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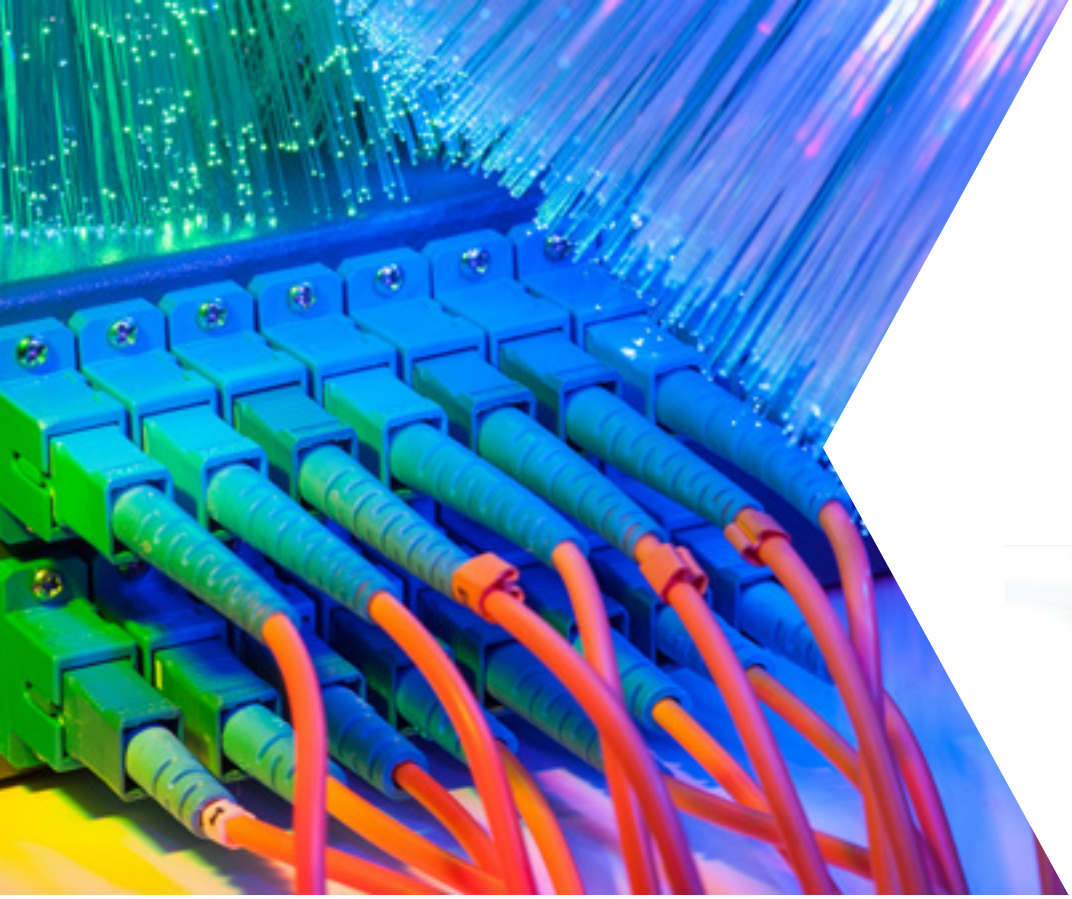
Multimode Measurement Cords

Recommendations for Multimode Link Field Certification

IT Networks



FiberXpert OTDR

1 BACKGROUND

Different Multimode Cable Categories
Multimode cables are at current categorised into 4 different categories: OM1 up to OM4. All categories support transmission of light at 850 and 1300nm, but are different in terms of modal bandwidth, maximum supported length and other optical transmission parameters. The maximum supported length also depends on the required application. A further difference between those categories is the fiber core diameter. OM1 has a core diameter of 62.5µm, OM2, OM3 and 4 have a core diameter of 50µm. The next revision of related international standards will also recognise a new cabling category OM5, which will again have a core diameter of 50µm but will support more wavelengths than OM1 to OM4 in order to increase the maximum possible information throughput.

The presence of today 4 and in future 5 multimode cable categories opens up an interesting question for fiber optic testing:
"Does the cable category of the measurement cord(s) influence the test results?"

With other words, do I get a different result if I use an OM2 or OM4 cord?
The answer is – as often in life - : "Well – it depends…"

Unfortunately, there is no simple "yes" or "no" – it depends on which cabling needs to be tested and which test method, Optical Loss Test Set (OLTS) or Optical Time Domain Reflectometer (OTDR), is used.

The following application note will give you 10 answers in order to help you to perform accurate fiber optic measurements.

2 NORMATIVE REFERENCES

A full page of normative references could be listed here. To cut the story short, only the most 2 relevant standards will be mentioned. On international level, IEC 14763-3 defines test method for testing fiber optic cabling with an OLTS and OTDR. IEC 61280-4-1 defines the properties of light sources used for OLTS measurements on fiber optic cables.

3 CONTRACTUAL SPECIFICATIONS

One aspect overrules all other considerations on measurement cords: contractual specifications.
To successfully deliver a cabling project, the contractor must fulfil the contractual specifications. If those include specification for measurement cords, those must be used for testing. If those specifications seem incorrect or incomplete, the contractor should raise those concerns with the client and clarify questions before starting fiber certification.

