All Copper Pipe Hentenna for 2 Meters

By Mark Hayden, KF6DSA with construction tips by Richard Anderson, KG6TRD

Adapted from an original article by Terry Fletcher, WA0ITP

Background: The **Hentenna** is a loop style antenna developed by Tadashi Okubo, JH1FCZ and others in Japan in the 70's. It was first described in the US in a February 1982 QST article by Koji Sugihara, JJ1UMS. Shirow Kinashita, JF6DEA/KE1EO wrote about it in the ARRL Antenna Compendium Vol 5. The gain is approximately equal to a 3 element tribander. JH1FCZ reported a gain of 5.1 dBd in 1972, remarkable for its small in size in comparison to a beam antenna. There are many references (in Japanese) to the Hentenna on the Internet, but only few articles are written in English. The Hentenna built in multiple arrays has showed great success as well. Six meter Hentennas are used widely. Read the following detailed instructions on development, construction, and installation of this great little 2 Meter antenna and then build your own!

BUILDING IT

We recommend building the 1/2 " copper pipe Hentenna to the following dimensions.

overall length = 40 inches
overall width = 12 3/4 inches
feed point = 7 3/16 to center line of T connector.

You'll need one 10' piece of ½ inch copper pipe, four right angle elbows, two tee's, and two end caps from the hardware store, total cost about $12. With the dimensions below you can just jam it all together heat and solder and it will work just fine. Or you can adjust the dimensions, test the antenna for SWR perfectly before soldering. The dimensions are very critical because there is no adjustment possible after you have soldered the fittings! The T connectors can be left unsoldered until the SWR is adjusted for optimum performance.

Cut the pipe as follows: (use a tubing cutter, a hack saw is too awkward, unless you're really good)
2 pieces 31 13/16" for the long side pieces above the T's
2 pieces 6 1/16" for the short side pieces below the T's
2 pieces 11 1/2" for the two end pieces
2 pieces 5" for the feed points.

These dimensions are critical!

Burnish the ends of the pipe sections thoroughly and ream the insides of all fittings before soldering with a

propane torch. Using a good grade of flux sparingly on all fittings , wipe down all connections with a wet rag before soldering with plumber' solder (do not use rosin core solder on copper pipe). This will allow the solder to "wick" into the joints. We just laid the antenna out on cement blocks to keep it flat and applied the heat to the fittings, not the joints. Be sure to wear safety glasses. The caps go on the end of the feed tubes and the distance between them is not critical. Solder the coax braid to the side of one cap and the inner conductor to the side of the other cap. Since it is very difficult to solder coax directly to the copper pipe caps with a torch , you can first solder copper lugs to both of the conductors it will be lot easier to solder to the caps.

INSTALLING IT

Here are several things to remember when installing this antenna.

1. Use a non-conductor for the mast. We used 1.25" schedule 40 PVC pipe. Wood poles and even using rope to hang the antenna from a tree limb will work! Be creative here.

2. For the vertically polarized version, tape or cable tie the coax to the middle of the end piece nearest the feed point, NOT the mast. Let it hang over the end some then attach it to the mast below the antenna, or side mount the antenna.

3. Use non-conducting hardware to attach it to the mast. Steel or brass bolts have a really detrimental effect on the match. You can use nylon bolts or screws, tape, cable ties, or wood dowels. Plastic pipe clamps made for ½ inch copper pipe are available at hardware stores.

4. For a vertically polarized signal for repeaters the 40" dimension must be horizontal to the Earth. The signal is perpendicular to the axis of the feed line. See the pictures below.

5. For a horizontally polarized signal for SSB, the 40" dimension must be vertical to the Earth. See the pictures below.

The SWR should be close to 1.0 at 146 MHz, and about 1.3 at both 144 MHz and 148 MHz. The 2:1 bandwidth is amazing, about 10 MHz. Our Hentenna had an SWR of less than 1.2:1 at 144.330 MHz with very little tweaking! The SWR approached 1.5:1 at the upper edge of the 2 meter band, but we were happy with that, since our target frequency is 144.330 MHz.

