Answers To Your Datacom Questions ASK BO!

Bo Conrad – a BICSI-certified instructor – provides answers to your datacom questions here in the quarterly POWER OUTLET as well as weekly at www.rexelusa.com. Send your questions to poweroutlet@rexelusa.com; put 'Ask Bo' in the subject line!

By **D.A. "Bo" Conrad**

Question

What is the proper way to store fiber optic spools of cable?

Large spools of fiber optic cable should be stored horizontally on their edges. This technique distributes the cable's weight of the cable evenly and spreads it along the entire length of the spool's center mandrel.

Compare this to a garden hose and reel (Figure One). You reel, store, and pull the hose from a horizontal position. If you stacked it upright, the combined weight of the hose and water would flatten the hose portion on the bottom and it would "attenuate" the water stream.

If you store and stock cable spools either flat side (top or bottom), you'll get the same effect. Figure Two shows that the cable's weight is compressing the cable portion on the bottom. This will eventually damage or flatten the cable strands inside and, over the long term, attenuate the glass.

When performing an OTDR test on a spool of fiber optic cable (especially loose-tube cable), ensure that the spool is on its edges for more accurate and consistent readings. This is common procedure by the manufacturers. Otherwise, you will find significantly higher attenuation and/or inconsistent readings when positioned on either flat side.

A knotty problem: Most shippers and carriers will stack spools on their sides. Though this is not recommended, it is temporary and the cable usually will have a chance to recover. Alternatively, it is relatively safe to store or stack lightweight, smaller spools on the flat sides.

Question

Why is there a need to keep the fiber cable shipping and test documentation? What QC procedures should be implemented to avoid the pitfalls of possibly installing bad cable?

Have you ever noticed how fast the fingers start pointing when an installation doesn't meet the spec? Who's to blame?

Was the right cable chosen for the particular application?

Figure One

Was it bad glass?

Were the spools damaged in transit?

Did other trades damage it?

Was the cable pulled, terminated, and tested properly?

Such questions can be answered by implementing a simple Quality Control (QC) procedure prior to an installation – a two-part process of documentation and testing.

Documentation

You'll need to establish an accurate record-keeping system for the project (and maintain it). It is also referred to as CYA documentation; see Figure Three. This will include keeping track of all the documentation that accompanies each delivered fiber-optic cable spool.

Optical cable specification sheets, from the manufacturer, are the first documents that should be in every installer's file. Make sure part numbers on the cable spools match the optical cable specified for the project and are UL-approved. The "spec sheets" provide two important references:

- ensuring that the correct glass type was chosen to meet the network's requirements; and
- ensuring that the cable's jacketing is suitable for the application, meeting both environmental and local code (fire-rating) considerations.

Obtain this information directly from the manufacturer or distributor; contact their local sales representatives with questions.

Why is this important? Product and installation warranties are being stretched out to 30 years . . . even out to "lifetime." Additionally, most project specifications require use of UL-approved cable. It may be difficult to obtain this information if the cable fails years after installation.

Documents With The Spool

Documentation that accompanies each fiber spool is one of the most valuable pieces of information. Unfortunately, it is often neglected. Once in the hands of the technicians, the information is usually ignored (or the documentation is discarded).

A typical QC documentation package should include the following:

- part numbers;
- OTDR test results for attenuation or insertion loss readings;
- length;
- UL approval labels; and
- the bill of lading.

Figure Two

It might sound strange, but the first QC step is to verify that the correct cable and length are being used! *Do NOT take this for granted!* Compare the cable spool's part number to the project's written specifications – as referenced in your documentation.

Attenuation readings verify that the cable complies with industry standards. It is represented as decibels per meter (dB/m) for the given length of the cable for that particular spool (one meter = 3.281 feet). Per industry standards, the loss is proportional to length at a given wavelength coefficient. Use the budget loss measurements in Table One as a guide.

Alternatively, the bandwidth is fixed and expressed as MHz/km from the glass manufacturer. OEMS, distributors, and installers cannot make significant bandwidth capability improvements. Note that the cutoff wavelength coefficient is logarithmic and *not* proportional to length.

However, bandwidth capability is slightly increased if the cable is cut shorter. Only the attenuation and length can be affected. See Table Two for reference.

Documentation purports to tell you that the cable is good and meets or exceeds industry specifications. As the installer, once you accept the cable – from the shipper or by picking it up at the will-call window – it is *yours*. You usually will not have any recourse to return bad cable if it is not tested prior to the installation.

