Omni-Gain Vertical Collinear for VHF and UHF

Coax comes alive II, the next generation.

by Mike Collis WA6SVT

This rugged antenna, an omnidirectional collinear, is capable of surviving harsh environments. It's a good choice for repeater installations and it can be easily top- or side-mounted to the tower. You can obtain approximately 3–10 dB gain over a dipole, depending on the number of elements you use. The higher the gain, the narrower the elevation pattern. Bandwidth is normally 10 MHz on the 70cm band and 25 MHz on 23cm, making the antenna an excellent candidate for ATV repeater use. Many improvements have been made since my original article, "Omni-Gain: Collinear for 70 Cm and 23 Cm," was first published in the May 1982 issue of *73*.

The main elements are constructed from ½-wavelength sections of coaxial cable. You can calculate the element length using the formula of 5904 divided by the frequency (MHz) times the velocity factor of the coaxial cable. In my original article, I used RG-213 with a velocity factor of 0.66. I now use RG-11 or CAC-11 (a solid conductor aluminum shield cable) for high power antennas and RG-6 for low power.

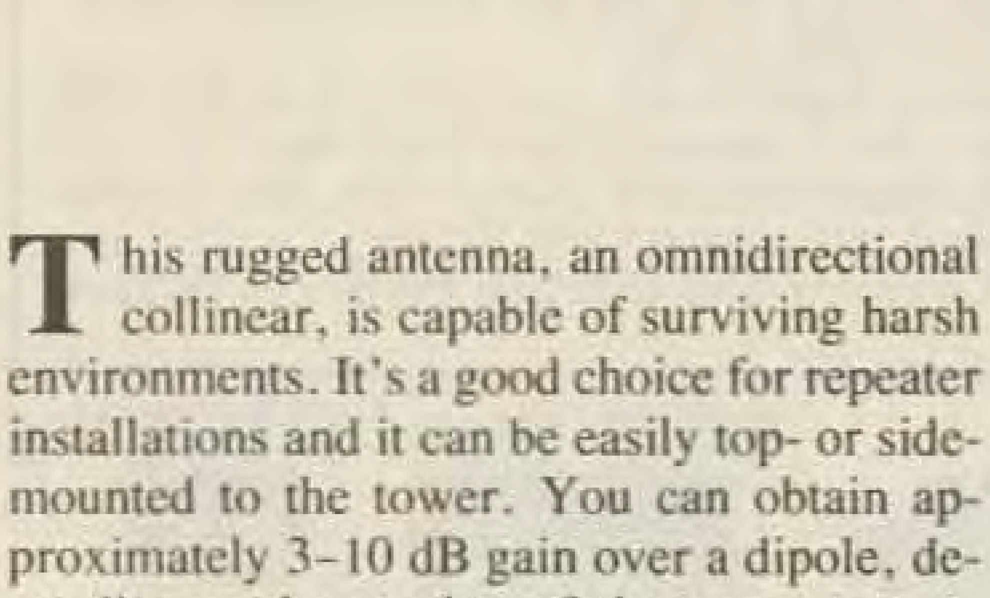

Figure 1. Element preparation.

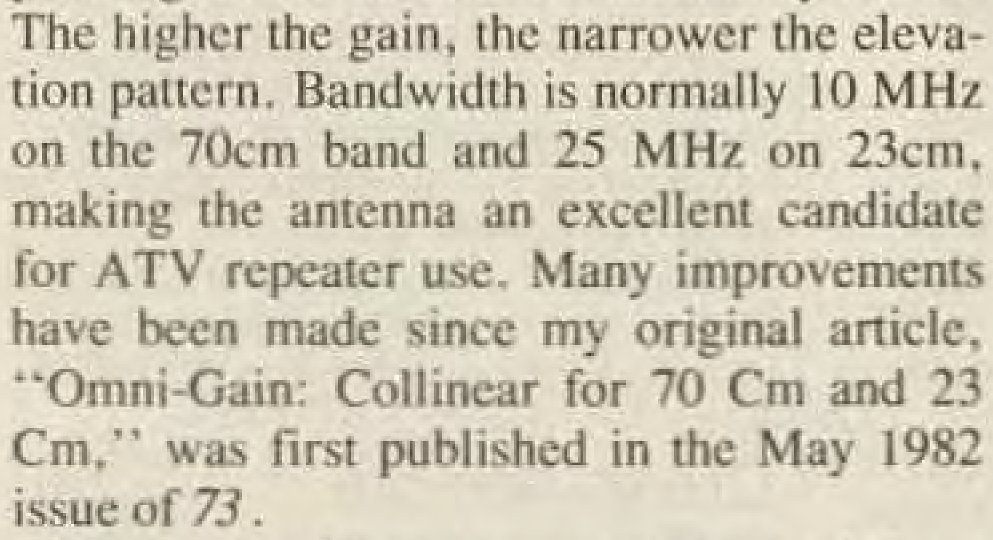

Figure 2. Element assembly.

