Tech Article

Using Fluids Other than Alcohol for Cleaning Fiber Optic Connectors

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Sticklers Resources

TFOCA connectors are some of the most complex devices on the market. They have ports and jumpers on the same device, which makes cleaning extremely challenging.

Since the 1970s, fiber optic providers have been working to find suitable ways to quickly, conveniently and consistently clean the delicate fiber optic connectors. They found very early on that even the slightest contamination on the end-faces significantly degraded the performance of their networks. Fiber engineers in the 1970s and 1980s recommended using reagent grade isopropyl alcohol (IPA), also known as rubbing alcohol, for cleaning their fiber optic connectors.

The Original Choice – IPA

They made this recommendation for two reasons: it was readily available on their workbenches, and it worked. It worked because the solvent provided additional chemical action to enhance the mechanical action provided by the cleaning device (the wipe or swab). Alcohol and other solvents also are very effective at softening, loosening and/or dissolving dried contaminants and particulate. In short, those engineers proved what everybody intuitively understands: a well-engineered cleaning fluid will enhance the removal of contaminants from the optical end-face.

Times Have Changed

Since that time much has changed. Fiber optics technologies are no longer the exclusive, exotic technology of the monolithic phone company, but an enabling capability of almost every company (and soon, every home). Data-intense applications have created sky-rocketing demand for greater bandwidth. Computing technology has plummeted in cost and expanded in capability. All of this means networks have become larger, commonplace and faster. Good news, all of it. Except for one odd little quirk: fiber networks, as they have become ubiquitous they have also become more fragile.

Today's fiber, while capable, is positively delicate. The first fiber link that built under the streets of Atlanta in 1976 operated at 44.7 MHz. The lasers generated a pulse of light that was enormously long by today's standard: literally hundreds of meters in length. But as fast as it seemed at the time, in today's 5G world 44.7 MHz is unthinkable. Modern networks work at gigahertz speeds, which means (since the speed of light is constant) the pulse of light is just inches long. Such an ephemeral signal is easily disrupted by the slightest contamination on the end-faces.

Leave IPA Behind

Everything has changed, except that technicians around the globe are still trying to clean their fiber with IPA. This is no longer a good idea. First, reagent-grade IPA is not readily available to fiber optic technicians, and ordinary alcohol is completely unsuitable for cleaning fiber optics. For example, drug store IPA is not an optical-grade cleaner because it is always diluted with water to lower the cost; it is often 30% water. The mixture comes in a relatively dirty plastic container from which all sorts of plasticizers and contaminates may leach. The container may be reused, and it certainly becomes contaminated as it rides around on an installer's truck.

Next, alcohol actually is not a very good cleaner. In terms of solvent technology, it's pretty far down on the list of old technologies. Alcohol has a very low density so it cannot easily clean particulate. It has a high boiling point so it is relatively slow to dry. It saturates easily, so it is no longer effective. Modern cleaning chemistries usually try to avoid or at least minimize the presence of alcohols in the fluid because of these problems.

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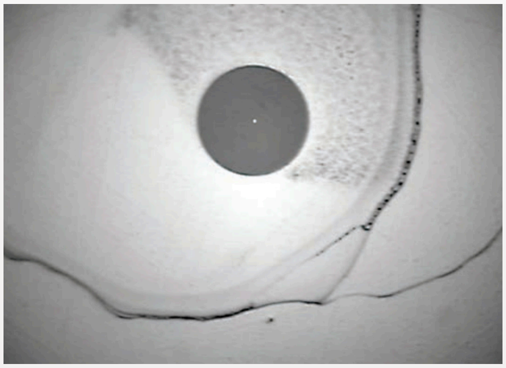
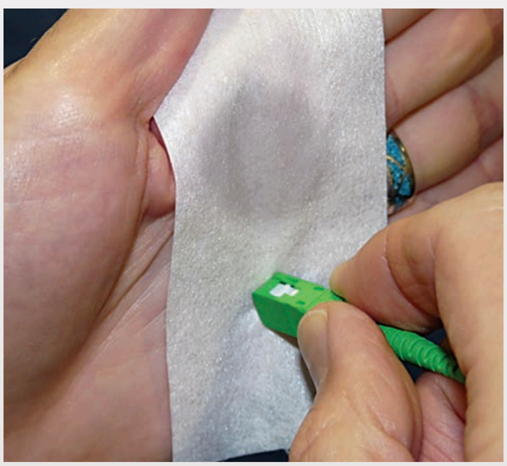


Early experiments with "reagent grade alcohol" to clean fiber optics proved that it worked fairly well. However, it still left residue behind.