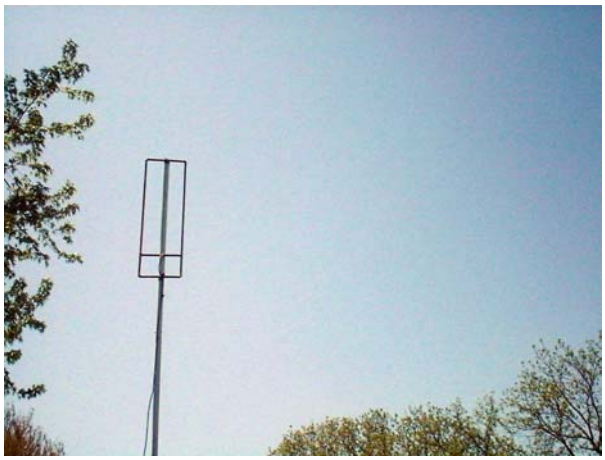
ON THE AIR TESTING RESULTS

Comments by Terry, WA0ITP*: "On the air testing has been gratifying. WAØMWW and I conducted a performance test between our QTH's, we're 12 miles apart, and he's in what I like to call the great Batavia RFDZ (rf dead zone). We used 146.52 MHz simplex and adjusting my power levels and his antenna orientations to get a noisy signal from me. The Hentenna proved superior to a 5/8 wave ground plane at the same height, 15' up. This was a "switch the coax" comparison so as to minimize propagation differences between tests. We evaluated both vertical and horizontal polarization and the Hentenna signal was better in all cases, sometimes by as much as two S units. I also can easily bring up 2 repeaters, one 30 and the other 20 miles distant off the sides of the antenna, using only 5 watts. So the pattern is very good for general use. Ron, WA0MWW and I have also used a repeater that is 45 miles away with 50 watts. A little noisy but a very Q5 copy."*

The mounting of your Hentenna is not critical as long as you use non-conducting hardware. We even had great results hanging the antenna in the garage less than ten feet off the floor and disregarding orientation! In no case did we get an SWR greater than 1.5 to 1. And we easily brought up all the repeaters we had programmed into

our HTX-252 emergency kit radio on less than 25 watts. The signal reports from other hams were all “full quieting”.

Vertically Polarized



Horizontally Polarized

Hentenna Basics

1. Basically the antenna is a 1 wavelength loop antenna. See diagram.

2. L1 works as a 1 loop antenna

3. L2 works as the matching section

4. The long vertical rectangle has more gain than an ordinary square loop antenna and less impedance. L2 is the matching section. This antenna has a low angle of radiation. See the wave pattern diagram of a typical Hentenna.

5. It is noted that in three dimensions the wave pattern is like the shell of a peanut

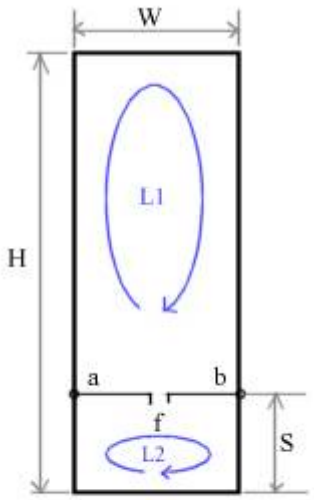
How to Adjust (refer to diagram below)

1. You will have to adjust "a" and "b" if the SWR is unacceptable, greater than 1.5 to 1..

Increasing the distance (S) increases the resonant frequency, while decreasing the distance (S) decreases the resonant frequency.

