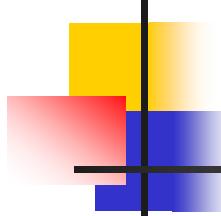


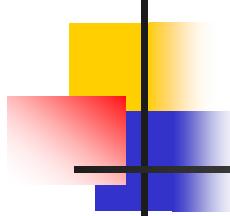


Optical Fiber Cables



Introduction

- Fiber optic cable is available in many physical variations.
- Regardless of the final outer construction however, all fiber optic cable contains one or more optical fibers.
- These fibers are protected by an internal construction that is unique to fiber optic cable.
- The two most common protection schemes in use today are to enclose the tiny fiber in a loose fitting tube or to coat the fiber with a tight fitting buffer coating.

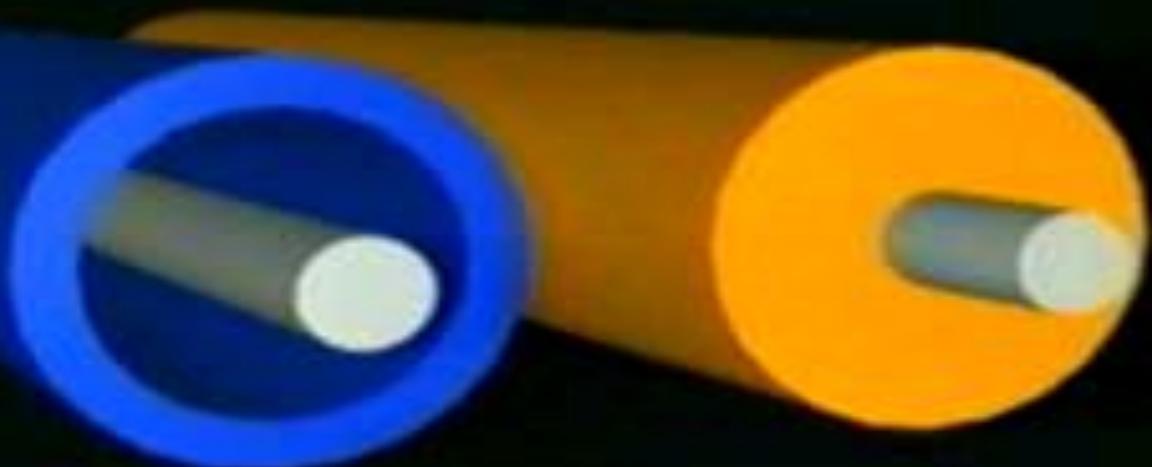


Introduction

- Buffer can be placed either loose or tight around the fiber.
- A cable with former type of protection scheme is termed as Loose tube cable and the later type of protection is termed as tight-buffered cable.
- **Loose-tube cable**, used in the majority of **outside-plant installations**
- **Tight-buffered cable**, primarily used **inside buildings**.

Types of Cable Buffering

Cable Buffering

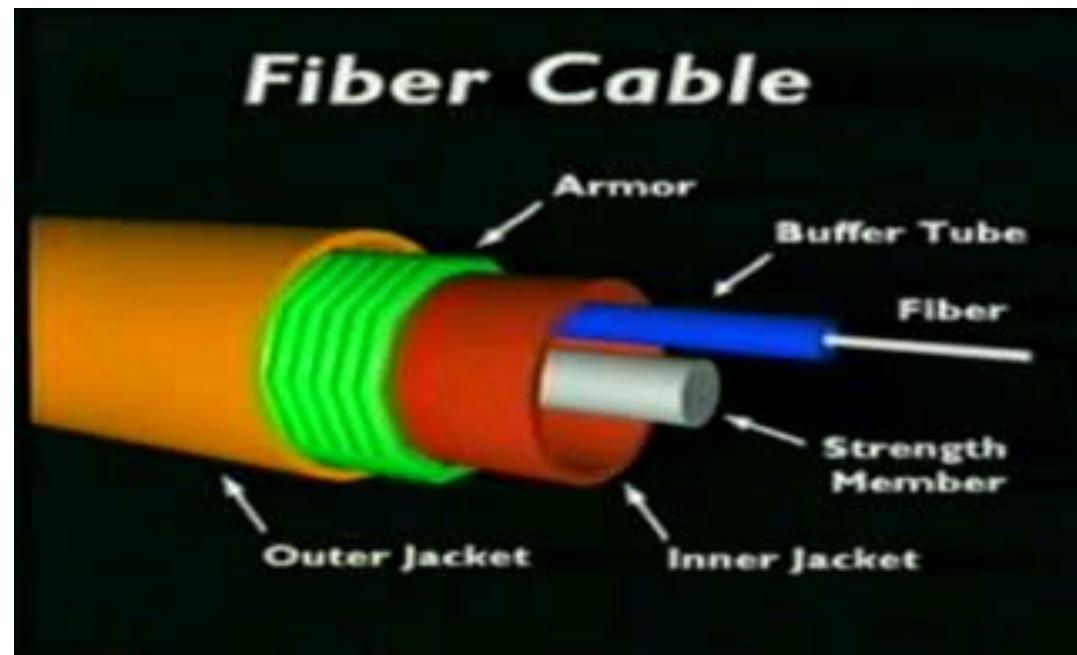


Loose Buffer

Tight Buffer

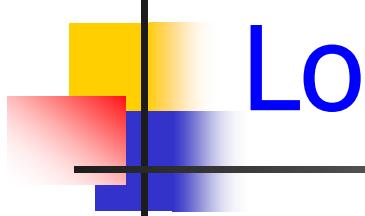
Fiber Optic Cable Buffering

- Generally **strength member** will be present at the center of the cable which absorbs stress during the installation.
- In some cases **aramid yarn** is used to handle external tension
- Some times there cannot be strength members and the cable rely on outer structure to handle stress.



Fiber Optic Color Codes

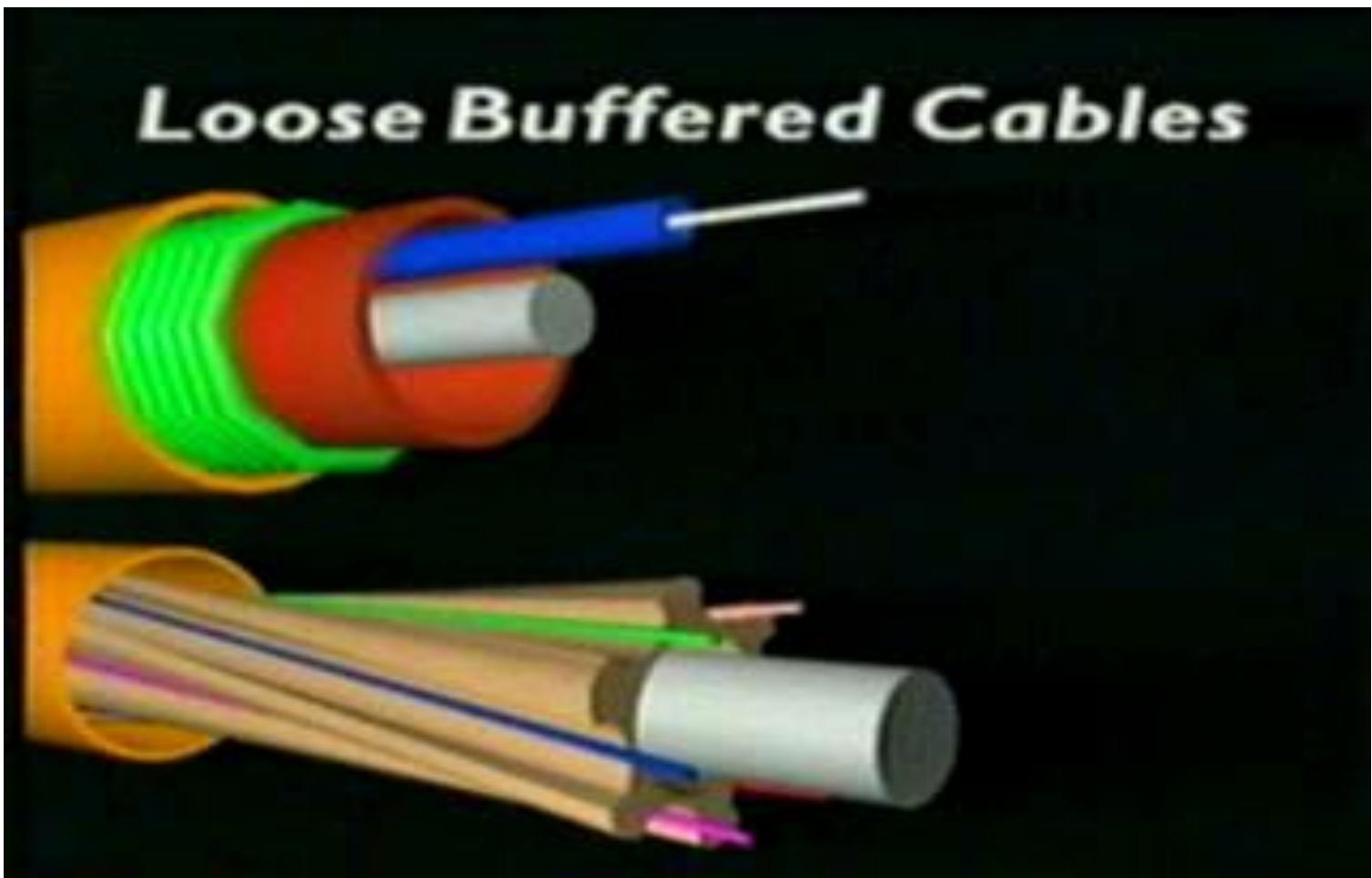
Position	Color	Position	Color	
1	Blue	13	Blue	Vwhite/black trace
2	Orange	14	Orange	Vwhite/black trace
3	Green	15	Green	Vwhite/black trace
4	Brown	16	Brown	Vwhite/black trace
5	Slate	17	Slate	Vwhite/black trace
6	White	18	White	Vwhite/black trace
7	Red	19	Red	Vwhite/black trace
8	Black	20	Black	Vwhite/black trace
9	Yellow	21	Yellow	Vwhite/black trace
10	Violet	22	Violet	Vwhite/black trace
11	Rose	23	Rose	Vwhite/black trace
12	Aqua	24	Aqua	Vwhite/black trace

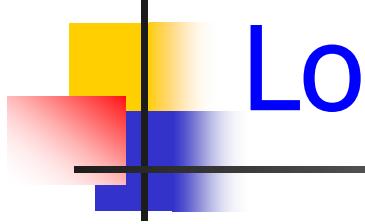


Loose Tube Cable

- In the loose tube method the fiber is enclosed in a plastic buffer-tube that is larger in inner diameter than the outer diameter of the fiber.
- This **tube is filled with a silicone gel** to prevent the buildup of moisture and to repel water.
- Since the fiber is basically free to "float" within the tube, **mechanical forces acting on the outside of the cable do not usually reach the fiber.**

Loose Buffered cable

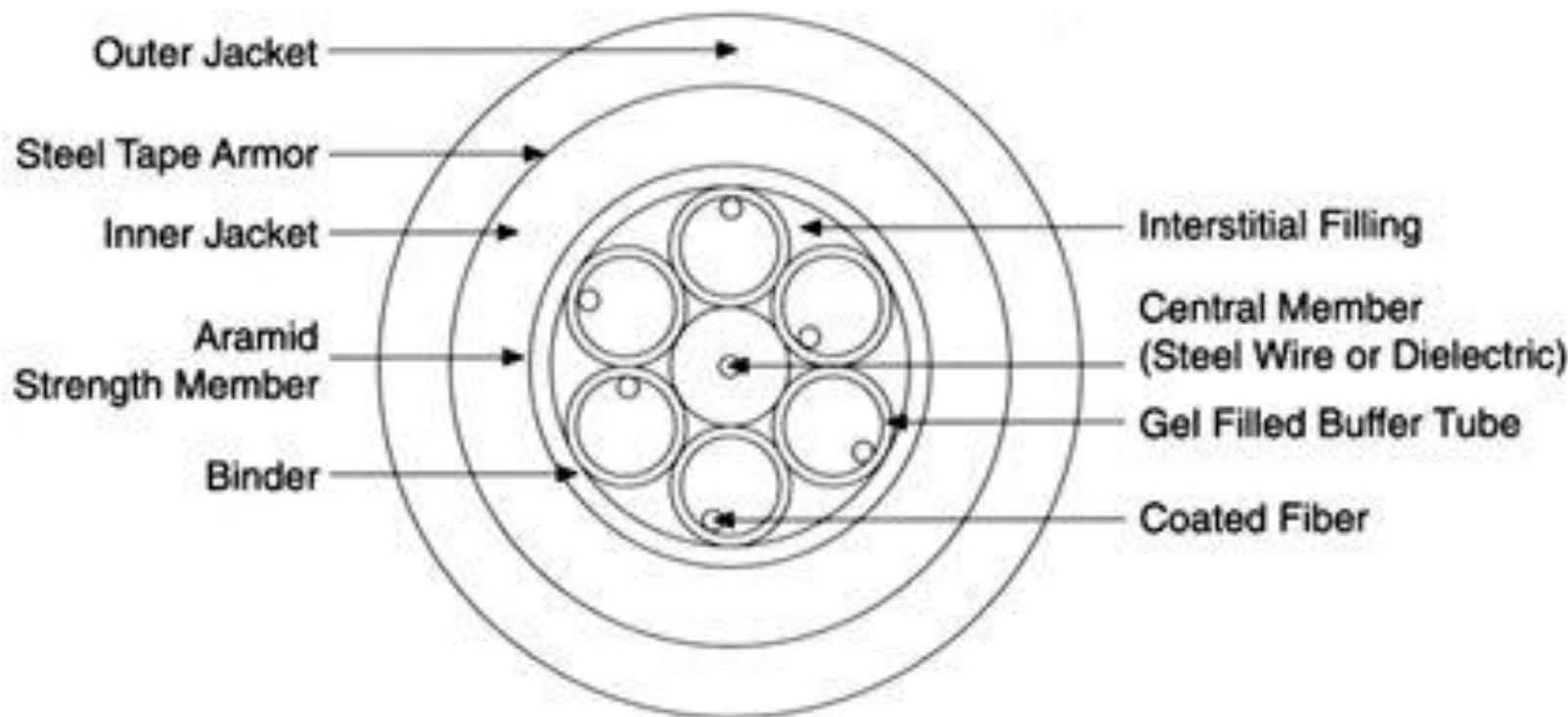




Loose Tube cable

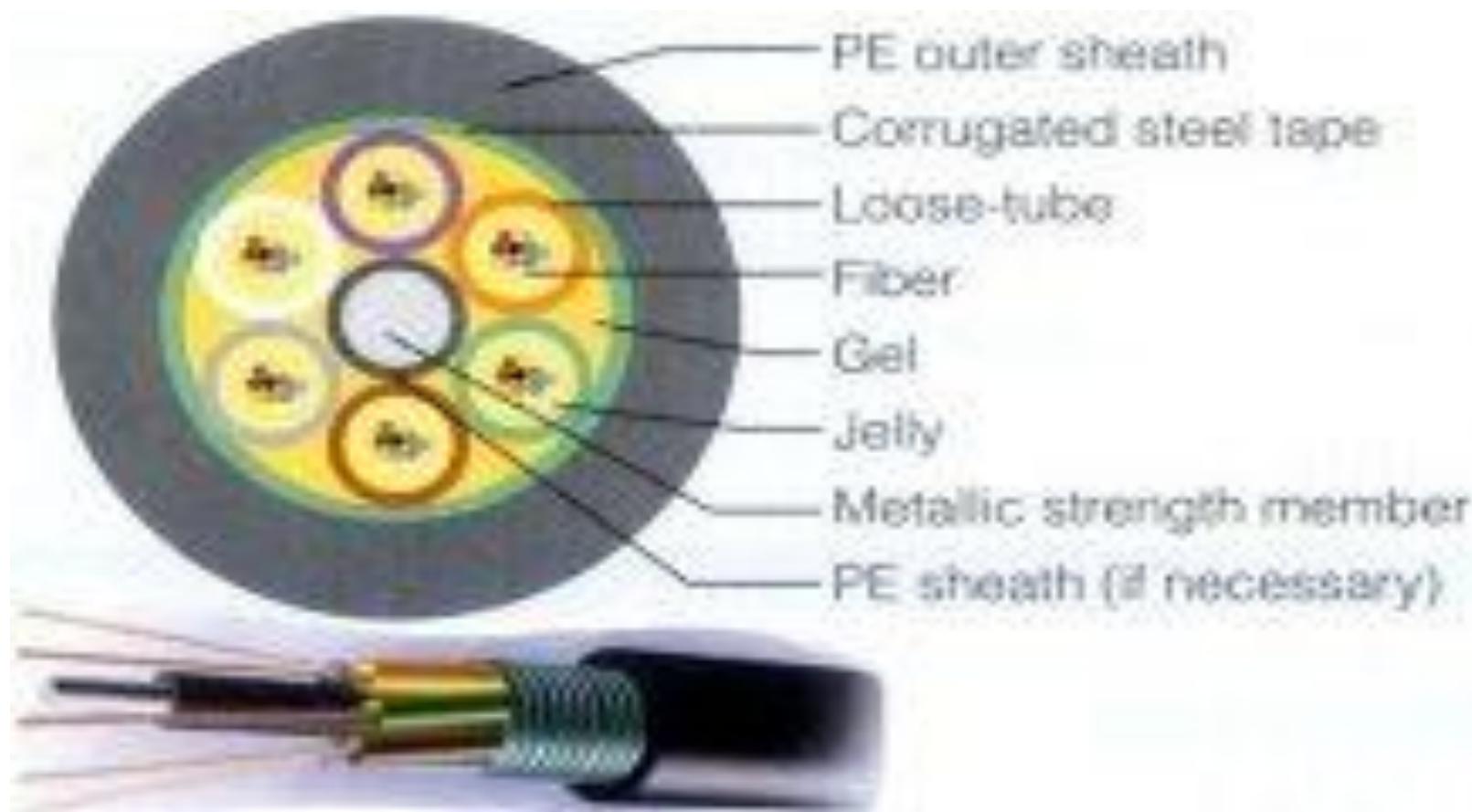
- Cable containing loose buffer-tube fiber is generally very **tolerant of axial forces** of the type encountered when pulling through conduits or where constant mechanical stress is present such as cables employed for aerial use.
- Since the fiber is not under any significant strain, loose buffer-tube cables **exhibit low optical attenuation losses**.
- The cable core, typically uses **aramid yarn**, as the primary tensile strength member.

Loose Tube cable

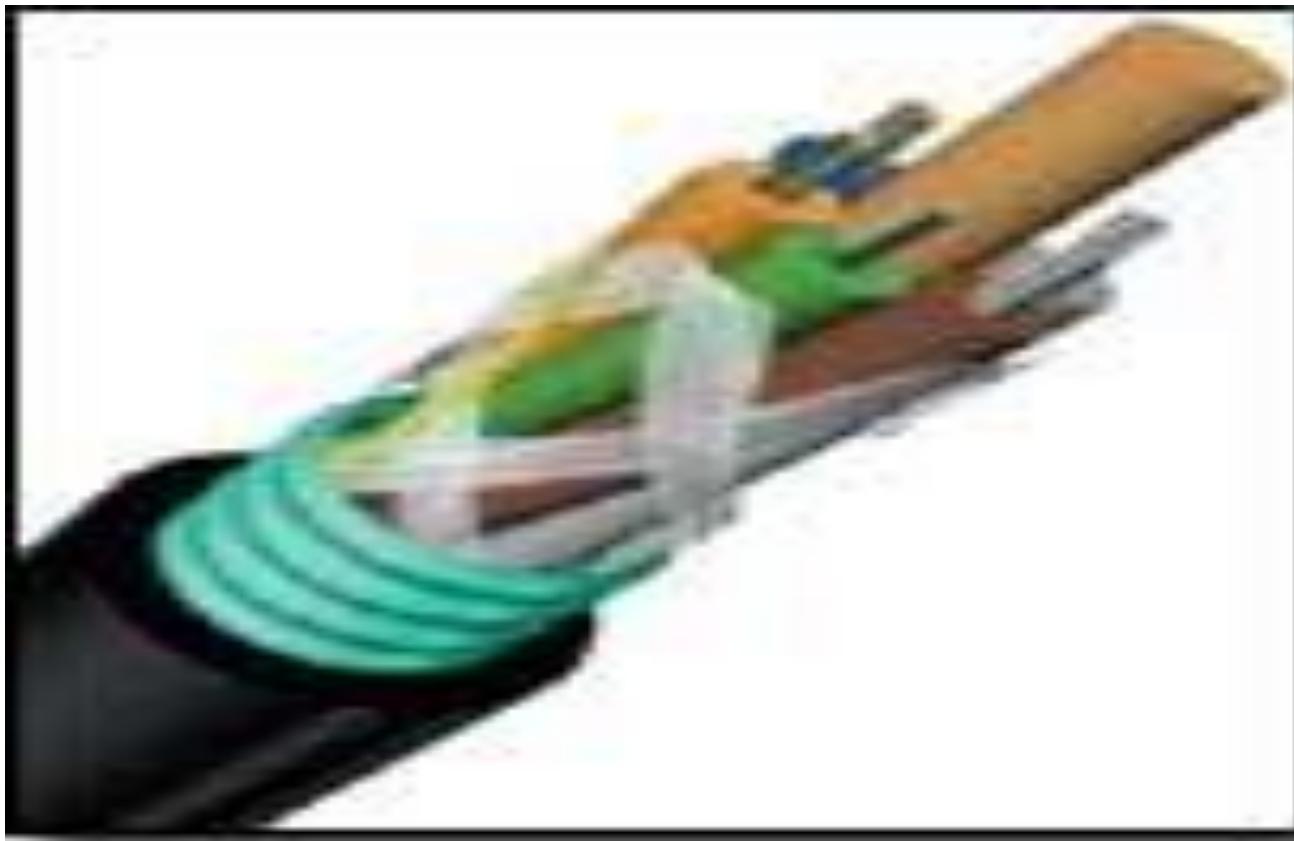


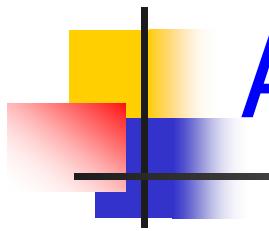
Loose-Tube Cable

Loose Tube cable

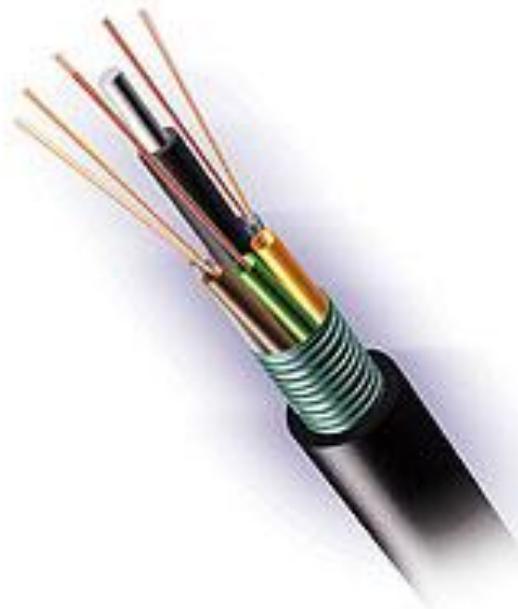


Non-Armored Loose Tube Cable





Armored Loose Tube cable



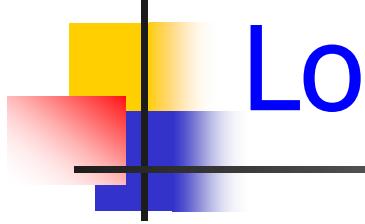
Single Jacket Armored cable



Dual Jacket Armored cable

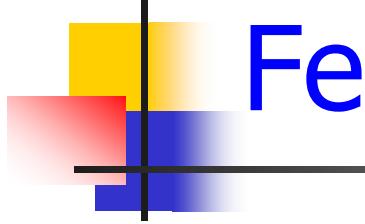


Armored Single Tube Cable



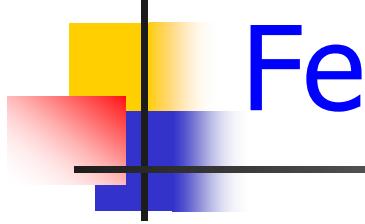
Loose Tube cable

- The loose tube design provides **stable** and highly **reliable transmission** parameters for a variety of applications.
- The design also permits significant improvements in the density of fibers contained in a given cable diameter while allowing flexibility to suit many system designs.
- These cables are **suitable for outdoor**, **aerial**, and **direct buried** installations etc.,



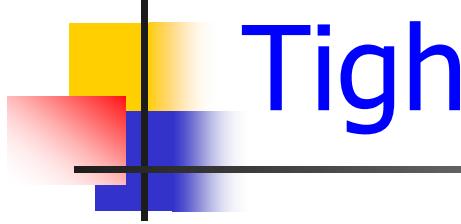
Features

- Different fiber types available within a cable (hybrid construction).
- Lowest losses at long distances, for use in outdoor, aerial, and direct buried applications.
- Wide range of fiber counts (up to 216).
- Available with single mode and multimode fiber types.
- All dielectric or steel central member.



Features

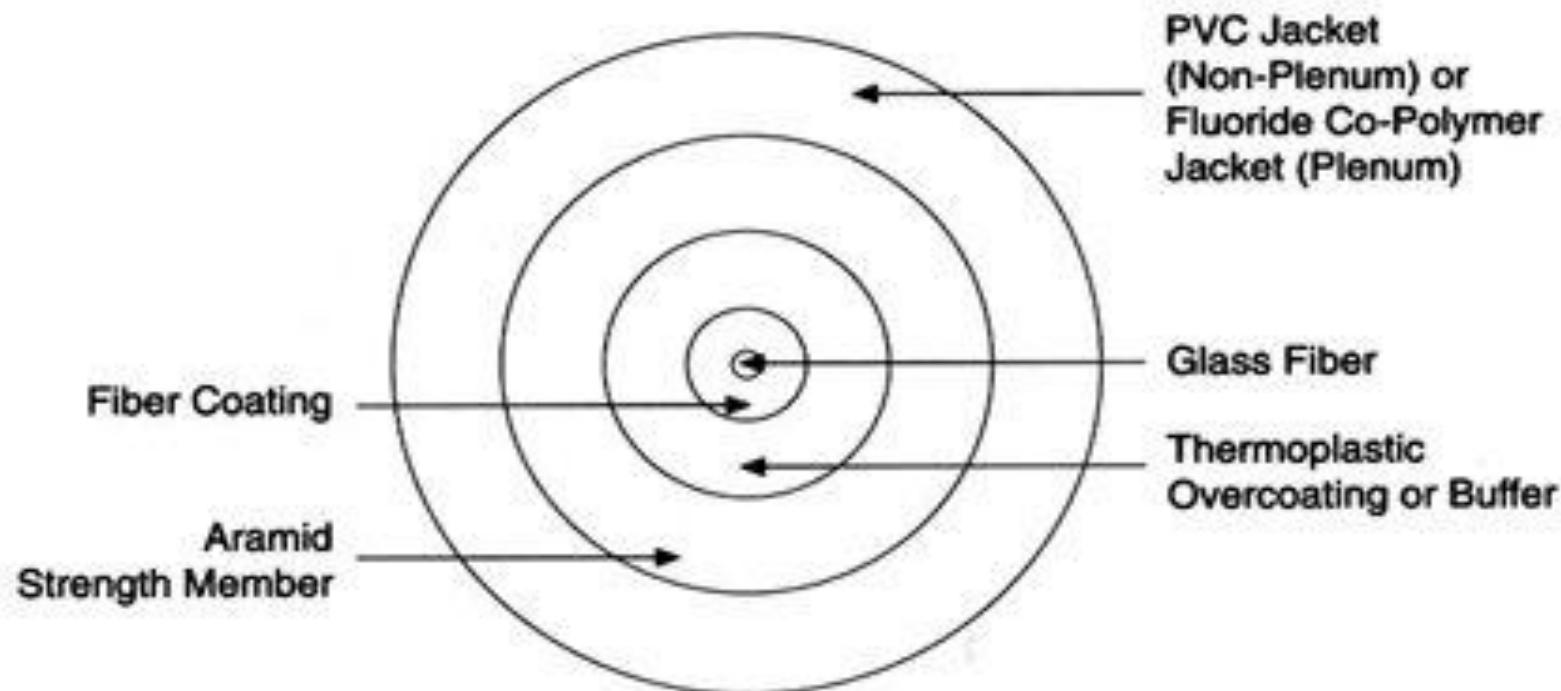
- Loose Tube Cable is also available with armored construction for added protection.
- Loose tube cables have lower signal attenuation due to micro bending.
- They provide excellent isolation from external forces.
- Under continuous mechanical stress, loose buffer cable exhibit better transmission characteristics.



Tight-buffered cable

- In the tight buffer construction, a **thick coating of a plastic-type material** is applied directly to the outside of the fiber itself.
- This results in a smaller overall diameter of the entire cable and one that is more resistant to crushing or overall impact-type forces.
- Because the fiber is not free to "float" however, tensile strength is not as great.

Tight-buffered cable



Tight-Buffered Cable

Tight-buffered cable

- Tight buffer cable is normally **lighter in weight** and **more flexible** than loose-tube cable and is usually employed **for less severe applications** such as within a building or to interconnect individual pieces of equipment.

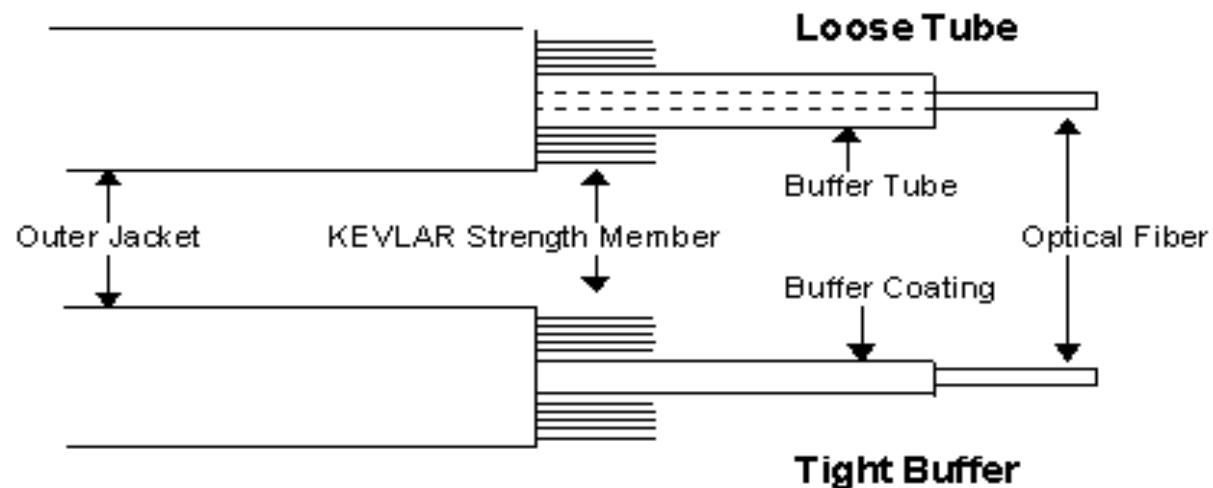


Figure 1, Basic Fiber Optic Cable Construction

Tight-buffered cable

- As can be seen from the diagram, in all cases the fiber/buffer tube is first enclosed in a layer of synthetic yarn such as Kevlar for strength.
- Tight buffer tube cables are more suitable for indoor applications.

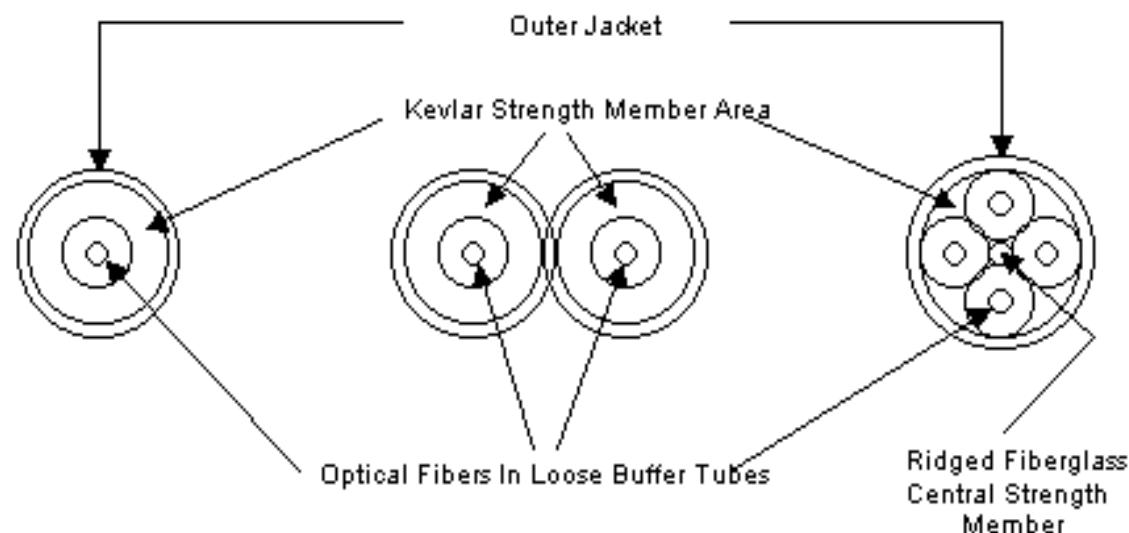
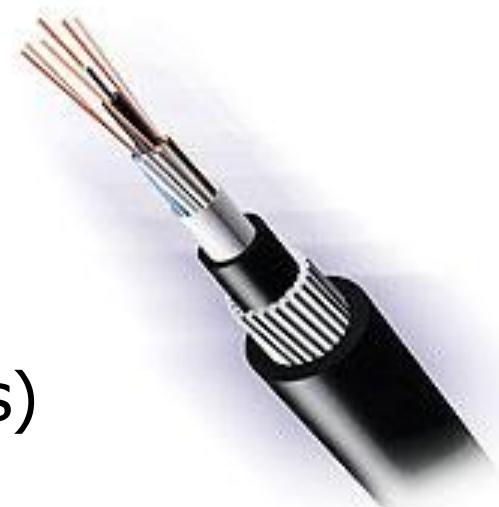


Figure 2, Cross Section Of Various Types Of Fiber Optic Cable

Fiber Optic Cable

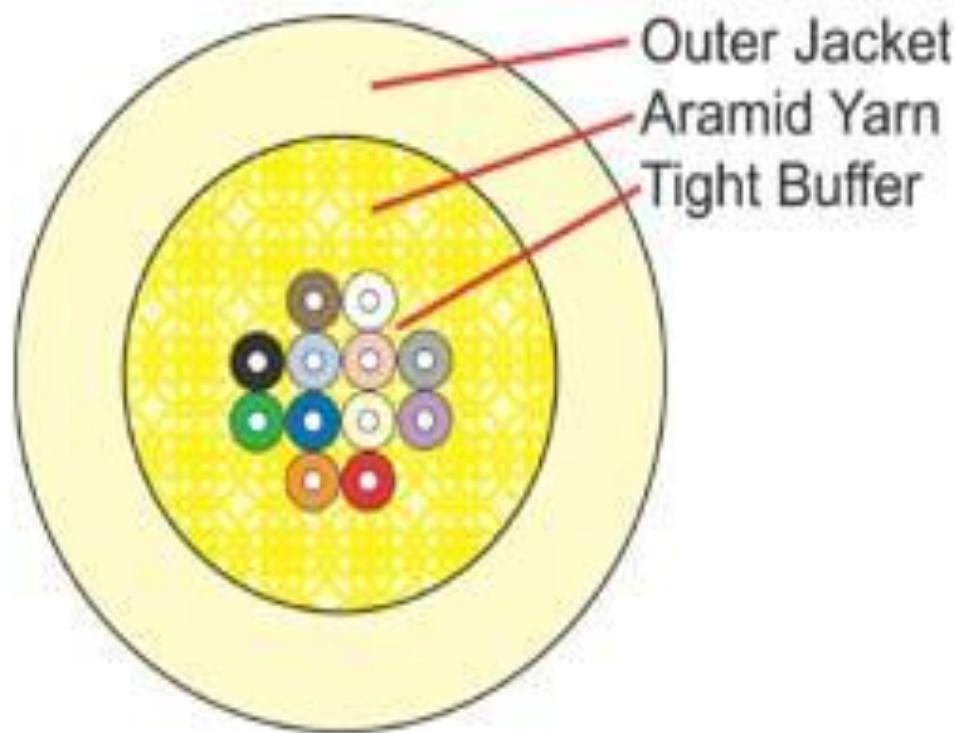
- An outer jacket of PVC (*Polyvinyl chloride*) or similar material is then extruded over everything to protect the inside of the cable from the rigors of the operating environment.
- In multi-fiber cables, an additional strength member is also often added.
- While most fiber optic cables are manufactured of totally non-conductive materials, there are some cable that employ steel tape-wound outer jackets for rodent resistance (direct burial types) or metallic strength members such as steel wire for aerial (telephone pole) use.



Cable Types

Distribution Cable

- It is a compact building cable, packages individual 900 μm buffered fiber reducing size and cost when compared to breakout cable.



Cables Types

Indoor/Outdoor Tight Buffer:

- These cables are flexible, easy to handle and simple to install.
- Since they do not use gel, the connectors can be terminated directly onto the fiber without difficult



Cables Types

Indoor/Outdoor Breakout Cable:

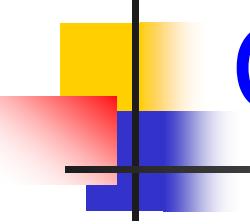
- Indoor/outdoor rated breakout style cables are easy to install and simple to terminate.
- Breakout cables are designed with all-dielectric construction to insure EMI immunity



Aerial Cable/Self-Supporting:

- Aerial cable provides ease of installation and reduces time and cost.



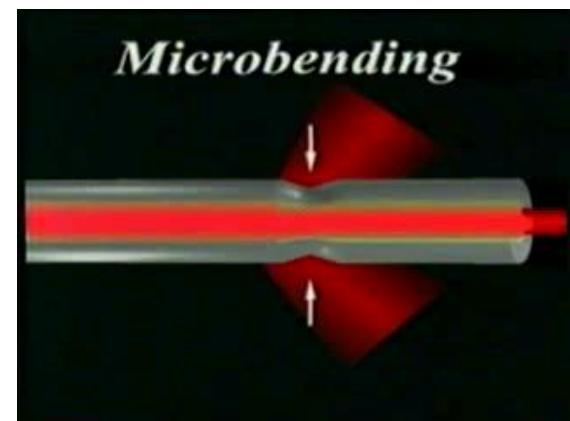
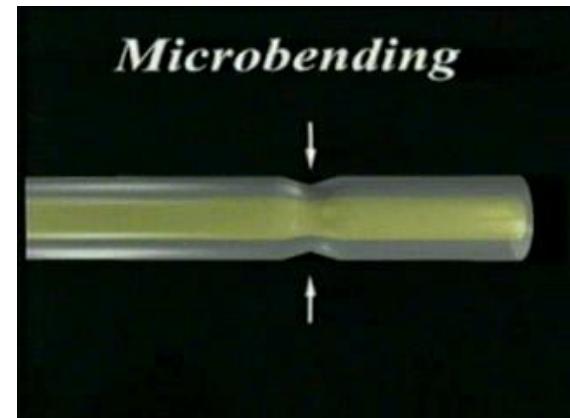


Cables Types

- **Distributed** and **Breakout cables** are considered as two types of **tight buffer cables**.
- **Distribution cables** feature a large number of fibers in a compact cable and mainly used in vertical cable runs with in buildings.
- **Distribution cables** are lighter than loose tube cables, provides more flexibility but less isolation from outside stress.

Cables Types

- Because of its sensitivity from external forces, it suffers from attenuation due to micro bending than other cables.



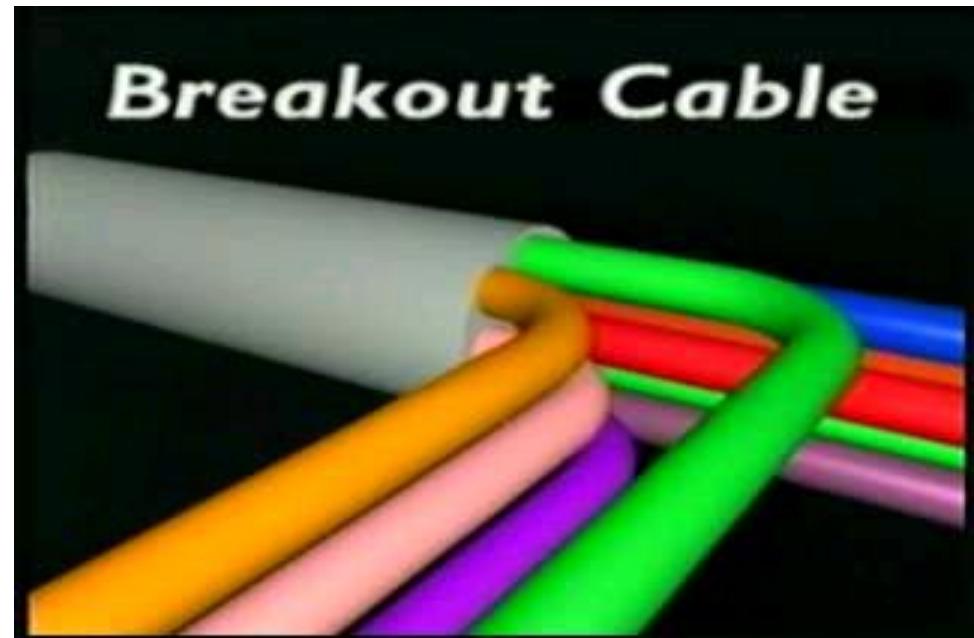
Cables Types

- **Breakout cable** contain tight buffered fibers individually enforced with aramid yarn.
- They are the largest and heaviest of fiber cables and are mainly used for horizontal runs and also for cross connects.



Cables Types

- The term **breakout** means at any location along the cable one could **breakout several fibers** and **route other fibers to elsewhere**.
- These cables are mainly used for **LAN**, **video systems**, **industrial control process** etc.,



Cables Types

Hybrid Cable:

- Cables that contain both optical fibers and twisted pairs (copper coax) are known as hybrid cables.
- Hybrid cables are used in fiber to home applications, LAN and television systems also.



Cables Types

- One type of Tight buffered cable that is finding its use in offices is **under carpet style** and by using this there is **no need to cut fiber in to walls.**
- This kind of cables is convenient for connectivity to desktops.



Cables Types ABF

ABF (Air Blown Fiber)

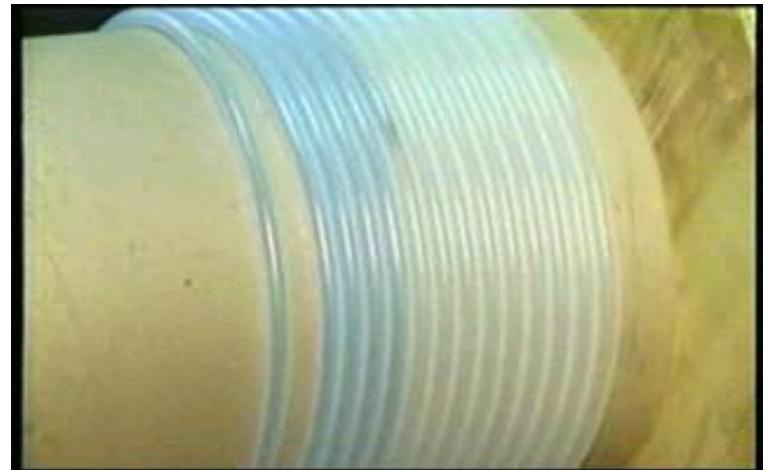
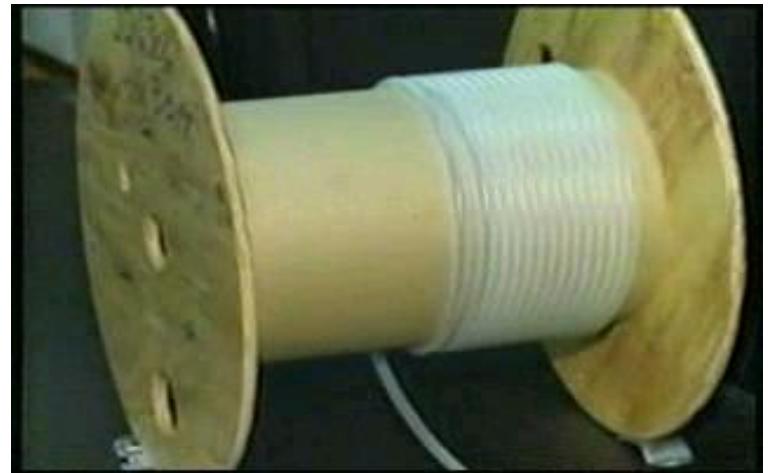
- ABF is a tight cable with no of small diameter tubes which are initially installed.
- At junction boxes small push to fit connectors connect tubes together to complete fiber route.



Cables Types

ABF (Air Blown Fiber)

- High pressure air is then used to blow fiber on it through the tubes.
- Installation is quick and efficient and also it is easy to make changes in the network.

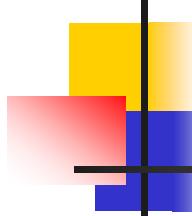


Cables Types

Armored Cable:

- Armored cable can be used for rodent protection in direct burial if required.
- This cable is non-gel filled and can also be used in aerial applications.
- The armor can be removed leaving the inner cable suitable for any indoor/outdoor use



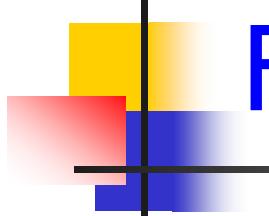


Fiber Types

- The International Telecommunication Union (ITU-T), which is a global standardization body for telecommunication systems and vendors, has standardized various fiber types.

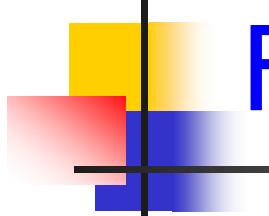
These include

- the 50/125- μm graded index fiber (G.651),
- Non-dispersion-shifted fiber (G.652),
- dispersion-shifted fiber (G.653),
- 1550-nm loss-minimized fiber (G.654), and
- NZDSF (G.655).



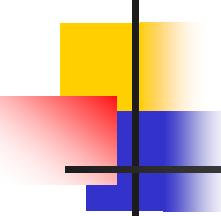
Fiber Types

- the 50/125- μm graded index fiber (G.651)
 - MMF, gradded index, 1300/850 nm, 0.8db loss
- Non-dispersion-shifted fiber (G.652)
 - SMF,
- dispersion-shifted fiber (G.653),
- 1550-nm loss-minimized fiber (G.654), and
- NZDSF (G.655).



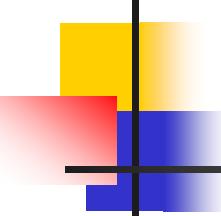
Fiber Types

- The outer jacket used for cable must be chosen carefully with respect to the application.
- Cables that are used for outdoor Ariel applications are exposed to elements and must be able to withstand heat, cold, moisture, pollution, fungus attacks, ultra violet rays.
- Polyethylene is a thermo plastic with good chemical and moisture resistant and is used in Ariel and direct burial applications.



Fiber Types

- Polyurethane, Poly Vinyl Chloride, Teflon etc., are other types of materials which can be used as fiber outer jackets.
- There are number of fiber cables designed to use for specific cables. For example in Ariel applications, fiber cables are used on high voltage poles or towers.
- Metallic components with in a cable accumulate dangerous electric charges due to induction providing a safety hazard to service personnel.



Fiber Types

- In addition, metallic components could attract lightning strikes which could damage the cable.
- **All Dielectric Self Supporting Cable (ADSS)** finds extensive use on high voltage transmission towers.
- It is made up of purely dielectric materials with increased strength members to allow cables to cross long spans.

Fiber Types

- ADSS will handle the thermal changes without excessive expansion and contraction.
- For Ariel applications, where proximity to high voltage is not a problem there are specific cables.



Fiber Types

- Here a cable is shown which is bonded to a metal messenger along its entire length.
- This kind of cables does not handle thermal expansion well because of different coefficients of expansion of glass and metal component.



- Many organizations require special cable designs to meet their unique requirements.
- One type of special cable is Optical power ground wire (OPGW).
- This type of cable is used in top of high voltage towers to channel lightning away from phase conductors.