

FASST

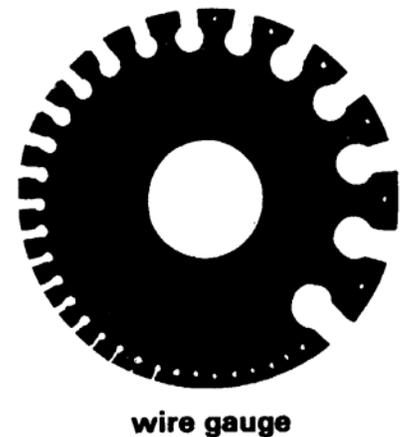
Field Associate Sound System Training

Wire

Think of wire (or cable) as being the blood vessels of our sound system. Using wire that is too small could have a drastically bad impact on the overall system. Wire size is measured using the term ‘awg’. This is an acronym for American Wire Gauge.

The American Heritage Dictionary defines gauge as: ‘The diameter of a shotgun barrel as determined by the number of lead balls in a pound that exactly fit the barrel’. While very interesting, it’s probably not the definition we’re looking for. Maybe ‘ a standard or scale of measurement’ is more appropriate for our application.

This gauge measurement represents the thickness or diameter of the copper conductor. A larger or thicker conductor has a smaller gauge number than a smaller or thinner conductor. For example, a 12awg wire is thicker than a 20awg wire.



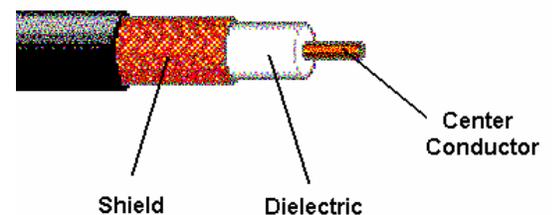
Another important term when discussing wire is plenum. For our purposes, a plenum is an enclosed air space. Restaurant and retail stores are often constructed with the space above the ceiling acting as a return air plenum. By doing this, the builder does not have to install return air ducts for the HVAC system. However, anything in this space must not emit toxic fumes when subjected to fire. During a fire, any toxic fumes would be circulated back down where people may be trying to get out. Therefore, the cable manufacturers use a Teflon jacket that satisfies these requirements. Cables with this jacket are said to be *plenum rated* and are typically labeled as CL2P or CMP.

Copper is the preferred material choice as it passes or conducts electricity with near 100% efficiency.

There are several different types of cables that are manufactured and numerous variations of each. Fortunately for us, there are only a few types that are predominately used in the A/V industry.

Coax

The first type we will look at is a coax or coaxial cable. Coax cables are typically used for video and RF distribution. Characteristically, they have a relatively wide bandwidth giving them the ability to transfer large amounts of information. Most coax cables are comprised of three distinct parts: the center conductor, the dielectric, and the outer shield.



For our applications, the center conductor is typically solid copper, however a stranded center conductor is occasionally used for analog video applications. A coax cable with a stranded center conductor is much more flexible than a solid conductor and works well for portable systems. Coax cable can be categorized based upon the thickness of the center conductor.

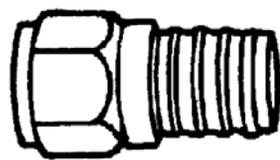
Type	AWG	Application
RG-11	14	RF for long distances, satellite and MATV
RG-6	18	RF for short distances (<200'), satellite and MATV
RG-59	20 – 22	Analog video
RG-58	20	50 ohm transmission. Used for some wireless mic systems.

An important point to understand when dealing with RF signals is the loss that is experienced over long runs. RG-11 experiences the least loss and RG-59 the most. In fact, RG-59 should never be used for satellite or MATV installations because of its high loss rate.

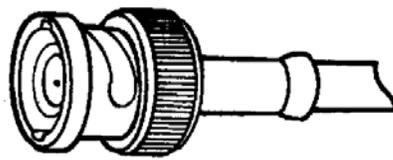
The dielectric is simply a non-conductive material isolating the center conductor from the shield.

The shield helps protect against undesirable noise from being inducted on the center conductor. All coax cables have one or more braided shields as shown in the diagram above. This braid is usually made of copper, aluminum, or a copper-tin composite. Additionally, the shield may include one or more layers of foil depending upon the users needs. For AV work, a single copper braid is usually sufficient.

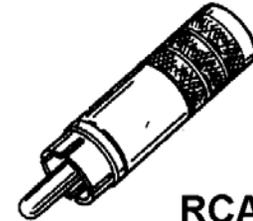
Connectors most commonly used on coax cable are F, BNC, and RCA. There are different connectors for a Teflon jacket than PVC, since the outer jacket is thinner. Crimp-on connectors can easily be pull off if used on the incorrect cable.