In the old days, many connectors were cleaned by the operator, who just rubbed the connector on his or her shirt or sleeve. That sort of "ad hoc" cleaning will no longer suffice in the world of gigabyte speeds. Operators need the right wipes and the right fluid to get the expected results.

Avoid Contamination

Thirdly, IPA is easily contaminated. Alcohol has a property of being infinitely hygroscopic, which means it likes water—it wants to absorb water. This property means that IPA in loosely sealed bottles will absorb moisture and any contamination from the air. This is why IPA often leaves a water-mark residue on the connector end-face. This residue can "burn" into the surface of the glass and increase the signal loss of the connector permanently, requiring time-consuming re-termination.

Lastly, alcohol is flammable. It cannot be carried onto an airplane, nor easily shipped without HAZMAT paperwork and fees. This means that technicians installing and repairing fiber links in remote locations, often have to leave their cleaning fluid behind.

Dry Cleaning

Becoming aware of the problems of alcohol, many technicians discontinued the use of solvents and went with dry cleaning only. However, dry cleaning has been proven undesirable. As it turns out, wiping dry on a fiber end-face will generate a static charge (technically known as a triboelectric charge) on that end-face that is extremely difficult to dissipate. This static charge turns the end-face into a microscopic magnet, attracting dust out of the air right onto the center of the end-face.

Triboelectric charging occurs when rubbing any non-conductive surface with any dry wipe such as an end-face cleaning tool or a fabric wipe. The build-up of this static charge on a connector end-face will attract unwanted airborne particulate and dust to the connector end-face. The condition worsens in dry conditions (low humidity) such as winter cold or desert heat.

Static Dissipative Fluids

The use of static dissipative fluids during the wet/dry cleaning of connector end-faces is now the recommended practice. With data rates over fiber only increasing, the need to clean properly has never been more important. A modern, water-free, high-purity fluid engineered for cleaning fiber optic connectors will both dissipate, and at least temporarily prevent, this build-up of triboelectric charges in the connector end-face. Therefore fluids should play an import role in cleaning.

During the wet/dry cleaning process, the cleaning fluid dampens a section of the cleaning wipe. The connector end-face is wiped, usually moving from the damp area towards the dry area of the cleaning material. In the case of port cleaning sticks or automated devices, a cleaning stick or device is dampened with cleaning fluid and used to clean the end-face. When using a fast-drying, static-dissipative fluid with a wipe or highly absorbent cleaning stick, no drying step is necessary. This saves time, money and cleaning supplies.

Selection Criteria

When a user (or corporate buyer) is selecting a fiber optic cleaning fluid, there are several factors that should be considered. The first consideration is whether the fluid readily removes a wide variety of soils and unwanted contaminates. This is easily tested in the field with sample product. Also, the user should make sure that the fluid is compatible with the wiping material or cleaning swabs. For example, one would not want to pair fluid with a swab or wipe, which was constructed of a

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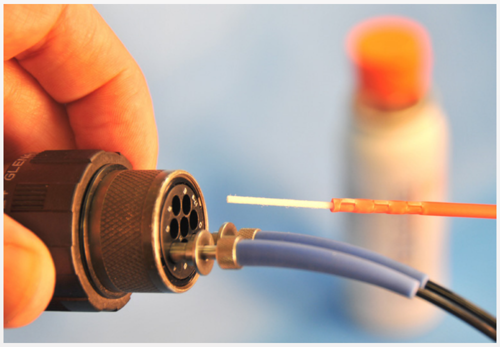
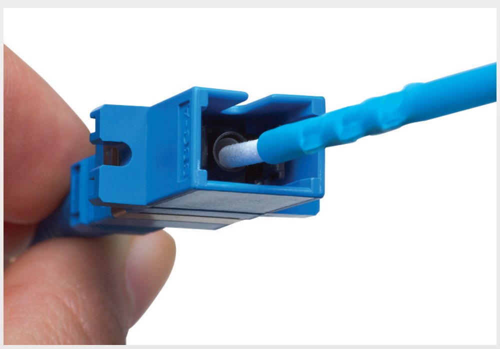


A high-purity cleaning fluid and the proper cleaning tools are essential for optimal network performance.



