

## COAXIAL CABLE CONSTRUCTION

This section provides an introduction to understanding coaxial cable construction. These fundamentals will allow you to understand the basic materials that are used in the construction of a coaxial cable. A coax cable type is determined by the specifications of the system installed, basic electronic principles, environment, and regulatory agencies. These various criteria dictate the type of conductor, gauge of wire, type of insulation, shielding, and type of jacket. A basic understanding of coaxial cable construction should be helpful in selecting and installing the proper cable for a particular system.

### Conductors

Conductors for coaxial cables can vary greatly from stranded conductors for maximum flexibility to copper covered steel which provides a stronger cable that will withstand a greater physical strain than copper. The American Society For Testing and Materials (ASTM) standards are followed for all of West Penn Wire conductor materials. The ASTM Standard defines standard requirements such as tensile strength, elongation, resistivity, dimensions, permissible variations, finish, inspection and testing.

#### Conductor Material

There are several types of material that conduct electricity well (aluminum, nickel, gold, silver). However, copper is the most popular due to its excellent conductivity compared to other material cost. West Penn Wire uses a variety of conductors in our cable. Material used can be bare copper, tinned copper, and copper covered steel. The conductor can consist of solid or stranded construction. The type of conductor selected is determined by the application the cable will be used for.

#### Solid Conductors

A copper rod provides a solid conductor for a wire. A solid conductor offers lower cost and is easily formed to any shape desired. A solid conductor does not have much flexibility and may break if flexed too much in one place. For these reasons, a solid conductor is best suited for use in a fixed or permanent installation.

#### Stranded Conductors

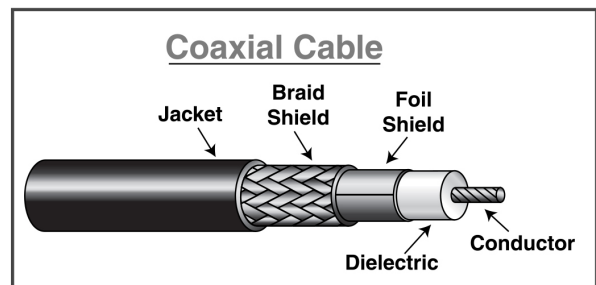
By combining several strands together, a stranded conductor can be formed. A stranded conductor is easy to pull, is flexible and is less likely to break if subjected to frequent bending. The finer the strands and the more strands used to assemble a conductor the more flexible the conductor becomes. Therefore, stranded cable is ideal for installations where frequent movement of the cable is required.

#### Bare and Tinned Conductors

Conductors can be either tinned or plain bare copper. Most electronic connectors today are designed to be used with bare copper. In cables that are terminated with soldered connectors, tinned plated conductors can help in soldering the wire to the connector.

#### Copper-Covered Steel

This type of conductor uses a steel conductor covered with copper. This type of conductor make-up is used for RF applications that require a cable to withstand added tension. The steel provides added strength and the copper provides good conductivity for higher RF signals such as CATV. This type of conductor is not good for low frequency transmission, such as CCTV.



### Dielectric

A coaxial cables dielectric is a highly resistive material that is applied to the conductor to resist the flow of electric current to the shield. It also sets up a cables electrical characteristics. There are several types of insulation materials and constructions used and each has its advantages and limitations. The type of insulation selected is based upon the application of the cable. Insulation is also referred to as the dielectric of a cable.

#### Solid Dielectric Construction

solid dielectric construction uses a process of extruding a solid material over the center conductor of a coaxial cable. It provides good electricals, added cable strength and uniformity of termination. However, a solid dielectric provides poorer electricals and less velocity of propagation than cellular designs.

#### Foamed (Cellular) Dielectric Construction

A cellular dielectric construction uses a process of extruding a cellular material over the center conductor of a coaxial cable. This improves the dielectric constant of the dielectric material which improves the electricals of a coaxial cable. The dielectric material exhibits a lower capacitance, which in turn provides lower loss. This dielectric material also provides a higher velocity of propagation. With the advent of the "Gas Injection" process, cable manufacturers are able to improve their cellular design and provide a lower loss cable with higher velocity of propagation values.

