Make Your Own Base-Station Antenna

You'll be amazed how much better your radio will hear with this $25 plumber's delight.

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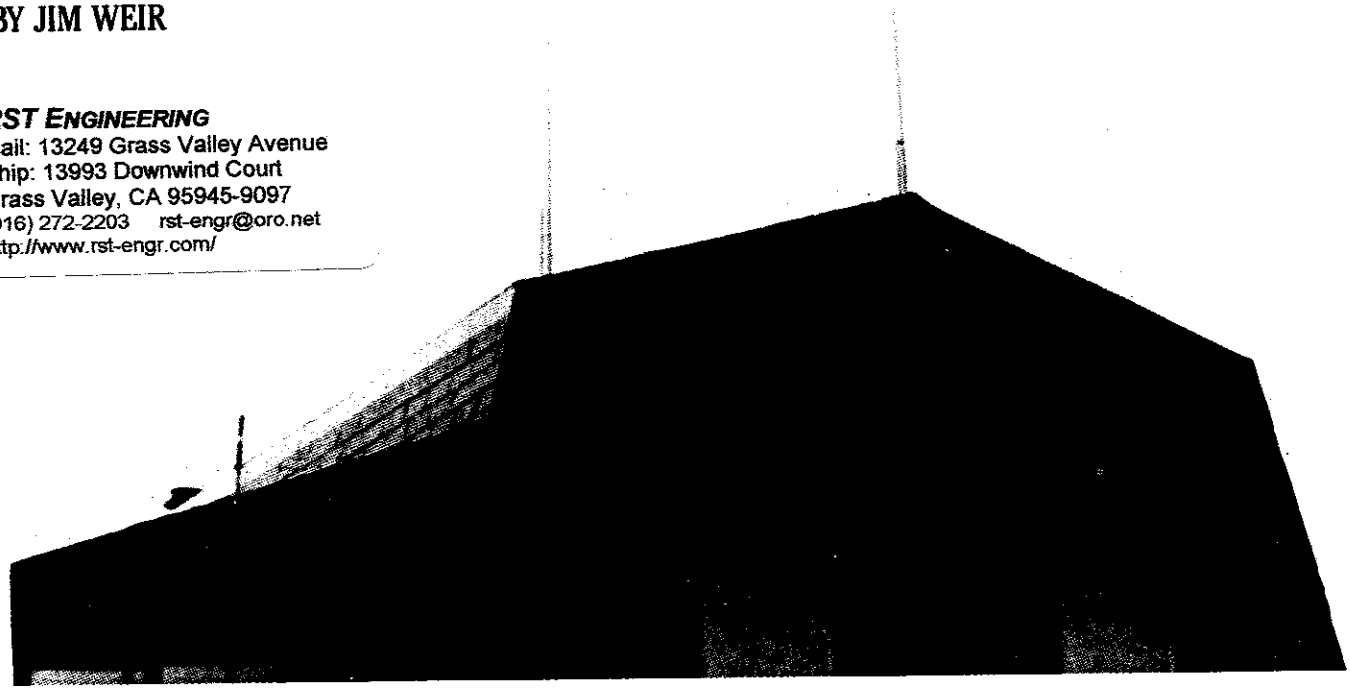


The Weir antenna farm includes several J-pole antennas. These omni systems work well and exhibit a wide bandwidth.

How would you like to build an antenna for your home or airport station that is easy to build, easy to tune, easy to mount, very broadband, virtually impervious to precipitation static, resistant to lightning strike, almost immune to wind damage, has the same gain as an airborne dipole and will cost you less than a double sixpack of Mexican beer?

How, you ask? Let me introduce you to the wonders of the water-pipe J-pole antenna.

Before I begin, let me make a personal observation. During 25 years of flying, I have examined the antennas at FBOs, repair shops, home installations and hangars throughout the country and no two are the same. Some are really quite elegant, and some of them resemble the antenna that one proud FBO in southern Missouri showed me. It consisted of about 20 turns of No. 22 wire wrapped around his building, across gutters, water pipes and electrical conduit. The operator said this arrangement didn't have quite the range that his "big antenny" on the roof had, but was a "mite easier to keep up in a snowstorm."