4 GENERAL RECOMMENDATIONS

Cleanliness
Before connecting ANY fiber to a fiber optic measurement device, it is highly recommended to ensure that the connectors of measurement cords are clean. Softing recommends to use video inspection probes such as the Softing video microscope that can pass/fail connectors to international IEC standards and appropriate fiber optic cleaning products. The user also needs to be aware that the tip of the measurement cord that will be connected to the link also needs to be clean in order to a) achieve an accurate measurement and b) not do distribute dirt on all links under test. Modern microscopes like the Softing video microscope 226539 even offer pass/fail inspection according to IEC standards.

WireXpert with
Encircled Flux Multimode Adapter

Always use measurement cords with reference connectors

***1st answer:** Regardless of connectors, fiber categories and measurement type, always ensure – preferably with a video inspection microscope - that your measurement cords and device ports are clean BEFORE making a fiber optic connection. Always use professional cleaning tools.*

Connectors
Regardless of optical category, connector style, measurement type or standard, a word of caution needs to be said about connectors. Standards recognise “random” and “reference” connectors. “Random” connectors have a much wider allowance in optical parameters tolerances than “reference” connectors. IEC 14763-3 specifies the use of “reference” connectors for testing. It must be ensured that measurement cords with reference connectors are used for testing, otherwise the tolerances solely due to the variances in connector attenuation can be in the range or even bigger than the attenuation budget of the link under test. (Example: A multimode connection with random connectors can have up to 0.75dB attenuation. A connection with reference connectors can only have up to 0.1dB) The connector attenuation is influenced by parameters like core concentricity and connector surface quality and shape. Reference connectors feature much tighter specifications for those parameters and are fully tested against those parameters.

***2nd answer:** Always use measurement cords with reference connectors.*

5 OLTS – TIER 1

Measurement Principle
An OLTS measures the overall attenuation of a fiber optic cabling using a light source on one side of the link and an optical power meter on the other side of the link. This method is also known as “Tier 1” measurement.
In this method, short measurement cords with a typical length of 2 meters are used for testing. Depending on the required test setup, 1 cord connected to the light source, or 2 cords (1 at light source, the other at the power meter) are used.
More sophisticated test sets such as the WireXpert 4500 can run that test on 2 wavelengths, support bidirectional testing and additionally measure the length of the link under test.

Core Diameter
The core diameter of measurement cords has a dramatic influence on the measurement results. If the OLTS was referenced (field calibration to the measurement cords used for testing) using 62.5µm measurement cords (OM1) , but an OM3 or 4 cabling with 50µm needs to be tested, the operator will notice substantial attenuation solely due to the core mismatch.
Vice versa, if the OLTS was referenced using 50µm measurement cords, but a 62.5µm cabling needs to be tested, the OLTS is “blind” for events (e.g. dirt on the connectors) that are in the circumference between 50 and 62.5µm.

***3rd answer:** Yes - the core diameter matters – always ensure that you use the correct core diameter for testing!*

Bend Insensitive Cords and Encircled Flux (EF) Compliant Testing
Bend Insensitive Multi Mode Fibers (BIMMF) are very nice for fiber optic transmission since those fibers feature very small bending radii and suffer less attenuation due to bending.

It does not matter for an OLTS, if OM3 or OM4 measurement cords are used for testing OM3 or OM4 links

However, those fiber types have an unwanted effect on EF compliant testing. (EF) is specified in IEC 61280-4-1 and basically defines the properties of the light source used for testing. In Multimode, many light modes travel through the fiber core. EF specifies the allowed power distribution of all those modes. BIMMF fibers can change the distribution of modes if the fiber is bend, and therefore change the power distribution of the modes.
What has this to do with measurement cords?
If EF compliant testing is required, the measurement cord must not alter the above modes of light that travels through the cords to ensure that EF compliant light will enter the link under test.
Not all fiber optic patch cords on the market can guarantee that since for normal fiber patching, EF compliance is not relevant.

***4th answer:** If EF compliance is required, ensure that the measurement cables are not made of BIMMF fibers, but are suitable for EF compliant testing.*

OM3 or OM4 – Does it Matter for an OLTS?
The difference between OM3 and OM4 fibers is the modal bandwidth, which basically describes how much information the fiber can transmit over a certain length. With less attenuation and better differential modal dispersion (DMD), an OM4 fiber can transmit more information over a longer distance than lower category fibers. On a longer multimode fiber link, DMD “blurs” a short pulse (e.g. pulses of an Ethernet frame) into a wider “smeared” pulse because outer modes take longer to travel through the fiber than inner modes. Since an OLTS measures with continuous light, this “blurring” is not relevant.Furthermore, the attenuation of the measurement cords is not included in the measurement since the OLTS has been referenced to the cords prior to measurement, so the potential difference in attenuation of an OM3 or 4 fiber also does not matter.

