

# Coax: Buyer Beware

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The coaxial cable running from your radio to the antenna is unbelievably important. Everything you transmit and receive must travel along its length. All too often the coax is ignored and performance suffers because of the lack of attention it receives. Having a hi-performance antenna and a defective piece of coax is the equivalent of having a hi-pressure nozzle at the end of a garden hose that is full of holes. Complaining about the antenna or the nozzle performance is unjustified. The fact remains, when it comes to buying coaxial cable, bulk or in assemblies, quality is everything!

Although there are many types of communications grade coaxial cables on the market, this discussion will primarily focus on those used in mobile communications applications. Before starting, a few terms and/or phrases need to be clarified.

**Coaxial:** two conductors sharing the same center

**Center Conductor:** the wire at the very center of the cable

**Insulator:** the material surrounding the center conductor

**Shield:** the outer conductor surrounding the insulator

**Jacket:** the outer covering of the cable

**Propagation velocity:** speed of signal traveling in coax

For mobile installations, there are three (3) primary types of coaxial cable used to build the assemblies.

**RG-58 type:** This type of coax is used for single antenna installations and for jumper wires that go between the radio and a test meter (SWR meter). The RF resistance of this type of coax is 50-ohms. Within this group you will find coax labeled with RG-58 or RG-58/U. These cables have a solid center conductor. The second type is RG-58A/U and they have a center conductor made up of many thin wire strands (normally about 17) that are twisted together to form the center conductor. The common outer diameter for this type of cable is about 0.20".

**RG-8X:** This type of coax is also used for single antenna installations or jumpers between pieces of equipment. Sometimes it is referred to as "Mini-8. Like the RG-58 type coax, RG-8X also provides 50-ohms of resistance. In short, this cable could be called hi-performance 50-ohm cable. It always has a stranded center conductor and a high shielding percentage. It will also handle higher power (wattage) and has a higher propagation velocity. For the general user, it is more than what is required. However, if you are using amplifiers or just like to get the absolute most from your set-up, it will deliver. The outer diameter of RG-8X is typically about 0.24".

**Several times a year we get tech calls from installers who place dual antennas on their vehicle and run RG-58 or RG-8X from each antenna to a T-connector at the back of their radio only to find that the system "doesn't get out". You should not use 50 ohm coax on a ground plane dependent dual antenna installation ... it MUST be 72 ohm RG-59 type coax. These flawed installs can be misleading because SWR tests can show exceptionally low SWR, making the installer think that all is well. However, the impedance of the antenna system does not match the requirements of the radio and therefore, the output power of the radio is greatly reduced. In several tests, we found that a 4-watt radio would only generate 1.75 watts of output power that is the equivalent of having an SWR reading that exceeds 6.0:1.**

**RG-59 type:** This type of coax is used for dual antenna installations only. The RF resistance of this type of coax is 72-ohms. Within this group you will find coax labeled with RG-59 or RG-59/U. These cables have a solid center conductor. The second type is RG-59A/U and they have a center conductor made up of many thin wire strands (normally about 19) that are twisted together to form the center conductor. The common outer diameter for this type of cable is about 0.22".

**About the center conductor:** We strongly believe that mobile installation should always use stranded center conductors. The reason behind this is due to potential breakage of solid conductors due to vibration and/or repetitive flexing. If you have ever picked up a piece of wire and bent it repeatedly until it broke, you would fully understand our reason for recommending stranded center conductors on mobile installations.

**About insulation:** There are two common types of insulating material used in coax. First there are the foam (poly-foam) types. Although most specifications sheets show that poly-foam insulated coax has a faster propagation velocity, we do not recommend it for mobile installations. We prefer the plastic types (poly-vinyl, polypropylene, etc.) because they are just plain tougher. The small loss in velocity, for all intents and purposes, is insignificant insofar as low power, low frequency communications are concerned. The properties of coax cable changes if the center conductor is not in the physical center. Poly-foam insulation deteriorates faster than the plastic types and also tends to collapse easier than the plastics when pinched or sharply bent

**About shielding:** The shield surrounds the center conductor and prevents internal leakage and external interference. The typical shield used on two-way radio communication cables is a woven braid. For the most part, it is formed with either bare or tinned copper wire and is a very important consideration when trying to determine the quality of the coax. Low percent coax has a loose braid and exposes more of the center conductor to leakage. Unfortunately, the cable industry did not invent a coding system that designates the type and percentage of shielding used to build the coax. Shielding percentage is the most abused part of the coaxial cable manufacturing process. There was a time when 70% coverage was considered the absolute minimum, but we have seen cheap cable with as little as 58% shielding being sold in recent years. Because it is readily available, we do not recommend coax cables with shielding less than 90%. Using anything less is the equivalent of watering your lawn with a hose that is full of holes and has a restricted opening. You must exercise caution when it comes to shielding.

**About the length:** This is a testy subject with many engineering types. They have argued with us on many occasions regarding this matter. They say that if your system is set-up properly that the length of the coax is irrelevant. We agree! However, mobile installations have so many variables that a perfect set-up is the exception, not the rule. One guy has a pick-up and another has a fiberglass motorhome. One wants the antenna on the bumper, another on the hood and a third on the roof. Few people want to drill holes in their vehicle so quality grounds are always a consideration. Because of the imperfect world, we almost always recommend 18' (5.5m) when our products are used. We do so with good reason too! At 18' the voltage curve has dropped back to the zero voltage point where the cable meets the antenna, which reduces the reactance within the cable itself (a null cable if you would). It has been our experience that if the antenna location makes it somewhat out of sync with its surroundings, cable lengths that are not multiples of our 18' suggestion adds to the problem. To that, our complaining experts say; "Then the antenna should be moved!" to which we say, "You tell the guy with the \$30,000 vehicle that he must drill a hole in his roof so he can use a 9' cable". We solve problems in the best way we can given the boundaries that the customer establishes.

On that note, when you have 18' of coax going to a radio that is only 8' away, what should you do with the other 10'? We recommend that you serpentine it like a skein of yarn so that it is 10-14" long and tie it in the center with a wire tie then tuck it away. Do not roll it up in a tight circle as this can cause it to act like an RF choke, which often times will cause system problems.

**Other ways to wreck your coax:** Wear holes through it, slam it in the door a few dozen times, attempt to splice it as you would a wire going to your taillight, tie it in knots or make real sharp bends in it.

For your information, all of our Fire-Flex coaxial cables have stranded center conductors, polyvinyl insulation and bare copper shielding in the 95% range. Even though we offer some cables that are not 18', we do so for the knowledgeable installer, who knows that if a problem shows up, he must exercise the 18' recommendation. All of our mini-kits and complete kits are packed with 18' cables.