### Dielectric Materials

#### Polyethylene

This compound offers excellent electrical properties providing for low loss of a signal. However, it can only be used on a non-plenum rated cable because the compound has a poor flame and smoke retardancy.

#### Teflon® (FEP)

A premium insulation that provides excellent electrical and mechanical properties. This compound is widely used as a dielectric for coaxial cables providing low loss and the ability to withstand high temperatures and also having low flame and smoke characteristics.

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### Shielding

There are basically three types of shielding techniques:

1. Foil Shielding, 2. Braid Shielding, 3. Combination Shielding

Shielding is utilized to prevent radiation and signal loss of high frequencies used in electronic circuits and to reduce EMI/RFI interference. However, shielding tends to increase the overall capacitance of the cable.

#### Foil Shield

Foil shields are usually made of a thin layer of aluminum bonded to a polyester film. A foil shield allows for 100% coverage if applied with an appropriate overlap construction. It is very good in reducing Radio Frequency (RF) interference, but does not perform as well in blocking Electro Magnetic Interference (EMI). Foil shields do provide easy termination and low cost protection, although they are fragile (low tensile strength and impact resistance).

#### BiFoil

This type of foil shield allows for added protection by increasing the metallic coverage without adding increased thickness to the diameter of the cable. Mainly, used in coaxial cables, the BiFoil shield is an aluminum-polyester-aluminum tape with 100% coverage.

#### Bonded BiFoil

This type of foil shield has the same aluminum-polyester-aluminum construction as the BiFoil shield, but is also bonded to the dielectric with adhesive. This allows for better shielding capabilities and also provides excellent ease of stripping and termination because the foil does not pull away from the dielectric.

#### Braid Shield

Braided shields can be constructed in various coverages (95% - 98% being about the highest coverage available with this type of shielding). The material can be bare copper, tinned copper, or aluminum. Depending on the amount of coverage, braid shields reduce EMI interference well, but are not as effective in the RF range. Copper braided shields also allow for a much lower shield D.C. resistance than foil shields.

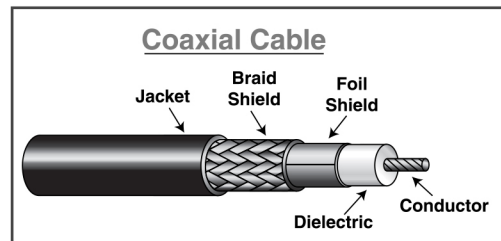
#### Combination Shielding

This technique offers the best of both types of shielding. First a foil shield is applied around the dielectric and then a braided shield is placed on top of the foil shield. This allows for greater coverage in blocking both EMI and RFI signals. There are also several versions of this basic technique such as triaxial and quad shielding.

#### Foil/Braid

This is the most common type of combination shielding. The aluminum foil is placed around the dielectric and then a braided shield is applied over top the aluminum foil. The metallic side of the foil shield is usually in contact with the braid. The braid is then used for shielding as well as ground termination eliminating the need for a drain wire. There are various types of shieldings offered on West Penn Wire coaxial cable:

1. Quad Shield - A Foil-Braid-Foil-Braid combination shield construction. This provides maximum shielding against EMI/RFI interference.
2. Tri-Shield - A Foil-Braid-Foil combination
3. Triaxial - A Braid-Separator-Braid combination shield construction.



### Jackets

The cable jacket is for strength, integrity, and overall protection of the other components inside the jacket. There are a variety of jacketing materials that are used in cable construction. Standard compounds and special variations of these compounds can be used in making the jacket. The selection of cable with the proper jacket and conditions of the environment the cable will be installed in are important considerations. Environmental parameters that should be considered include temperature variations, chemical reactance, sunlight resistance, mechanical and abrasion impact. Jackets are sometimes made up of the same material as insulation used on a dielectric. To learn more about various compound properties, please refer to the Dielectric Section.