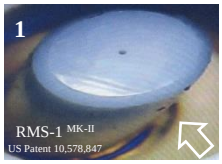
WHAT ELSE DO WE NEED TO KNOW ABOUT FIBER OPTIC PRECISION CLEANING AND INSPECTION?

by: Edward J. Forrest, Jr. SME

Abstract: Cleaning fiber optic surfaces remains one of the most discussed and mission-critical topics. End face cleaning, consideration of misalignment by cross-contamination of unseen surfaces is an essential topic. Proper cleaning of gels and stripping residues prior to fusion splice of both single and multiple fibers is another. Related to fusion splice and successful deployment is maintenance of the critical mechanical components of each fusion splicer. A new amalgamated understanding of the correlation of these leads to future-proof best practice deployments.

IS PRECISION CLEANING AN END FACE … GOOD ENOUGH?

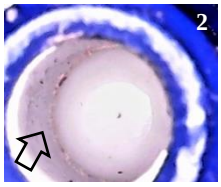


It is understood well that the transmission fiber or 'core' is the most critical component. If this area is contaminated there may be insertion loss, reflectance from phenomenon such as refraction, or, misalignments caused by a mismatch. Most have been trained to consider the horizontal surface as seen in Image 1. Researchers are expanding awareness beyond the relatively small horizontal surface area diameter of 250-400 microns around the core to the total horizontal known as "Zone-4". In this image the horizontal end face passes auto-detect based on IEC 61300-3-35. The arrow points to potential cross-contamination from debris on the unseen "Zone-5" vertical ferrule.[a.]

As one jumper is inserted into the alignment sleeve, unseen debris on those surfaces also become problematic. Unseen connector surfaces are the potential cause of failures.

These are not new awareness. Beginning in 2005 Cisco Systems published studies that spoke to obscured surfaces and removal techniques of complex debris and the need for first time cleaning.[b] An extensive 2016 report expanded the Cisco Series of complex debris by creating worst case 'combination soils'.[c]

Even so, end face cleaning remains an unnecessarily parochial and (by and large) a non-scientific product based approach.[d] Crafts persons are most often taught to clean 'dry' first and use 'we-to-dry' when that does not work.[e] Dry cleaning is a 'mopping action' for fluids and 'wet-to-dry' cleaning works best for dry debris. While 100% inspection is a highly desirable ideal, the reality is that more likely is a cleaning procedure of some type. Many years of field-proven work and scientific study have detailed that proper use of a solvent enhances precision end face cleaning of all tools. This 'open architecture' cleaning procedure is a major advance over 'dry and wet-to-dry cleaning'.



Since it is most likely the technician will clean in some way…retraining to one common process, for all deployments, is an invaluable new skill. This an 'open architecture' process. It is adaptable to most cleaning tools and is vendor neutral. As technicians migrate between work orders, fundamentals of these critical tasks become an essential cross-pollination.

One cleaning procedure is the common base line that transcends all deployments in a common value of this critical function. Inspection awareness of the 3D nature of connections is 'new best practice'. Debris is often present in unseen areas. Re-training to this potential is an invaluable higher-standard.

IMPROVED FUSION SPLICE PREP

Gels, pulling lubes, dirty and oily hands all play a critical role in precision cleaning…anything! For the small and precise surfaces that are fiber optic, selection of the actual cleaning materials is *'pretty-darned-important'*! Imagine your new car…surely you would study which detergent would remove mud or road tar. When considering a fiber optic solvent…there are critical decisions as well. Career experiences in high value electronics lead to the conclusions that a precision cleaning solvent must be: **1.)** effective on a wide range of debris, **2.)** used minimally in an applications specific manner, **3.)** safe on plastic substrates, **4.)** evaporate quickly but not so much as to leave behind a residue more difficult to remove than the original contamination and, **5.)** be safe for the end user and environmentally responsible. It's a tall order that began to be unwound with The Montreal Protocol of the late 1990's and continues to this day.

Each of these qualifiers is essential. For the fusion splice prep operation perhaps the least understood is Item-2. 99.9% Isopropanol remains the solvent of choice for cleaning gel and buffer residues from the sides of the glass fiber prior to placement in v-grooves. However, even 99.9%[f.g] IPA is not an effective universal cleaner and far too often it's use for fusion splice becomes a cross-application for end face cleaning. As well, some of the ultra-fast evaporators are also deficient choices as these are weaker cleaners for both non-polar soils that may contaminate the bare glass.[hg] My personal choice for fusion splice prep and end face cleaning are the precision hydrocarbons. Coming from the same general chemical family as IPA, these solvents work exceptionally well on both polar and non-polar soils[h] . This means that were there a cross-application the universal nature of the cleaner does not limit cleaning ability and simplifies training.

MAINTAINING FUSION SPLICE MACHINERY

I have no reason to doubt the rep's tale how his father would spend an entire day welding two fibers with an acetylene torch!

Equally amazing is the current generation of fusion splicers. Lower loss with every generation, simplified to where training is minimal, and essential for long runs and fiber breaks, the contemporary fusion splicer is micro-machinery at its very best. All of this comes with maintenance awareness of the myriad components: **1.)** v-grooves, **2.)** lenses, **3.)** LEDs, **4.)** electrodes, **5.)** fiber clamps, **6.)** fiber holders, and even cleaning-the-cleaning-brush and fiber cleaver are only a few possible 'soil points'.**(h)** Some have reported use of IPA corrodes the electrodes causing premature failure. (IPA attracts ambient moisture to itself so this is a possibility.)

As in other high-value cleaning operations, precision swab tools are the best choice for 'cosmetic cleaning'. The contemporary worker 'steps forward' to assure all functions of the fusion splicer are synchronized with advanced precision cleaning and inspection methods/procedures beyond convenience and price![h]

Trainers, marketers, and end users have essential roles in standards which should be 'blogged' for field input. Standards are minimum requirements: guidelines for network designers and local managers who shall specify cleaning and inspection procedures as "applications specific".

a.) "The Impact of 'Primary' and 'Secondary' Contamination on all fiber optic surfaces". Edward J. Forrest, Jr. 2022 White Paper **b.)** CISCO EDCS-519772 2009 **c.)** "A Comparison Study of Cleaning Methods for Fiber Optic Surfaces". Edward J. Forrest, Jr. 2016 Amazon.com **d.)** "How we do and should not; should and may not clean a fiber optic connection". Edward J. Forrest, Jr. 2016 Amazon.com **e.)** IEC 61300-3-35/IEC TR-62627. **(f)** "99.9% IPA Cleaning comparison to precision hydrocarbons". James Fitzgerald. 2003. **(g)** "A Comparison of Hydrofluoroether and other cleaning solvents". James Kehrem. 3M 2009. **(h)** "The Role of Craftspersons, Marketers and SME in fiber optic precision cleaning and inspection: Training the Trainers" Edward J. Forrest, Jr. 2022. Others on request.