Other documents: The UL-approval number on the cable spools (and the cable itself) verifies compliance for both the glass and the jacketing. The bill of lading is documentation for the type and quantity of the product that was shipped.

Testing

Unfortunately, more than 90% of installers do not check the cable before an installation. Time and expense are the main reasons. This is fine when the installation meets compliance, but when it doesn't, the fingers start pointing.

"Bad cable" is usually the first guess. All doubt can be erased with an established QC procedure – testing the cable ***prior to*** installation. The larger the project, the more critical this process becomes.

An OTDR measurement is preferred. This is easily accomplished using mechanical splices or bare fiber adapters. The "temporary" mechanical splice procedure is fairly simple:

(1) Prepare the strands by separating them from the cable.

(2) Strip off the buffer to expose about 2" of "raw" glass.

(3) Use a quality cleaving tool to cleave the fiber to the length specified by the manufacturer of the mechanical splice.

Figure Three

(4) Insert the fiber into the mechanical splice that has an index matching gel inside. There is no need to "permanently" seal the splice as it is "temporary."

(5) The other end of the splice is a fiber pigtail attached to the OTDR.

See Figures Four and Five.

Bare fiber adapters (see Figure Six) are suited for this type of testing. Prepare the cable in the same manner as stated before. The exposed fiber strand is inserted into the bare fiber adapter that is attached directly onto the OTDR.

Another option is to use a low-intensity laser light to check for "continuity" (see Figure Seven). However, it does not ensure that the glass is compliant or that has any damaged – but not broken – fiber strands are not hidden inside the jacketing.

Testing cable prior to installation is an installer's only option. Even if just one strand fails OTDR measurements or a "continuity" check, the whole cable spool could be returned.

What if the cable tests well, but does

not perform up to standards when installed? Mitigating circumstances can be identified with some troubleshooting. Among the possible causes: Other trades damaging the cable during the construction period, bad connectors, or even poor installation techniques.

Tests, performed before and after installation, are your evidence that the fault is not cable or installation-related.

To repeat: A simple QC procedure prior to installation qualifies as both preventive maintenance and an insurance policy. If your records are in order and you test the cable before installation, you create for yourself a most valuable resource. It will be very useful in helping to determine who's at fault if a fiber cabling network is not in compliance.

. . . or, in the worst case, should you become involved in a lawsuit.

