OptoTest

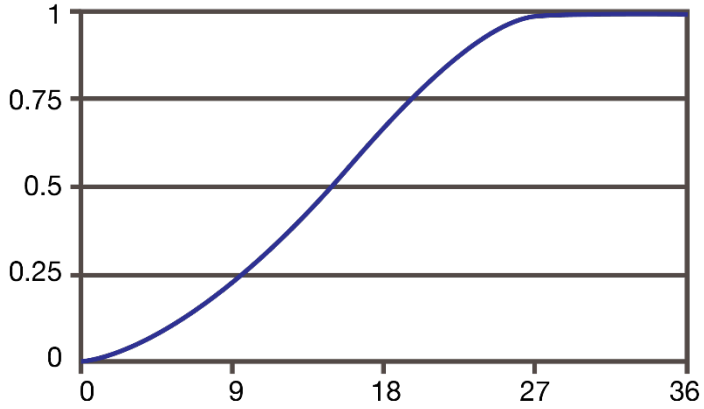
Your Partner in Fiber Optic Test Solutions

Fiber Optic Training Sessions

Launch Conditions for Multimode Testing

March 2019

$$EF(r)=\frac{\int_0^r xI(x)dx}{\int_0^R xI(x)dx}$$



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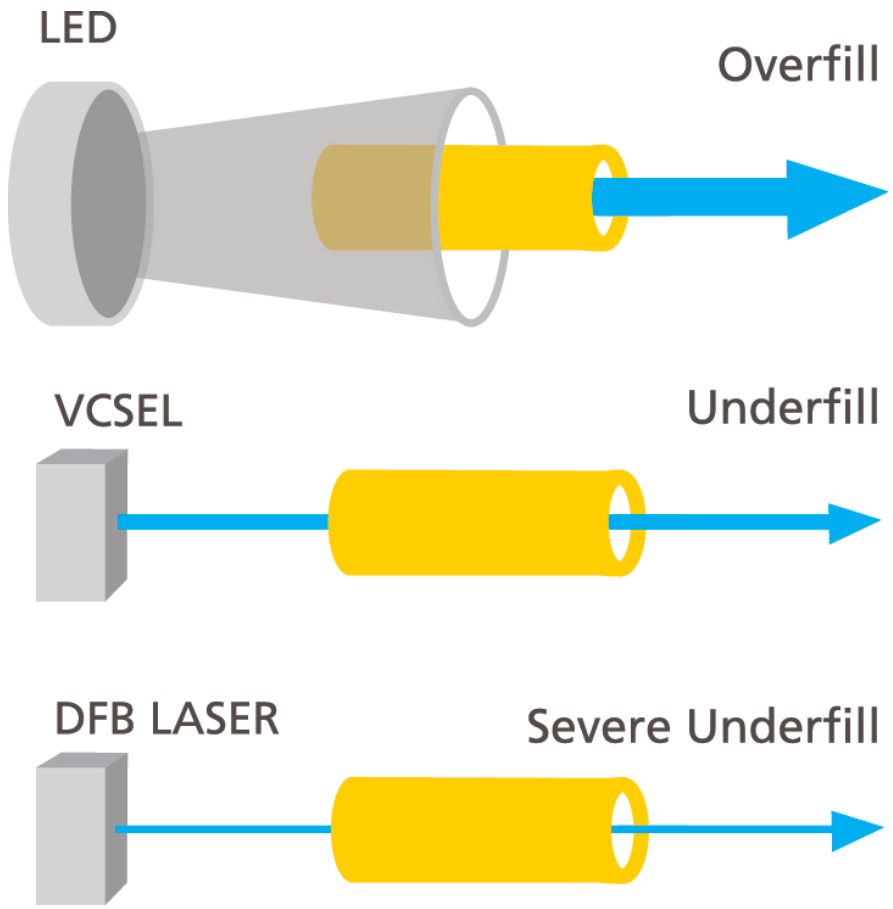
What are Launch Conditions?

- **Launch Condition:** the way a light source fills the fiber it is propagating through.
- Almost all insertion loss (IL) measurements on multimode (MM) fiber are extremely affected by the launch into the reference cable.
- Depending on the launch of the reference cable, the results could be overly optimistic or overly pessimistic in relation to the actual IL of the device under test (DUT) when used in the field.



