An-Ten-Ten-nas

INFORMATION
To help you decide
On the best
Antenna for you

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In each issue of the News, we shall try to clarify a significant cluster of ideas in antenna work. Our object is to help you make the best decisions about the antennas you buy or build without imposing our own prejudices on you. The more you understand, the better your choices will be.

Frequently Asked Questions about Coax

Over the course of the 15 years that I have been putting together 10-meter antenna notes, certain questions pop up, especially as folks buy new antennas. What the builder and the buyer have in common is that both must attach a feedline, usually coaxial cable, which runs from the antenna to the shack. The length of the coax may be short or long, but everyone knows how to measure the necessary length. The questions that arise involve some that have appeared before and some that are new to this collection.

1. *Which coax should I use?* We really have about 4 choices. A. RG-58 (a, b, c, etc.). For all but the most temporary field situations, avoid this cable. Coax losses even when well matched increase with frequency and at 10 meters coax losses become significant. RG-58 has about the highest loss level of any coax available (except for the very thin RG-174). B. RG-8X. This cable is almost as thin and light as RG-58, but with lower losses. Where you need light weight (in the field, with a travel trailer, etc.), this cable can serve very well. C. RG-8 or RG-213. RG-213 replaced standard RG-8 and has tighter, more complete braiding. It is fatter (1/2" outside diameter) and heavier than RG-8X, but usually has lower losses. It also has a higher power rating (considering both voltage and current). If you run the legal limit, this is the minimum cable to use. D. Lower-loss special cables. The LMR series of cables and similar lines are designed for high power and low loss. They have the size of RG-213. However, the losses are lower, and prices may vary with the loss figure.

There are also some specialized cables to consider. Some have special jackets designed for maritime use. Others have jackets designed for use underground with the need for a special conduit. (Be careful of running conduits underground, since they will gather water from condensation alone, even if you add all of the protections from water entry. Put gravel in the conduit ditch and have weep holes to release the moisture.

2. *How do I match my coax to the antenna, especially a Yagi?* If you are purchasing a Yagi, read the manual and find out what the impedance at the antenna feedpoint is. If it is 50Ω, you only need to connect the coax to the antenna connector and you are almost ready. (But do not stop reading, because there is a precautionary measure to take.)

However, many hams buy used beams with no manuals available. You may be able to obtain information from the maker on line or via regular mail. If you are buying someone's home-built antenna, you may have to use clues to determine what matching system is in use if any. There are 3 main matching systems used on monoband 10-meter beams. **Fig. 1** shows what to look for to see which one your beam uses. For 2- and 3-element Yagis, we can design 50-Ω beams, but the booms get longer for the same gain level as shorter beams with impedance (before matching) in the 20-25-Ω region.

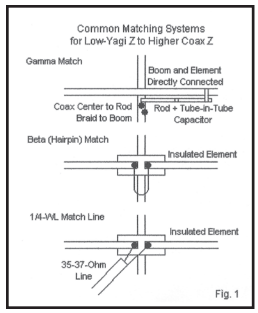

Fig. 1

If the driver element attaches directly (metal-to-metal) to the boom, then the builder will usually employ a gamma match, as shown on the left. The system uses a rod for inductance and a series capacitor. However, most gamma systems today form the capacitor by sliding a thinner tube inside a fatter tube, with an insulating sheath between. So the capacitor may not be visually evident..

Most beta matches uses what looks like a hairpin across driver terminals that are insulated from the boom. The hairpin may look like a short circuit, but it is actually a length of shorted transmission line that provide inductive reactance. The driver is shortened to make it correctly reactive capacitively, and the two reactances form an L-network to match the lower antenna impedance to the higher 50-Ω coax impedance.

If we make the insulated driver resonant and the feedpoint impedance is about 25 Ω, then we can attach a ¼-wavelength section of 37-Ω cable between the antenna feedpoint and the main coax line to the shack. Although 35-Ω coax is available, most hams use side-by-side strips of 70-75-Ω cable (such as RG-59) to form a 35-37.5-Ω matchline. At each end, we connect the center conductors together and we also connect the braids together.

All 3 systems work equally well, with low losses. But note that each one requires different circumstances to work. The gamma is for driver elements directly connected to the boom. The beta requires an insulated driver and shortening to make the element capacitively reactive. The ¼-λ matching section requires an insulated resonant driver. Those are the main clues to what you have. Even though the gamma may also use a shortened driver, you cannot interchange a gamma with a beta, since they need different boom-junction treatments. Element require some change of length depending on whether they attach directly to the boom or we insulate them from the boom, so changing a match system may detune a given antenna.

