

# Cleaning Challenging Military Fiber Optic Connectors

**Author:**

Jay Tourigny, MicroCare Senior Vice President

**Industry:**

Fiber Optics

**Published:**

*Aerospace Manufacturing and Design*



There are over 300 fiber optic connections on an F-35 Lightning aircraft.



Fiber optics are in many military aviation applications. This includes fighter jets, spaceflight avionics and unmanned drones. For example, there are over 300 fiber optic connections on an F-35 Lightning aircraft. The fiber optic connectors used for military aircraft applications must be durable. They are often exposed to demanding conditions. For instance, punishing temperatures, high moisture, harsh wind and excessive shock and vibration. However, as rugged as these connectors are, they still require special attention. Especially when it comes to cleaning before connecting the end-faces.

## Problems With Dirty Connectors

There are many sources of end-face contamination. These include salt, fog residue, hydraulic fluid and jet fuel. Also atmospheric dust, penetrating oils and vehicle emissions. Even removing the protective dust caps that the end-faces come with from the factory may cause contamination. All of these types of contamination, if left between the mated termini pairs, will spread and disperse across the end-face surfaces. This alters the signal path and changes the refractive index causing signal degradation. If the contamination is severe enough, it could also result in a complete system failure.

## Friction Causes Contamination

One of the most pervasive sources of end-face contamination on an aircraft is wear debris. Wear debris comes from the motion of the aircraft while in operation. The constant vibration of the aircraft creates surface-to-surface wear between the individual components of the mated connector. This results in dust contamination. A common connector system for military aircraft is the MIL 38999 connector with the MIL 29504 termini. These high-performance cylindrical connectors are most often used for cable-to-panel I/O applications in military aerospace applications. They depend on spring loaded termini to maintain the physical contact when exposed to high vibration, impact, and shock motions. But, the same strong contact force that holds the pair mated termini together, also will grind dust particles into the ferrule surfaces. This results in scratched end-faces.

## Static Problems

Electro-static charge build up on the ceramic and composite ferrule materials makes contamination on the end-faces worse. The ferrules and the glass fibers are dielectric and act like an electrical insulator when it comes to holding a static charge. Oppositely charged dust particles attract to oppositely charged fibers and ferrules. As is true with most termini specifications, both MIL 38999 and MIL 29504 allow end-face geometry to be domed in the shape of a convex curve. As a result, electro-static charges concentrate at the apex of the two mated connectors and physically draw dust contamination to the point of physical contact. In addition, the lower the humidity levels, the greater the static issue becomes.

The MIL 38999 connectors are designed to survive extreme mechanical stresses and the harshest environments that military aircraft are subjected to in battlefield conditions. However, the MIL 38999 adaptors are too deep to be cleaned with traditional fiber optic cleaning tools. Disassembling the adaptors and the connectors to clean the fiber end-faces is time consuming and expensive. So, it requires the use of special tools and methods to clean them effectively. Some best practices for a fiber technician to get optimal performance from an optical network include the following:



*Optical-grade cleaning fluid and wipes engineered for cleaning fiber optic end-faces are best.*

## **Prepare for Cleaning**

The process for cleaning the fiber optic connectors is to reduce problems before cleaning. When possible, clean in an enclosed area, such as an aircraft hangar. Cleaning the fiber on the aircraft ramp presents more of a challenge because the fiber is exposed to dust and debris.

Also, clean the outside of the mated fiber connector with aerosol packaged duster and general cleaning wipes first. Do this before disconnecting the end-faces. However, do not use duster products directly on the end-faces after disconnecting them. The movement of the duster gas as it dispenses creates static and draws dust and other contaminants to the end-faces like a magnet.

Then clean any inspection tools and the adapters used to inspect to prevent any cross-contamination. After performing those initial cleaning steps, then the technician is ready to clean the fiber connectors.

## **Choose the Right Cleaning Fluid**

An optical-grade cleaning fluid engineered for cleaning fiber optic end-faces is the best choice. It should be an ultra-pure, non-flammable, residue-free cleaning fluid. The fluid must be safe for glass, ceramic and plastic surfaces. It should also be in a hermetically sealed (un-refillable) container. This prevents cross-contamination and spilling. Using a fast-drying, static-dissipative fluid also eliminates any additional drying step, saving time.

Avoid using water-based cleaners because they are very slow to dry and freeze at low temperatures. Also, don't use isopropyl alcohol (IPA). Although it is usually inexpensive, it has vulnerabilities. Alcohol is flammable and must be kept away from ignition sources. So, it is not compatible for military use. IPA also absorbs moisture from the air. This in turn contaminates the IPA. Thus, making its use in cleaning counterproductive. It also is a hazmat issue and cannot be easily shipped – a no-go when used on aircraft.