LEDs & Lasers

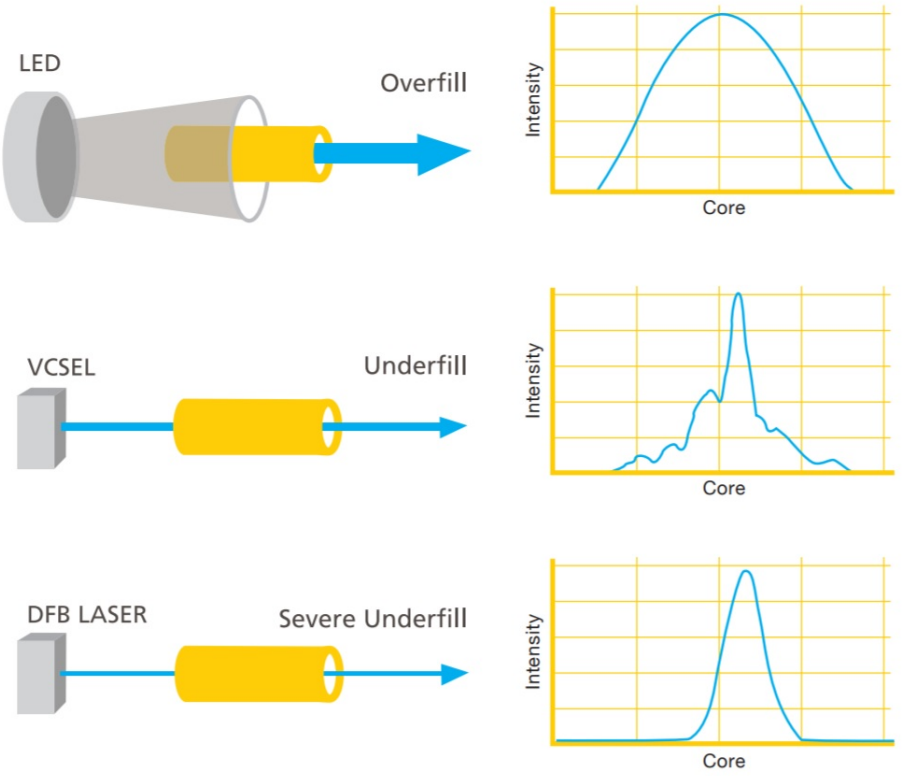
For testing, light sources should be repeatable and test the performance of most of the core.

LEDs

- Typically have a very broad emission cone.
- Often fill both the core and cladding.
- This is bad for testing since it causes otherwise good cables to fail simply because the light at the core/cladding boundary gets attenuated off.

Lasers

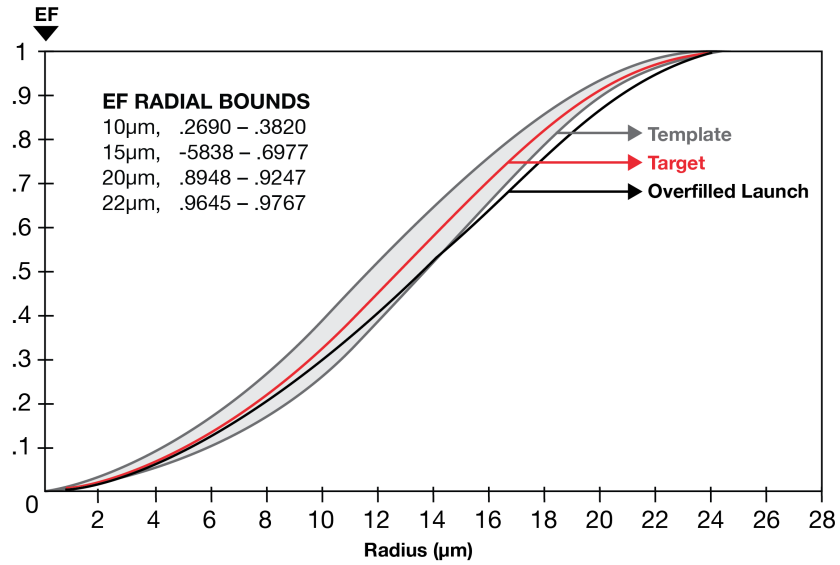
- Don't fill the core of MM fiber and typically propagate unevenly; the light is not always centered in the core.
- This is bad for IL testing since unstable measurements and loss readings only account for part of the fiber rather than the entire core; this can lead to overly optimistic results and cables that pass IL tests in production but fail in the field.



Standards

- Some end-users require that strict and specific launch conditions be met, often requiring documentation as proof.

- To help standardize the requirements of specific industries, their relevant standards bodies often set the launch conditions necessary for testing based on the system requirements that the DUT will be deployed into.