I offer you a standard antenna design that is efficient, easy to build, inexpensive and easy to maintain—even in a snowstorm.

As I sit here at my word processor in Grass Valley, California, typing this article, I am listening to my radio desk (see photo) aircraft-band radio attached to my J-pole antenna (see

Table 1

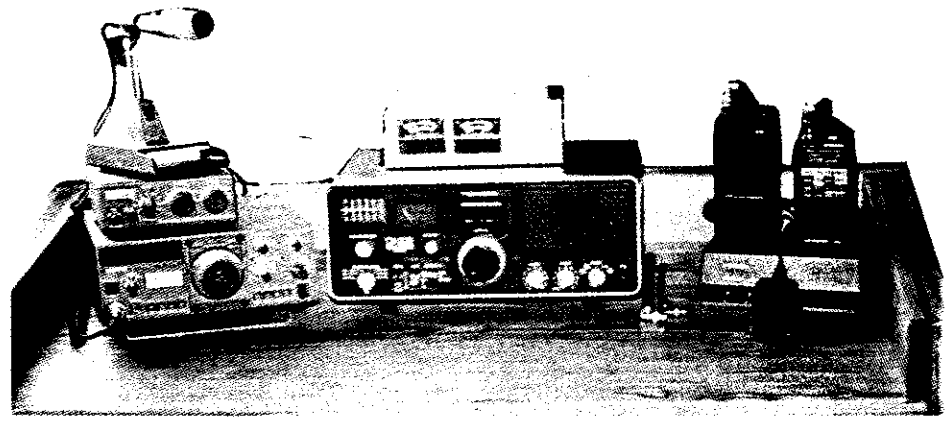
center frequency	matching element	radiating element	tap point
127 MHz	21.8 in.	67.8 in.	2.9 in.
146 MHz	19.0	59.0	2.5 in.
general	K × 0.235	K × 0.730	K × 0.031

where K = 11800 / frequency in Megahertz

Important note: These lengths are measured to the *bottom* of the antenna. Don't forget to allow for the fact that the copper pipe does not fit all the way to the bottom of the "L" and "T" fittings.

photo) on Unicom 123.0 MHz. Columbia (100 miles south), Angwin (70 miles west) and Weaverville (100 miles north) are coming in clearly. Tuning in San Francisco Bay Approach (90 miles west), I can hear both ground and aircraft transmissions as clearly as if I were in the pilot's seat. The best part of it all is that I started construction on my J-pole antenna about this time yesterday afternoon, soldered it together last night, and tuned it this morning.

The J-pole can be used for any VHF frequency band you like. In particular, you can see in the photo above that my home station uses the J-pole for both two-meter amateur radio (the peak of the roof) and the aircraft band (to the left of the peak). Both antennas were constructed of the same material, and both exhibit all the great characteristics described above. In particular, the aircraft- band antenna has a VSWR (standing-wave ratio) below 2:1 from 118 to 136 MHz, and at the band center, the reflected-



Both VHF amateur radio and aircraft-band radios are hooked to simple J-pole antennas described here.

signal loss is less than my most sensitive instruments can read. I can tune the band center from below 122 to above 130 MHz, and as far as I can tell, the antenna response is equal to all points of the compass. It is, by my picky standards, the best omnidirectional broadband base station antenna I have ever used.

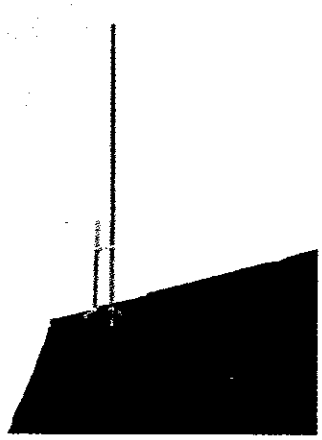
You need a torch of some sort to put this J-pole together. I've tried using a really big soldering iron, and it didn't work; you need direct flame to solder the structure as rigid as I wanted. You also will need a small can of non-acid flux, a roll of plumber's solder, a tubing cutter, and a few lengths of half-inch copper water pipe.

