IDEAL INDUSTRIES, INC.

# Application Note

LED vs. Laser for Testing of Multimode Fiber

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The issue of testing multimode fiber with LED vs. laser light sources has been a debate since the introduction of Gigabit Ethernet in the late 1990's. The common view was that an LED source would always show the worst case loss (higher dB loss) and a laser or VCSEL (Vertical Cavity Surface Emitting Laser) would show lower losses. Lasers made the most sense when testing fiber that was intended to support Gigabit Ethernet since the networking equipment would employ lasers.

An LED typically creates an overfilled launch (OFL) condition, where the core of the fiber and a good portion of the cladding are filled with light. Think of an LED as a flood light. This filling of the fiber creates a condition where bends or misalignment of connectors creates a high loss reading. The thinking is that this is the worst case scenario and it's always better to be on the conservative side when taking measurements. However research showed that field loss measurements were often significantly higher than what networking equipment was actually exposed to.

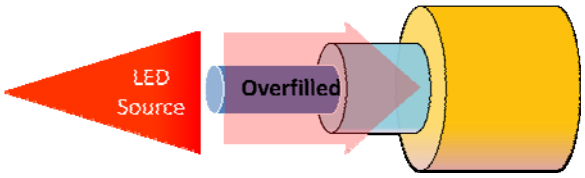


Figure 1: Overfilled Launch condition with LED source

A laser source, especially a VCSEL creates an under filled launch (UFL) condition where only the core, and sometimes not even the whole core is filled with light, think spotlight. This creates a condition where offset fibers and even tight bends create little measureable loss because the beam is going down the very center of the fiber. The scrutiny is comes in when long fibers are tested and show very little loss, because under UFL conditions the loss of the connectors can be greatly under-reported.

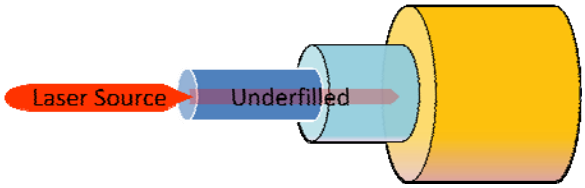


Figure 2: Under-filled launch condition with VCSEL laser

Today, manufacturers of optical fiber are introducing higher grades of multimode fiber to support very high bandwidth and generically these fibers are referred to as *laser optimized*. The purpose of these fibers is to support very high bandwidth signaling compared to early generation multimode fibers. These new fibers are categorized as OM3 and OM4, providing up to 4.7GHz*km of modal bandwidth. The term *laser optimized* leads installers to believe that they must use a laser light source to test this type of fiber. Not so. To get the best indication of actual system loss the preferred method was to use an LED source with mandrels for field testing. A mandrel is a small diameter (about ¾") spool that acts as a "choke" to limit the filling of the fiber from an LED source.

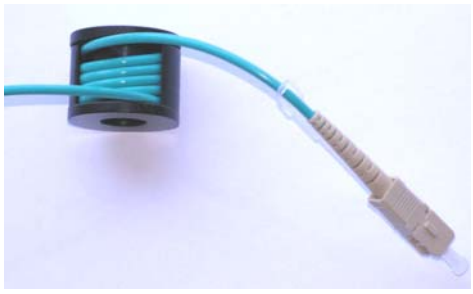

Figure 3: Fiber optic mandrel wrap

To eliminate this confusion, the IEC (International Electrotechnical Commission) embarked on the development of a new

standard to define the proper testing equipment, conditions and procedures for optical fiber. The document number is the IEC 14763-3 and a good portion of it is spent defining the launch condition of light sources used to test optical fiber. In summary, to comply with the standard, a multimode light source, either LED or laser must meet the launch requirements. A light source meeting these requirements can be used to test any type of multimode fiber, eliminating the need for mandrels with LED sources and resolving the under-reporting of link loss with laser sources.

The IDEAL FiberTEK® FDX Multimode LED (Cat# 33-990-FA01) *does* comply with the IEC 14763-3 launch conditions and therefore can be used to test any type of MM fiber. The Multimode Laser version (Cat# 33-990-FA02) *does not* comply with the requirements but can be used to test at the operator's discretion. So why use the laser source at all?


**Figure 4: LanTEK® II with FiberTEK® FDX**

With the adoption of the IEC fiber testing standard, a good LED source should be fine for testing *most* multimode installations. However one must consider the intended application. High bandwidth multimode systems are generally limited to very short distances such as data centers. So the expected loss will usually be less than 3dB. The most limiting factor of an LED light source, especially one compliant to the IEC 14763-3 is that its power output is going to be much lower than that of a laser. This can limit the maximum measurement distance of fiber optic links. They would be fine for applications that fall within the TIA-568 commercial building specifications (2km), but for specialized applications like CCTV over MM fiber the links can be many kilometers long. In those cases a laser source provides much greater power and thus can measure much greater distances, perhaps to 10km or more.

Unique in the industry is the capability of the LanTEK® II with FiberTEK® FDX to test a single fiber in both directions at two wavelengths. This eliminates the need to swap fibers and handsets, resulting in testing times that cannot be beat.


**Figure 5: FiberTEK® FDX bi-directional testing without mandrels**

Compliance with the IEC 14763-3 makes this possible because adding a mandrel at each end would cause the signal to pass through two mandrels, making the test results unreliable.

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