IMPORTANCE AND EFFECTIVENESS OF COMBINATION CLEANING™ PROCESS

The future of fiber optics is big. It's growing, both in complexity and priority, and that means that cleaning processes are more important than ever. Speeds and capacities are expanding from gigabytes to terabytes, petabytes, and beyond to exabytes. Systems and networks are evolving beyond combinations of copper, wireless and fiber optics.

As capacity and bandwidth expand, deployments are updated, and new technicians trained, a clear understanding of the tenets of precision cleaning the connection becomes even more crucial. Unfortunately, that same exponential expansion also means that virtually all standards are outdated by the time they are written and implemented. IEC 61300-3-35 and IEC TR 62627 have influenced TIA 455-240, Telcordia GR-2923-CORE, and SAE AR-6031, and yet still, cleaning processes are often behind the curve. This paper is a suggestion, with practical recommendations, to exceed these standards to ensure best practices to future-proof the installation.

First Things First

In order to assure accurate test, measurement, and high-speed transmission of services, precision cleaning the end face is the first step before test, deployment, and trouble-shooting. In any cleaning experience, the results depend on the materials, tools, products and processes. Not all cleaning returns the same result. The same is true for cleaning a fiber optic connection.

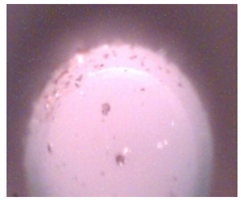

Figure 1 - Dry debris

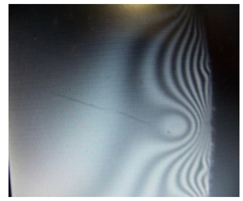

Figure 2 – Fluidic/Flood contamination

Figure 3 - combination debris

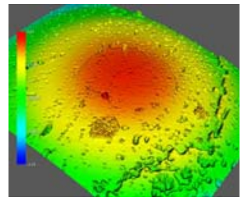

Figure 4 - 3D soils

Standardizing Equals Excellence

A best practice procedure doesn't necessarily require multiple techniques and numerous attempts. In fact, one standardized precision cleaning procedure for all connections is ideal. The process should remove the widest range of debris and contamination the first time.

First, it is essential to consider all potential sources and types of soils. Ineffective cleaning procedures may result in debris being mischaracterized as an artifact. Many types of debris and contamination can negatively impact fiber optic connections, including:

- dry (figure 1)
- fluidic (figure 2)
- a combination of the two (figure 3).

Contaminants also have height (figure 4), which can increase refractive interference.

Recommendations for Common Cleaning Methods

"First time cleaning" means more than an economy of time. In fact, first time cleaning of simple debris such as Arizona Test Dust or finger oil is not much of a challenge, and possibly relevant only to OEM (Original Equipment Manufacturer) and not OSP (Outside Plant)/Field Service.

Field applications, however, differ widely. For field applications, a cleaning process must be effective on a range of debris and contamination, including contamination or cross-contamination from previous use of inappropriate cleaning products. There should be special consideration of Zone 4 and 5 (figure 5).

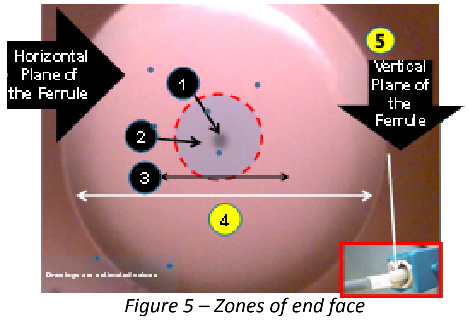

Figure 5 – Zones of end face

Testing and field experience consistently shows common cleaning techniques, even those recommended by existing standards, are not reliably effective. It is, however, possible to clean completely and reliably the first time using a modified cleaning method and materials.

Dry vs. Wet/Wet-to-Dry. Per IEC 63100-3-35 and IEC TR-62627, the dry process is identified as the first-choice followed by a "wet/wet-to-dry" technique if the first dry process does not work. Standards and individual business units can recommend cleaning up to five times after which comes field replacement or warranty claim.

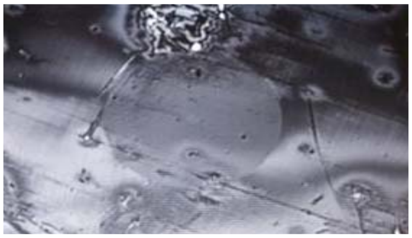

Figure 6 - Dry cleaning tends to move debris

Dry cleaning is often done with a tool for the end face, or swab or probe for the back plane connection. It may be effective on oily contamination, but has several significant limitations. Most significantly, dry cleaning tends to move, but not remove, debris and contamination (figure 6). Tips for success:

- Use dry cleaning only with 100% video inspection, due to its unreliability and unrepeatability.
- Modify the twist or figure-8 cleaning motion to a straight-line motion that moves the debris away from the initial point of contact. The dry technique can generate a static field that attracts additional debris, and since debris has height as well as diameter, some types of debris may damage a connection during dry cleaning or create a standoff, which can magnify loss.