See Table 1 and cut the half-inch copper pipe *driven element* (also known as the radiating element in a transmitter antenna), one half-inch copper-pipe *matching element* and one half-inch *coupler* (it's 0.75 inches long).

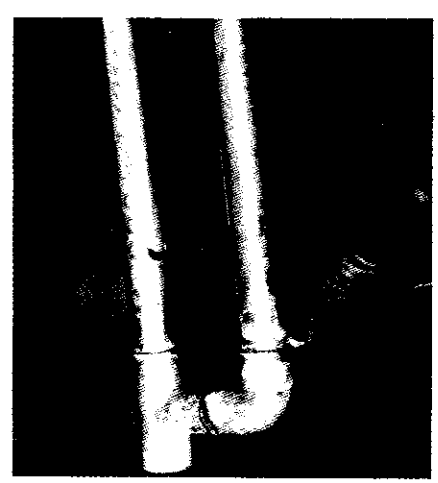
Assemble the antenna as follows, referring to Diagram 1:

1. Drill one copper cap through the top with a ¼-inch bit. Lightly butter a No. 12 brass (or cad-plated steel) nut with flux and center it inside the cap on the ¼-inch hole. Thread a No. 12 stainless steel or aluminum screw

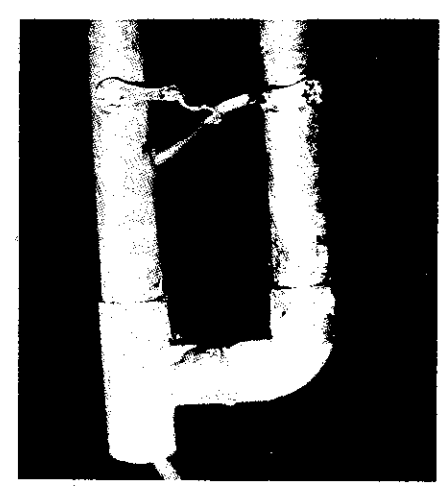
Here's the completed antenna mounted on the side of the Weir residence.



Soldering copper pipe is easy. Use non-acid flux and plumber's solder.



The coax is fed through the copper pipe and attached to solder lugs on the two arms of the J-pole antenna.



Author Jim Weir tries to maintain his footing while adjusting the new antenna for lowest standing-wave ratio.

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continued

into this nut and tighten it against the cap. Force a piece of copper pipe into the cap as you are tightening the nut to help center the nut.

2. Drill the copper-pipe driven element one-half inch below the *tap point* (see Table 1) with a ⅜-inch bit.

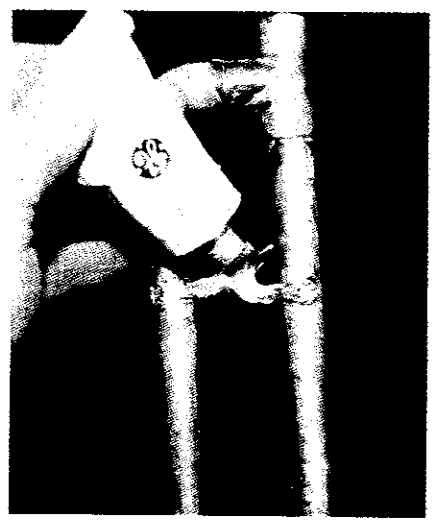
3. Using flux, assemble a copper cap onto the driven element and the drilled copper cap with screw and nut onto the matching element. Torch-solder each into place.

4. Again using flux, assemble the matching element, driven element and coupler with a copper "T" and "L" as shown in Diagram 1. Torch-solder each into place. (It may be easier if you temporarily install the insulating spacer in Step 5 before you perform the torching operation.)

5. Install an *insulating* cable clamp onto both matching and driven elements about a third of the way down from the top of the matching element. Bolt both cable clamps together to keep the radiating element and the matching-element spacing constant. You will probably need a short spacer between the clamps to keep the spacing equal at top and bottom. I used a short length of copper wire between the bolts.

