

**Want to achieve polished fiber end faces that are consistent and perfect? Read on.**

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## Datacom Q&A: Fiber Perfection?

By D.A. "Bo" Conrad, RCDD

**Q.** Achieving a clean "bull's eye" look has become vital to support the stringent parameters of 10 Gigabit Ethernet (GbE), or 10GBaseSX (850 nm) and 10GBaseLX (1300 nm). **SEE PHOTO ONE**

How well do different termination options achieve consistent, near-perfect polished end faces for both multi-mode (MM) and single-mode (SM) fiber?

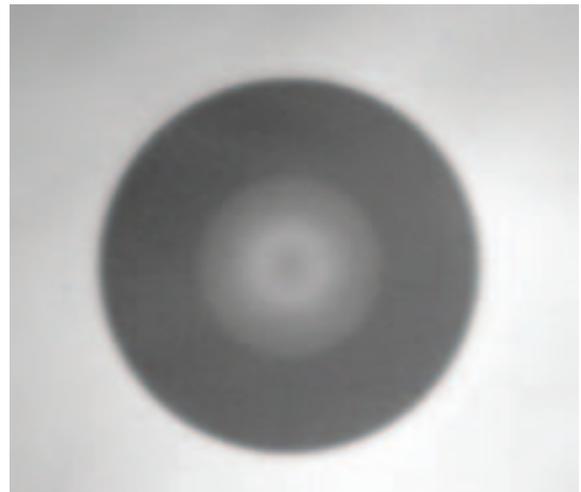
**A.** Anaerobic, epoxy, hot melts, UV, crimp type fiber connectors and other traditional field terminations requires scribing and figure-8 polishing on the pad or glass.

Novices and experienced techs in a hurry typically do not produce consistent high-quality results using such legacy methods. **SEE PHOTO TWO**

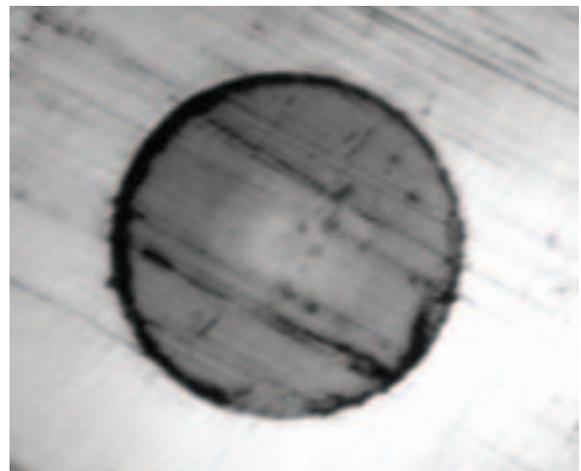
High-quality results can only be produced properly following the exact three-to-four step polishing process guidelines of the manufacturer and discard used papers, contaminated needles, and outdated consumables.

Conventional methods were sufficient over the past 15 years for applications up to 100BaseFX with parameters of 2 kilometers with an 11 dB budget loss.

However, the 10-Gigabit-Ethernet parameter in the 850 nm wavelength range is reduced to 300 meters with a maximum insertion loss/attenuation of only 2.6 dB for 50.0/125 μm using laser enhanced fiber.



**PHOTO ONE.** The (Near) perfect fiber connector polished end face.



**PHOTO TWO.** A typical "two minute or less" scribe-to-figure 8—hand polished end face result with scratches.

Making matters worse, single-mode terminations are more susceptible to back reflectance when they have a poorly polished end face.

Existing ANSI/TIA/EIA 568B.3, 526-14A and 455 FOTP 171 standards of 0.75 dB maximum loss per "mated pair" are simply too high when determining the aggregate budget loss of a fiber segment or link.

A more realistic approach is to use similar termination and polishing guidelines to achieve Telcordia GSR 326 specifications.

This would include a maximum insertion/attenuation loss of 0.50 dB with a nominal target loss of 0.30 dB or less.

One might well be skeptical of manufacturers' claims about their "scribe to hand-polish" terminations in "2 minutes or less." Why?

In most cases, the "end" result looks terrible when viewed on a 400 X DORC video microscope. Micron scratches and pits that cause high back reflectance are usually visible.