***5rd answer:** It does not matter for an OLTS, if OM3 or OM4 measurement cords are used for testing OM3 or OM4 links.*

What about OM5?
OM5 will use additional wavelength for parallel transmission of information. Those new wavelengths will be between the classical 850 and 1300nm. Since the attenuation curve of a OM5 fiber between 850 and 1300nm is fairly linear, international standards will only require testing on the classical wavelength 850 and 1300nm. Same above considerations regarding EF and modal bandwidth etc. will also apply to OM5 fibers.

***6th answer:** It does not matter as such for an OLTS if OM3, 4 or 5 measurement cords are used for testing OM5 links, but do take into account the prior answers and below summary as well!*

Mode Conditioning Patch Cord and EF Compliance
Mode conditioning patch cords are helpful with some Ethernet applications but cannot be used for EF compliant testing and must not be confused with EF compliant measurement cords. Mode conditioning cords do not turn a non EF compliant light source into a EF compliant device.

***7th answer:** If EF compliance is required, do not use mode conditioning cords but use EF compliant measurement cords or EF compliant light sources*

Summary:
The fiber category by itself is not sufficient to decide if a cord can be used as a measurement cord. With the answers above, you can

Always use launch and tail cords with reference grade connectors

see that of the shelf patch cables should not be used for OLTS measurements. Softing highly recommends to use proper measurement cables in order to achieve accurate measurement results.

6 OTDR – TIER 2

An OTDR measurement is a single sided measurement. The OTDR sends sharp light pulses into the link under test and measures on the same port reflections that come back from that fiber. OTDRs are capable of measuring very small events (e.g connectors, splices, macro and micro bends) along the fiber and also give accurate information on the location of that event along the fiber.
An OTDR uses a "launch cord" to connect to the link under test. If the last connector of the link also has to be measured accurately, a "tail cord" needs to be connected to that end of the link as well.

Due to the fact that the light source sends powerful and sharp pulses and uses a very sensitive receiver on the same measurement port, other effects that do not matter at OLTS tests now have to be taken into account.

Launch and Tail Cord Length
Since OTDRs send and receive on the same port, launch and tail cords of an OTDR have to be substantially longer than an OLTS measurement cords. The additional length is necessary to give the receiver enough time to settle after the transmitter has sent a pulse. When the transmitter sends a pulse, the receiver is completely saturated (=blind) for a certain time and is not able to measure. The time the receive is "blind" equals a certain fiber length. Typically, the launch cord is substantially longer than the minimum required length in order to avoid any issues.

***8th answer:** Independent from the cable category, make sure that the measurement cord length is sufficiently long. See specification of the respective tester for details. Do not use measurement cords that are shorter than recommended. Note that some standards demand to use launch and tail cords with different lengths.*

Cable Category
Since OTDRs measure events along the fiber, a mismatch in fiber types can be detected by an OTDR. If that mismatch happens between the launch cable and the link under test, that mismatch could influence the result of the first connector of the link under test.

***9th answer:** It is recommended to use the same fiber category for launch and tail cords as for the link under test in order to minimize potential effects caused by fiber mismatches at the first and last connector of the link under test.*

Connectors
Same as in OLTS measurements –see above answer #2 – the use of reference connectors is very important for OTDR measurements. in order to accurately measure the first connector of the link under test, reference grade connectors are essential to limit tolerances caused by the launch cable connector.

***10th answer:** Always use launch and tail cords with reference grade connectors.*

Summary:
Same as in OLTS measurements, a regular of the shelf patch cable should not be used for measurements. Always ensure to use proper measurement launch and tail cords in order to achieve accurate measurements.

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Rev. 2018_03_EMEA

About Softing IT Networks.

Founded in 2003 as Psiber Data, and as a sister company of Psiber Data Systems Inc. USA, Psiber was acquired by Softing AG in January 2014.

Softing AG is a publicly traded Germany company, specializing in software developed for industrial and automation, automotive electronics and manufacturing, as well as hardware/ software solutions for IT Network solutions. The company was founded in 1979 and its headquarters are in Haar, near Munich. In fiscal 2015, Softing employed 429 employees and had a turnover of 82 million euros.

The competencies of Softing IT Networks are complemented by the Softing Industrial division's expertise in networking industrial worlds and Softing Automotive's expertise in evaluating the functionality of electronic vehicle components.

Competencies & specilization

Softing IT Networks specializes in measurement equipment for testing, qualifying, certifying and documenting the performance of copper and fiber-optic IT cabling based on global technological standards.

Whether it is used for telecommunications, databases, mainframes or plant engineering in the field of industrial automation, the professional measurement equipment from Softing IT Networks will help you optimize the performance of your data communication through faster, more secure connections over the entire lifecycle of your network.

With the rapidly growing and all-encompassing networking of people, things and services (Internet of Everything/IoE), powerful and reliable IT networks have already become the backbone of our modern world.

The failure of such networking infrastructure can lead to data loss and is almost always very costly. This is why it is so important to prevent unplanned network outages. To make this possible and ensure a rapid response in the event of network faults, installers, system integrators and network operators, need access to powerful and professional measurement equipment.

Our measurement equipment makes it possible to ensure the physical efficiency and high quality of communication between network components.

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