

Fiber Certification Basics: What MDU Owners Need to Know

No one wants fiber-to-the-home to repeat coax's astoundingly poor reliability record. Here's how testing works to minimize chances of that happening. We concentrate on the needs of property owners, developers, and managers.

By Varis C. Hicks and Vincent Racine ■ EXFO

Before you commission a network, it is vital that you have it certified as ready, and as meeting all applicable standards. Fiber certification ensures that the fiber was properly installed and is within specifications prior to commissioning the network – providing customers the quality of service (QoS) they need.

Fiber certification by testing to industry standards protects both the installer and the client. The process has been evolving, and new test equipment makes it easy – easier in many respects than certification for copper wiring.

Certification should be part of the contract for any network build. This article explains the process for property owners and network managers buying certification services. It also has enough detail for technicians and installers to follow – especially those who are just moving into fiber.

MAJOR INDUSTRY STANDARDS

Enterprise certification is done in accordance with standards that regulate total link loss, as well as total fiber length from central office or local point-of-presence to the user. Failing to respect one of these criteria will have a direct impact on the QoS delivered to the cus-

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tomers. The tables list the major industry standards that are currently adhered to.



AXS-200/360 test set device.

EXFO'S FIBER CERTIFICATION TEST SET

At first glance it seems overwhelming. But test equipment vendors have found ways to handle multiple certification tasks with a few basic, rugged instruments. EXFO's latest is the AXS-200/360 Fiber Certification Test Set.

Instruments such as this are ideal for enterprise-network installers and contractors. This one supports all applicable industry standards, including 10 Gigabit Ethernet. The bright color display – usable outdoors – gives straightforward, automated test results.

The AXS-200/360 also comes with a step-by-step fiber loss “wizard” that guides the user through all the steps required to perform a proper fiber certi-

Wavelength	Loss	Saved Data Loss	P/F
850 nm	0.65 dB	0.63 dB	✓
1300 nm	0.72 dB	0.71 dB	✓

Margin = 0.25 dB Pass ✓

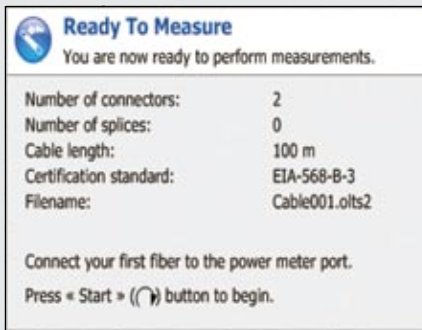
Wavelength: 1300nm VFL: OFF

Save Prev. Fiber Next Fiber

Loss certification screen.



Loss certification wizard screen.



Ready-to-measure screen.

fication according to a preprogrammed standard, while automatically calculating the appropriate pass/fail thresholds

– greatly reducing operator errors and test time and increasing productivity in the field and at the office.

NETWORK STANDARDS LIMITS						
	Maximum Insertion Loss (dB)					
	50/125		62.5/125		SMF	
	850	1300	850	1300	1310	1550
10GBASE-LX4	---	2	---	2	6.2	---
10GBASE-ER/EW	---	---	---	---	---	10.9
10GBASE-SR/SOFTWARE	---	---	1.6	---	---	---
10GBASE-LR/LW	---	---	---	---	6.2	---
1000BASE-SX	6.8	---	12.5	---	---	---
1000BASE-Ease-LX	---	2.35	---	2.35	4.56	---
100BASE-Ease-FX	---	6	---	11	---	---
10BASE-Ease-FB	6.8	---	12.5	---	---	---
10BASE-Ease-FL	6.8	---	12.5	---	---	---
FDDI PMD	---	6	---	11	---	---
FDDI SMF-PMD	---	---	---	---	10	---
ATM-155	7.2	5.3	7.2	10	7	---
ATM-622	4	2	4	6	7	---
Token Ring 4 and 16 Mbps	8	---	13	---	---	---
Fibre Channel 1062 Mbps	4	---	4	---	6	---
	Maximum Fiber Length (meters)					
	50/125		62.5/125		SMF	
	850	1300	850	1300	1310	1550
10GBASE-LX4	---	---	---	---	10000	---
10GBASE-ER/EW	---	---	---	---	---	40000
10GBASE-SR/SW	---	---	33	---	---	---
10GBASE-LR/LW	---	---	---	---	10000	---
1000Base-SX	550	---	275	---	---	---
1000Base-LX	---	550	---	550	2000	---
100Base-FX	---	2000	---	2000	---	---
10Base-FB	1514	---	2000	---	---	---
10Base-FL	1514	---	2000	---	---	---
FDDI PMD	---	2000	---	2000	---	---
FDDI SMF-PMD	---	---	---	---	2000	---
ATM-155	1000	2000	1000	2000	2000	---
ATM-622	300	330	300	500	200	---
Token Ring 4 & 16 Mbps	1857	---	2000	---	---	---
Fiber Channel 1062 Mbps	500	---	300	---	2000	---