## **Use the Wet/Dry Cleaning Method to Dissipate Static**

During the wet/dry cleaning process, a technician uses a section of an optic-grade cleaning wipe. The wipe is dampened with a static-dissipative cleaning fluid. The technician wipes the connector end-face starting at the damp area and moving in one direction towards the dry area of the cleaning wipe. This removes the contamination and dissipates electro-static charges in one step. In the case of port cleaning sticks or clicker devices, the cleaning stick or device is dampened with the cleaning fluid first. Then it is used to clean the end-face.

## **Opt for High Grade Optical Wipes**

Less expensive paper wipes are rarely up to the task of cleaning microscopic contamination from optical connectors. They tend to rip and shred. Also, as they degrade, they tend to leave lint and debris behind. They often generate high static charges making their use counterproductive. Therefore, use high grade, optical-grade wipes that do not lint and do not generate static charges. Economize by purchasing smaller sized wipes that reduce waste. Look for a wipe sold in packaging engineered to minimize static charges as individual wipes are dispensed.





*The MIL 38999 connectors require special tools and methods for effective cleaning.*

Also, leaving the wipes in the packaging until ready to use ensures they stay clean, preventing waste. Wipes should be used only once and then thrown away to prevent cross-contamination on the network end-faces.

## **Use Cleaning Sticks for Better Cleaning**

Mechanical clickers are available and often well suited for cleaning connectors. However, in many instances they are not sized for cleaning termini in hardened connector housings. A cleaning stick and static-dissipating cleaning fluid combination are perfect. It allows for easier cleaning of connectors mounted in hard-to-clean alignment sleeves. Cleaning sticks conform to the end-face geometry and can clean the entire end-face without the need to disassemble the connector or adapter. They give the largest effective cleaning region on the terminus surface for eliminating issues associated with contaminants migrating into the signal path. The cleaning fluid also raises the local humidity level for effectively creating a dissipative path removing any incumbent static charges.

During cleaning, a technician dampens the cleaning stick with cleaning fluid first. After inserting the stick into the connector, they rotate it about six times in the same direction. They avoid extreme force and do not excessively scrub the end-face to prevent scratching, pitting or scarring end-faces. A cleaning stick should be engineered specifically to match the configuration of the end-face and be non-linting for optimal cleaning. A well-engineered cleaning stick also makes incidental contact with the alignment sleeve sidewalls. This allows the fluid from the cleaning stick to contact the sidewalls. The contact instantly defuses static charges so debris that exists on the alignment sleeve stays put. It does not jump onto the clean connector end-face during insertion. Keep cleaning sticks in their package until ready to use to prevent soiling or damage.

## **Inspect-Clean-Inspect**

The most practical thing a technician can do is to always inspect, clean and reinspect all the termini on both ends of a connector pair before mating. Inspecting helps to visually identify problems. This includes permanent defects, for example, scratches and pitting, and any contamination that can interfere or damage the surface of the optical termini.

When the technician takes the time to visually inspect the termini for contamination, it benefits them in two ways. First, they can identify the possible sources of the contamination and take steps to try and eliminate the root problem. Second, the technician will know when the terminus surface is free of contamination and ready for the connector pairs to be mated. Inspection adds an extra cleaning step to the process, but for trouble-free connections it is essential. Taking extra care to inspect, clean inspect both ends before mating will ensure the reliability and longevity of the military aircraft fiber optic network.

## **A Cleaning Plan Promotes Reliability**

The frequency needed to clean the fiber optic connectors on an aircraft will vary. But implementing a maintenance program is advisable. In addition to regular maintenance, fiber connections should be cleaned if the signal is showing degradation of the applicable system it communicates with.





*During cleaning, a technician dampens the cleaning stick with cleaning fluid first.*

The cleaning procedures themselves are straightforward. Technicians should follow the technical manual to the letter so that the fiber system is properly cleaned and maintained. If technicians take the extra few minutes and don't rush the process, the connections will have greater integrity over the life of the fiber optic system.

### **Find a Cleaning Partner**

When choosing fiber optic cleaning fluids, tools and methods, technicians should seek the help of an experienced supplier. Choose one that specializes in military fiber optic cleaning tools and methods. They can recommend specific products engineered for military use. Ones that effectively clean the unique military connectors used within harsh environments.

---

#### **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](http://microcare.com).*



ISO 9001:2015 Registered  
© 2020 MicroCare. All Rights Reserved. "MicroCare", "Sticklers", the Sticklers logo and "When you need perfectly clean splices & connectors" are trademarks or registered trademarks of MicroCare, LLC. Rev. 20237