F



BNC



RCA

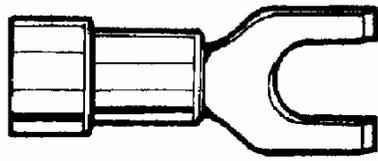
Unshielded Twisted Pair (UTP) - Loudspeakers

All audio signals are transmitted over stranded, twisted pair cable as shown in the adjacent diagram. Loudspeaker cable should always be between 18awg and 12awg depending upon the load. The chart below gives an indication when larger gauge cable should be used.

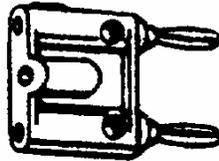


AWG	Application & Load Limits
18	Small 70 volt systems with loads below 200 watts
16	Larger 70 volt systems and long home runs
14	Low impedance loudspeakers on runs less than 200'
12	High powered low impedance loudspeakers (subwoofers) or long home runs

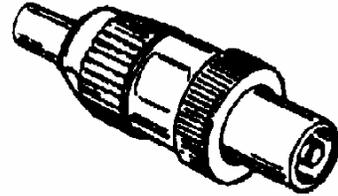
Typical amp level connectors are spade lugs, banana plugs, and speakon connectors.



Spade Lug



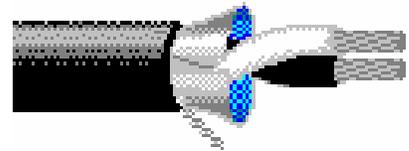
Banana Plug



Speakon

Shielded Twisted Pair – Line Level, Mic Level and Control.

Low level, pre-amplified signals use stranded, twisted pair cable as well. The main difference is that these signals require a shield around the pair that carries the audio signal. This is crucial since these signals are relatively weak to begin with and therefore, very susceptible to noise induction. They also have a 3rd conductor that is an unjacketed drain wire. This 3rd conductor is necessary for balanced signals used in microphones and professional line level equipment. Some devices use this type of cable for their communication protocols as well.



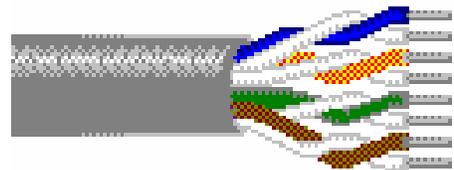
Microphones with push to talk buttons require an additional pair of cables for each button. In those instances it is convenient to have an additional pair of cables in the overall jacket with the microphone. Multi-pair cables like this need to have a shield around the audio pair, but not around the control pair, similar to the diagram at the right. Cables with multiple shielded pairs are said to be individually shielded while a cable with all conductors within the shield are said to have an overall shield.



The conductors in this cable are typically 20 or 22awg. 22 awg is sufficient for most runs under 100 feet. Anything longer than that should consider using the larger 20awg.

Category 5 cable

CAT-5 cable is also a good cable to use for contact closure control. It is a 4 pair, solid conductor, unshielded cable. Most often used for computer networks and phone systems, it is fairly inexpensive and has a variety of applications.

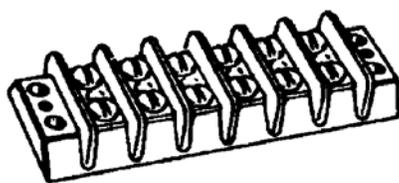


Many multi-pair cables come with a tear string in them. The intent of this string is to allow the installer to quickly remove a large amount of outer jacket if needed. When terminating a cable, cut the string off. Not only does it look bad, but it has been know to get caught in ventilation fans.

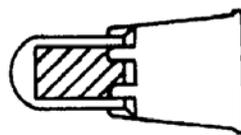
Tips:

- Twisted cable has inherent noise rejection properties. That is why you should never use ‘lamp cord’ for your loudspeakers.
- Red jackets on cable are reserved for fire alarm cabling. Don’t use it, get close to it, or tie anything to it when installing a sound system. The inspector can make you come back fix it.
- An S-video signal can be sent across two separate coax lines. A couple S-video to dual BNC adaptors can be used to do this.
- Teflon jackets tear easily. Be careful when pulling it. If it gets snagged, it can quickly short out on aluminum framing.
- Be careful when stripping back the outer jacket. It is very easy to cut through the inner jackets as well and create a short.
- Color coding of the inner jackets can be confusing. It can be red & black, white & black, white and green, etc. As a rule of thumb, the darker color should always be the common or neutral leg and the lighter color will be the hot. In the white and green example, the white is hot and the green is neutral. *However, This applies to low voltage only. To an electrician it is reversed with the black being hot!*

Other approved terminating connectors



Terminal Strip

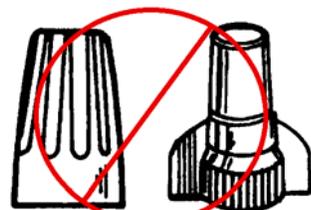


Closed End Crimp



Inline Crimp / Butt Connector

Not allowed:



Straight Winged

Screw-on Terminals / Wirenuts