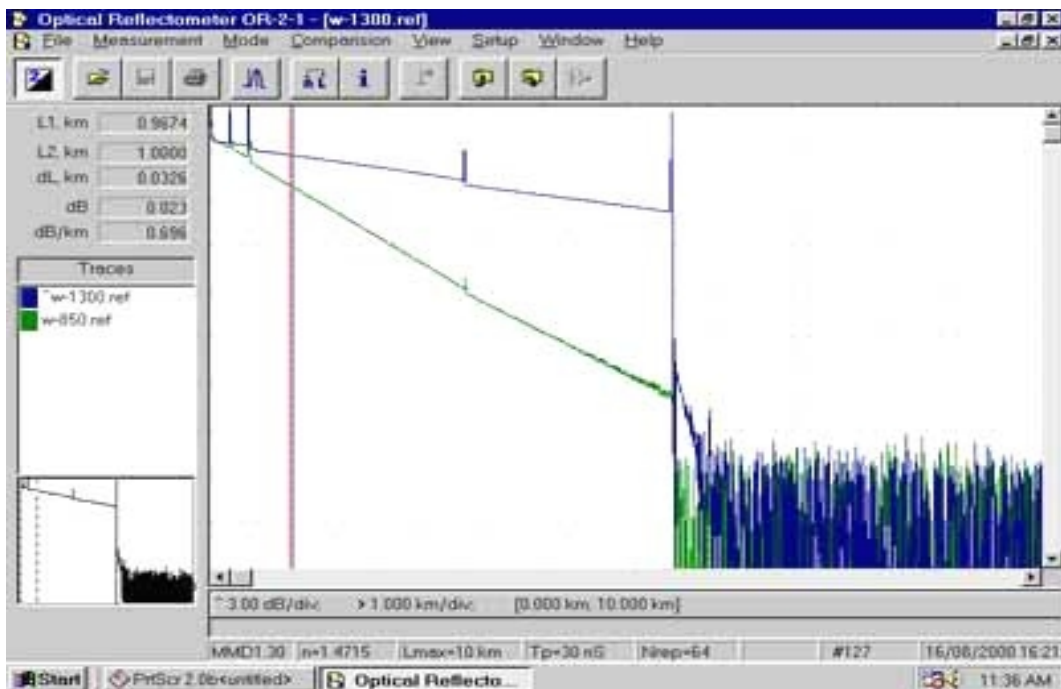
Unlike sources and power meters which measure the loss of the fiber optic cable plant directly, the OTDR works indirectly. The source and meter duplicate the transmitter and receiver of the fiber optic transmission link, so the measurement correlates well with actual system loss.

The OTDR, however, uses backscattered light of the fiber to imply loss. The OTDR works like RADAR, sending a high power laser light pulse down the fiber and looking for return signals from backscattered light in the fiber itself or reflected light from connector or splice interfaces.

At any point in time, the light the OTDR sees is the light scattered from the pulse passing through a region of the fiber. Only a small amount of light is scattered back toward the OTDR, but with sensitive receivers and signal averaging, it is possible to make measurements over relatively long distances. Since it is possible to calibrate the speed of

the pulse as it passes down the fiber, the OTDR can measure time, calculate the pulse position in the fiber and correlate what it sees in backscattered light with an actual location in the fiber. Thus it can create a display of the amount of backscattered light at any point in the fiber.

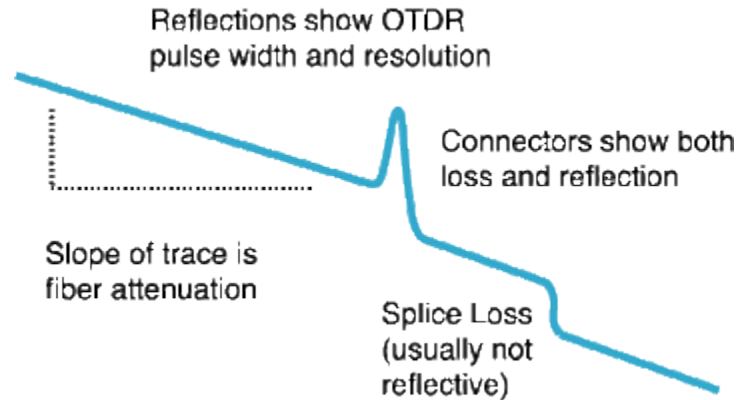
Since the pulse is attenuated in the fiber as it passes along the fiber and suffers loss in connectors and splices, the amount of power in the test pulse decreases as it passes along the fiber in the cable plant under test. Thus the portion of the light being backscattered will be reduced accordingly, producing a picture of the actual loss occurring in the fiber. Some calculations are necessary to convert this information into a display, since the process occurs twice, once going out from the OTDR and once on the return path from the scattering at the test pulse.



There is a lot of information in an OTDR display. The slope of the fiber trace shows the attenuation coefficient of the fiber and is calibrated in dB/km by the OTDR. In order to measure fiber attenuation, you need a fairly long length of fiber with no distortions on either end from the OTDR resolution or overloading due to large reflections. If the fiber looks nonlinear at either end, especially near a reflective event like a connector, avoid that section when measuring loss.

Connectors and splices are called "events" in OTDR jargon. Both should show a loss, but connectors and mechanical splices will also show a reflective peak so you can distinguish them from fusion splices. Also, the height of that peak will indicate the amount of reflection at the event, unless it is so large that it saturates the OTDR receiver. Then peak will have a flat top and tail on the far end, indicating the receiver was overloaded. The

width of the peak shows the distance resolution of the OTDR, or how close it can detect events.



OTDRs can also detect problems in the cable caused during installation. If a fiber is broken, it will show up as the end of the fiber much shorter than the cable or a high loss splice at the wrong place. If excessive stress is placed on the cable due to kinking or too tight a bend radius, it will look like a splice at the wrong location.

### **OTDR Limitations**

The limited distance resolution of the OTDR makes it very hard to use in a LAN or building environment where cables are usually only a few hundred meters long. The OTDR has a great deal of difficulty resolving features in the short cables of a LAN and is likely to show "ghosts" from reflections at connectors, more often than not simply confusing the user.

### **Using The OTDR**

When using an OTDR, there are a few cautions that will make testing easier and more understandable. First always use a long launch cable, which allows the OTDR to settle down after the initial pulse and provides a reference cable for testing the first connector on the cable. Always start with the OTDR set for the shortest pulse width for best resolution and a range at least 2 times the length of the cable you are testing. Make an initial trace and see how you need to change the parameters to get better results.