Wet/wet-to-dry cleaning is commonly done with a presaturated wipe soaked in a solvent, followed by drying with a similar material as dry cleaning. The "wet-to-dry process" is an advance over the dry technique, but one challenge is that too much solvent can flood the connector, drawing up contamination from around the ferrule. Tips for success:

- Addition of a precision cleaner will remove a far wider range of contamination, and inhibit static generation.
- Prevent the common misinterpretation that wet-to-dry term means solvent oversaturation, which can cause the cleaning solution to become trapped in zone 5, the barrel of the ferrule. Simply wiping a ferrule or end face with a presaturated IPA wipe can result in contamination moving from zone 5 through zone 1, causing failure.

Combination Cleaning for First-time Cleaning

The Combination Cleaning procedure offers the insurance of proven cleaning effectiveness with maximum repeatability. The Combination Cleaning process utilizes:

- minimal amount of a precision solvent with the ability to remove the widest range of debris and contamination
- a no-linting, highly absorbent wiping media
- an integrated drying step within the cleaning procedure

When the correct materials are used, this simple process improves results in typical first time cleaning.

Process:

Figure 7 – Combination Cleaning process

1. Place a drop of solvent (enough for a dime-sized spot) on the wipe, and then lightly draw in a straight line from the solvent over the dry wipe, removing the soils and drying the end face in one motion. (figure 7).
2. Move debris and contamination are moved away from the initial point of contact in a straight line only.
3. Avoid figure 8 motions and twisting or turning motions, as these can redeposit contaminants or grind debris into the end face.
4. Avoid hard-backed surfaces, as they can also grind debris into the end face, and palm cleaning, which can transfer body oil or other contaminants through the wiping material.

The combination cleaning process has been proven effective on all types of connectors including: SC/LC UPC and APC, OptiFit™, MT-Types, e2000™, and various expanded beam geometry.

The Paper Towel Problem

Wiping material must be clean and not susceptible to generating particles or other soils. Paper towels are comprised of 100% cellulose, which can generate and shed particles when wiped, making them an ineffective cleaning material.

The best choice is a nonwoven mixture of polyester and cellulose, which has proven to be extremely effective at not generating particles as well as entrapping the soils removed from end faces. Some cleanroom grade microfiber materials have also proven to be very effective at cleaning with the addition of the proper cleaning solution.

Choose the Right Solution

The choice of cleaning solution should be based on the required properties of the solution.

- Aqueous cleaners, as effective as precision hydrocarbons, require an active drying phase.
- IPA itself, even in 99.9% strength, is not the best choice because it is ineffective on the widest range of debris and contamination and it is hygroscopic: it quickly attracts moisture to itself to the time it reaches a 65% IPA/35% water equilibrium.
- Non-flammable solvents, like those based on 3M HFE or DuPont® HFC, offer safety and performance advantages, but at a relatively high cost and with limited performance over the wide range of contaminants seen in OSP.
- AK-225 based solvents are scheduled for phase-out per international agreement.

The Right Tool for the Job

The right cleaning tool is just as essential to the effectiveness of the cleaning process. There are many devices that include reel type cassettes, probe-type tools, precision swab tools, and cleaning platforms, each with its own advantages and challenges.

Producers of cassettes and probe tools claim convenience, while developers of cleaning platforms point to the larger cleaning surface that allows more process flexibility with profoundly better cleaning of APC geometry. Cleaning platforms work better as there is a larger surface to carry away the debris and contamination: they are easier to moisten for a best practice technique. Probes and swab tools have the smallest cleaning surface and have the most difficult task of removing debris completely. It is highly recommended your choice be made not on convenience, but rather performance. This added performance can return benefits in time, reputation, and customer satisfaction.

Always Improving

Adaptability and advanced training are just as important as tools and materials. Standards themselves should be adaptable and updated as new challenges are found, and yet even in these days of lightning-fast communication, a published standard published may not be disseminated into the field for some years and not updated for more years after that time.

As an industry, fiber optic transmission changes quickly, and the precision cleaning process must be responsive to those changes. Most importantly, processes should be developed to anticipate those changes, working from worst case to best practice, and ending only in the best possible result.

References

1. Interferometer readings courtesy of Promet Corporation using a FiBO® 250 device.
2. TIA 455-240 September-2009. IEC 61300-3-35 ed1.0 2009 August 2009. Telcordia GR-2923-CORE. February-2010, SAE AIR-6031. September-2012

Biography:

Edward Forrest is a graduate of Kenyon College, Gambier, Ohio, USA. With over twenty years experiences and expertise in precision cleaning various applications that range from electronics to fiber optics, he has seven patents (with others pending) in the specific area of fiber optic precision cleaning.

Scan to see Combination Cleaning in action

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