



# Answers To Your Datacom Questions **ASK BO!**

**POWER OUTLET** readers can get special 'consultations' here in the magazine from **Bo Conrad** – a BICSI-certified instructor. A contributor to EIA/TIA international datacom standards committees and a datacom design consult to Intel and Hewlett-Packard, Conrad will answer our questions – right here in our pages. Send your questions to [poweroutlet@rexelusa.com](mailto:poweroutlet@rexelusa.com).

By D.A. "Bo" Conrad

## Question

**What design considerations should be taken into consideration when choosing backbone outdoor or outside plant (OSP) loose-tube fiber optic cable?**

**A.** Many items must be considered before designing or ordering the cable. What follows is a sampling.

**Glass type:** The first consideration for any backbone cable is the quantity and type(s) of glass that will be required to support the needs of the network – now and in the future. This may include legacy 62.5/125  $\mu$ m multi-mode glass to support existing equipment as well as 50/125  $\mu$ m multimode glass to support Gigabit Ethernet – plus any single-mode applications.

For the sake of discussion, this article will concentrate on OSP loose-tube round, 250  $\mu$ m coated strands and not ribbon fiber.

Note that it is also reasonable for us to evaluate the controversy between tight-buffer vs. loose-tube designs for outside plant applications. That discussion will appear in a future issue.

As much as 70% to 80% of the cost of manufacturing the OSP loose-tube cable is the cable construction itself – tubes, jacketing, rip cord, skip wrap, Kevlar, etc. So it makes more (dollars and) sense to maximize the amount of fiber to be installed –

factoring in a minimum 20% growth rate.

Backbone cable is designed to last a minimum of seven to 10 years. *Need 12 fibers? Plan a minimum 24 and preferably 36. Need 24 fibers? Plan at least 48 or 72.*

Why? The slightly higher initial cost will be your return on investment the first time you need more fiber!

### **Special considerations:**

For nuclear – power plants or military – the glass may be required to be mil-spec'd or "irradiated." The water-absorbing dopants inside the glass have been removed during the manufacturing process. When exposed to radiation, the glass will not fog up; it will remain clear, and the network still should function ( . . . yes, this might sound bizarre considering the human factor).

**Environment/Jacketing:** This is a second consideration. There is no "perfect polymer" applicable for outside water and UV protection that also will offer an inside plenum fire-rating as required by the NEC.

OSP loose-tube cable is considered OFN or Optical Fiber Non-conductive –meaning "all dielectric" (like tennis shoes and screw driver handles). OSP cable's outer jacket is typically made with Polyurethane (PE) or Polyethylene (PU) polymers to protect it from water migration and ultraviolet rays.

### **See Figure One.**

As you might be able to detect in the



Figure One

photo, the jacketing is relatively thick (as much as two or three millimeters), providing added protection with a slick, black finish for ease of pulling through conduit.

### **Fire rating**

NEC Chapter 800 (Article 770 particular to fiber optic cabling) requires any cable to have a fire-rating within 50 feet inside the building or leaving a rigid metallic conduit.

Do you need to route an OSP fiber cable through the building? As it is made of plastic (PE or PU), OSP cable typically *does not have a fire rating*. (The problem is getting the icky pic – about which, see below – to pass the UL tests.)

Therefore, it must be transitioned (on both ends of the building) to a tight-buffer fire-rated cable (OFNP for plenum-rated and OFNR for riser-rated). This adds time, labor,



Figure Two

and materials.

More importantly – over the long term – this transition introduced the possibility of **signal loss** in the fiber link. Additionally, it is not recommended to pull any OFC-type cable inside the building.

For a slightly added cost, the option is

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 Your questions will  
 be answered  
 in future issues.

to order OSP loose-tube cable that has an OFNR rating (or if available, an OFNP rating). A more expensive option is to install and route it through rigid metallic conduit (note that plenum-rated innerduct does not qualify).

