PROJECT BUILD

Build a 2-Meter Yagi Antenna

Tools

- PVC cement
- Epoxy cement
- Large wire cutter
- Hacksaw or PVC cutting tool
- Soldering iron and solder
- Electric drill and a selection of bits

Materials

- 72-inch length of 3/4-inch PVC plumber's pipe.
- 3/4-inch PVC T-connector.
- Three 40-inch (minimum length) steel welding rods or brass "hobby" rods. Thirty-six-inch rods can also be used. See text.
- Two copper split bolts.

Here's an antenna that will give any 2-meter transceiver — even a handheld — a substantial boost. Not only will your signal be louder at the receiving end, the signals you hear will be louder as well.

This type of antenna is known as a *Yagi*, or technically a "Yagi-Uda." It was invented in 1926 by Shintaro Uda and Hidetsugu Yagi. Their novel antenna revolutionized communication technology, and it's still in use almost 100 years later.

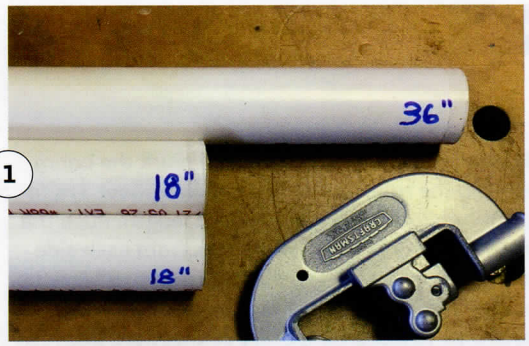
This antenna is a three-element Yagi. It's really nothing more than a half-wavelength dipole antenna (the *driven element*) mounted between two other elements known as the *reflector* and the *director*. Typically, the reflector element is about 5% longer than the driven element, and the director is 5% shorter. The reflector and director shape the energy in a particular direction. By focusing the radio energy in this way, you concentrate the power in the direction you desire (just like a spotlight). You'll notice that this antenna is vertically polarized. This is best for FM work. (For more about antenna polarization, see "Why Antenna Polarity Matters," in the November/December 2020 issue of *On the Air*.)

Construction

Step 1

For a diagram of this antenna, see Figure 1 on page 25. Using a saw or PVC cutting tool, cut two 18-inch lengths of the PVC pipe. These will become the boom pieces. The remaining 36-inch piece will be used as a mast (see ①).

Attach the boom and mast pipes at the PVC T joint. We used PVC cement for this purpose. (Follow the instructions provided by the cement manufacturer.) However, you could also use stainless-steel screws if you want an antenna that can be easily disassembled.

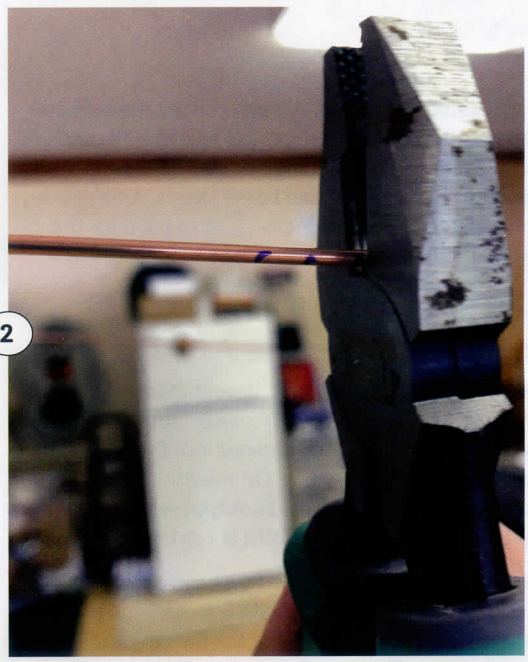


1

Step 2

The elements of the antenna can be made from steel welding rods. You'll find these for sale at most home and hardware stores. Hobby stores often carry brass rods that are suitable, too (see ②).