With very limited knowledge and training in fiber optics and with limited knowledge of the standards, the user may easily and quickly perform fiber network certification. This does not necessarily mean that contractors can be “chosen off the street” to handle certification, but it does mean that the talent pool is already quite large, keeping certification costs fairly low, and assuring that the tasks involved can be done quickly. That’s a key need in the construction cycle. Builders want to start closing walls as soon as the fiber is installed and tested.

On the latest test equipment, such as this model from EXFO, an intuitive graphical user interface guides the user through the fiber certification process.

Test equipment is expensive, and network builders always want to make sure the certifying technicians are using the latest versions, because test requirements change as fiber evolves. Test equipment vendors have risen to the challenge with devices that evolve right along with the needs.

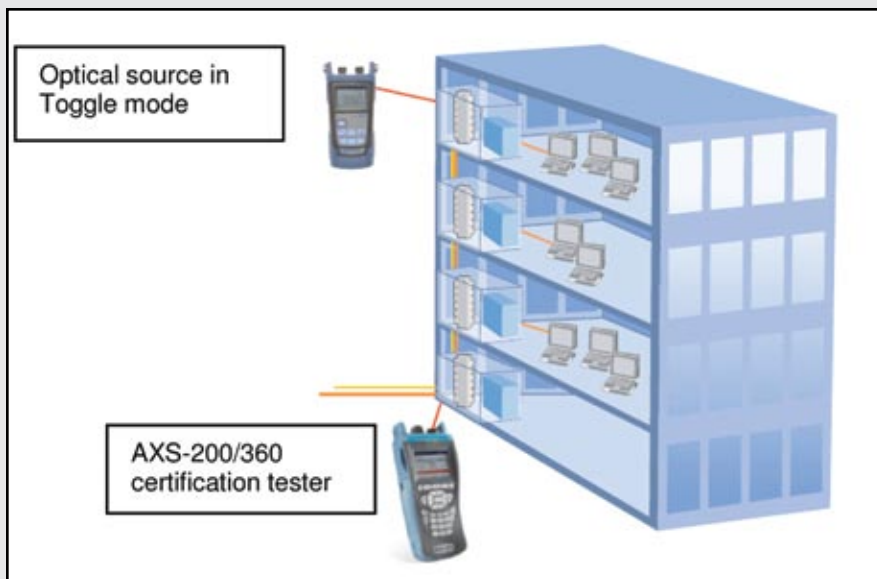
For instance, the AXS-200/360 Fiber Certification Test Set is built on the AXS-200 Handheld Modular Platform, which offers many advantages, including:

- Future-proof modularity
- Wide, easy-to-read color display
- Large internal and external data storage
- Windows CE
- Multilingual support (English, French, German, Spanish, Russian, and Simplified Chinese)
- On-screen help.

TESTING IN THE FIELD

The AXS-200/360 test kit includes a certification power meter and a stand-alone, fiber optic light source.