Encircled Flux Requirements per IEC 61280-4-1

- For example, the IEC has set a standard for the launch condition for MM cables under **IEC 61280-4-1**. This condition is known as Encircled Flux (EF). The standard focuses on controlling the distribution of light relative to the distance from the center of the core.

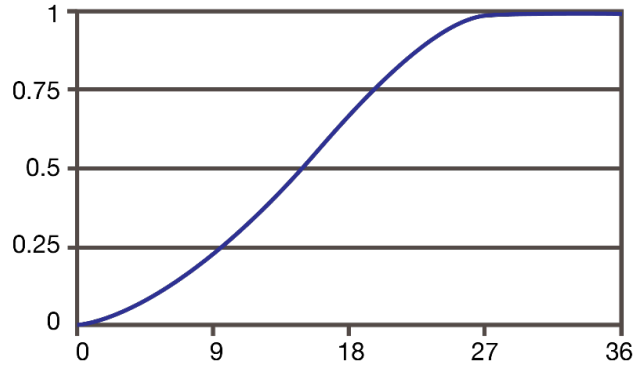
- Certain military, aerospace, and harsh environment standards specify their own launch conditions, such as M80 and 70/70, with requirements based on the NA of the fiber, spot size of the source, and other factors.

Encircled Flux

- Specific launch conditions allow for testing that mimics certain conditions that DUTs may face when deployed in the field.

- EF in particular was developed to mimic the worst case scenario a component would see in the field; not to be confused with the EF launch that applies to transceivers.

$$EF(r)=\frac{\int_0^r xI(x)dx}{\int_0^R xI(x)dx}$$



- A typical test for EF compliance checks the amount of light at five points across the diameter of the core to make sure that it fits within certain bounds.

- Functionally, these bounds create a slight underfill of the multimode fiber, testing a large area of the core without including lossy higher order modes to the outermost edge of the core.

- It also creates reliable results from the time of production which are easily replicated during quality tests by the end user.

Keep in Mind

- The Encircled Flux launch condition standard for testing fiber optic cables is different than the standard of the same name that applies to transceiver launch requirements.

- Launch condition standards for patch cords and other fiber optic assemblies overwhelmingly apply only to the test system used for qualifying insertion loss. Whether the cables themselves maintain a launch condition would not be covered under the same standard. It would typically be a separate requirement that would be explicitly called out by the customer.

- Typically, launch conditions have specific requirements for each wavelength and fiber core size combination and it is important to make sure that the devices you use to verify this can cover the necessary wavelengths, numerical apertures, etc., of the standards that apply. Many launch condition analysis modules are valid only around the 850nm wavelength and will not support the launch condition verification for the full spectrum of light that multimode fibers can carry.

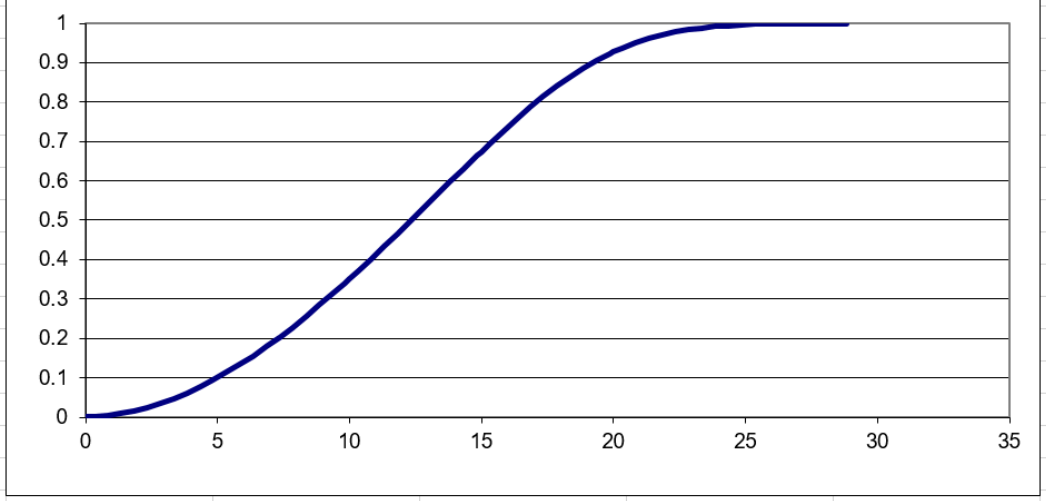
Verifying Compliance to Launch Condition Standards