Given all of the above—what are the options to achieve consistent lower dB insertion/attenuation loss results while achieving lower labor costs?

#### TERMINATED FIBER OPTIONS

Several options offer advantages over traditional mechanical splicing.

**Fusion splicing pigtails:** The most

common alternative to field hand-polishing is to pull unterminated cable and fusion splice it to factory-polished pigtails.

A "pigtail" is simply a short, one meter bare, 900  $\mu\text{m}$  fiber cable assembly (vs. a 3 mm jacketed patch cord) that has been tested and then cut in half for splicing. The splice is placed into a splice tray fitted to the same fiber enclosure manufacturer. **SEE PHOTO THREE**

As with all packaged multi-mode fiber patch cords and pigtails, bi-directional insertion/attenuation test results should be in the bag with the cable. Single-mode patch cords should also include back reflectance and interferometer readings.

#### GET A FUSION SPLICER!

For fusion and mechanical splicing, the ANSI/TIA/EIA 568B standard is still 0.30 dB. Given the quality of splice machines and (mechani-

### Got Questions About Datacom?

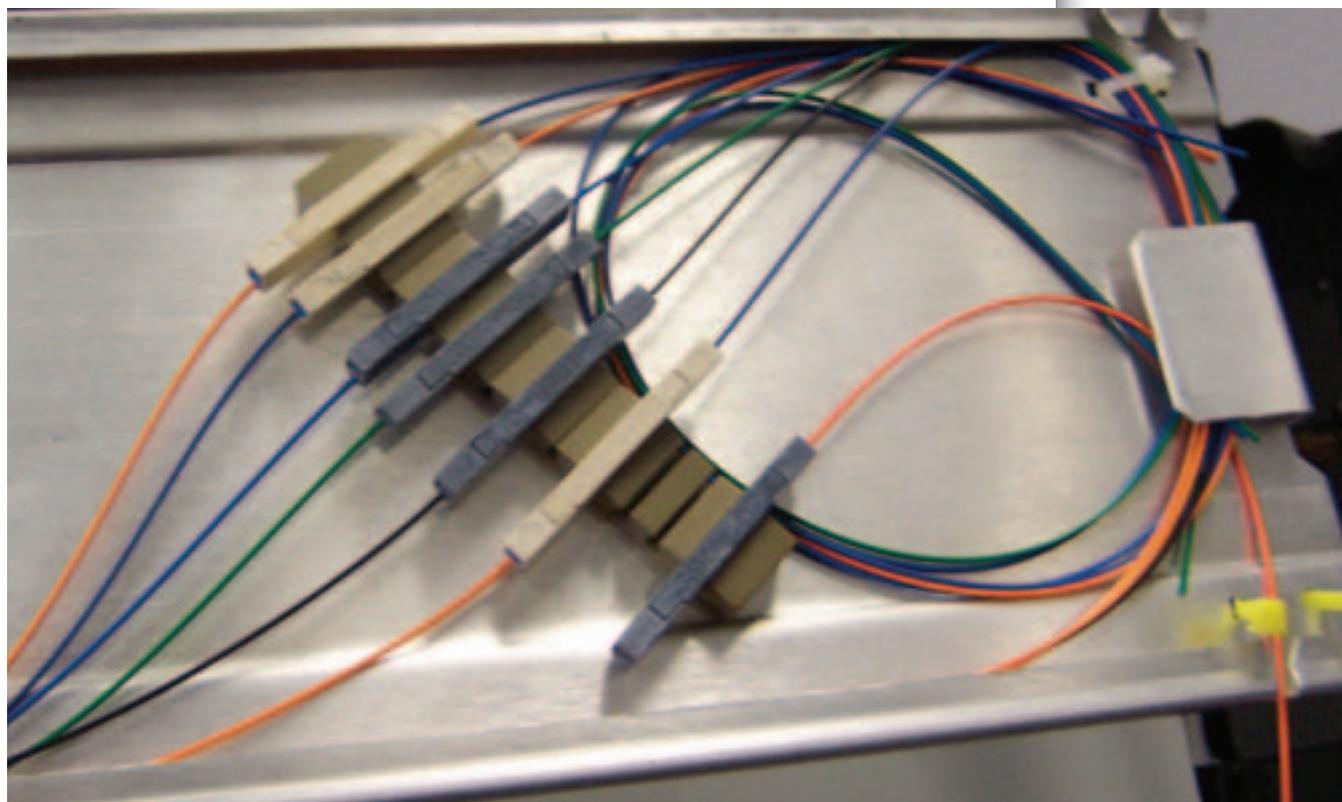
Bo Conrad, a BICSI-certified instructor, will answer them.