- The operator sets the optical source at one end of the network, and the optical source will be set in Toggle mode, which alternates between both test wavelengths (850/1300 nm for multimode fiber and 1310/1550nm for single-mode). For a simple explanation



EXFO AXS-200/360 in the LAN network.

of fiber types, see the glossary in this issue.

- At the other end of the network, the AXS-200/360 automatically synchronizes with the light source and performs a dual wavelength insertion loss (IL) measurement in a matter of seconds.
- At the end of the certification test, all the results are displayed on a single screen with the pass/fail status clearly indicated.

THE IMPORTANCE OF THE LIGHT SOURCE LAUNCHING CONDITION WHEN CERTIFYING MULTIMODE FIBER LINK

As more and more multimode 62.5/125 μm and 50/125 μm laser-optimized fiber is installed, an area that remains widely overlooked is the multimode launching condition. Testing this type of fiber accurately requires a light source that has controlled launching conditions – ways of getting light into the fiber. This type of light source ensures accuracy, reproducibility and consistent loss readings.

The type of light source used for multimode fiber link certification and

the way it is coupled to the fiber greatly impacts launching conditions.

Over the years, many standards have tried to address multimode launching conditions, including:

1. 1-km multimode fiber after over-fill launch (OFL)
2. 70/70 launch (steady-state launch)
3. Mandrel after OFL (coupled-power ratio – CPR – C1, plus mandrel)
4. CPR (class 1 to 5)
5. Specific diameter requirements at 5 percent relative power (RP) on near field (NF) and far field (FF) (70/70 to 95/95)
6. Three diameter requirements at 5 percent, 25 percent and 75 percent RP on NF and FF
7. Mode-power distribution (MPD) template, plus tight CPR (1 dB tolerance)
8. Encircled Flux (EF) template: target with upper and lower limits

It sounds more confusing than it actually is. Number 1 on the list is in standard TIA/EIA-455-50A; number 2 is in TIA/EIA-455-50B; number 3 is in

TIA/EIA-526-14A; numbers 4, 5 and 6 are mainly used by the military; number 7 is in ISO/IEC 14763-3 and number 8 is the latest proposal from IEC 61280-4-1.

The AXS-200/360 offers controlled multimode launching conditions that comply with the latest developments, such as the Encircled Flux standard, providing the most reliable loss measurements. It all comes down to these variables:

Type of Light Source Used

Generally, surface-emitting LED sources overflow the fiber, while edge-emitting light sources (EELS), including both LED and laser sources, have a smaller spot size, numerical aperture and emission, and significantly underfill the fiber.

A vertical-cavity surface-emitting laser (VCSEL) is similar to laser light sources; it underfills the fiber. Generally speaking, certifying fiber link using a light source with too much underfill when testing multimode fiber link attenuation could produce misleading and test results that are overly optimistic.

Also, some connector problems could remain hidden, such as when a connector ferrule is slightly misaligned (this type of problem may not be detected).

On the other hand, using a light source with too much overfill for testing attenuation of a multimode fiber link produces poor repeatability, due to the significant “transient loss” effect.

In addition, using a laser source (or any highly coherent light source) for measuring attenuation of a multimode fiber link involves coherent modal noise, which results in measurements that are unreliable and cannot be repeated.

This is why international standards, such as IEC-61280-4-1, recommend using an LED light source with a mode launch that is neither too overfill nor too underfill, as defined by EF templates for link and channel-loss measurements.