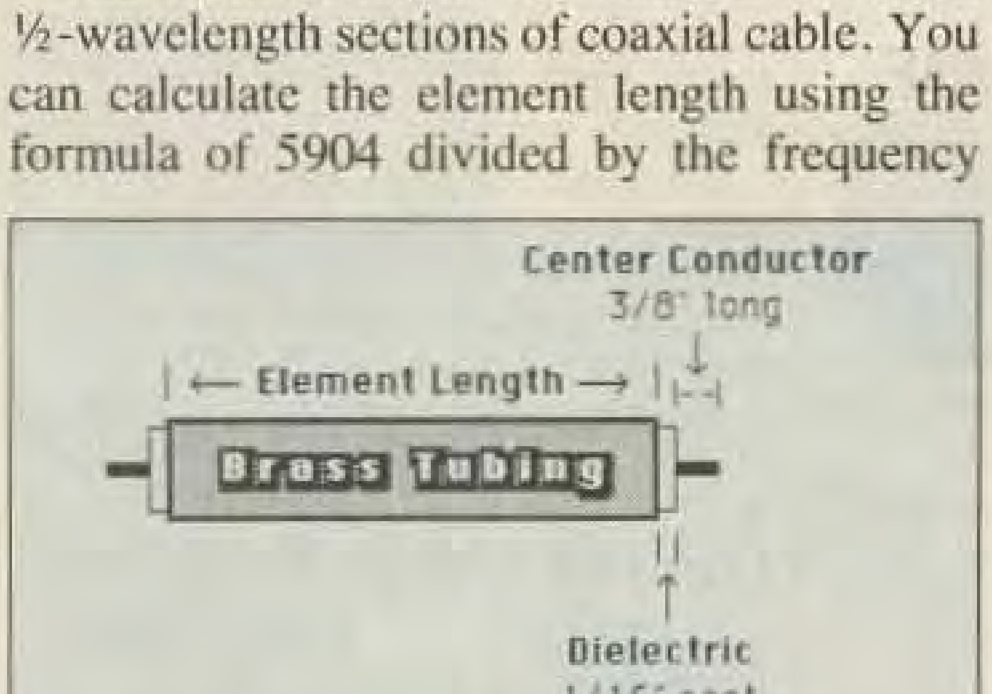

Figure 3. Top section of collinear.

To begin construction, remove the jacket and shield from each element and slide it into hobby brass tubing. Select the diameter of the brass tube to just fit snugly over the dielectric of the coax. The brass tube provides a more rigid support for each element and makes it easier to solder them together. Use the above formula to calculate the lengths of the brass tubes. Cut the coax segment long enough to allow 1/16" of the dielectric and ⅜" of the center conductor to extend past each end of the tube. Make as many ½-wave elements as needed for the gain you desire: 4 elements = approx. 3.5 dBd; 8 elements = 6 dBd; 18 elements = 9 dBd; and 21 elements = 10 dBd. In addition, you need a ¼-wave element and a ¼-wave whip for the top of the antenna. The whip is cut to a true one-quarter wavelength (no velocity factor correction) and is made out of number 12 wire or ⅛" brass rod. *[Editor's note: If brass tubing is unavailable, you can leave the shield and jacket of each element intact. Cut the shield to the formula length and remove enough of the jacket to allow soldering.]*

