Fiber-Handling Essentials For Next-Gen Networks

Traditional methods of handling and testing optical fiber can be dangerous in fiber-rich networks, new research shows.

By Matt Brown ■ *JDSU*

As demand for data continues to increase, so does the penetration of optical fiber into networks. Although fiber's contribution to network performance is indisputable, fiber connectors are widely recognized as physical networks' most problematic elements. Troubleshooting statistics show that fiber endface contamination is the number-one cause of poor network performance and that mating (splicing or otherwise connecting) contaminated fibers is the primary cause of permanent optical component damage.

The increased reliance on fiber in next-generation networks and its negative potential when contaminated make proper fiber handling critically important. Administrators and technicians must become proficient at conducting systematic, proactive inspection at every stage of fiber handling. Proactive inspection is the cornerstone of fiber-handling best practices, as it is the only way to ensure that no contaminated fiber is ever installed into a network.

To overcome intrinsic barriers to systematic proactive inspection, a best practice is to replace the optical power meter (OPM), currently the tool fiber technicians use most commonly, with a fiber tool. An integrated OPM/inspection device can be used systematically to meet established International Electrotechnical Commission (IEC) fiber-inspection standards.

An integrated OPM/inspection device..

A single microscopic particle on a fiber endface can become permanently embedded in the fiber core, causing back reflection and optical loss.

Equipping technicians with a tool based on IEC standards provides them with systematic procedures and pass-fail criteria that are key to ensuring that proactive inspection is carried out correctly every time. It will eliminate the installation of contaminated fibers and optimize network performance.

AN OPM ISN'T ENOUGH

Currently, the only tool most fiber technicians consider essential is an OPM, which measures the energy in an optical fiber and lets technicians determine whether enough power exists to support an application and whether the attenuation of the link meets specifications.

However, testing fiber signal strength was deemed insufficient after troubleshooting statistics revealed contamination as the number-one cause of poor physical network performance. Manufacturers of high-bandwidth equipment and their installation teams were the first to discover the impact of contamination on network performance. Their experience revealed that even the best clean-manufacturing practices could not prevent microscopic particles from entering sealed bags and slipping under dust caps, creating the potential for contamination even in brand-new components.

Just one microscopic particle on a fiber endface can become permanently embedded in the fiber core during mating. Once embedded, such a particle causes significant back reflection and insertion loss – two primary causes of poor network performance.

About the Author

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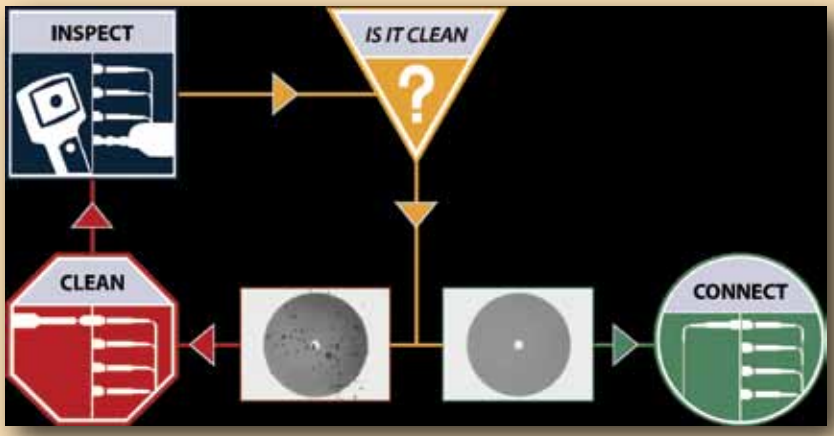
PROACTIVE INSPECTION MODEL

This simple inspection process ensures that fiber endfaces are clean prior to mating connectors:

1. **Inspect:** Use a microscope to inspect the fiber. If the fiber is dirty, go to step 2. If the fiber is clean, go to step 4.
2. **Clean:** If the fiber is dirty, use a cleaning tool to clean the fiber endface.
3. **Inspect:** Use a microscope to reinspect and confirm that the fiber is clean. If the fiber is still dirty, go back to step 2. If the fiber is clean, go to step 4.
4. **Connect:** If both the male and female connectors are clean, they are ready to connect.



Inspecting fiber endfaces before mating them is a well-established best practice.

Because microscopic particles on a fiber can go undetected by an OPM, testing alone before mating is not enough. The only way to ensure that a fiber is truly clean before mating is through proactive visual inspection using a microscope designed specifically for inspecting optical fiber.

THE CASE FOR PROACTIVE INSPECTION

With microscopic contamination always a possibility even in new fiber components, the full potential of a low-loss fiber connection is realized only when technicians ensure *prior to a fiber's first mating* that no contamination is present. This is possible only through microscopic visual inspection of every fiber, every time, before it is mated – the definition of systematic proactive inspection.

Anyone familiar with the physical layer of a network understands the potential for contamination once a fiber is in the network environment. Because of this potential, technicians' practicing systematic proactive inspection every time they handle a fiber is essential to network performance.

In the absence of systematic proactive inspection, administrators run the risk of installing dirty fiber that impairs optical signals and decreases network performance. Mating dirty fibers carries the additional risk of embedding dirt into the fiber, which can permanently damage the fiber and the connected network equipment. This may lead to network interruption later, when fiber repolishing or replacement becomes necessary.

Worse, when the damage done to fiber by embedded dirt is discovered only after the fiber has been installed in costly network equipment, replacing or repolishing the fiber is not always an option. This makes troubleshooting costs, asset damage and network downtime exponentially higher. However, with systematic proactive inspection, fiber can almost always be cleaned. This completely eliminates the potential for fiber contamination, network downtime and permanent equipment damage.

The impact of contamination on network performance and the benefits of systematic proactive inspection led to practical research by the International Electronics Manufacturing Initiative. The findings of this research became the pillar for the international standard IEC-61300-3-35.

This standard specifies visual inspection procedures and pass-fail criteria that must be used to achieve the measurable benefits associated with proactive inspection. Equipping technicians with a model based on this IEC standard is key to ensuring that proactive inspection is carried out correctly every time.

Making the connection between the benefits of proactive inspection of optical fiber and the bottom line is easy. Companies that have adopted proactive inspection on a large scale have massively reduced the need for troubleshooting and have lowered operating costs, showing that the operational benefits of proactive inspection clearly outweigh the costs. Adopting proactive inspection also reduces network downtime and maintenance costs. Keeping a network active and users online improves productivity. In addition, because proactive inspection ensures that network components operate at their highest level of performance, it can optimize signal and network performance, prevent network damage and protect equipment and technology investments.

BARRIERS TO PROACTIVE INSPECTION

In spite of these considerable benefits, proactive inspection is not systematically practiced. In 2008, approximately 60,000 OPMs were sold, compared with approximately 7,000 optical inspection devices. These figures reflect the first barrier to proactive inspection: cost. This includes both the cost of purchasing optical fiber inspection devices and the cost of the time required to add proactive inspection to the optical fiber handling process.

Although they are real, these costs are significantly less than the costs of reactive inspection that result from poor network performance. This fact, coupled with the financial and productivity

benefits of proactive inspection, should compel network administrators to make efforts to overcome these barriers.

To overcome barriers to systematic proactive inspection, network administrators and technicians should adopt integrated OPM/inspection devices and a proactive inspection model based on established IEC fiber inspection standards. This will help ensure consistently optimized network performance.

Integrating an OPM with a video inspection monitor, a probe microscope and a patch cord microscope facilitates quick and easy inspection of connector endfaces. It integrates testing and inspecting procedures, thus driving and enabling best-practice fiber handling. Two hand-held microscopes for inspecting both female (bulkhead) and male (patch cord) connectors, as well as other optical devices, creates a real workflow advantage while ensuring that both sides of each connection are inspected and cleaned before the fibers are connected. This is the only way to ensure fiber will be free of contamination and defects and perform optimally within the network.

A dual-microscope design is a key advantage. Dedicating one microscope to male connectors and one to female connectors saves technicians time and effort by allowing them to inspect both sides of a connection without changing tips. This configuration also provides a safe "parking lot" for male connectors during fiber handling or testing.

The proactive inspection model promotes the visual inspection procedures and pass/fail criteria set forth in the IEC-61300-3-35 visual inspection standard. By guiding technicians who have varying levels of expertise in the proper implementation of proactive inspection, the addition of this procedure to fiber-handling essentials ensures that proactive inspection is performed correctly every time.

SUMMARY

Fiber's increased penetration in next-generation networks and its potential for damaging network performance when contaminated makes systematic proactive inspection essential to next-generation network performance. It also makes obsolete the current practice of using only an OPM when testing fiber.

Adopting an integrated OPM/inspection device and a proactive inspection model based on IEC fiber inspection procedures and pass/fail criteria is critically important.

Replacing the OPM with these two fiber essentials will fully equip network technicians and drive them to systematically practice proactive inspection every time, reinforcing best practices and avoiding bad ones, no matter what level of fiber expertise technicians have.

The widespread adoption of the fiber-handling best practice of systematic proactive inspection will eliminate the installation of contaminated fibers and optimize the performance of next-generation networks. ❖