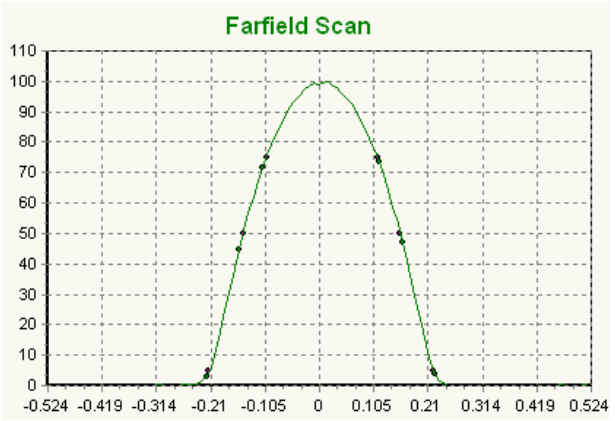
- These graphs and results are generated by the OPL-LCA software that controls the **OP1021 Launch Condition Analyzer**.

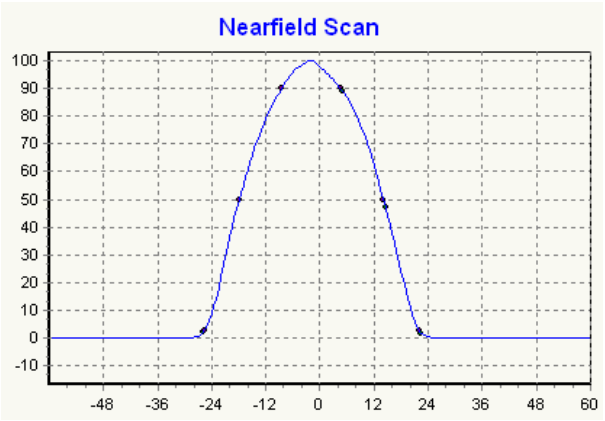
- The OP1021 verifies that light sources adhere to the specific launch conditions they are designed for.

Encircled Flux Analysis

Radial Offset	EF Lower Bound	Target	Actual	EF Upper Bound
10	0.2785	0.335	0.351	0.3915
15	0.598	0.655	0.675	0.7119
20	0.9105	0.9193	0.927	0.9295
22	0.969	0.9751	0.973	0.9812
0	0	0	0	0
0	0	0	0	0

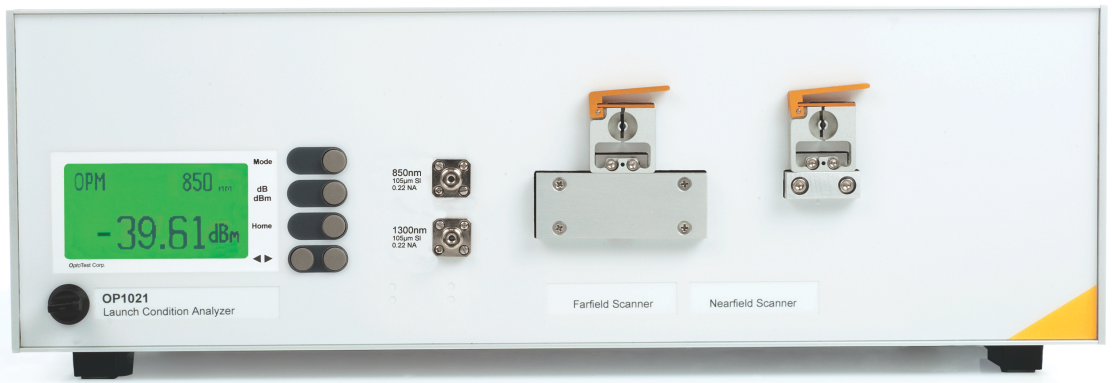






OP1021 Launch Condition Analyzer

The **OP1021** comes with 2 internal sources. These are usually one 850nm LED and one 1300nm LED. Both sources are coupled into a 105/125µm step index fiber to provide an overfilled launch condition into both 50µm and 62.5µm fibers.



Farfield Measurement

- +/- 0.5 radians scan angle
- 0.001rad step size
- measure numerical aperture NA

Nearfield Measurement

- +/- 250 µm scan range
- 0.1 µm step size
- Software computes Encircled Flux
- Auto-align feature to center and focus Nearfield scanner

Overall Features

- Wavelength Independent: measures 850nm to 1625nm
- Farfield and Nearfield analysis in one instrument
- Integrated OPL LCA software
- Directly links to Excel spreadsheet – quick print

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For more details, see our Application Note:

AN-135 Launch Conditions for Multimode Testing

https://www.optotest.com/an-135-launch-conditions-for-multimode-testing/

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