**IMPORTANT SAFETY NOTE:** Using polyvinyl chloride or PVC jacketing outside can be a safety hazard – like leaving your Christmas lights outside all year long. Not only does it look tacky to the neighbors, but PVC does not provide proper UV protection.

*Bottom line:* PVC left exposed to the elements eventually will dry up. It will develop cracks over time and may lead to a fire hazard. Less hazardous but not so wonderful . . . it might well lead to a breakdown in your fiber network.

See Figure Two.

#### Special jacketing

For “environmentally sensitive” or toxic situations, specialty jacketing has added polymers that make the jacket more robust for the application and should be labeled as such. Applications include oil refineries, water control systems, underground mines RLTM, and more.

OFC (*optical fiber conductive*) indicates conductive or metallic material in the cable – a stainless steel central-strength member, protective armoring, or toner wire on the outside of the jacket. In any case, OFC *must be properly grounded* per manufacturer specifica-

tions at both ends.

**Aerial cable** is offered in a “Figure 8” design. The fiber portion is lashed or molded to stainless steel strains that function like a suspension bridge. As an OFC-rated cable, it must be grounded . . . as a lightning strike can instantly melt an entire segment.

See Figure Three.

**Direct burial cable** is designed for underground applications without conduit. It will have a flexible armor for protection against the dreaded shovel! Frequently, this type of cable also is installed in conduit or tunnels to provide protection – not from the absence of harmonics (like UTP), but against the possibility that rodents will find the jacketing . . . *tasty!*

If you’ve never before worked with direct burial cable, please note that it is very difficult to work with (bending and pulling). Special handling will be necessary when removing the armoring. Also, as an OFC cable, it must be grounded.

See Figure Four.



Figure Four

For use between telephone poles or high power lines, ADSS (*all-dielectric self-supporting*) cable typically is made with black medium-density polyethylene (MDPE). You’ll find it familiar if you’re ever smoked a big cigar.



Figure Three



Figure Five

ADSS incorporates a secondary outer jacket that houses extra layers of Kevlar aramid yarn for added tensile support between poles. You'll order these cables based on *specific suspension/distance requirements*. You'll need specially designed mounting hardware to do the job.

Further, you might find ADSS types that incorporate a jacketed armoring to protect it from rodents and bird claws. If and when you work with such cable, you'll find it falls into the "OFC" classification – it must be

grounded.

[See Figure Five.](#)

#### Tubes

Inside the OSP loose-tube cables are 2.5 mm "tubes" that house the 250  $\mu$ m fiber strands. Protecting the tubes are layers of Kevlar aramid yarn. This also provides the industry-standard minimum of 600 pounds-per-foot pulling tension for OSP fiber cables.

[See Figure Six.](#)

To keep the cable concentric (round),

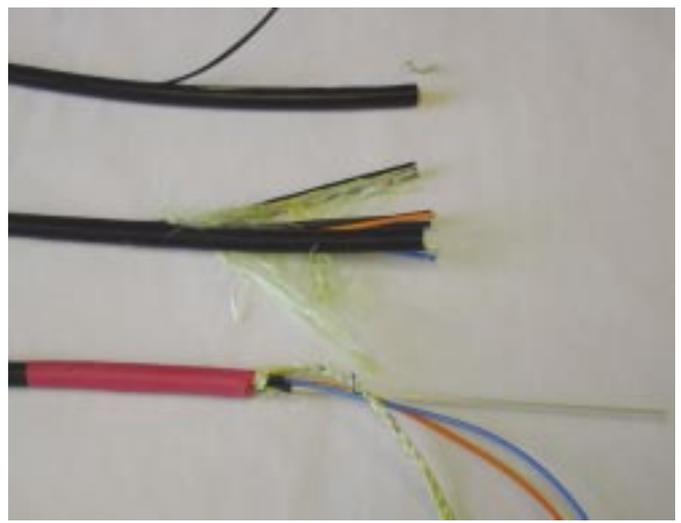


Figure Six

the magic number "six" (or 12) tubes/fillers are helically wrapped around a central strength member. This central element can be made of epoxy, fiberglass, or stainless steel (for toner/tracing purposes). Unassigned or unfilled tubes are solid; these "fillers" are 2.5 millimeters in size, usually black or white. They are cut away blunt with the jacket when prepping the ends of the cable.