In an ideal world, techs and operators would have the right tools to clean any connector, regardless of the configuration.

material that the liquid would dissolve (perhaps a glue used in construction of the swab).

Fluid Safety

The second consideration is the safety of the fluid. Is the cleaning fluid flammable? Is the cleaning fluid safe for technicians to handle? Can it ship as a nonhazardous material? Will it freeze? Is it safe for the environment? The answers are on the product spec sheet and the SDS sheet for the cleaning fluid. If the answers are not instantly available on the published documents, this usually is a sign of a vendor not fully disclosing the contents and properties of the material and the fluid should be avoided.

Another consideration is the speed of drying of the cleaning fluid—faster is better. Slower drying fluids require more time or more wiping to dry, which can delay progress and also contribute to static charge buildup. But more importantly, slower drying solvents can “hang” in the split of the alignment sleeve of an adaptor or optical port of a device. The trapped liquid, which cannot be seen with an inspection scope, can then weep back onto the connector end-face spreading contamination. Very fast drying fluid will not remain in the liquid state long enough to become trapped within an alignment sleeve. A water-based cleaner would certainly require very special attention to drying. In the manufacture of precision optics, many aqueous cleaners have been replaced with fast-drying fluids to eliminate spotting and drying issues.

Packaging is Important

Another consideration is the packaging of the fluid. The ideal packaging will prevent spillage, prevent re-contamination of the fluid during storage and normal use and only dispense in quantities that are well-suited for a single cleaning. The fluid should be safe to use over a wide temperature range and should not freeze in field applications. Spilling is another worry, as it can be costly and dangerous, particularly in the case of flammable liquids. Open containers (bottles) or pump-type dispensers are easily contaminated from wipes, airborne contaminates or by refilling with unapproved fluids. Metered pumps are the ideal dispenser since the user cannot over apply the cleaning fluid (which can also be costly and dangerous). Excessive use of the cleaning fluids is very easy with uncontrolled aerosol sprays.

Consider also materials compatibility. A well-engineered fluid will be compatible and safe to use with a wide range of materials. This includes optics, plastics, metals, elastomers, electronic assemblies and adhesives. A proper cleaning fluid will dry without residue and will not create unwanted corrosion, surface crazing or otherwise damage/alter the connector end-face, its housing or the surrounding associated equipment.

Environmental Impact

The environmental impact of the fluid is important as well. The USA Government has four classifications of chemicals affecting air quality and the environment. The classifications are VOCs (Volatile Organic Compounds), which contribute to ground level ozone and smog; ODPs (Ozone Depleting Pollutants), which breakdown the protective ozone layer of the atmosphere; HAPs (Hazardous Air Pollutants), which consist of a list of chemicals whose use must be measured and monitored; and GWP (Global Warming Potential), a measure of the potential damage to the

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environment over 100 years. In general, most fluids should not be positive in all four categories. For example, if a material is not a VOC then it probably has a higher Global Warming Potential. The best recommendation is to select the safest cleaning fluid that will satisfactorily perform the cleaning task. Also select the best packaging to utilize as little fluid as possible.

Lastly, one must consider the cost. This includes safe storage and transport of the fluid (shipping) and packaging of the fluid (the amount of solvent used per clean). Engineers should search for the lowest cost per connector cleaned, to make bonafide comparisons among competing brands.

In conclusion, technicians will need new cleaning fluids in data centers, telco central offices, cable TV head-ends and in the field to clean today's fiber optic connectors. There are many considerations when choosing a fiber optic cleaning fluid. Price per can/bottle alone does not reflect real cost. Safety, convenience, reliability and sustainability also need consideration.

Companies are stepping up to meet the market needs with special cleaning fluids and special packaging, which makes "wet-dry" cleaning fast, easy and reliable. In this case, the product is a spill-proof package, which cannot be refilled. It ensures the dirt stays outside of the package and away from the cleaning fluid.

About the Author:
Mike Jones, retired Vice President of International Sales for MicroCare, has over 30 years of experience in the critical cleaning industry. He is a prolific writer and educator focusing on critical cleaning in general and vapor degreasing and benchtop cleaning in particular. For more information, visit www.microcare.com.