Using a large wire cutter or a hacksaw, cut the director and reflector elements to the lengths shown in Figure 1: 35 inches for the director and 40 inches for the reflector. If you can't find a 40-inch rod for the reflector, don't worry. You can attach small pieces at the ends to achieve the total length. We'll discuss this in Step 5.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Step 3

Drill a hole all the way through the boom at a point about 1/2-inch from one end. Now use a yardstick to draw a straight line from one of these holes along the boom to a point 1/2 inch from the opposite end. Look along the length of the boom and make sure this line is straight. Mark the end of the line and drill a hole through the boom here as well. Take care when drilling these holes; you want them to be aligned with each other as closely as possible. Choose a hole size that offers a snug fit when you push the rods through.

After drilling, slide the director element through the holes, moving the rod back and forth until you have an equal length on each side of the boom (see ③). Use epoxy cement to hold it in place. Do the same with the reflector element.


3

Continues on following page.

Step 4

To construct the driven element, measure and mark the boom about 16 inches from the reflector. Drill two holes about 1/8 to 1/4 inch apart. Cut two rods, both 20 inches in length. Push the rods through the holes until 1/4 inch protrudes from each side of the boom (see (4A)). In (4B), you'll see that we used two black tie wraps as temporary stabilizers, but these are optional. We are also using alligator clips to make temporary connections between the coaxial cable and the driven element. These are optional as well.

Step 5

At this point, if you couldn't locate a 40-inch rod for the reflector, use the split bolts to attach equal lengths of rod to both ends of this element to achieve the proper length (see (5)). Split bolts are commonly available from hardware and home stores. Alternatively, you can solder the pieces to the reflector. Just make sure the overall length is 40 inches.

Tuning and Mounting the Antenna

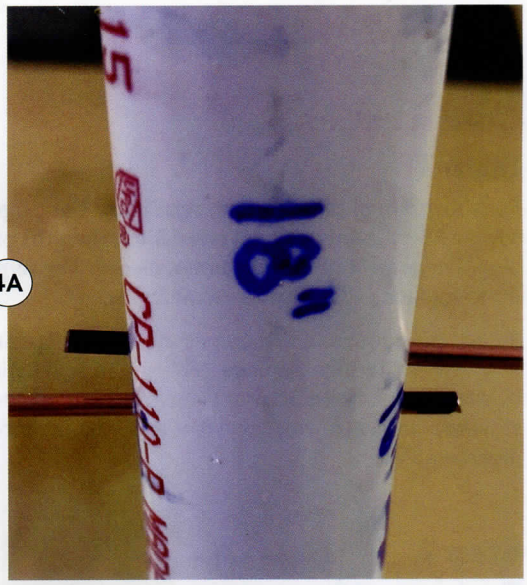
Now it's time to tune the antenna for the lowest standing wave ratio (SWR). If your transceiver has an RF power output indicator and it indicates full output when you transmit into this antenna, chances are the SWR is reasonably low. On the other hand, if your transceiver indicates that it is reducing its output when you transmit, it probably means that your SWR is too high.

Even if you believe your SWR is adequate, it never hurts to be sure. If your 2-meter transceiver has a built-in SWR meter, you can use it during this step to adjust the antenna for the lowest possible SWR. Unfortunately, most FM transceivers lack SWR meters, so you'll need to either (A) acquire a VHF SWR meter, or (B) purchase or borrow a VHF antenna analyzer. An antenna analyzer offers the easiest approach to tuning any antenna, and we'll talk more about these devices in an upcoming issue of *On the Air*.