To have your question answered in **Power Outlet**

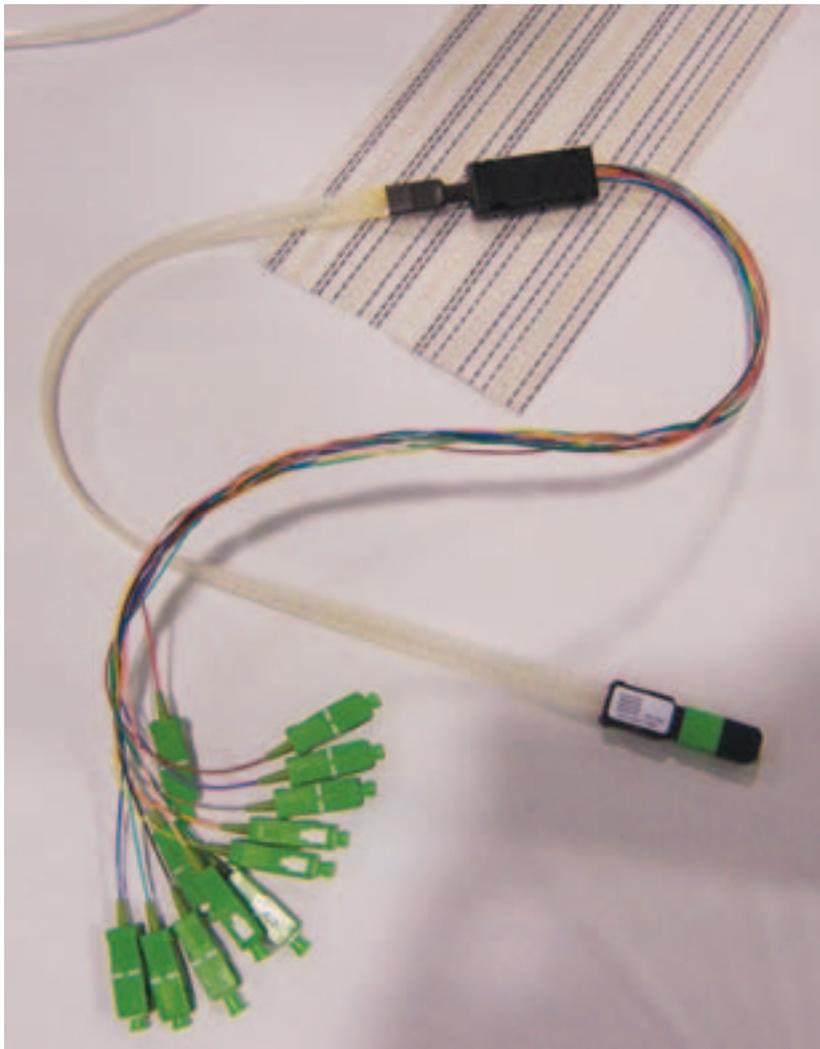
e-mail us at

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and put "Ask Bo" in the subject line.



**PHOTO THREE.** Mechanical (and Fusion) splice tray inside enclosure.



**PHOTO FOUR.** Ribbon fiber encased in a patented plastic having MTP-to-SC connectors.

cal) connectors today, I would reject any installation that had over 0.10 dB and would insist on a target with a maximum 0.05 dB.

Subsequently, the splice should be transparent and not have any significant contribution to overall insertion/attenuation loss.

*Note:* It would be difficult to isolate the loss of a mechanical splice whereas a fusion splicer can accurately determine the loss of a splice.

Of course, not everyone can afford a \$22,000 to \$65,000 fusion

splicer. Daily rental rates are \$300 to \$500, weekly from \$1,000 to 1,400, and monthly from \$1,800 to \$2,100.