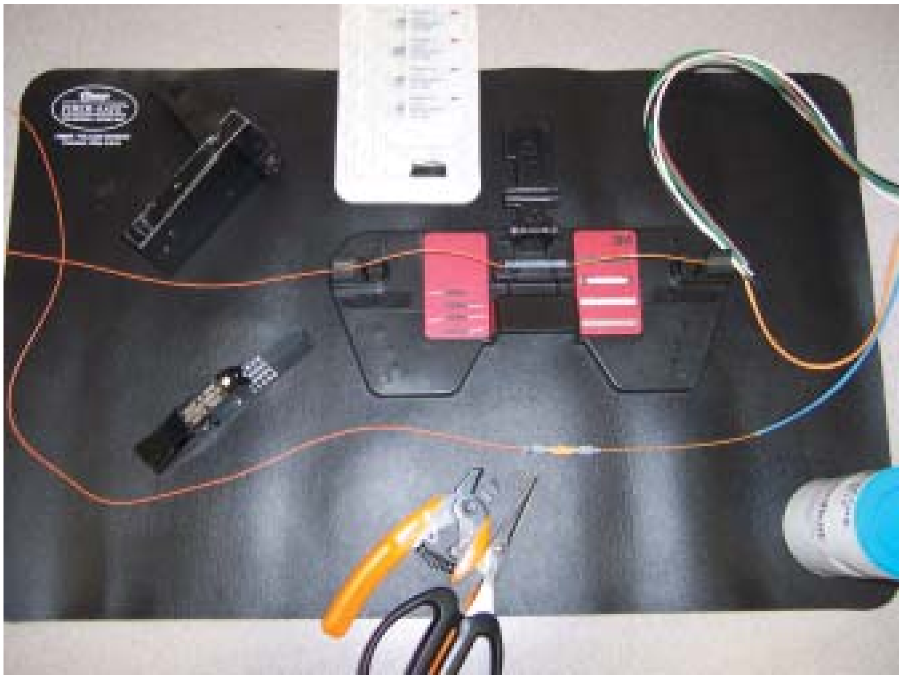

Figure Four

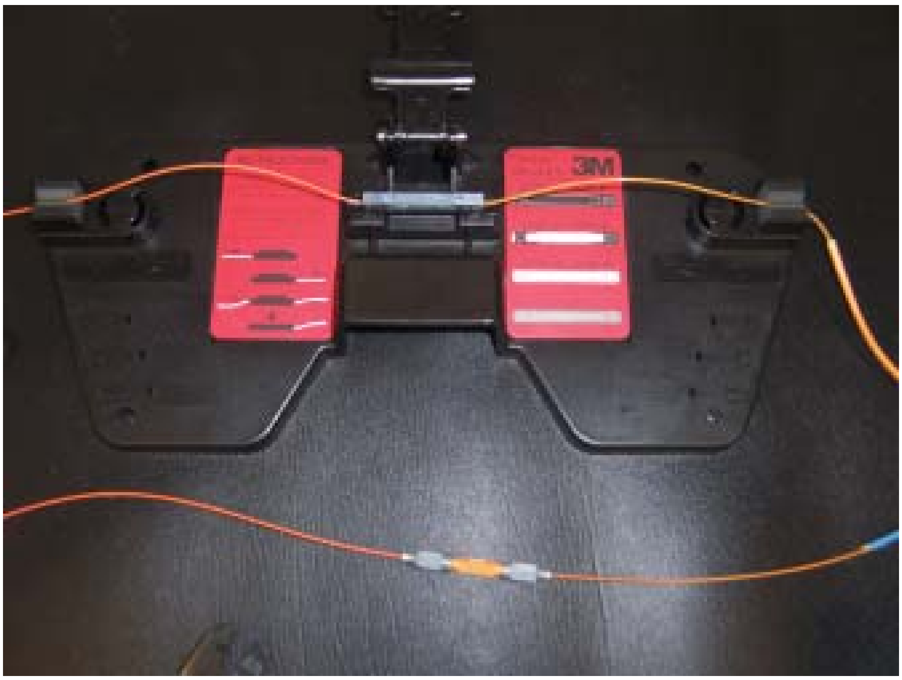

Figure Five

Question

What is the process from manufacturer of the cable to delivery to my job site? How can I (the installer) be sure that we have not obtained "bad" cable?

Many Installers have no real concept of the tracking or documentation process at each stage from manufacturing, through distribution and shipping, to when cable is ready to be installed. By knowing more about how the "system" or the documentation process works, you may avoid some pitfalls.

Have you ever been to a track meet and seen a relay race – such as the 4 x 400 – in which the baton is passed from one runner to the next? Each runner covers 400 meters, then "hands off" the baton to the next.

If you've seen that, you already understand the process. Each time the glass or cable is cut it becomes the "point of demarcation." One source's responsibility ends where the next begins. See Chart One.

Step 1: Making Glass

Optical glass production requires large economies of scale; there are relatively few manufacturers. Dominant players in the U.S. are Corning (which formerly was half owner of the joint venture Siecor) and OFS (formerly Lucent/Spectran). European sources include Alchatel, Draka, and Pirelli. Asian sources include Sumitomo, AFL Telecommunications (Alcoa/Fujicura), and Yangtze.

These glass manufacturers produce "raw" 245 µm clear acroylate-coated glass (*not* the optical fiber cables!). The glass product is used by original equipment manufacturers (OEMs) to make optical fiber cables. Today's practices see most manufacturers conform to strict industry standards (including concentricity, eccentricity, bandwidth,

Figure Six

attenuation, and more). This makes the cable intermixable.

As the glass manufacturing process ends, each fiber strand is carefully spooled and shipped in sealed plastic containers. One of these relatively small-looking containers can hold as much as 25-50 kilometers (15 to 30 miles) of one strand of single-mode glass (and up to 8 km of multimode glass).

You may better comprehend these lengths if you conceptualize a couple hundred yards of four-pound test line spooled onto a fishing reel. See Figure Eight.

Glass suppliers have to provide accurate test documentation to their OEM customers – for each strand of glass produced. Glass that fails attenuation or bandwidth test parameters will not leave their docks.

Typically, the glass manufacturer-to-OEM handoff is accomplished via sealed, boxed containers, each of which contains 12 to 24 spools of glass. Experience has led the glass makers to turn the packaging and protecting of glass fibers for transportation into a science.

Accordingly, it would be rare for a bad cable installation to be attributable to the glass.