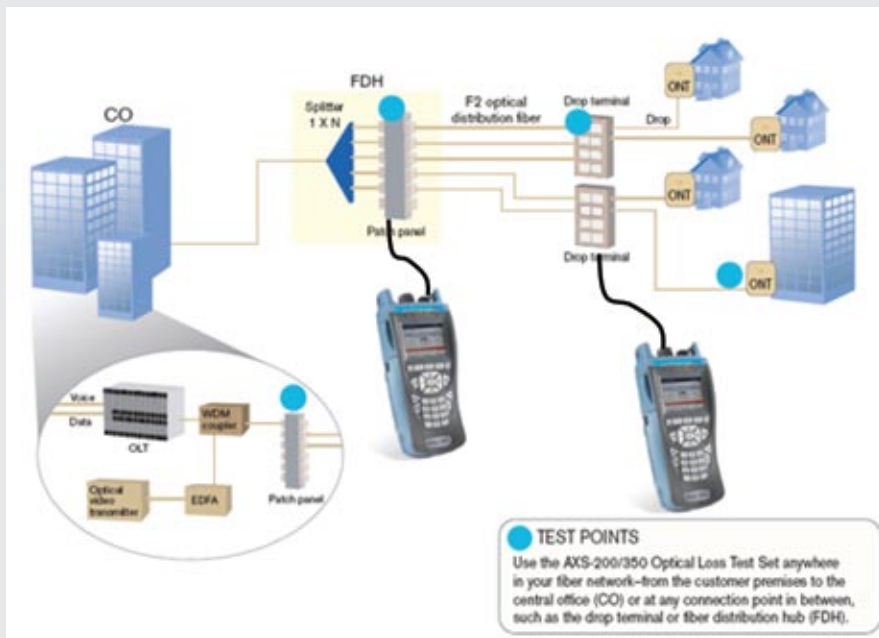
Use of a Mandrel Tool

The next issue that arises when using a LED light source is the use of a mandrel tool. If the LED light source has over-fill launch (OFL) conditions, a mandrel tool of the correct diameter is recommended.

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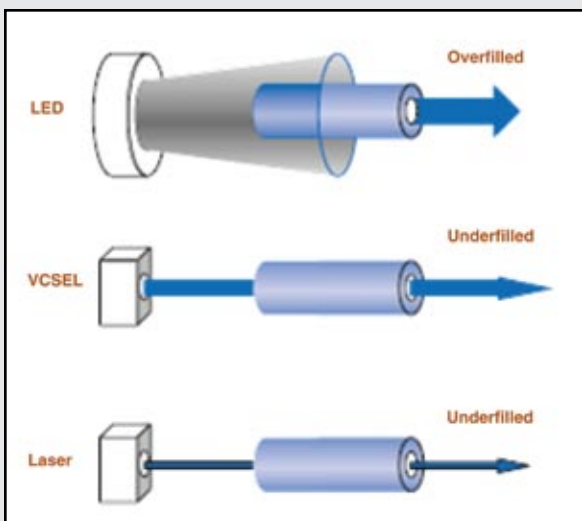
Test equipment is expensive, and network builders always want to make sure the certifying technicians are using the latest versions, because test requirements change as fiber evolves. Test equipment vendors have risen to the challenge with devices that evolve right along with the needs.

A mandrel tool filters out the higher-order mode powers that are present, but

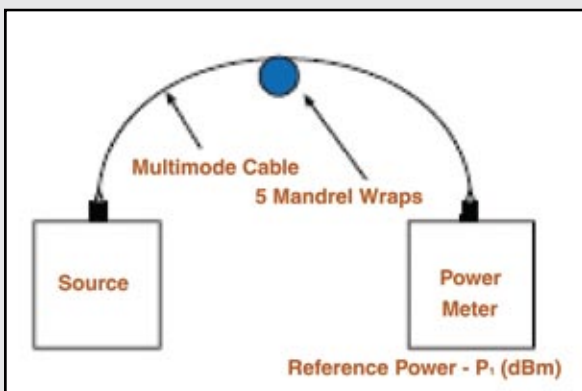


TEST POINTS
Use the AXS-200/350 Optical Loss Test Set anywhere in your fiber network—from the customer premises to the central office (CO) or at any connection point in between, such as the drop terminal or fiber distribution hub (FDH).

Drop fiber test scenario: Using the AXS-200/350 to access network certification.



Typical launch conditions from commonly used light sources.