These devices are worth the cost because they make splicing fairly simple and routine. All that is required to achieve a good result is to calibrate the machine to the environment, prepare the fiber, cleave (\$1,200 cleaver included), place and align the fiber in the splicer's guides and press the button!

*Voila!*

The visual LED steps you through

the process from alignment, the arc, to testing, and encapsulating.

A near-perfect end face is possible because the cable is spliced to pigtail factory-polished connector ends.

**PULLING PRE-TERMINATED CABLE**

Pulling pre-terminated fiber cables with a pulling eye is commonly referred to as the “plug and play” method. It was popularized by the higher density ribbon-fiber of the MTP and MPO connectors.

Key is that the connector ends have been terminated, polished, cleaned, tested, and placed in “protective custody” of a pulling eye.

**SEE PHOTOS FOUR**

Pulling eyes protect connectors while providing a pulling point with properly distributed tensions on the cable assemblies. A rotating swivel end clip—or “dog latch” without the catch—minimizes cable twisting.

A fully-protected plastic “condom” covering can reduce the chance of pulling cable through water and contaminants.

Those near-perfect factory-polished connector ends provide the same advantage with this method, but only if they are not damaged during installation.

**AUTOMATED FIELD POLISHING EQUIPMENT**

To achieve results in the field similar to those from the factory, be prepared to purchase proprietary equipment, consumables, and connectors.

◆ **Suhner Fiber Optic Quick Assembly Field Termination System**—This system uses a device called the Manipulator™. It is about the size of



**PHOTO FIVE A.** Suhner Manipulator™ for field terminations.



**PHOTO FIVE B.** Scribing the fiber like a guillotine.



**PHOTO FIVE C.** Complete Manipulator™ termination kit.

a flashlight and has a built-in visual grinding checking feature.

**SEE PHOTOS FIVE A, B, & C**

Suhner ([www.hubersuhner.com](http://www.hubersuhner.com)) claims termination is reduced to less than 2 minutes because a technician can “manipulate” the assembly, epoxy, scribing, and polishing processes from a single unit. No AC

power cord is required.

Manipulator’s proprietary connectors have butterfly-like wings for securing into the unit. The patented bonding epoxy agent is premixed and stored as a powder in an integrated container.

In addition to Manipulator, the system includes adapters for ST and SC,

lapping wheel, coating stripper, Kevlar scissors, marker, polishing paper, and isopropyl cleaning clothes.

◆ **Ultra Tec FTTX Portable Fiber Polisher**—This polisher is also about the same size as a D-cell flashlight, but it has a larger head and can be held at any angle. **SEE PHOTOS SIX A & B**

This device has a built-in polishing pad mechanism under the connector jig. It can house up to four connectors.

More important, it functions like an (mini) automated industry-standard table-top production polisher machine with easy-to-replace connector plates, or “jigs,” to accommodate a variety of connector types.

It is rechargeable or can be powered with an AC adapter.

◆ **Krell Technologies Proton FTTX Field Polisher**—Krell’s ([www.krelltech.com](http://www.krelltech.com)) portable, battery-operated polisher offers patented independent suspension and optically aligned work holder design to

consistently achieve UPC and APC finishes. **SEE PHOTO SEVEN**

Krell's SpecPro™ uses the same technologies in its Proton™ polisher to offer low volume application “workcell” for precision polishing. Interchangeable workholders accommodate a variety of connector types and make it ideal for retro polishing and repair.

◆ **Seikoh Giken's mini Repair Mate**—This device, which is just

under 6 inches tall, can remove up to 10 μm scratches in a one- or two-step process. It operates on either 4 AA batteries or an AC adapter. Replaceable fixtures (jigs) polish SC, ST, FC, LC and MU connectors. **SEE PHOTO EIGHT**

◆ **Diamond Corp's Connector Fusion Splicer**—Diamond Corp. ([www.diamond-fo.com](http://www.diamond-fo.com)) offers the E2000 connector (LC/MU size