Step 2: **Jacketing Glass**

OEM fiber optic cable manufacturers (sometimes referred to as "vendors" or OEMs) include names that might be familiar to you: Avaya, Belden, Berktek, Chromatic, Commscope, Corning, General Cable, Mohawk/CDT, OCC, Pirelli, Superior/Essex, and Tyco.

Note that all purchase glass from the same sources! For some, the supplier is a parent company. This is similar to the Pontiac, Buick, and the Oldsmobile divisions obtaining similar parts and engines from GM.

Be aware of marketing hype. Not one OEM glass manufacturer magically has cable with "better bandwidth capability" than another when comparing apples to apples (same glass types) . . . as it is based upon the glass, not the jacketing!

After accepting the shipment from the glass maker, the OEM cuts the cable strand into various lengths as required for production. The baton has been passed – the OEM is now responsible for the cable's performance warranty.

Basically, the OEMs just jacket the glass! This may include multimode fiber or single-mode fiber, for producing patch cords, tight-buffered breakout and non-breakout style cable (OFNR and OFNP), loose-tube ADSS, Figure "8," mil-spec shipboard, direct burial (OFC), etc.

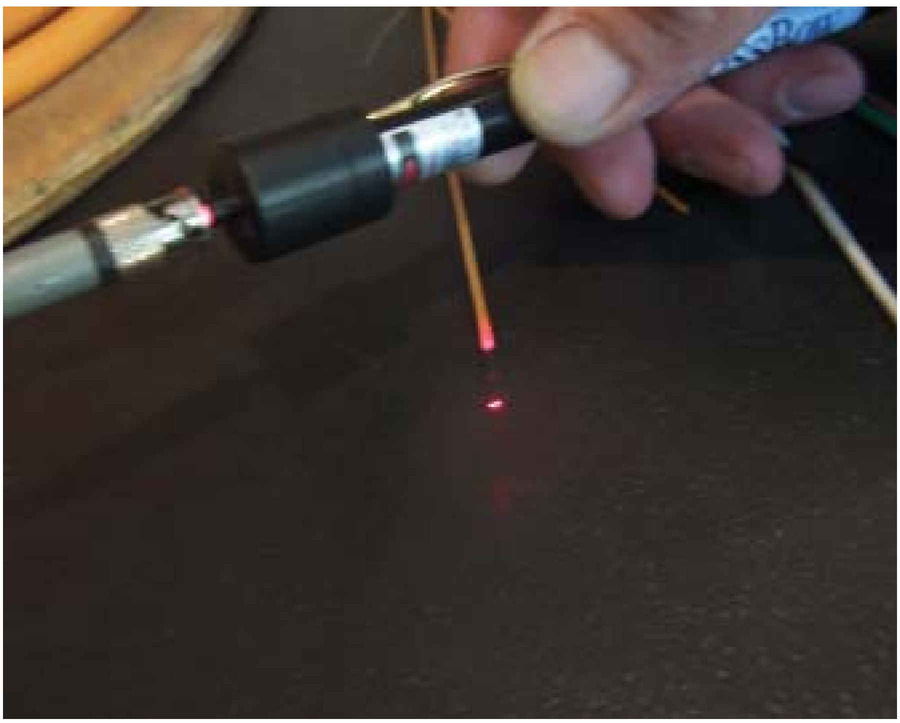

Figure Seven

distributor, in turn, spools off the ordered amount onto another smaller spool (sized for this length). *Alternatively, the distributor may try to sell you the whole spool at a more attractive price!*

If that's not the case, the new (smaller) cable spool should be packaged to protect it from shipping damage – along with the proper documentation.

IMPORTANT: Since the original cable was cut, the baton has been passed again. Before delivery, all of the cable's strands should be tested with an OTDR or, at least, a continuity test. Many will just copy and affix the OEM cable manufacturer's documentation to the new, smaller spool.

Is this a problem? Yes! As the cable has been cut, both the attenuation and length test readings will be different from the original.

***Step 4:* Baton To Contractor**

Whether the cable was cut or not, the baton has passed again once the contractor accepts delivery. This is a key step in the warranty process. Have accepted delivery, the onus for the cable performance warranty now resides with the contractor/installer.

As noted above, it is critical to establish a QC procedure (re-read if necessary the info about record-keeping and documentation). The cable also should be tested prior to installation; OTDR use is preferred.

***Step 5:* Installation**

As this point, the contractor/installer might well have a subcontractor perform the work. One possibility here is that our spool of cable enters into a "black hole" of responsibility.