Some manufacturers offer an "S-Z" molded tube wrap. During the spooling process, the tubes are wrapped for a short one-foot distance clockwise ("S") and then again counterclockwise ("Z"). This type of molded construction process provides for "mid-span" access in case of emergency splicing.

By carefully stripping away the outer jacket, individual fiber tubes can be pulled away from the bundle without having to strip away yards of outer jacket (as otherwise would be required in working with a traditional continuous clockwise twist).

Tubes have no minimum, but the maximum is 12 fiber strands per tube. Therefore, a 72-count fiber cable will have six tubes with 12 fiber strands each; a 144-count cable will have 12 tubes of 12 fiber strands each.

Like the fiber strands, the tubes are color-coded (making identification easier); tube one is blue, tube two is orange, etc. The fiber strands also have the same color code pattern (see Table One) – and repeat themselves for each tube.

#### Icky pic

The 250  $\mu$ m coated strands are loosely floating inside a water-blocking substance (thus the name "loose tube"). This substance, called



Figure Seven

interstitial gel, is commonly referenced as “icky pic” . . . because it is icky to work with.

What’s behind all of this? Icky pic protects the fiber strands from water migration while allowing for the expansion and contraction of the jacketing without putting any undo stress on the fiber strands. In fact, the ANSI/TIA/EIA standards for single-mode fiber allows for 0.5 dB for OSP loose tube and 1.0 dB loss for tight buffer (but no differential for multimode).

Only a few years ago, the whole inside of the cable – tubes and all – was also packed with icky pic. In today’s technology, cable manufacturers are using “water blocking tape” that is wrapped around the tubes. This tape has the feel of tissue paper and is easily removed.

For most installers, this is a welcome alternative to cleaning off the icky pic. It reduces the labor time in the furcation kit-cleaning preparation process. Note that *protection is not sacrificed*; when the tape is exposed to water, it turns into an icky pic-like gel.

#### Furcation breakout kits

Keep this in mind when designing or ordering OSP loose-tube cable: The labor-intensive and material cost requirements of installing furcation breakout kits.

A furcation breakout kit is required to build up the 250  $\mu\text{m}$  coated fibers inside the tubes of the OSP cable to 900  $\mu\text{m}$  to prepare for connectorization. Kits are offered in multiple lengths. However, a kit is not required for splicing.

Additionally, different manufacturers have *proprietary solutions* . . . and the parts are not interchangeable.

Preparation for installing furcation breakout kits is a tedious procedure. A great deal of cleaning – to remove the icky pic off the fiber strands (and tubes if necessary) – is required. Dry “baby powder” lubricant is needed to assist in inserting the 250  $\mu\text{m}$  fiber strands into the 900  $\mu\text{m}$  tiny spaghetti-like tubes of the furcation kit, plus proper sealing and dressing of the cable with shrink-tube.

See Figure Seven.

#### Subgrouping

Subgrouping usually is overlooked when designing or ordering OSP loose-tube cable. For example, a 24-fiber-strand cable can be subgrouped in a variety of ways.

It will become apparent that using two fiber strands in 12 tubes is a misuse of design – as “distributing” fiber strands evenly in the

tubes will not increase the integrity of the cable.

Here are two examples:

**Example One:** If all the glass is the same type for the same purpose, the preferred method is to designate two tubes or subgroups of 12 fiber strands each. These two fiber tubes plus four “filler” or fake tubes are required to complete the magic number six for concentricity. Subsequently, only two 12-count furcation breakout kits would be required.