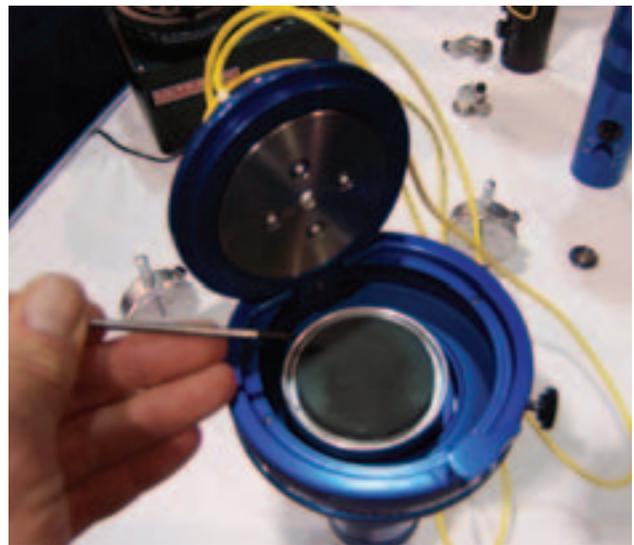
and shape but with a shutter) and a unique Fusion Field Termination kit for both MM and SM fibers.

Key to this system is the proprietary “crocodile alberino”™ field fusion ferrule assembly, available in both PC (basic polished Physical Contact) and APC (Angle Polish).

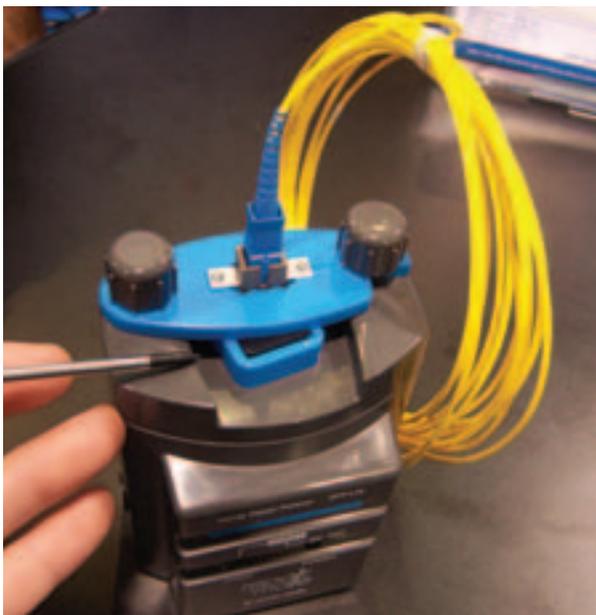
It encapsulates a factory-polished fiber end face and ensures lower insertion/attenuation loss and back reflec-



**PHOTO SIX A.** Ultra Tec FTTX portable fiber polisher.



**PHOTO SIX B.** Built-in polishing pad mechanism.



**PHOTO SEVEN.** Krell Technologies Proton™ FTTX Field Polisher.



**PHOTO EIGHT.** Seikoh Giken mini-Repair Mate™ field polisher.



**PHOTO NINE.** Diamond fusion splicer for splicing glass directly into proprietary connector.

tions. **SEE PHOTO NINE**

A fusion process—rather than a crimp process—mates and secures the cable’s cleaved fiber to the factory pre-polished fiber within the ferrule assembly—in lieu of index matching gel.

Besides a fusion splicer, the kit includes the cleaver, stripping tool, and different fiber holders to accommodate different connectors.

Diamond also has a Crimp and

Cleave field termination kit specifically designed for HCS fiber applications.

◆ **Neptec’s EZFieldMate™ Field Termination Kit**—Neptec ([www.neppot.com](http://www.neppot.com)) markets the kit as the only traditional method, hand-polish figure 8 process that achieves PC, UPC, and APC finishes.

It is portable and self-contained, and satisfies the GR-1081-CORE criteria for installing 50



**PHOTO TEN A.** Neptec’s complete polishing kit meets the GR-1081-CORE criteria for terminating 50 connectors in one kit.