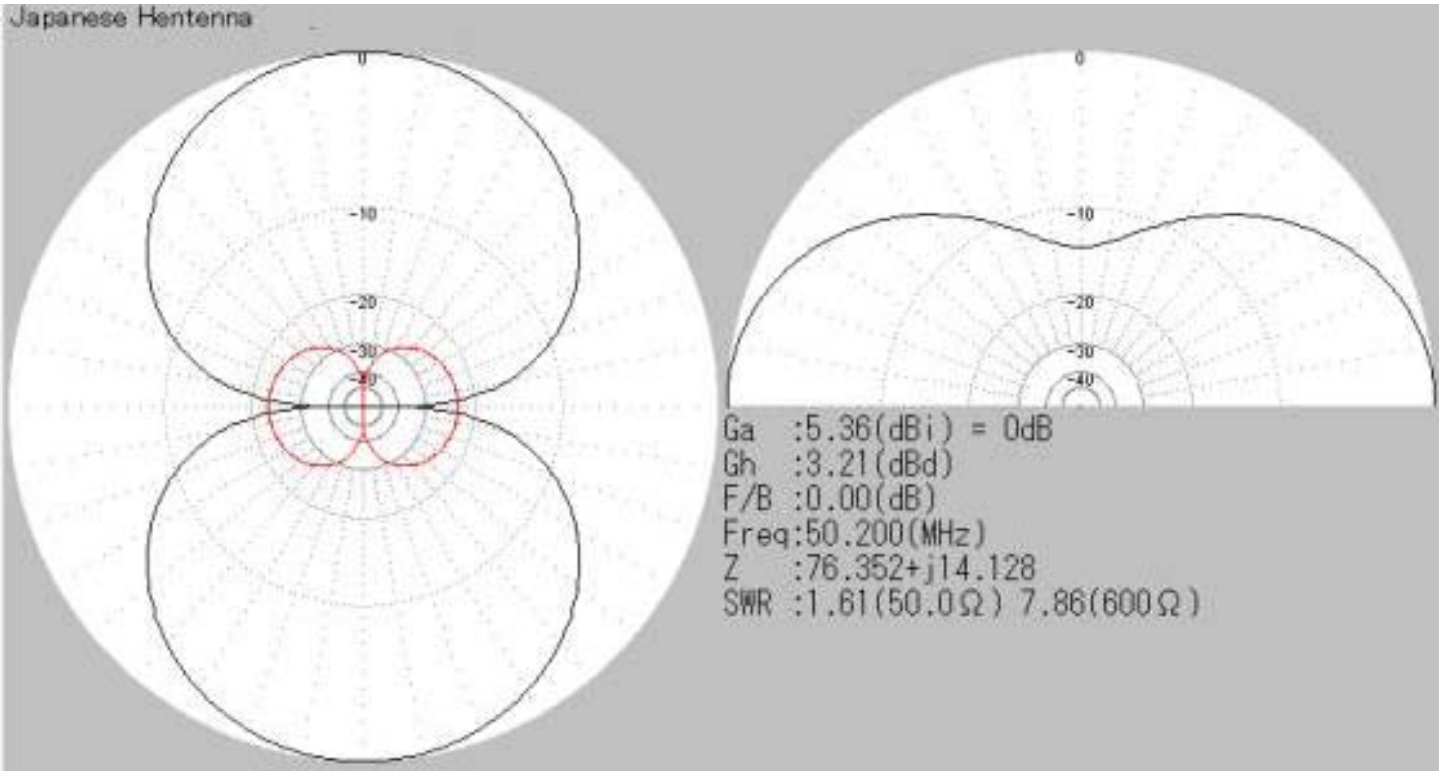
Hentenna Measurements for Various Bands

The Hentenna has three critical dimensions height (H), width (W) and matching section (S). See diagram at right.



The following list gives standard measurements (in meters) for several ham bands.

	80m	40m	30m	20m	17m	15m	12m	10m	6m	2m
Freq.(MHz)	3.550	7.050	10.10	14.20	18.15	21.25	24.95	28.50	50.20	144.2
Wavelength (m)	84.51	42.55	29.70	21.13	16.53	14.12	12.02	10.53	5.976	2.083
Height: H (m)	44.25	21.28	14.85	10.56	8.26	7.06	6.01	5.26	3.00	1.04
Width : W (m)	14.08	7.09	4.95	3.52	2.75	2.35	2.00	1.75	1.00	0.35
Position of Loop separator : S (m)	8.45	4.26	2.97	2.11	1.65	1.41	1.20	1.05	0.60	0.21



Note: While this pattern is for a 6 meter version of the Hentenna, it shows **bidirectionality** and the peanut shaped pattern of all single element hentennas.

Hentenna Project Check List

Parts List	Unit Cost	Total
1 - 10 foot x ½ inch copper pipe		
4 - ½ inch copper elbows		
2 – ½ inch copper Tees		
2 – ½ inch copper end caps		
1- RG8x Coax (figure length needed)		
1- Connector (PL259, BNC, etc)		
2 - Lugs (optional)		
2 - Plastic pipe clamps (optional)		
2- Plastic screws (optional)		
1- 10 ft Schedule 40 PVC pipe (optional)		
Tools Needed		
Propane torch		
Emery cloth		
Steel wool		
Burnishing tools for ½ inch pipe (optional)		
Pliers		
Safety glasses		
Plumber's water soluble flux		
Plumber's solder		

Notes: