# Coaxial Cables

A coaxial cable may simply be defined as the kind of copper cable used by cable TV companies between community antennas and consumers' homes or business places. Coaxial cables are also used by telephone companies for connecting telephone lines to road side poles near users' home. It has got its wide use in business and corporation Ethernet and local area networks. The term coaxial is given to the cable because it includes one physical channel that carries the signal and surrounded by another concentric physical channel (with a layer of insulation in between), and both running along the same axis. Number of these cables or pairs of coaxial tubes may be placed in a single outer sheathing, which can carry information to a great distance. Coaxial cable was invented in 1929 and commercially used in 1941. Carrier technologies will differ along with other factors but generally speaking twisted pair copper wire and optical fiber are alternatives to coaxial cable.

A Coaxial cable carries electromagnetic signals without any or very low emission along the length of the cable. It also effectively protects the signals, which it carries. Coaxial cables are mostly used for transmission of radio frequency signals. The construction features of a coaxial cable include an inner conductor which is surrounded by insulating layer of flexible material with high dielectric constant. The insulating material is tubular in shape. All the above i.e. the inner conductor and the tubular insulation, are covered by another conductive layer of thin metallic foil or finely woven wire to provide flexibility, and then finally covered again with a thin layer of insulating material on the outer surface. Since the inner conductor and the outer sheathing share the same geometric axis, the term coaxial has been adopted for the cable. In a perfectly constructed coaxial cable, the electromagnetic field that carries the signals exists only in the space between the inner and outer conductors of the cable. The inner conductor of a Coaxial cable preferably should be made of strands that make the cable flexible. However, solid conductors are also used in coaxial cables. The inner conductor may be silver plated to get high frequency performance. At times, copper plated iron wire is also used as an inner conductor. The design parameters of a coaxial cable are based on the following:

- Size of the Cable
- Frequency level of transmission desired
- Attenuation
- Power handling capabilities
- Strength of the cable
- Flexibility of the cable desired
- Cost

The use of proper insulation that surrounds the inner conductor is of paramount importance in a coaxial cable. The insulating material may be plastic, a foam plastic or may be air with spacers combine (the spacers will support the inner wires and keep them away from touching the shield). The properties of dielectric control some electrical properties of the cable. The choices are either polyethylene insulator or solid Teflon insulator; which will reduce transmission loss in the cable.

Coaxial cables may use in their construction varieties of shields. Braided copper wires are normally used as shield in conventional coaxial cables. The braids are sometime silver plated for better shield performance. At times even double layered braids are also used for the same reason. These days it is more common to have a thin foil shield covered by a wire braid. Even more than two layers of shields are also used in some coaxial cables. Where more emphasis is given to shielding the inner conductors, solid metal tube shields are used, sacrificing the flexibility of the cable proper. Such cable cannot take sharp bends as the shield may kink causing damage to the cable. However, these hard core coaxial cables also have specific customers who prefer such hard core cables for longevity and they provide a lower signal losses viz. CATV distribution system.

Another important feature of the coaxial cable construction is the insulating jacket. These jackets can be made of PVC or made of some fire-resistant materials. Further, when the cables are used for outdoor applications, it should be equipped to resist ultra-violet rays emanating from sunrays and also tackle oxidation. However, for indoor application, the insulating jacket may be omitted.

RF connectors are normally used at the ends of a coaxial cable. Some of the essential characteristics of a connector are: to have similar impedance as the related cable, better to have similar cut off frequency, dielectric may be different. These connectors may be plated with nickel, tin, gold, rhodium or silver. Micro miniature coaxial cables are increasingly being used in the consumer electronics sector. These cables are used in mobile phones.

Coaxial lines confine the electromagnetic wave inside the cable, between the central conductor and the shield. The transmission of energy in the line occurs through the dielectric between the conductors inside the cable. That's why coaxial cable can be strapped to conductive supports or bent and moderately twisted without negative effects of current induction

Coaxial cable length has nothing to do with coaxial cable impedance. The impedance is determined by the size and spacing of the conductors and the type of dielectric used between them. Common coaxial cable impedance in various applications is 50 Ohms and 75 Ohms. Coaxial cables with 50 Ohms impedance are used in radio transmitter antenna connections, data communications (Ethernet). 75 Ohms coaxial cables are used to carry video signals, TV antenna signals and audio signals. Different impedance have different characteristics. Coaxial cables handling maximum power, somewhere between 30 to 44 Ohms are considered optimum. Impedance around 77 Ohms give lowest loss in a dielectric filled cable line. 93 Ohms coaxial cables give low capacitance per foot. Impedance higher than that is not normally found in coaxial cables.

## Co-axial Connectors

Coaxial connectors are vital link between high frequency signals and coaxial cables. These coaxial connectors are often used to interface two units such as antenna to a transmission line, a receiver or transmitter. Importantly, a proper choice of a coaxial connector will facilitate the interface. These connectors come in many impedances, sizes, shapes and finishing's. There are

thousands of models and variations of these coaxial connectors, each with its advantage and disadvantage. However, coaxial connectors are referred by groups or series designations and fortunately there are only about a dozen or so groupings or series designations. Each group or series has got its own characteristics. The most popular coaxial connectors are: TNC, UHP, N, BNC, SMA, DIN, F. A quick review of these connectors is elicited below:

- "UHF" connector: it is one of the oldest connector in the market for frequency above 50 MHz
- "BNC" connector: it has a bayonet-lock interface which is suitable for uses where numerous quick off and on insertions are required. BNC connectors are available at 50 Ohms and 75 Ohms versions. These connectors have low cut off frequency and higher loss.
- "N" connector: it is one of the oldest high performance coaxial connectors that came in the market.
- "TNC" connectors: it is an improved version of BNC connector with a threaded interface.
- "SMA" connectors: these are miniature connectors which became available in mid 60's. They are primarily designed for small dia. Metal jacketed cable.
- "7-16 DIN" connector: these connectors are recently developed and are quite expensive connector series that is primarily designed for high power applications where many devices are co-located viz. cellular poles.
- "IEC" antenna connector: this is a very low cost high volume 75 Ohm connector used for TV and radio antenna connections.
- "F" connector: are primarily designed for very low cost high volume75 Ohm applications such as TV, CATV etc.