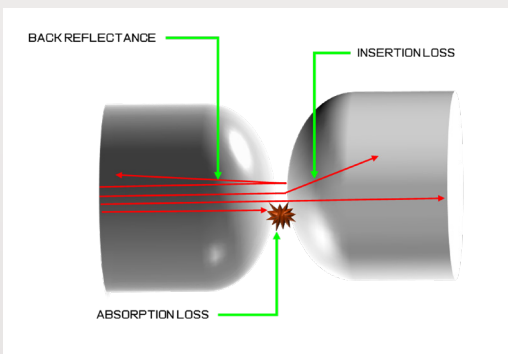


Contamination Beware: Cleaning 101 for Medical Device Fiber Optics

- Author: Jay Tourigny,
MicroCare Senior Vice President
- Industry: Medical Device
- Published:
*Medical Device and Diagnostic
Industry Magazine*



A dirty fiber optic end-face significantly degrades signal transmission.

Grasping a few techniques can save time and money

The use of fiber optics in the medical industry has steadily increased over the past decade. From extensive medical applications including light therapy, arthroscopic surgery, x-ray imaging, ophthalmic lasers and lab and clinical diagnostics, to simple communication methods such as transmitting patient information, fiber optics help medical professionals conduct procedures that were previously not possible.

Maintenance of the fiber optic network including the connecting end-faces is imperative for fiber optic medical instruments to work correctly. It is an exacting job. The microscopic termini that create a connection must meet at an exact place. And the fiberglass cores need to be perfectly aligned in order to have signal transmitted to and from the device. In addition, the termini end-faces must be completely clean of contaminants to ensure minimal signal loss. Cleaning the fiber optic termini is one of the most basic and important procedures for the maintenance of fiber optic systems.

Contamination Challenges

Like many medical devices, cleanliness is crucial to the performance of fiber optic instruments. Any contamination on the termini end-face can cause failure of the component or the system 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 typically use a specialized 200x or 400x inspection scope to determine the cleanliness of the end-face. The connector must be inspected closely to identify that particles and residue are completely eliminated, therefore ensuring that connections work to their full potential.

Dangers of Dirty Fiber Optics

A variety of serious, undesired outcomes, from deteriorated performance levels to ruined instruments, could occur if a contaminated fiber optic connection is used. A dirty fiber optic end-face will significantly degrade signal transmission and can result in blocking the fiber optic signal altogether. Even if a particle is only situated on the ferrule or the edge of the end-face, it can cause an air gap or misalignment in the termini between the cores. This can result in back reflections, instability in the laser system, signal attenuation, or even system shutdown. Another potential issue is a scratched surface as a result of dust particles trapped between two termini end-faces. In addition, some fiber optic instruments, such as those using high-power Class IV lasers, generate a significant amount of heat. If that heat contacts with contaminants, it can spark a violent reaction or fire.

One of the biggest challenges related to cleaning fiber optic termini is finding a process that works. Improvising a cleaning process will almost certainly lead to failure, as previously outlined. The best advice is to inspect, clean and inspect again. Repeat this process until you are absolutely sure the instrument connection is clear of all contaminants. Spending the time to clean it right the first time saves time and money in the end.

Cleaning Methods 101

Materials used to clean the end-faces must be pristine, otherwise you could be adding contamination. It may be intuitive to wipe the end-face on your gown or a cloth, but under a typical fiber optic inspection scope, those items carry a large variety of contaminants that could soil the connector. Even touching the termini with your finger causes it to be significantly dirty with skin oil. To avoid further contamination, make sure to use products that have been specifically manufactured for cleaning fiber optics. Always wash your hands prior to using cleaning materials to minimize the transfer of skin oil onto the connector surfaces.

There are two primary tools available to clean fiber optic termini: a specialty wipe for male connectors and a swab for female connectors. Particulates, oils and salts are the three basic types of contaminants found on the end-faces, all of which require their own cleaning methods.

Particulates are solids that are held on the end-face by a static attraction. The best way to clean this type of contaminant is by dissipating the static charge that both attracts and holds them in place, which is usually done with a specialty cleaning fluid. Cleaning fluids are also used to dissolve oils found on the end-faces. Salts, on the other hand, are typically not fully removed by cleaning fluids alone. While cleaning fluids may quickly rinse away the oils, they tend to leave salt remains behind in the form of a white residue that can be very difficult to remove. Adding mechanical action from a wipe or a swab is usually combined with the cleaning fluid to fully eliminate any oil or salt on the termini end-face.

