

433.92 MHz Yagi Antenna - Unknown Author

Perhaps the most important component in the rocket direction finding project is the antenna. Heck, nearly any transmitter or receiver will work -- it's the antenna that gives you the ability to hunt down the transmitter! The yagi antenna type works pretty well for direction finding as the yagi exhibits gain in one direction (and attenuation in others) -- an oversimplification; but the net effect is that the signal strength is greatest off one end of the antenna and quite a bit less in all other directions. You get the strongest signal when the yagi is pointed towards the transmitter.

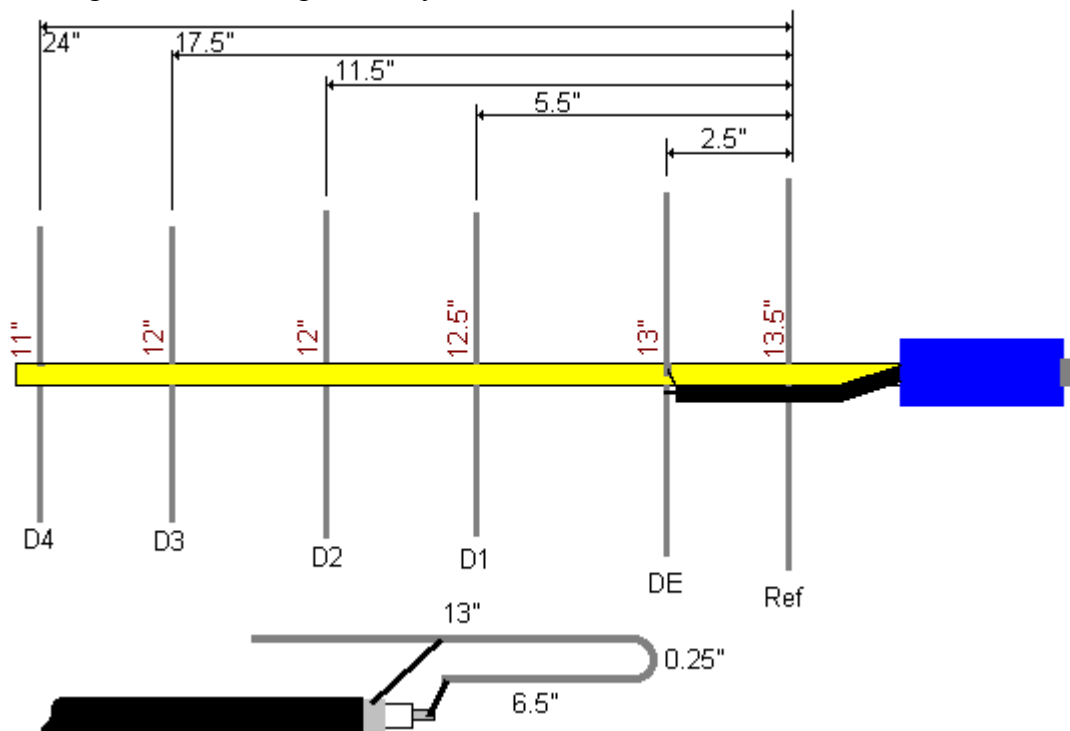
The antenna I'm using for my 70 cm experimentation is a home built yagi. The antenna is quite a bit smaller than the 2m antenna I built. The small size of the 70 cm antenna makes it much easier to carry around and wave back-n-forth while I look for the transmitter. The rest of this web page covers the construction of the 70cm antenna.

My home made yagi is very easy to build. All of the measurements are in inches. Use care when measuring; remember to measure twice, cut once.

Materials:

- a three foot long piece of 1/2" square wood; I picked some up from the local hardware store for less than a buck
- a few sections of 1/8" brass rod; again, I found some at a local hardware store
- bicycle hand grip; pick it up from a local store, I found a rubbery plastic one that works pretty good.
- a female BNC connector (Radio Shack)
- a length of RG58 coax cable (Radio Shack)

The diagram shows the general layout of the antenna:



The yellow section is the 1/2" square wood, 3 feet in length. The gray sections with the dark red inch measurements are the antenna elements (Ref = reflector, DE = driven element, D1-D4 = directors 1 through 4). The blue rectangle on the right hand side is the bicycle hand grip. The black section between the DE and hand grip is the RG58 coax. And finally, the gray square at the far right of the hand grip is the BNC connector.

Below the antenna graphic is a graphic showing the construction of the DE (driven element). The DE is shaped some what like a hairpin. The DE is virtually identical in construction to the 2m antenna I built except that it is smaller and has closer spacing. No special phasing lines or trim caps are needed with the DE; pretty neat stuff!

Construction:

Begin construction by trimming the 1/2" square wood stock to 36" long. The piece I bought was 48" long, so I trimmed off a foot of wood (saving the scrap for later). Next, using a ruler or measuring tape, place a mark on one side of the wood 11 inches from one. This mark represents the drilling location for inserting the Ref (reflector). All further measurements are made using this mark as a reference point.

Using the ruler or measuring tape, place marks on the side of the wood at the points noted in the graphic above: 2.5", 5.5", 11.5", 17.5", and 24". If you measured everything accurately the distance from the last mark (24") to the end of the piece of wood should be exactly 1". Remember that all measurements are from the Ref measurement you placed earlier.

Next you'll need to drill holes through the wood at the marks that you've measured. Center the holes at the mid-way point along the side of the wood (1/4" in from either side). I used a small drill press to make sure that the drilled holes were perfectly perpendicular to the face of the wood. The diameter of the holes you'll drill depend upon the diameter of the brass rod you've got. The brass rod I had was 1/8" in diameter. I drilled the holes using a drill bit just slightly smaller than 1/8". The idea is to have a hole that will tightly hold the brass rods into the wood. (Don't worry too much about this. If your holes are a little over-sized you can always use a dab of epoxy to hold the rods in place.)

On to the brass rod. Measure and then cut off a 13.5" long piece of brass rod. This rod will become the Ref (reflector) on the yagi. I used a Dremel tool with a cut-off disk to cut the brass rod. Use a file to round off the ends of the brass rod -- but keep the length of the rod to precisely 13.5". Press the brass rod into the Ref hole you drilled into the wood, centering the rod so that the same amount of rod extends from either side of the wood. Use a bit of epoxy or CA to hold the rod to the wood if necessary.

Skip the DE (driven element) for now. Instead, cut and round the ends of the Directors (1-4). D1 is cut to 12.5". D2 and D3 are cut to 12". And finally, D4 is cut to 11" long. Press the directors into the wood at the locations drilled earlier. Use a drop of epoxy or CA to hold the brass rods to the wood if necessary.

Now the DE (driven element). Cut a piece of brass rod to 19.75" long. The extra length is needed because you are going to bend the rod over upon itself to make a "hairpin" shape (as shown in the graphic). Measure in 6.5" from one end of the prepared brass rod and place a mark using an ink pen. Carefully bend the rod from this point so that you end up with a hairpin shape with a distance of 0.25" between the upper and lower sections. NOTE: I found that heating the brass rod with a propane torch REALLY helped with the bending. Without heating the brass rod tended to crack; however, if I heated the rod it became pliable enough that bending the rod was actually quite easy.

Double check the measurements of the hairpin shaped piece. As with any antenna, the measurements are critical. For our purposes you'll want to be within 1/16" of the prescribed measurements and closer is even better!

Finally, before mounting the DE (driven element), take a piece of fine steel wool or extra fine sand paper and clean the center of the upper section of rod and the tip of the lower section. We will be soldering a wire to the upper and lower sections so the brass must be clean.

Install the DE into the wood at the hole you drilled earlier. The lower (shorter) section of the DE should just fit over the side of the wood, centered to the middle of the side. Don't glue the DE to the wood just yet -- wait until you've soldered the coax to the DE.

Prepare one end of the RG58 by separating about 1/2" of ground shield into a wire and tinning. (This is something for which I really should draw a picture. If you've worked with coax before, you'll know what I'm writing about -- if not, find somebody who has worked with coax before!) Solder the prepared end of coax to the BNC connector using black electrical tape or heat shrink tubing to insulate the shield from the center conductor.

Drill or cut a small hole in to the bicycle hand grip so that the BNC connector will fit. Pass the coax through the hole, leaving the BNC connector's base in the hole. Using the nut that came with the BNC connector, affix the connector to the bicycle hand grip.



Push the hand grip on to the wood on the end closest to the Ref (reflector). As you push the hand grip onto the wood, maneuver the coax so that it ends up on the same side of the wood as the short section on the DE (driven element). Don't push the hand grip too far or you'll crush the coax / BNC connection. You may need to shim the inside of the hand grip with another piece of wood in order to achieve a tight fit between the hand grip and the wood (I used some of the wood that I had cut off earlier to shim the handle).



Route the coax down along side the wood to the DE. Trim the end of the coax so that you'll be able to solder the center conductor to the end of the short end of brass rod and the coax shield to the longer length (see the drawing). Tin the brass rod at the end of the short end and the long end

next to the wood. Solder the coax to the DE (see the drawing). Add a dab of epoxy or CA if necessary to hold the DE in place.



That's all there is to it! Your antenna is complete and ready to use. If you want to further tune the antenna, the mounting point of the center conductor has an effect on the rf resistance of the antenna. The tip of the DE furthest from the bend can be trimmed for resonance. However, using the measurements I've given, without further tuning, will produce an antenna close enough to resonance and 50 ohm resistance that further tuning may not be necessary as long as you use the antenna for receiving only (no transmitting).

Mark also suggested I bake the yagi in a low temp oven for a day or so to drive all moisture out of the wooden boom, then give it a coat of clear lacquer.

[Go back](#)