**Example Two:** Alternatively, a cable having 24 strands can be constructed having four tubes of six fiber strands each – plus two filler or fake tubes (equaling six). However, this will now require *four* six-count furcation breakout kits . . . which adds to the material cost and also will take longer to prepare (adding to installation cost, if not the total price).

Note that the cost difference between six- and 12-count furcation kits is insignificant. Add to that consideration the fact that it takes less time to prepare the one 12-count tube, and you’ll come to the conclusion that it makes more sense (saving money) to design subgroups into a minimum of 12 fibers in each “tube.”

#### Subgrouping guidelines

These subgrouping guidelines should help to reduce confusion during installation. These should prove useful, even if the “tubes” are being routed into the same fiber enclosure:

1. A “hybrid” cable is one that consists of different optical glass types – whether the cable is tight-buffered or OSP loose tube. If the cable is designed for use as a multi-use backbone hybrid cable, each subgroup should be separated for the optical glass types:

- 62.5/125  $\mu\text{m}$ ;
- 50/125  $\mu\text{m}$  multimode; or
- 8.3/125  $\mu\text{m}$  single-mode.

See Figure Eight.

*Note:* The term “composite” cable includes a combination of both *fiber* and some type of *copper* UTP or coax – also recognized as “Smart Home” cable.

2. Subgroups should be separated – by means of termination – at each end of the cable. In so doing, subgroups that will be



Figure Eight

terminated with connectors and connected to couplings/adapters should be separated from the subgroups that will be spliced (mechanical or fusion) and placed into splice trays.

3. The designated application of the subgroups should be separated if used as a backbone. For example, this may include separation for each floor’s Telecommunication Room or “Closet” in a high-rise, designated departments (Accounting, Engineering), or even “reserved dark fiber” strands for future plans.

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Do you have questions?

? Please e-mail them to my attention, care of [poweroutlet@rexelusa.com](mailto:poweroutlet@rexelusa.com). ?



### OSP Installation Guidelines

**Basic installation guidelines for OSP loose tube cable include:**

- maintaining bend radius of 10X non-stress (static) and 20X cable diameter for pulling
- always use a POLY-lube (NOT Yellow 77 “Gorilla Snot”) when pulling through longer lengths or crowded conduit
- *never* exceed manufacturer pulling tension (minimum 600 pounds per foot)
- never twist the cable during the pull and use Kellum grips (Chinese fingers) with a swivel.

### Loose-Tube Design Notes

To maximize return on investment, and to reduce installation mistakes in the field, design and/or order OSP loose tube fiber optic cable with the following considerations:

1. Quantity and type of optical glass (the more the merrier!).
2. Determine the proper jacket as dictated by the environment and/or NEC requirements.
3. Consider the option of “S-Z” molded-tube construction.
4. Use water-blocking tape in lieu of “flooded” icky pic gel.
5. Condense 12 fiber strands per tube.
6. Sub-grouping fiber strands based upon glass types, termination, or splicing technique; and designated applications.

These design and installation techniques will help assure a more professional, longer-lasting fiber optic backbone cabling system.

### Fiber Color Chart

Source:  
CrossBow  
Communications

Slang Terms	Number	Color	Number	Color	Identifier
British	1	Blue	13	Blue	w/--dash---
Only	2	Orange	14	Orange	w/--dash---
Go	3	Green	15	Green	w/--dash---
By	4	Brown	16	Brown	w/--dash---
Sea	5	Slate	17	Slate	w/--dash---
White	6/"0"	White	18	White	w/--dash---
Running	7	Red	19	Red	w/--dash---
Backwards	8	Black	20	Black	w/--dash---(Wht or Yel)
You	9	Yellow	21	Yellow	w/--dash---
Vomit	10	Violet	22	Violet	w/--dash---
Girls before	11	Rose	23	Rose	w/--dash---
Boys	12/"0"	Aqua	24	Aqua	w/--dash---