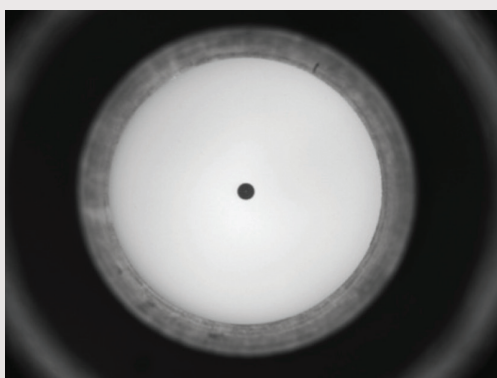
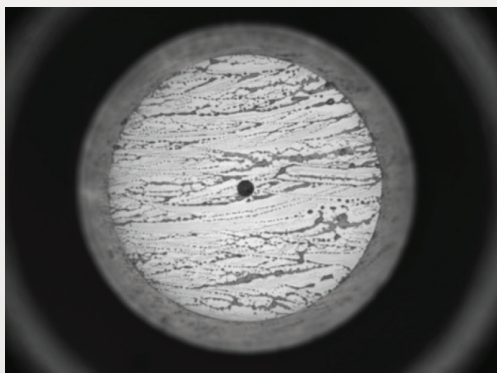


## Tech Article

### ■ Advancing Precision ■ Fiber Optic End Face ■ Cleaning: Insights ■ from a Three-Year ■ Study on Dust and ■ Oil Removal

○ Industry: Fiber Optics

#### Contaminated vs Clean



*Even microscopic dust and oil on a fiber end face can scatter light, increase insertion loss, and disrupt high-speed network performance.*

#### Introduction

In today's high-performance fiber optic networks, the importance of clean connectors cannot be overstated. Fiber systems carry massive amounts of data at high speeds, and even microscopic particles can compromise performance. A speck of dust or a trace of oil can scatter or absorb light, causing insertion loss (signal reduction) or back-reflection (signal bouncing back to the source). In extreme cases, contamination can block transmission entirely, creating costly downtime and network interruptions.

Because of these risks, repeatable, effective fiber end face cleaning is a top priority for technicians and network operators. But cleaning is not always straightforward. Traditional methods can remove visible debris yet will miss contamination outside the contact zone to the ferrule edge. Left unaddressed and due to network vibration, residues in these areas can migrate back into the optical path during use, quietly degrading signal performance over time.

To investigate these challenges in detail, the MicroCare Critical Cleaning Lab conducted a comprehensive three-year study. The goal was to evaluate how evolving cleaning technologies—both established and emerging—perform in removing two of the most common types of contamination: fine dust particles and oily films.

#### Evolving Cleaning Technologies

For twenty years, technicians have relied on mechanical click-to-clean tools. These are compact, portable, and easy to use in the field. Their design allows for quick removal of contamination in the fiber core, making them highly convenient for day-to-day maintenance.

However, the study reinforced a key limitation: click-to-clean tools will leave contamination outside the contact zone. While industry inspection standards (IEC 61300-3-35) have strict criteria for evaluating the core and contact zones of a fiber end face, contamination outside these zones can migrate back due to vibration, introducing future maintenance requirements. Other items found in the study were static buildup due to many clicks of the tool and scratching of lens if a dirt particle was found inside connector.

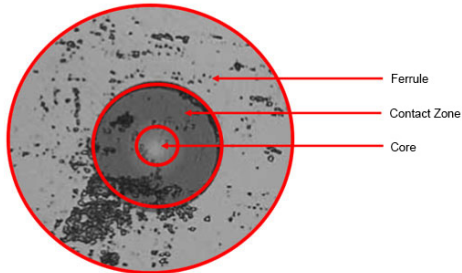
To address this, new touchless fluid-dynamics-based cleaning tools have been developed. These systems harness the Coandă Effect, where air pressure forces fluid to cling to a convex surface and sweep across it. In fiber cleaning, this creates a fluid and air flow that cleans the entire connector end face removing both dust and oils with complete surface coverage.

#### Study Parameters and Methodology

The three-year evaluation compared mechanical click-to-clean devices with a touchless cleaner based on Coandă Effect fluid flow. Testing was designed to reflect real-world conditions while maintaining strict repeatability.



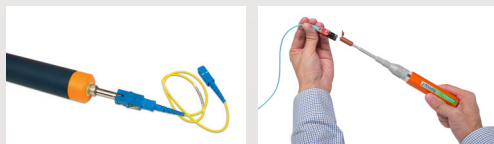
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While industry standards focus on the core and contact zones, contamination at the ferrule edge can migrate back into the optical path over time.



Mechanical click-to-clean tools offer fast, convenient core cleaning but may leave contamination outside the contact zone.



A combined approach—one touchless cleaning cycle followed by a single click—delivered the highest confidence in connector cleanliness.

