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The Importance of Clean Fiber Optic Termini

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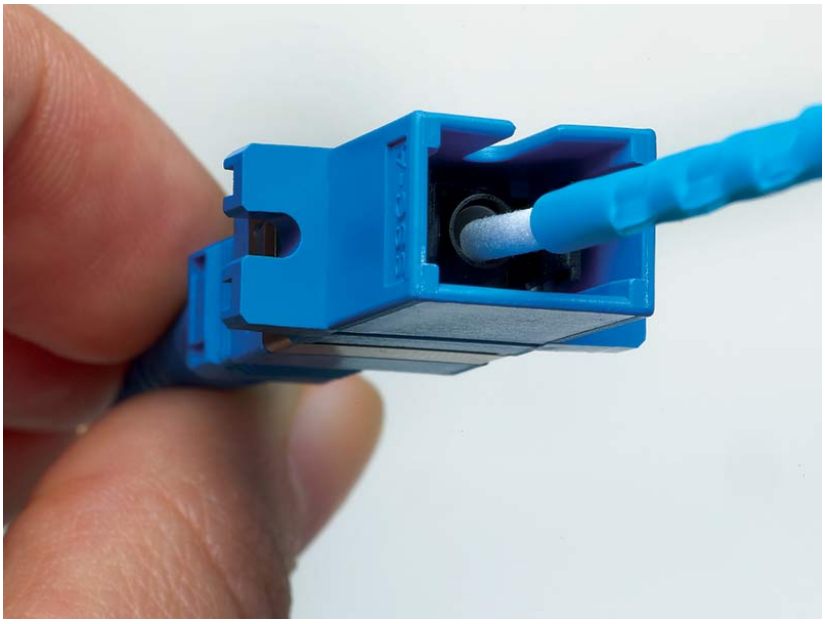
Over the past decade, the use of fiber optics throughout industry and our daily lives has seen a remarkable increase. High power laser energy is routinely carried through fiber for precision cutting, marking and etching of surfaces in conditions and places previously not possible. High definition TV, internet gaming, medical data imaging, financial services, cloud computing, smartphones, general commerce and social networking all have dramatically increased the demand for bandwidth. Be it long haul, backhaul, FTTX, WAN or LAN, all the elements of optical networking are experiencing increased demand for bandwidth and the utility it provides. But, while the technology and reliability of optical components has improved over the past decade, there still remains predictable system vulnerability at the points of interconnect.



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An interconnect is the point of mating two fiber optic connectors, or the mating of a fiber optic connector with an optical device. It's been estimated that connection points are the source of about 70% of the optical network failures, and more than 70% of those failures are a result of connector end-face contamination. This is because the interconnect is the only point in the network where the core of the glass fiber carrying the optical signal can be exposed to contamination from the external environment.

When in service, connectors are mated and make physical contact at their end-face within an alignment sleeve. They're held in place by springs contained within the connectors. This ensures physical contact will be maintained, contamination will be kept out, and the integrity of the optical path will be preserved. However, during installation, maintenance, rerouting, and equipment upgrades, connector end-faces are disconnected and exposed to the environment. It's at this time the end-face may become contaminated by accidental human contact, by contact with an unclean connector such as a test jumper, or by coming in contact with airborne contaminates.

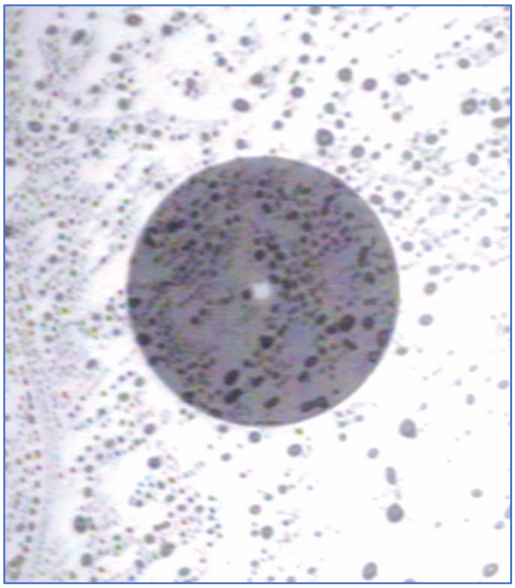
Maintenance of the connector end-face is imperative for the fiber optic network to work correctly. It is an exacting job: the termini that create a connection must meet at an exact place, and the microscopic glass cores need to be perfectly aligned in order to have signal transmitted through the interconnect. In addition, the termini end-faces must be perfectly cleaned of all contaminants to ensure minimal signal loss. Thus, one of the most basic and important procedures for the maintenance of fiber optic networks is to clean the fiber optic termini.