However, in theory, the same "chain-of-responsibility" continues – as the baton is passed to the subcontractor. Additionally, the cable spool may have to be transported again to the job site (unless drop-shipped to the site or picked up at the will-call window).

Note that, at this point, the fiber

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Figure Nine

optic cable is finally getting close to the hands of the installing technicians. The route from the factory to those hands has seen the cable pass through many stops – inventory clerks, drivers, warehouse workers . . . and now, finally, to the techs.

Perhaps it has become obvious why it's prudent to test the cable every single time it changes hands . . . no matter how much time is consumed, or how "silly" it might seem. Installers *should* receive quality cable with supporting documentation as written proof. But without a QC procedure, there is no insurance policy.

As the last one in the race to receive the baton, the installer ends up with the onus of any performance warranty (attenuation and length).

Conrad, with a bachelor's degree in engineering and an MBA, has held corporate executive positions from international marketing and manufacturing to corporate distributor sales and training. He holds a BICSI certificate as a certified trainer and his company, CrossBow Communications (www.crossbowcom.com), is licensed by BICSI to conduct the Professional Cable Installer Program.

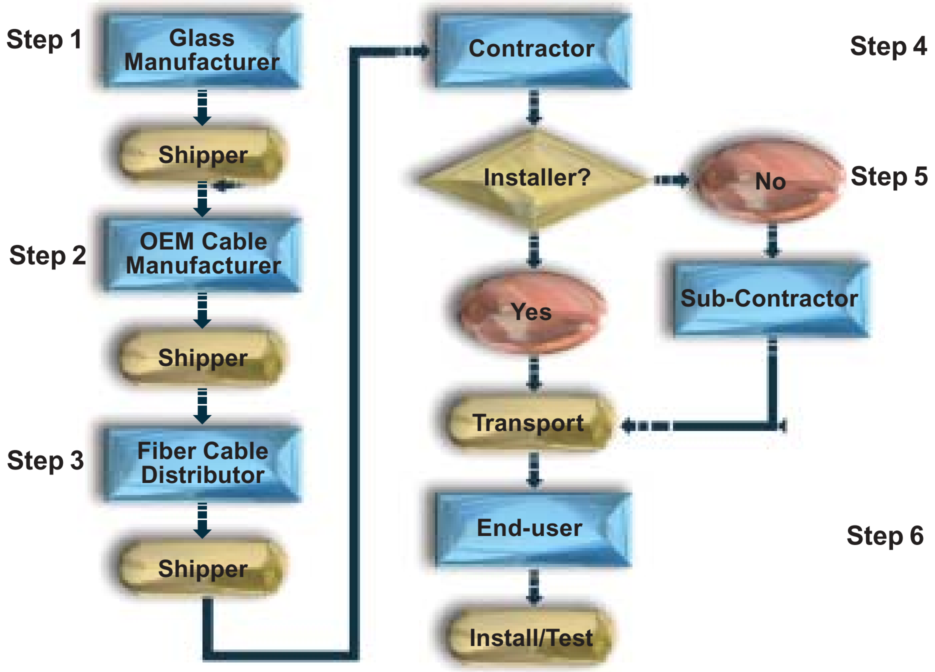

Table One

Attenuation

Type of Glass	Wavelength	Attenuation/km	Attenuation/1000 ft
MMF 50 & 62.5/125 µm	850 nm	3.5 dB/km	1.1 dB/Mft
MMF 50 & 62.5/125 µm	1300 nm	1.5 dB/km	.45 dB/Mft
SMF 8-9/125µm			
Intrabuilding (Inside Tight-Buffer)	1310 nm & 1550 nm	1.0 dB/km	0.30 dB/Mft
Interbuilding (Outside Plant Loose Tube)	1310 nm & 1550 nm	0.50 dB/km	0.15 dB/Mft

Do you have questions?

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Please e-mail them to my attention, care of poweroutlet@rexelusa.com.

Table Two

Wavelength & Bandwidth

Type of Glass	Wavelength	Bandwidth
MMF 50 /125 µm	850 nm	500 MHz
MMF 62.5/125 µm	850 nm	160 MHz
MMF 50 /125 µm	1300 nm	500 MHz
MMF 62.5/125 µm)	1300 nm	500 MHz
SMF 8-9/125µm		
Intrabuilding (Inside Tight-Buffer)	1310 nm & 1550 nm	Unlimited
Interbuilding (Outside Plant Loose Tube)	1310 nm & 1550 nm	Unlimited