Note: The cable clamps must be insulators; do not use metal clamps with insulating shells. The clamps are there only to prevent antenna vibration in the wind.

6. Torch-solder one solder lug onto each element at the tap point as calculated from Table 1. You may wish to use some sort of clamp to keep the lugs from moving during the cooling process. Although there will be no mechanical fastener to hold the lugs to the elements, I have had plumber's solder hold fast through 90-mph winds without a hint of failure.



7. Cut your coaxial cable to length to reach from the antenna location to your radio. Feed the coax up through the copper "T" and through the drilled ⅜-inch hole. Pull just enough coax through the hole to reach the solder lug on the matching element, plus just a little extra for strain relief. Slide a 5/16-inch rubber grommet over the coax and work the grommet into the ⅜-inch hole using a small screwdriver or awl. (The ⅜-inch hole was drilled oversize on purpose to allow a 5/16-inch grommet with coax to be worked into the hole fairly easily.)

8. Strip about half of the outer sheath of the coax that protrudes from the grommet. Work the coax shield braid from around the coax center conductor and solder the braid to the solder lug on the radiating element. Strip a small amount of the center conductor's insulation back and solder the center conductor to the solder lug on the matching element.

9. Install whatever coax connector your radio requires on the other end

Silicon sealant waterproofs the finished antenna.

of the coax. You can use a handheld aircraft transceiver as a transmitter to adjust the antenna for best SWR (lowest reflected power). Use a VSWR bridge or directional wattmeter in line with the coax and adjust the screw on the matching element for minimum reflected power as you transmit at your chosen operating frequency. I prefer to install a BNC mating pair (UG-88 and UG-89) on the coaxial cable about three feet out of the bottom of the antenna so that I can use my bridge up on the roof and not have to climb down and read the meter after every adjustment. *After* you have tuned the antenna and tested in on the air, use a liberal dose of silicone seal ("RTV") on all the exposed solder-lug connections and the open end of the coax sheath so that no water can get into the coax and contaminate the inside.

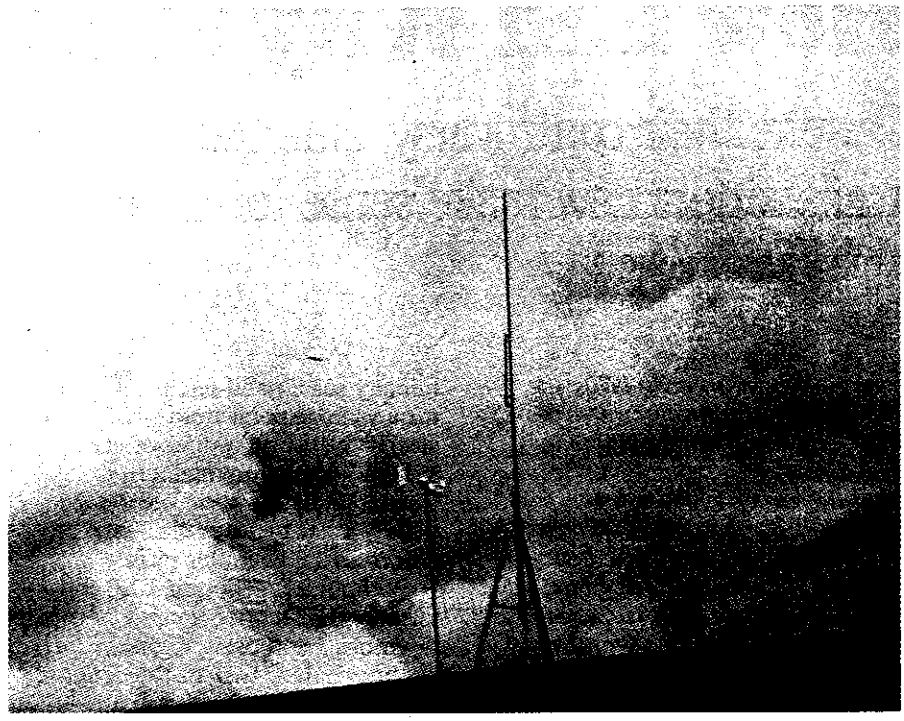
Either of two mounting techniques works with excellent results. At Grass Valley Intentional Airpatch (our local airport), I soldered a half-inch-to-¾-inch adapter onto the "T" fitting on the bottom of the radiating element and then torched a four-foot section of ¾-inch copper pipe onto the adapter. This pipe mast is held firmly onto the roof with a regular old tripod mast mount. Note: torch the pipes together *before* installing the coaxial cable or you will melt the coax into oblivion.