Importance of Cleaning

Any contamination on the termini end-face can cause failure of an optical device or the network as a whole. Even microscopic particles on the end-faces can cause a variety of problems for optical connections. One of the biggest challenges of contamination is that it cannot be seen with the naked eye, and one must use a specialized 200x or 400x inspection scope to determine the cleanliness of the end-face. A close inspection of the connector is

critical to confirm that particles and residue are completely eliminated, thereby ensuring the interconnects perform to their full potential.

A dirty fiber optic end-face (photo, below) will significantly degrade signal transmission and can even result in blocking the optical signal all together. Even if a stray particle is only situated on the ferrule edge of the end-face, it can cause an air gap or misalignment in the termini between the glass cores. This can result in back reflections, instability in the network, signal attenuation or even a system shutdown. Another potential issue is a scratched surface as a result of dust particles trapped between two termini end-faces. What's more, some fiber optic instruments such as those using high power Class IV lasers, generate a significant amount of heat, which, when in contact with contaminants can spark a surprisingly violent reaction or fire.



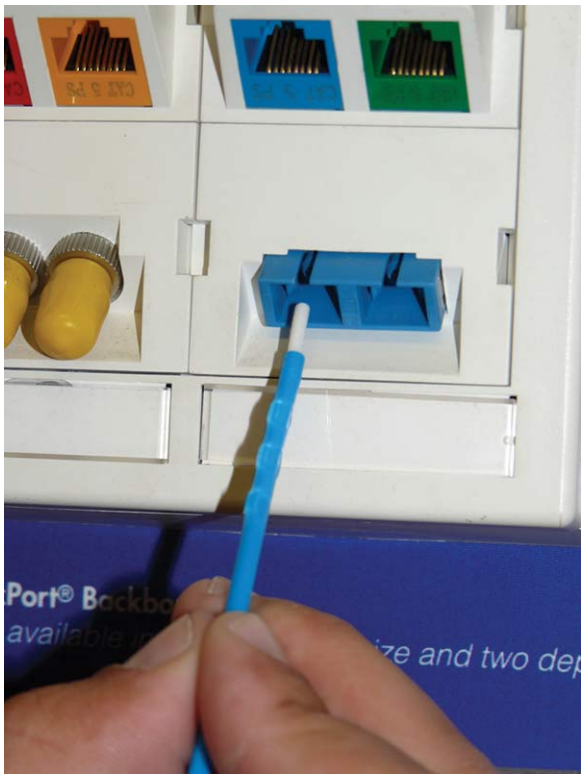
One of the biggest challenges in cleaning fiber optic termini is establishing a process that works consistently. Improvising a cleaning process will almost certainly lead to failure, as outlined above. The best advice is to inspect, clean, and inspect again. Repeat this process until you are absolutely sure both ends of the interconnect are completely clear of all contaminants. Spending time to clean it right the first time will save you time and money in the end.

Cleaning Methods

Materials used to clean the end-faces must be perfectly-clean, otherwise you can easily make the end-face worse by adding contamination. It may be intuitive to wipe the end-face on your coveralls or a spare cloth, but under a fiber optic inspection scope, those items carry a surprising variety of contaminants that will soil the connector. Even briefly touching the termini with your finger will cause it to be significantly dirtied with skin oil. To clean properly and avoid further contamination, make sure to always use a cleaning product that has been specifically

engineered for cleaning fiber optics. It's also a good practice to always wash your hands prior to using fiber optic cleaning materials (if possible) to avoid the transfer of skin oil onto otherwise pristine cleaning products.

There are two basic methods used to properly clean fiber optic termini: a high purity wipe for male connectors, and a specialty swab for female connectors. It's important to note that while wipes will work on almost all configurations of male connector termini, swabs are sized specifically for the type of connector being cleaned. Beware, a swab sized to clean an SC connector will not fit in a LC connector alignment sleeve! To achieve your goal of a perfectly clean termini end-face, swabs and wipes should always be used with a high purity fluid.



In very general terms, contamination found on termini end-faces will fall into three basic categories: particulates, oils and salts. Each requires specialized methods for proper removal.

