Choosing The Right Fiber Optics Cable

Fiber optics is becoming more prevalent in today's telecommunications systems. Fiber is moving deeper and deeper into the network, i.e., we are installing more fiber than ever before. Determining which cable design and which type fiber to install requires one to have a vast knowledge of both cable design and glass types.

Questions like these must be answered:
Which fiber optic cable design should I install? Does it really need to be outside plant or can I install the same cable everywhere? Does the glass type (singlemode or multimode) matter? Does it matter who manufactures the glass or cable? What's the difference between distribution and breakout? Just what is cordage? Is tight buffer better than loose tube? Should I choose stranded loose tube or central (uni) tube? Should outdoor cable be flooded or are these new "dry" cables OK? These are just some of the questions one might ask when determining the proper fiber optic cable for an installation.

Let's start by describing the various fiber optic cable designs. Cable can really be broken into two (2) categories: loose tube design and tight buffered. Loose tube cable, simply put, houses the fiber (250 μm (micron) in a loose buffer tube. Each tube will contain multiple fiber strands. The fiber strands will be color coded for identification. Loose tube cable design provides the maximum protection for the fiber strands. The loose tube design allows the cable (loose buffer tube, strength member, and jacket) to expand and contract without conveying these movements to the glass inside. The fiber strands are protected from damage and the stresses of the outside environment. Since a loose tube cable design provides such excellent protection for the fiber strands, this is the design normally chosen for installation in the outside plant environment for aerial, underground (in ducts) or direct burial.

Loose tube cables come in two (2) designs, stranded loose tube (See Figure 1) and uni or central tube (See Figure 2). Stranded loose tube cable contains multiple buffer tubes stranded together normally using a reverse oscillating lay (commonly called SZ) around a central strength member. The buffer tubes contain up to twelve (12) individual fibers. Uni or central tube cable contains one (1) single tube, which contains all the fibers. If individual fibers are used they are bound in groups of twelve (12) using colored binder thread. Both cable designs provide excellent protection for the fiber strands. In the past all loose tube cables were "flooded" with water blocking "gel" to prevent water migration within the cable. Today, these cables are manufactured using dry water blocking technology, which means there is no "gel" outside the buffer tubes.

What is the difference between a stranded loose tube and a uni or central tube cable? The basic difference is in fiber management. Stranded loose tube cables contain multiple tubes allowing for easier "mid-sheath" entry. In other words, if you are going to "drop" fibers at points along the route, then stranded loose tube is the cable of choice. Because the fibers are contained in separate buffer tubes you only access the fibers necessary at the location. All the other fibers remain protected within their buffer tubes. On the other hand, if all the fibers are to be terminated at a single location, a point-to-point cable run, then uni or central tube is an excellent choice. Since all the fibers are contained in a single buffer tube, you only have to open one tube to access all the fibers.

Figure 1
60 Fiber Cable Shown

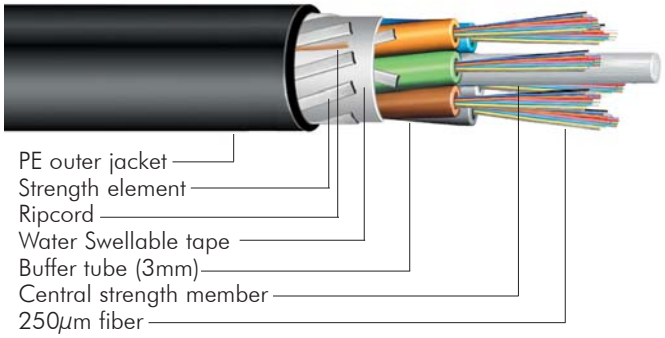
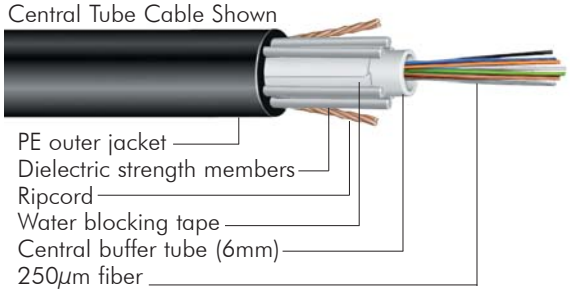


Figure 2
Central Tube Cable Shown



If loose tube cable is the choice for outside plant installation, then how about cable for installation inside the building? A non-listed cable must be terminated within 50 ft. of entering a building or as soon as possible to the entrance of the building (per the National Electrical Code and the Canadian Electric Code). For in-building installation, we would choose tight buffer cable design. In a tight buffer design, we place a 900 micron buffer jacket on the 250-micron fiber strand. The 900 micron buffer aids in handling the fiber strands and allows us to place a connector directly on the fiber. Tight buffered cables are used in the inside plant were we do not have to be concerned with large temperature fluctuations or moisture.

