Fibre Optic Testing

Having had premises fibre network installed and terminated within a commercial building, as the general contractor and/or building owner, you will want assurance that the cabling infrastructure has been properly installed.

So, how do you tell a good fibre link from a bad one? Furthermore, what's the definition of a good fibre? These questions are common in this industry.

General Requirements and Standards

TIA/EIA-568-B.1 “Commercial Building Telecommunications Cabling Standard” rates the quality of a link based on several performance characteristics. This classification or definition of quality, based on the performance characteristics for horizontal, backbone, and centralized applications that are listed in table 1 below is widely accepted throughout the industry. BICSI has adopted this definition and references it in the organization's *Telecommunication Distribution Methods Manual* (TDMM).

Cabling Application	Link Loss Budget (dB)	Wavelength (nm)	Length (m)
Horizontal, MM	≤ 2.0	850 or 1300	≤ 90
Backbone, MM	≤ 3.5/km + 0.75/conn + 0.3/spl	850	≤ 2000
	≤ 1.5/km + 0.75/conn + 0.3/spl	1300	≤ 2000
Backbone, SM	≤ 1.0/km + 0.75/conn + 0.3/spl	1310	≤ 3000
	≤ 1.0/km + 0.75/conn + 0.3/spl	1550	≤ 3000
Centralised, MM	≤ 3.3	850 or 1300	≤ 300

Table 1

Bespoke Solutions

All CASS **fibre installations** are tailored to individual’s current network requirements with expansion and future proofing built in to the overall design. A range of individual high class products are available including all connectors and panels. Within the standard 2.5mm ferrule range **ST** and **SC** type **connectors** and the new small form factor (SFF) **connector** range **LC**, MT-RJ and the SG (VF-45) are used.

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Visual Fault Locator (VFL)

For visual verification and troubleshooting, a visual fibre tracer and a VFL are required. The latter uses a bright red laser that's visible through some cable jackets to pinpoint the location of significant optical events like breaks in the fibre or loss caused by overly tight bends in the cable. However, the faults must occur where the cable is in the open and visual location is possible. You can also use VFLs to verify the integrity of mechanical splices and factory-polished/no-epoxy connectors during termination.

Optical loss test set (OLTS).

This test tool provides a quantitative optical loss measurement using a light source and an optical power meter. The tool directly measures loss by computing the difference between the optical power entering a fibre and the optical power exiting it. This test method can accurately predict actual network loss because it duplicates the transmission path and the wavelength of the active network. Cable and Splicing Services use the EXFO FOT-932 Bi-directional Multimode & Singlemode OLTS which includes a fully featured Optical Power Meter calibrated at four wavelengths & a stabilised Light Source containing a Class 1 laser source and Class 1 LED for both multimode and single-mode fibres. The meter is capable of storing results to speed testing and simplify reporting.

Optical time domain reflector (OTDR).

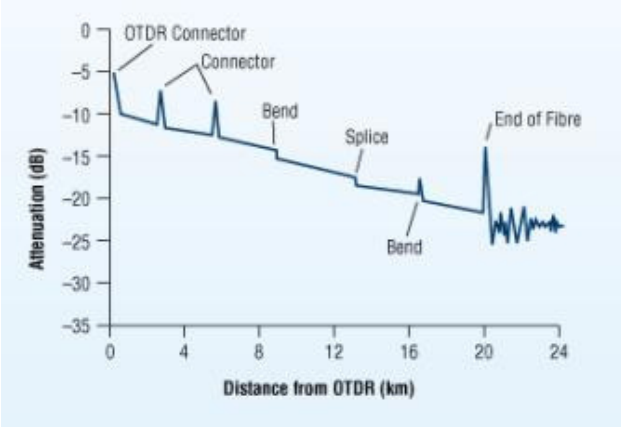
This advanced diagnostic tool for optical fibres allows the Fibre Engineer to take a snapshot of a fibre link. Like optical radar, the OTDR sends short pulses of light down one end of a fibre at a specified repetition rate. Light reflected back from fibre discontinuities and light continuously backscattered from the fibre itself travels back to the OTDR, where the instrument records the optical power and arrival time. The arrival time of the pulse from a given point in the fibre is related to its distance from the OTDR. With this information, the OTDR graphically displays returned power versus distance. OTDRs are well-equipped for troubleshooting problems because they allow you to visually locate reflective events like connections and fibre breaks and nonreflective events like splices and tight bends by studying the graphical “trace.” The power difference between two points on the trace is an estimate of optical loss.

The fibre link test procedure consists of three steps:

- Measure the optical link loss at the appropriate wavelength(s) as dictated by the application and fibre type.
- Measure the link length.
- Compare the results to the link loss budget, which represents the uppermost limit above which a fibre is considered no longer usable.

A typical OTDR trace shows the general attenuation along a fibre and the reflections from various “”events’’. Eventually, either the end of the fibre or the OTDR’s inherent noise level prevents further reflections.

There is one caveat here: the Fibre Engineer must understand OTDR behaviour when making measurements. It must be keep in mind that an OTDR is limited in its ability to resolve two closely spaced features by the width of the transmitted pulse. In other words, two closely spaced events may appear as one. OTDRs also have a dead-zone that limits their ability to locate events near the instrument, which can result in inaccurate length measurements, especially on short lengths found in the horizontal plant. Also, the reported end-to-end cable loss is an estimate based on the assumption that the fibre link's backscatter level is homogenous over its length. This is often incorrect due to manufacturing variations or different fibres on each side of a feature. For this reason, an OTDR end-to-end link loss measurement often differs from that obtained by an OLTS.



Test tools are different.

Premises Local Area Network (LAN) networks differ from their long-haul Wide Area Network (WAN) cousins in several ways. First, multimode fibre dominates in premises applications. Second, premises link lengths are relatively short with few or no splices. Third, optical loss events are closely spaced and the number of terminated links to test is large. For example, it's not unusual for the number of links to exceed 1,000, especially when the installation includes fibre in the horizontal to desktops. For these reasons, the tools you use to test LAN networks will be different from those you use to test WAN networks. But knowing which one to use and when can be a challenge if you don't know what you're looking for.

Attribute	Visual Fault Locator	Optical Loss Test Set	OTDR	
Fibre Tracing	Best	Worse	NA	
Fault Location	Better	Worse	Best	
End-to-End length	NA	Better	Best	
End-to-End link loss	NA	Best	Better	
Splice Loss	NA	NA	Best	

Table 2

Test tools for premises fibre testing.

Whilst there is a choice of troubleshooting and testing tools available, certain types of fibre test equipment are better suited for premises testing. Table 2 gives an overview of their strengths and weaknesses of four fibre testers for different applications..

At CASS, we offer all forms of Fibre Testing, as well as a comprehensive design and installation service, with project management from start to finish. Call us today on +44 (0) 1789 730555 and let us help you get your project started