Particulates are solids usually held on the end-face by electrostatic attraction. Even experienced technicians are surprised to learn that static attraction can be increased by the mechanical action of a cleaning product creating a triboelectric charge on the nonconductive termini end-face. That triboelectric charge will actually attract dust particles like a magnet!

The best way to clean particulates is by dissipating the static charge that both attracts and holds them in place. This can be done with a specialty cleaning fluid that actively dissipates static charges. A well-engineered cleaning fluid will also selectively dissolve oils found on the fiber end-face without damaging materials used to make the connector, its housing, or surrounding components. Salts, on the other hand, are not necessarily fully removed by cleaning fluids alone. While cleaning fluids may quickly dissolve oils and rinse away particulate,

they frequently dry and leave salt remains behind in the form of a white residue that can be very difficult to remove. The absorbency and mechanical action of a wipe or swab is best combined with a cleaning fluid to fully eliminate oils, particulates and salts that would otherwise be left on the termini end-face.

Buyer beware, it is a fact that some cleaning products on the market will leave the end-face dirtier than when you started. To avoid this situation, look for products that combine wipes and solvents engineered to work together to rid the termini end-face of particulates, oils and salts.

Avoid using aqueous (water based) cleaners or isopropyl alcohol (IPA), as both present significant limitations. Aqueous products are slow to dry and when used improperly can leave moisture on the end-face. In cold ambient temperatures, the moisture may actually freeze on the end-face or in the alignment sleeve. In extreme cases with high power lasers, if the moisture is not completely removed before the connectors are mated in the sleeve, the laser-energized fiber can instantly transform the remaining liquid into vapor, causing a small explosion through sudden expansion of the vapors.

IPA is typically sold in low purity grades and packaging simply not suitable for cleaning fiber, and as a result frequently leaves a hazy film behind when it dries. As with water-based cleaners, in extreme situations IPA may cause sudden vapor expansion problems or possibly ignite if left on a highly energized fiber end-face. What you should look for is a fast drying, high-purity fluid formulated, packaged and labeled specifically for cleaning fiber optics.

High-purity cleaning fluids should always be used with both wipe and swab applications. But, beware of pre-saturated cleaning materials. Pre-saturated wipes and swabs often contain

microscopic oily residues extracted from the plastic packaging, which will then transfer to the end-face during the cleaning process. Instead, carefully apply a small amount of high purity cleaning fluid on a corner of a dry wipe or the tip of the swab and then clean the fiber optic termini. A well-engineered cleaning fluid will not only dissolve oils found on the end-face, but will help to eliminate the electrostatic charge generated as the applicator is pulled out of its packaging or drawn across the fiber end-face when cleaning.

Remember, microscopic amounts of contamination can cause big problems on a termini end-face. Use care to not touch the area of the wipe or swab you will be using to clean with your finger or your clothing. Should you touch the area of the wipe or the tip of the swab with your finger or drop it on the ground, discard the wipe or swab and start over. Avoid reusing cleaning swabs and wipes because they will transfer contamination onto the next connector. Once the cleaning process is complete, discard the wipe or swab and inspect the end-face to make sure all contaminants have been eliminated.

Bottom Line: Performance Critical Cleaning

Our reliance on fiber optics will continue to grow and it is imperative to clean interconnect end-faces perfectly the first time around with the right products, the right way. Fiber optic service professionals can't afford to leave behind end-face contamination which results in poor network performance and costly callbacks. Use the correct cleaning products and closely inspect the end-face to avoid these costly mistakes. Investing the time, energy and money into the cleaning process at the beginning will end up saving you in the end.

About the Author

Jay Tourigny is Vice President of Operations at MicroCare Medical and can be reached at JayTourigny@microcare.com. He has been in the industry for 25+ years, and holds a Bachelor of Science degree from Massachusetts College of Liberal Arts. Tourigny holds numerous US patents for cleaning-related products that are used on a daily basis in medical, fiber optic and precision cleaning applications.

About MicroCare

MicroCare is a supplier of advanced cleaners, coatings and lubricants used in electronics, avionics, medical device and fiber optic applications throughout North America and Western Europe. To learn more about fiber optic cleaning products, see the MicroCare, Sticklers® brand cleaners at www.sticklerscleaners.com.