Here at the house, we use rubber-coated aircraft-style Adel clamps, wooden homemade spacers and wood screws to fasten the antenna to the eaves of the roof.

Caution! Use the metal clamps *only* on either the "T" or "L" copper fittings on the bottom of the antenna. Do not use metal clamps anywhere above the tap point on either radiating or matching elements.

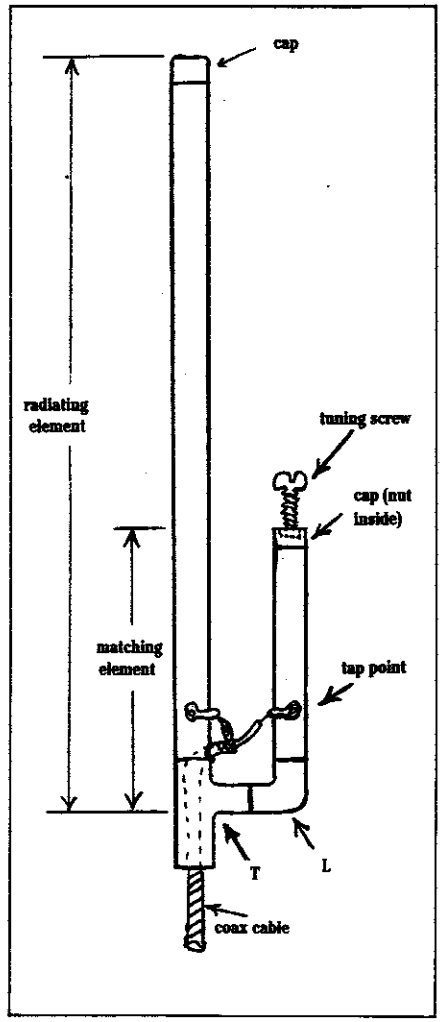
What about the availability of all this stuff? I admit admit that if it were not for the fact that I use solder lugs, stainless hardware, grommets, cable clamps and coaxial connectors in my business, it would take me the better part of a week to chase these bits and pieces. Therefore, I've made arrangements with my company, Radio Systems Technology, to package a kit of everything but the copper fittings, copper pipe and coaxial cable and sell it to KITPLANES readers [redacted] Cite part number 2706.

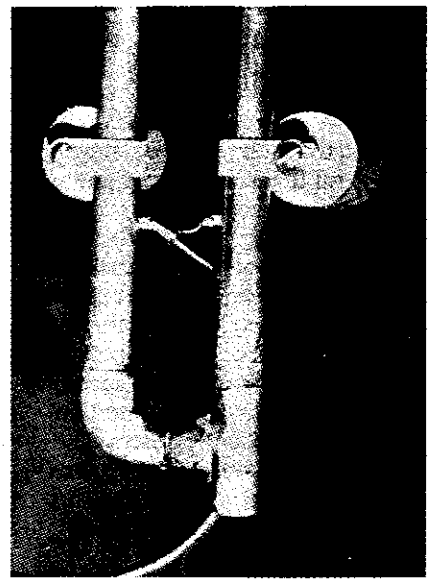
Write and tell us your experiences with our little gem of an antenna and we will pass your comments on to other homebuilders. □



Here's one method of installing the new antenna.

Diagram 1.





Insulator and wooden spacers are used to mount the J-pole to a vertical surface.

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