Use of a mandrel tool.

does not travel down the fiber very far. By using a mandrel tool, these higher-order powers are filtered out. However, a mandrel tool is not always needed. In the case of EXFO's AXS-200/360 Fiber Certification Test Set, the LED light source has internal mode conditioning; therefore, a mandrel tool is not required when testing 62.5/125 μ m multimode fiber. However, when testing 50/125 μ m fiber, a mandrel tool (which comes standard with the certification kit) is recommended.

TELCO FIBER CERTIFICATION

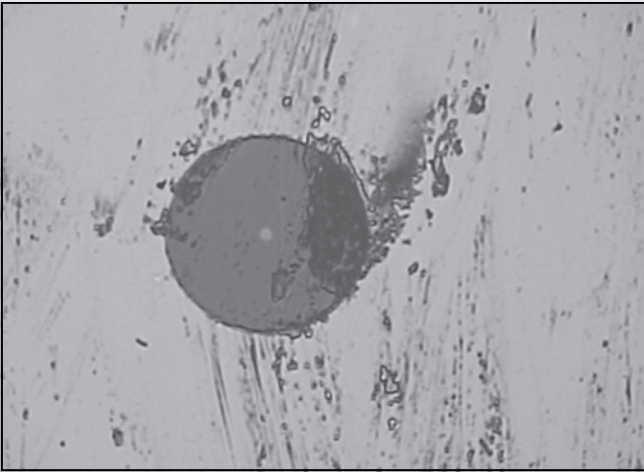
EXFO has recently created an optical loss test set certification kit for telco applications, which has all the features of the fiber certification kits and includes important telco features, such as:

- High power GeX (+25 dBm)
- 1310/1490/1550 nm configuration for FTTx testing
- 1310/1550/1625 nm configuration for FTTx testing
- Standard 40 calibrated wavelengths for coarse wavelength-division multiplexing testing
- Hold min/max for source or transmitter stability verification

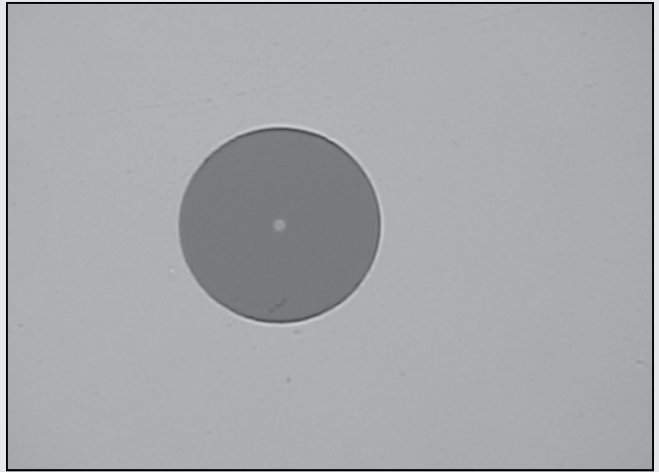
This test set, the AXS-200/350, is a good solution for customers looking for a semi-automated solution for IL testing. It offers an optical loss test set (OLTS) configuration, including an optical source and certification power meter in each test set. The ability to program a standard according to specific needs makes it flexible enough to access network certification during construction phase.

FTTX NETWORK FIBER INSPECTION

There is also a set of tests specific to FTTx builds, designed for access and FTTx construction and for premises network testing. It is likely to appeal to fiber installers and contractors. With the optional high-resolution fiber inspection probe (FIP), which can be directly connected to the unit, the AXS-200/360 offers a complete fiber solution – not requiring a separate stand-alone unit.



View of a dirty connector.



View of a clean connector.

There is also a set of tests specific to FTTx builds, designed for access and FTTx construction and for premises network testing. It is likely to appeal to fiber installers and contractors.

In fiber installations, dirty or damaged connectors are by far the biggest cause of problems. Quickly correcting this error is essential; therefore, specialized equip-

ment such as an FIP is required.

Because inspecting and cleaning connectors saves time and increases productivity, connector care and inspection

are key to obtaining optimum results, which makes the inspection of connectors an absolute must to meet today's tighter budgets. **BBP**

About the Authors

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