[sidebar] Educational Do's and Don'ts when Cleaning Fiber Optics

Due to the meticulous procedures of maintaining any fiber optic network, it is critical that service professionals working with fiber optics be educated and trained to know exactly how to properly handle and clean termini end-faces. Because you cannot see end-face contamination without an inspection scope, the cleaning process is not always intuitive. Make sure you and your staff are using the right product engineered specifically for cleaning fiber optics and that it is being used correctly. Use the do's and don'ts of cleaning fiber optics below to help you during the education and training process. And always remember to inspect – clean – inspect.

Inspect

Don't look directly at laser-energized fiber optic termini with your eyes, and avoid exposing your skin to direct or scattered radiation. Most laser and LED light sources used in fiber optics operate in the near-infrared and infrared wavelengths. While they are invisible to the eye, they

can cause significant damage in the form of corneal, retinal or skin burns. Only view the termini with equipment engineered to safely inspect fiber optic end-faces. Be safe and always treat all termini as though they are laser-energized.

Do learn what each type of contaminant looks like. It is important to know which contaminants you are working with in order to properly clean the fiber optic termini.

Do a thorough examination to find the type of contaminant(s) on the end-face. It might just be one pesky dust particle or a laundry list of dust, oil and salts combined. Understand what you're facing in the beginning to eliminate the source of contamination and reduce the number of cleaning rounds.

Do determine which cleaning technique is appropriate for the contaminant and the instrument termini. Do you need a wipe? What specific sized swab? When cleaning the common interconnect, you will almost certainly need at least one of each along with cleaning fluid to get the job done. Know what you need in order to perform an efficient cleaning process. Consider purchasing a ready-to-use fiber optic cleaning kit that includes everything needed to perfectly clean most commonly used and sized connectors.

Cleaning

Do thoroughly wash your hands before handling the fiber optic connector and the cleaning supplies. Clean hands will be less likely to transfer dirt, oils or the remains of that lunchtime hot dog that will compromise the cleaning process.

Don't apply a moisturizer or lotion to your hands prior to cleaning the termini. This will attract more contaminants and will almost certainly transfer onto the cleaning wipe or swab, and eventually onto the end-face you're trying to clean.

Don't wipe the end-face of the fiber optic on your coveralls or other clothing. This is not an appropriate cleaning mechanism, and will only cause the end-face to be dirtier than when you started.

Don’t wear gloves when working with wipes and swabs. While you may think that wearing gloves will protect the cleaning materials from the oils in your skin, you will actually be adding more particulates. Gloves, like your clothing, are a carrier of all kinds of microscopic contaminants. It’s best to simply wash your hands prior to cleaning a connector and avoid skin contact.

Do throw away all wipes and swabs after each use. This will ensure that the contaminants picked up by the cleaning materials won’t end up back on the next end-face you clean.

Inspect

Don’t forget to finish cleaning with an inspection. This is a critical step to make sure that the fiber optic connector is perfectly clean and the system will perform at full potential.

Do make sure the termini end-face is clear of any contaminants before it is mated in the interconnect. If you see contaminants left on the end-face, repeat the cleaning process with a new wipe or swab until it inspects as perfectly clean.

Do perform routine inspections for interconnect cleanliness before installing new, or servicing existing fiber optic connections. Even new connectors will have unacceptable levels of contamination and should be cleaned before use. Clean connectors ensure that your network is running correctly and all information is being transmitted at optimum.

Do it right the first time. Leaving contaminants on the end face can degrade network performance or in extreme situations cause a violent reaction in the interconnect, leading to costly downtime or callbacks. If you do it right the first time around, you can avoid spending more time and money on it later.

About the Author

Jay Tourigny is the Senior Vice President at MicroCare Corp. He is the principle inventor of many of the Sticklers products. Contact Jay at JayT@MicroCare.com.

About Sticklers® Fiber Optic Cleaners

Sticklers® fiber optic cleaners deliver perfectly clean ports, jumpers and splices every time. Sticklers® cleaners out-perform all of the old-style cleaning choices you might have seen: alcohol pump-bottles, linty paper wipes and expensive cartridge cleaners. For an even better value, the Sticklers® cleaners are available in handy toolkits, with thousands of cleanings in each kit. Sticklers® products are non-hazardous, so they can be shipped hassle-free. This means you get a cleaner network at the lowest possible cost. Eliminate expensive repair calls, boost customer satisfaction and avoid costly warranty claims, all while saving money – chose Sticklers® cleaners.

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