Choose Wisely

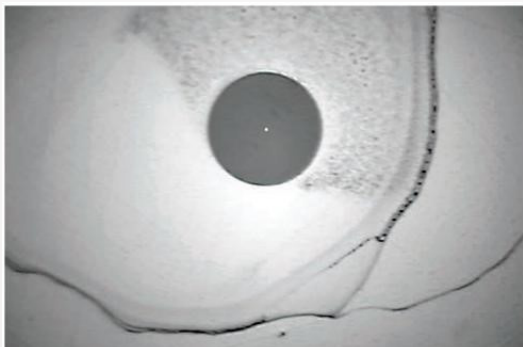
However, be aware; some cleaning products on the market can leave end-faces dirtier than when you started. To avoid this situation, look for products that offer engineered solutions formulated to rid the termini end-face of particulates, oils and salts.

Avoid using aqueous (water-based) cleaning fluids or pure isopropyl (IPA), as violent reactions could potentially occur. Aqueous products are slow to dry and can leave moisture on the end-face. In cold, ambient temperatures, the moisture may actually freeze on the end-face alignment sleeve. If the moisture is not completely removed before the fiber is connected in the sleeve, the laser-energized fiber will instantly vaporize the remaining liquid into a gas, causing an explosion through sudden expansion of the vapors.

As with water-based cleaners, IPA may explode or catch fire when left on a highly energized fiber end-face. IPA also frequently leaves a hazy film behind when it dries. Therefore, it is important to use a fast-drying, high-purity fluid engineered specifically for fiber optics.

Beware of Presaturated Wipes

High purity cleaning fluids can and should be used with both wipe and swab applications. However, beware of presaturated cleaning materials. Presaturated wipes and swabs often contain microscopic contaminants drawn from the plastic packaging, which will transfer to the end-face during the cleaning process and result in further contamination problems. Instead, carefully apply a small amount

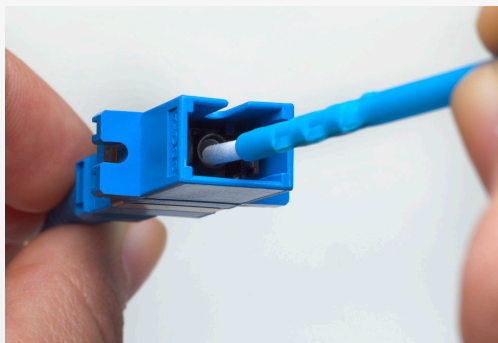


A fiber optic end-face contaminated with alcohol residue.



A fiber optic end-face contaminated with fingerprint oil.

Tech Article



A fiber optic cleaning stick cleans a fiber optic termini end-face.



A cleaning fluid and wipe dissolves contaminants and helps eliminate static.

of high-purity cleaning fluid on the corner of a dry wipe or the tip of the swab then apply the fiber optic termini.

A well-engineered cleaning fluid dissolves oils found on the end-face. It also helps to eliminate the electro-static charge generated when the wipe or swab is pulled out of its protective packaging. Be sure to not touch the areas of the wipe or swab you are using with your finger or clothing. Should you touch this area or drop it on the ground, discard the wipe or swab and start over. Once the cleaning process is complete, discard the wipe or swab and inspect the end-face to make sure all contaminants are eliminated. If the end-face is still contaminated, clean it again using fresh fluid and a new wipe or swab.

The Bottom Line

Fiber optics usage continues to grow in the medical industry. Therefore, it is imperative to clean the termini end-faces properly. That includes the first time around with the right products the proper way. The consequences of an unclean fiber optic network can be detrimental to your business operations. Medical professionals cannot afford to have a blocked connection, a fire or a complete fiber optic system shutdown. Especially while a patient undergoing treatment. Use the correct cleaning solutions and closely inspect the instrument end-faces to avoid these costly mistakes. Investing the time, energy and money into the cleaning process at the beginning saves you in the end.

About the author:

Jay Tourigny is Senior Vice President at MicroCare which offers precision cleaning, lubricating and debinding solutions. He has been in the industry more than 30 years and holds a BS from The Massachusetts College of Liberal Arts. Tourigny holds numerous U.S. patents for cleaning-related products that are used on a daily basis in medical, fiber optic and precision cleaning applications. For more information, visit microcare.com