Tight buffer cables are made in two designs, distribution style (See Figure 3) and breakout style (See Figure 4). Distribution style cable is made up of 900 micron buffered fibers, which are SZ (reverse oscillating lay) stranded together then a strength element, normally aramid yarn, is helically stranded around the fibers which forms the "cable core." A jacket then covers the "cable core." Breakout style cable is made up of multiple simplex (single fiber cable) cables stranded together with an overall jacket.

Both cable designs are available in either Plenum or Riser per NEC Article 770 or CEC Table 19.

Tight buffered technology is also used to manufacture "cordage." We call cables containing one or two fibers cordage. The names used for the cables may vary between manufacturers but the usage is the same. Cordage is used for connections between patch panels (cross-connections) or for equipment interconnections. The most common type cordage for interconnection or cross-connections is "Zipcord," two single fiber cables connected by a thin web.

Now that we have looked at the basic cable designs of loose tube cable, which is used for outdoor environments, and tight buffered cable which is used for indoor environments, we will cloud the issue and introduce "indoor/outdoor" cables. Indoor/Outdoor cables combine the benefits of cables designed for outdoor use with cables designed for indoor use. Essentially we take loose tube cables and change some of the materials so that the cable will pass the requirements for flammability. We also take tight buffered cables and change the materials so that the cable will handle the stresses of the outdoor environment. The "Indoor/Outdoor" cable eliminates the need to terminate the cable at the building entrance thus saving time and money.

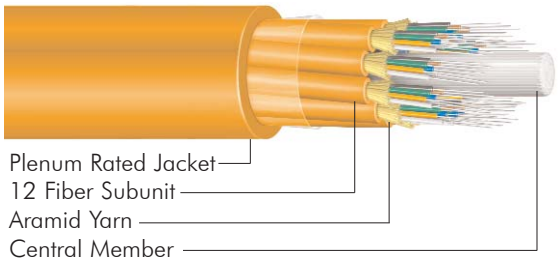
When determining which cable design to use, one must consider the environment - if the cable is installed primarily in the outdoor environment, then a loose tube cable should be selected. If the cable is to be installed indoors, then tight buffered cable is the choice. Remember you must use cable that meets the flame requirements of the installation (either plenum or riser). If you are installing a cable between two buildings (in a campus) then one may choose "Indoor/Outdoor" cable to eliminate the change over to a properly listed cable at the building entrance. However, even in this case, if a majority of the cable is outdoors then a true outside plant style cable may be the best choice.

Now that we have confused the cable issue how about the type fiber, singlemode or multimode and which multimode 62.5 or 50 micron? Singlemode fiber is normally chosen when distance is required or for high data rates. Singlemode is the fiber of choice for applications like Optical Carriers (OC-1 or higher). Multimode is chosen when the distance is minimal (up to 2 kilometers for lower bit rates) or for connections inside a data center or storage area network. We are seeing more and more singlemode installed in backbones in campus networks to accommodate higher bit rates as the systems grow.

What about the difference between 62.5 and 50-micron multimode? In the United States and Canada, 62.5 micron has been the accepted standard for multimode. We are seeing a shift back to 50 micron as the bit rates increase. A 50 micron fiber has a higher available bandwidth at the 850 nanometer window which is the transmission window used for a majority of multimode applications. One caution, all multimode should be "laser certified" and 50 micron should be Differential Mode Delay (DMD) tested and certified if you plan to use it for the emerging 10 Gigabit Ethernet applications. The IEEE committee for 10 Gigabit Ethernet has specified 50 micron DMD certified fiber for operation at the 850 nanometer window for up to 300 meters.

To summarize, choose a loose tube cable for installations in the outdoors. Choose a tight buffered cable for indoor installations. If you are installing a fiber cable between two buildings in a campus and a majority of the cable is indoors, consider an "Indoor/Outdoor" type cable. As for glass (fiber) type, multimode may be used as long as the distance is not too great or the bit rate too high. Singlemode fiber will allow more distance and higher bit rates but the electronics cost much more.

Figure 3
72 Fiber Plenum Distribution Cable Shown



12 Fiber Subunit Cable Shown

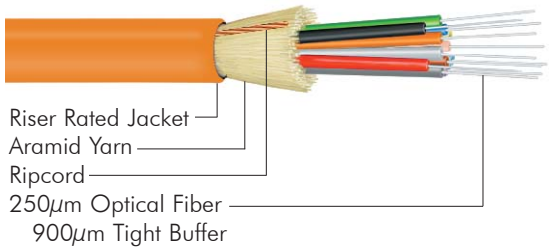
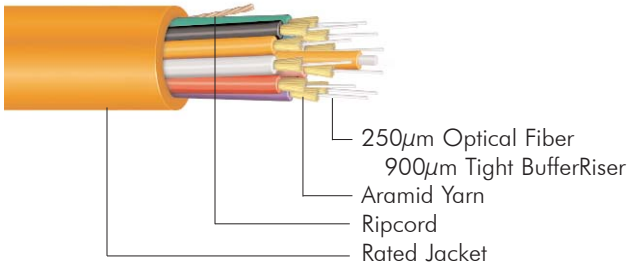


Figure 4
12 Fiber Riser Breakout Cable Shown



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