3. *Do I really need a balun at the feedpoint*? The answer here is "no" and "yes." You do not need a balun to match impedances. However most 1:1 baluns also act as RF chokes, and that is what you need. Let **Fig. 2** be your guide.

When you think of coax cable, mentally separate the inside of the braid from the outside of the braid. The

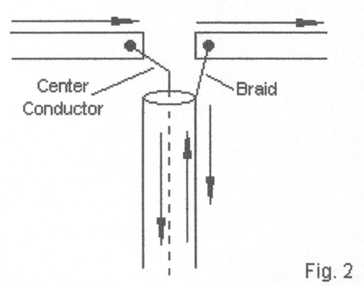

Fig. 2

energy to make the antenna radiate appears between the center conductor and the inside of the braid. When we connect the antenna, the energy from inside the braid can take 2 paths: the element half and the outside of the braid. Whether significant energy flows down the outside of the braid depends on many variables, including the length of the coax. However, it does not take much energy on the braid to throw off the SWR meter, to lock up solid-state circuitry in the rig, and to interfere with other sensitive devices in the home. Therefore, it is wise to add an RF choke that blocks the errant right at the feedpoint. Use any kind of choke that affects only the outside of the braid with no effect on the inside of the coax. A coil of coax will work, but is usually heavy. You must also wind it with care so that the weather cycles will not ruin the spacing between the center conductor and the braid. A 1:1 balun will also work, but most such devices use toroid cores that result in heavy units. The simplest effective choke is a W2DU-type unit that is a linear section of coax with ferrite beads on the outside for about a foot. The unit is light and we can tape it to the boom. A choke at the feedpoint makes good insurance, so I always install one as a precaution, even before checking for RF in the house.

4. *How long should I make a coax run?* I thought we already answered this question. Actually, we only gave the total amount of coax needed to reach from the antenna to the operating position. However, let's now subdivide the coax into three parts. **Fig. 3** shows the parts.

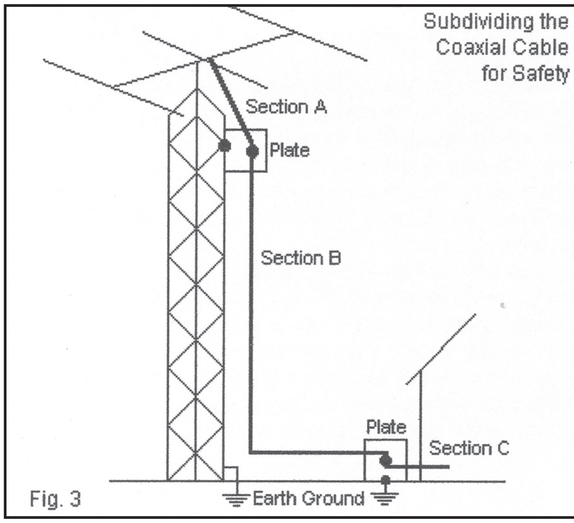

Fig. 3

Section A runs from the feedpoint (or the feedpoint and the choke) to a position near the tower's top, but below the rotator. At that point, note the plate that is electrically connected to the tower. (If you are using only a metal mast, substitute it for the tower leg.) The plate uses a double-female bulkhead connector. Essentially, the braid of the coax uses the tower leg as the shortest, most direct path to a good earth ground. Many lightning experts have noted that when a lightning bolt gets into coaxial cable, most of the current is in the braid. So the connection becomes a first line of defense or line for safety.

Section B runs from the plate to another plate at ground level. Here, we have a connector that we can detach and re-attach to a grounded rod long before the line enters the house. There is no reason for a 10-meter amateur operator to be on the air during a thunderstorm. So the safest course is to disconnect the antenna cable(s) out of doors and to re-connect them directly to ground.

Section C runs from the outside plate to the rig. Be sure to disconnect this section of cable from the rig when a thunderstorm is near.

All of these measures require periodic inspection and preventive maintenance to ensure that they all work as well as when freshly installed. Keep records on your SWR curves across the band (and any other bands that you use). Be suspicious if the SWR starts going up. Be equally suspicious if the SWR starts going down since this situation often indicates that the feedline run is getting lossy for some reason. Inspect and test every 6 months or so (every Spring and Autumn). Replace lines every 5 to 7 years, especially if the lines undergo very hot summers, very cold winters, or very heavy precipitation. Give your antenna and feedline system the same treatment that you give a fine automobile, and you will get about the same durability. However, your antenna and feedline should net you many more miles of contacts.