- Duration: Three years of continuous testing
- Connector types: LC and SC
- Contaminants tested: Fine lab-generated dust and oils, including artificial sebum (to simulate natural skin contact)
- Tools compared: Click-to-clean mechanical devices and a fluid-dynamics-based touchless system
- Inspection standards: Extended beyond IEC 61300-3-35 to evaluate the entire end face—not just the core—using a VIAVI™ 4030 FVAi-2030 ultra-wide field of view microscope. This methodology ensured that both visible and “migratory” contamination risks were measured.

## Dust removal findings

**Click-to-clean tools** worked well but often needed multiple passes. Dust particles remained outside the contact zone due to its technology.

**Touchless cleaning** A single clean cycle removed dust and cleared contaminants across the full surface for 90% of the tests performed.

## Oil removal findings

- Both tools were generally effective at addressing light oil contamination.
- Mechanical click-to-clean tools managed core cleaning well but left thin residues outside the contact zone.
- Touchless cleaning systems delivered broader coverage, consistently clearing oily films across the entire end face, including the harder-to-reach edges.

## Visual inspection outcomes

Touchless cleaning systems deliver a strong overall clean, but like any technology, they are not flawless. Under magnification, occasional traces may remain, or small “dots” may appear from fluid that hasn’t fully evaporated. Similarly, click-to-clean tools can also leave behind some contamination, particularly outside the contact zone of the ferrule.

However, when used together, these tools provide excellent results. The touchless tool ensures comprehensive coverage across the connector, while the click-to-clean tool quickly addresses the core contamination. This tandem, 1 cycle – 1 click approach gives technicians confidence that connectors are not merely “passing inspection” but are as pristine as possible for reliable performance.

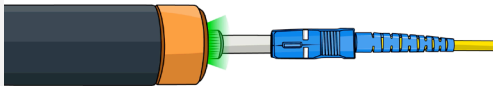
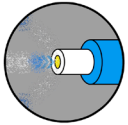
## The Benefits of Combining Tools

One of the study’s most valuable insights was that technicians benefit from using both types of cleaning tools together to cover the occasional times when microdots remain after one touchless cleaning cycle.

- Touchless fluid-based cleaners provide comprehensive coverage across the end face. The fluid breaks the soil bond loosens the material followed by more air flow which pushes soils out of the connector.
- Click-to-clean tools remain excellent for quick, targeted cleaning of the fiber core, especially in environments with lower levels of contamination and low volume requirements. They are easy to carry and intuitive to use,

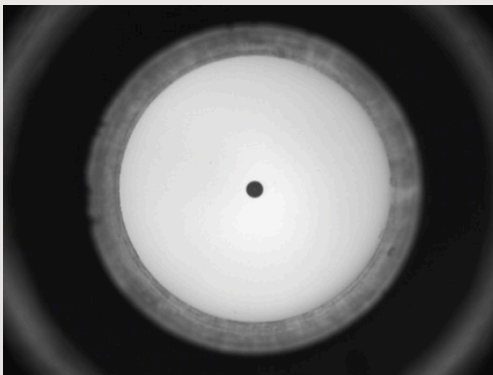
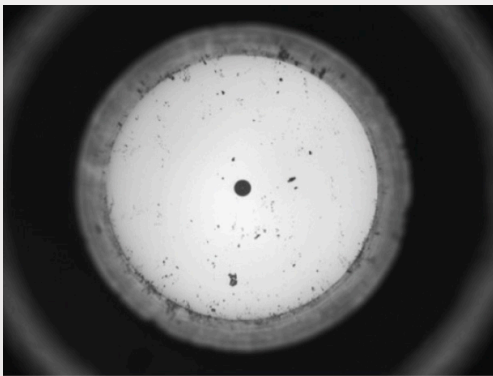


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*Touchless cleaning systems use fluid dynamics to sweep across the entire connector end face, removing dust and oils from core to edge.*

## Dust Removal Before/After



*Mechanical tools often required multiple passes, while touchless cleaning achieved full-surface dust removal in one cycle.*



making them ideal for fast maintenance and troubleshooting. Often though technicians need to click 4-6 times on average per ferrule.

- Using both in tandem gives technicians a flexible strategy. Using a touchless, solvent based, cleaning cycle followed by a single click from a click-to-clean tool ensures a full clean over the entire surface. Used only once after a touchless fluid clean, the occasional remaining “loosened” material gets “wiped off” much easier.

This combined approach maximizes first-pass yields, reduces the need for re-cleaning, and helps prevent contamination from migrating into the optical path. For network operators, this translates into fewer callbacks, less downtime, and extended system reliability.