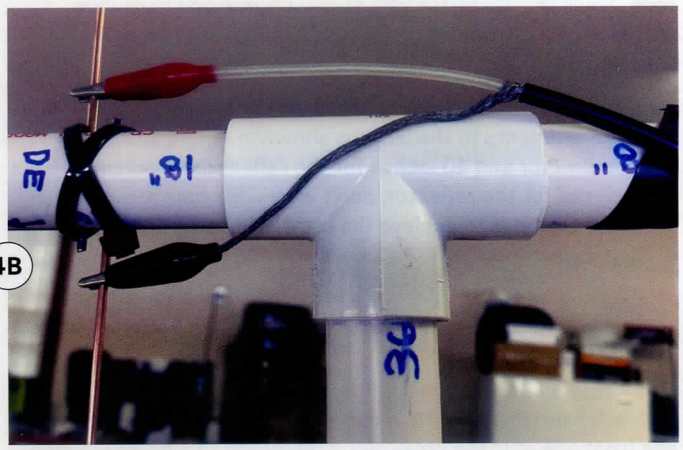
When measuring the SWR, make sure the antenna is being held aloft, preferably at least 6 feet off the ground (see (6)). You'll likely find that the lowest SWR will occur at the low end of the 2-meter band, at or below 144 MHz. If this is the case, trim 1/4-inch from the ends of both driven element rods and measure again. Keep measuring and trimming (in equal lengths) until you get the lowest SWR at about 146 MHz.

Finally, remove the temporary alligator clips and solder the outer braid of the coaxial cable to one side of the driven element that protrudes slightly near the boom. Solder the center conductor to the other section of the driven element, also near the boom. It doesn't matter which part of the coaxial cable is soldered to which side.

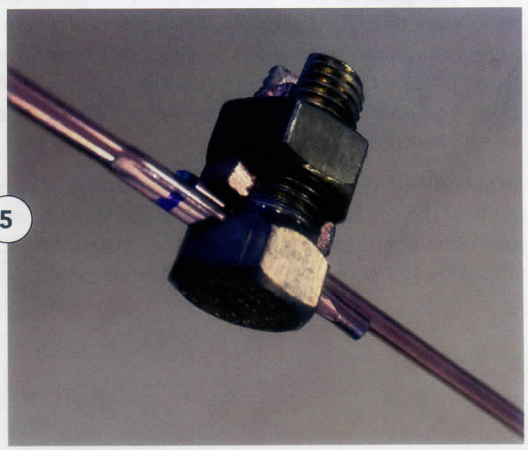
For portable use, almost any coaxial cable will do. For permanent applications, or situations where the length of cable between the antenna and your radio is greater than 15 feet, use a low-loss cable such as LMR-400 or LMR-240.



4A



4B



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6 When measuring the SWR, make sure the antenna is being held aloft, preferably at least 6 feet off the ground.

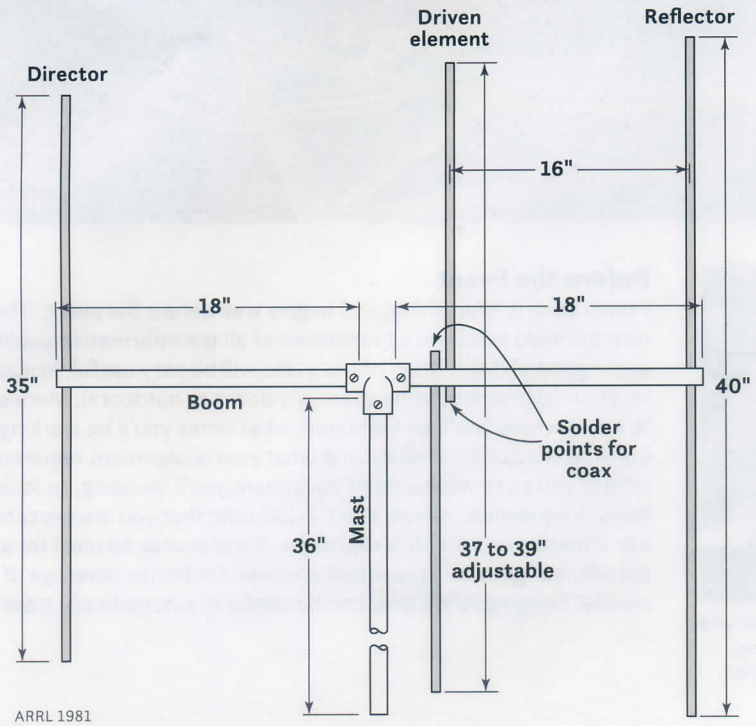

Figure 1: The assembly diagram of the three-element 2-meter Yagi antenna.