connectors from one single case. **SEE PHOTOS TEN A, B, C, & D**

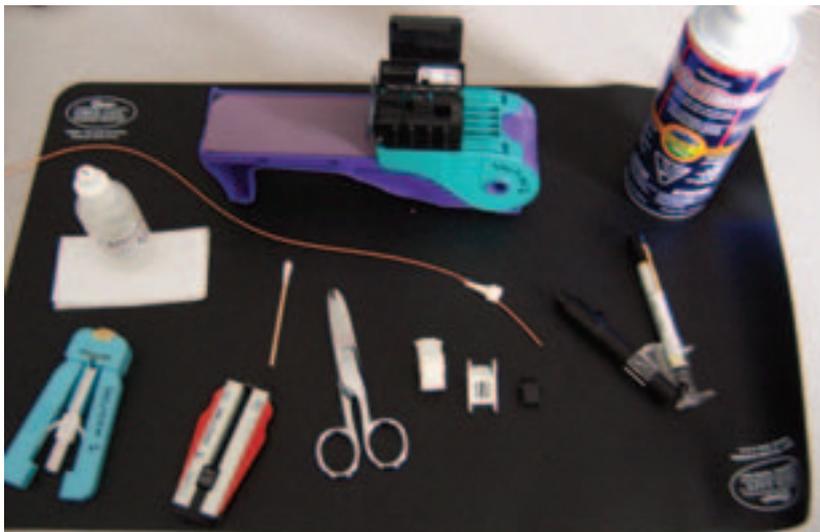
Neptec claims that any field technician can provide quality, consistent terminations within 10 minutes.

This kit uses conventional epoxy-type connectors that are cured in an oven hooked up to a portable self-contained 12-volt battery.

Once cleaved, any UPC/APC



**PHOTO TEN B, C, & D.** Four adhesive-backed polishing papers of different coarseness are to be cleaned after each wet-polishing process.



**PHOTO ELEVEN A.** 3M Volition™ VF 45 complete termination kit.



**PHOTO ELEVEN B.** Two fibers being inserted into the proprietary VF 45 connector-holder.



**PHOTO ELEVEN C.** Two fibers being inserted into the connector-holder.

connector is placed into a spring-loaded polishing puck/jig that will ensure proper, consistent pressure as well as flatness to minimize fiber-to-ferrule offset.

A six-step polishing process using a special engineered polishing puck/jig is the key to maintaining compliance to Telcordia GR-526.

Four of the steps are wet and include adhesive-backed polishing papers of varying coarseness adhered to a large plastic polishing plate.

After each incremental wet polishing step, the ferrule and papers are cleaned. The final step involves a dry wipe and index matching-gel paper to fill in any micron scratches. It is similar to polishing or waxing a car.

Neptec also sells the FiberSwiper™, QuikSwiper™, and KleanCore™ dry-clean options for a variety of connectors and applications.

#### PRE-POLISHED CONNECTORS

This method is becoming very popular and being heavily promoted by Corning (formerly Siecor; [www.corning.com](http://www.corning.com)) and Belden/CDT (formerly Nordx; [www.beldenIBDN.com](http://www.beldenIBDN.com)).

Both product lines use the proven

technology of a mechanical splice—the cable is prepared, cleaved, and inserted into the connector having a pre-polished, fiber stub. Fiber ends are secured and mated together with an index matching gel to reduce insertion loss. A proprietary jig houses the connector. The fiber is secured with a crimping process: Corning uses the jig and Belden/DCT uses a crimp hand tool to complete the crimp process.

An alternative to the ferrule polished end concept is 3M's proprietary Volition VF-45™. It also qualifies as a Small Form Factor (SFF) because it mates two polished bare fibers together with two other bare fibers in a proprietary connector jack and plug RJ-45 like array.

It supports 10GbE while reducing cleaving time to less than two minutes—given the absence of the ferrule. **SEE PHOTOS ELEVEN A, B, & C**

#### SO—WHAT'S THE BEST CHOICE?

Searching for a perfect bare fiber polished end face is an adventure. You really have to admire the ingenuity of the many engineering “solutions” being offered. The choice becomes what really “tickles your fancy.”

Carefully evaluate the features and benefits with price and labor costs savings—while keeping in mind standards compliance and reliability. ⚡

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*Conrad, a BICSI-certified trainer, has a bachelor's degree in engineering and an MBA. His company, Crossbow communications ([www.crossbow-com.com](http://www.crossbow-com.com)) is licensed by BICSI to conduct the Professional Cable Installer program. See “Datacom Q&A” questions (and answers) online at [www.Rexelusa.com](http://www.Rexelusa.com) in Rexel's E-Zine.*