## Operational Advantages of Touchless Cleaning

Beyond their ability to deliver full end face cleaning—covering the core to the edge in a single pass—touchless fluid-dynamics-based systems also offer several everyday advantages:

- **High efficiency:** A single canister can deliver at least 2,100 cleans, reducing the need for frequent refills and helping technicians stay focused on their work. The large number of single clean greatly reduces “per clean cost”.
- **Environmental responsibility:** The cleaning fluids are nonflammable, non pressurized, and formulated without HFCs. With a low global warming potential (GWP), they align with industry sustainability goals.
- **Portability:** Touchless cleaners are lightweight and cordless, giving technicians the freedom to work easily in labs, data centers, or field sites without relying on bulky support equipment.
- **Cost savings:** In addition to the per-clean cost savings made possible by the Touchless Cleaner’s large fluid capacity, further savings come from reducing call-backs and minimizing troubleshooting caused by network vibration issues. Together, these advantages help lower labor hours and overall service costs.

## Case Example: Data Center Deployment with Combined Cleaning Approach

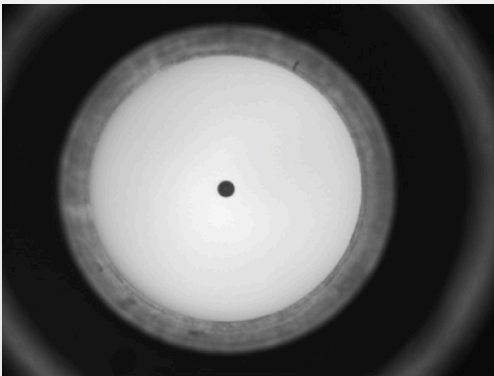
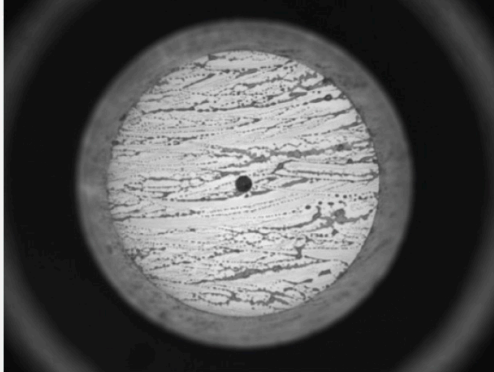
A global financial services provider recently undertook an expansion of its high-density data center. The project involved installing thousands of LC/UPC connectors across multiple floors, each supporting critical trading platforms where milliseconds of delay could have major business impacts.

During installation, technicians followed standard procedures using click-to-clean tools to prepare connectors before mating. While most connectors initially passed IEC inspection, routine spot checks under higher magnification revealed small traces of contamination at the ferrule edges. These particles posed a potential long-term risk, as even minor migration into the fiber core could have disrupted signal quality over time.

To improve cleaning reliability, the team added the Sticklers™ Pro360°™ Touchless Cleaner to their existing clickers. The touchless cleaner swept across the entire connector face, removing residual dust and oils. When occasional microdots remained, a single click with the clicker delivered an excellent final clean.

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## Oil Removal Before/After



*Touchless systems consistently cleared oily films across the entire end face, including hard-to-reach edges.*



*Advancing precision cleaning practices helps safeguard the future reliability of fiber optic networks.*



This dual-step approach produced notable benefits:

- **Improved cleaning assurance:** Connectors consistently appeared clear across the full surface, reducing the chance of future signal loss or back-reflection.
- **Time efficiency:** Although an additional step was added, the touchless tool required only a single quick application. The overall process was still faster than multiple recleans with click-to-clean devices alone.
- **Reduced callbacks:** Over the course of the project, technicians reported fewer instances of re-inspection or troubleshooting, saving valuable labor hours.
- **Expectation management:** Importantly, technicians understood that no single tool was perfect. Both systems occasionally left minor traces under magnification, such as small “dots” from unevaporated fluid or from particulate. However, using them in tandem delivered a far higher level of confidence than either tool alone.

By the end of the deployment, the combined cleaning strategy had become standard practice for the provider’s technicians. They valued the speed and simplicity of clickers for everyday cleaning and relied on the full surface coverage of touchless cleaning for assurance. The approach not only supported the reliability of their trading systems but also gave operations managers greater confidence in long-term network performance.

### Toward a Higher Standard of Cleanliness

The three-year study conducted by the MicroCare Critical Cleaning Lab confirms what many field technicians already know: no single cleaning method is perfect in every situation. Mechanical click-to-clean devices remain valuable for speed and simplicity but may leave behind hidden residues. Touchless fluid-based cleaning systems provide very good cleaning and comprehensive coverage for a great percentage of connector cleaning, but for the remaining percentage, are best used alongside mechanical tools.

By combining both methods, technicians gain flexibility to respond to varied contamination challenges, from fine dust to light oily residues. The result is cleaner connectors, more reliable network performance, fewer service disruptions, and lower long-term costs.

In a field where even microscopic contaminants can cause major disruptions, advancing precision cleaning practices is not just a matter of efficiency, it is a safeguard for the future of fiber optic connectivity.



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