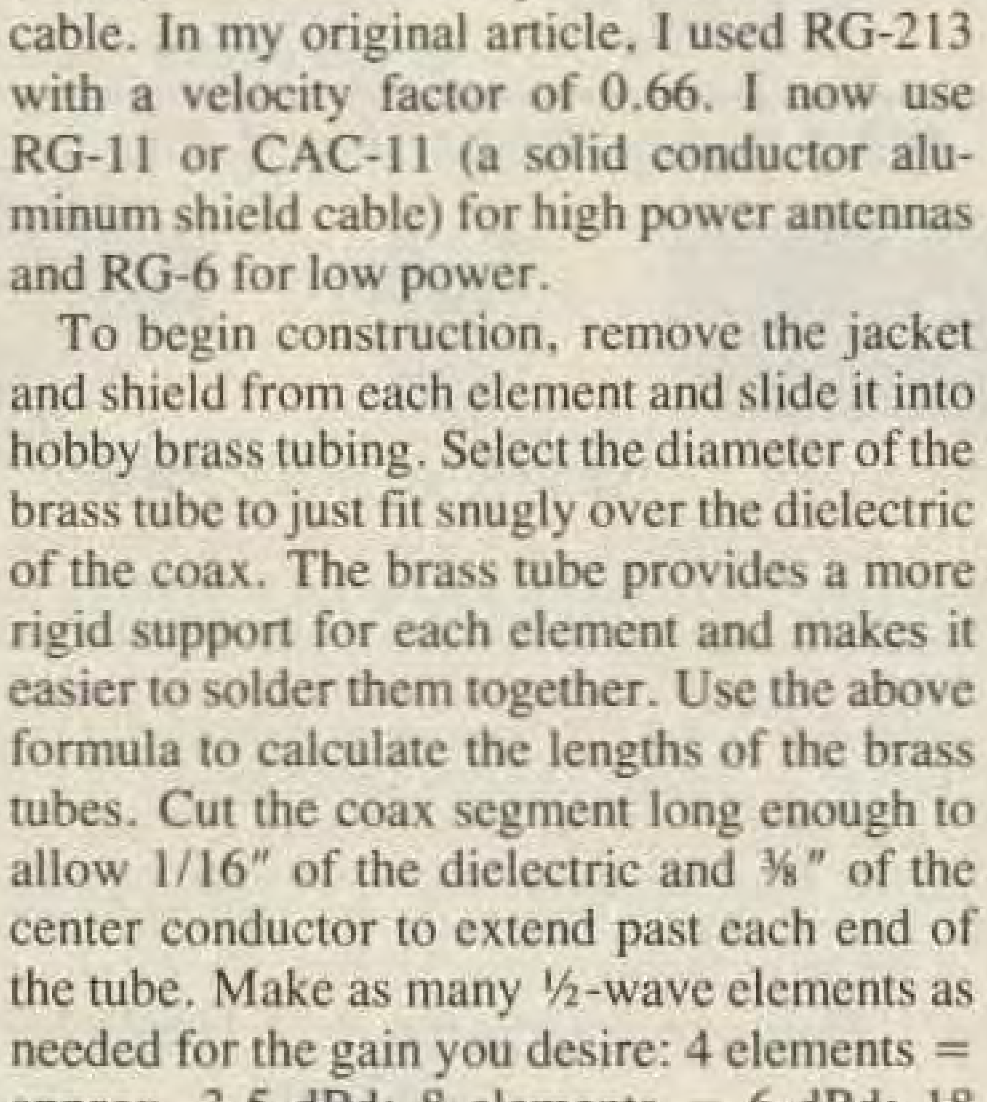

Figure 4. Feedline attachment and decoupling sleeve.

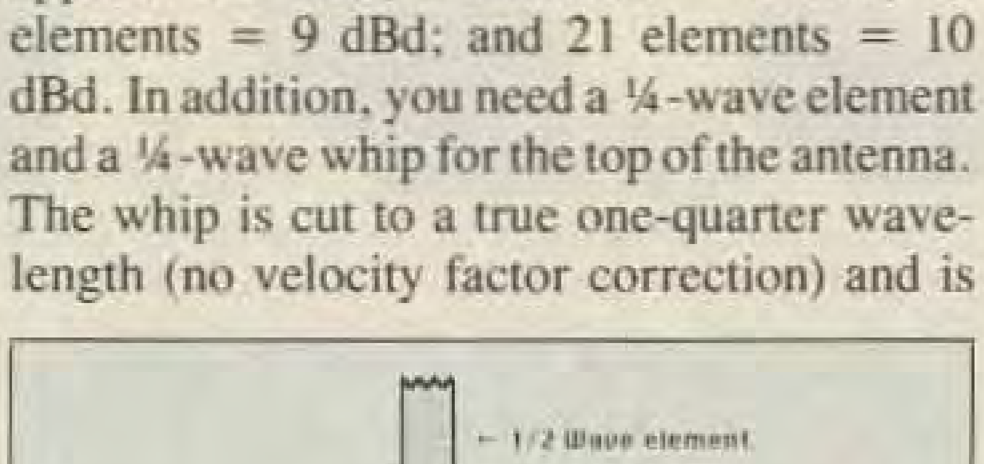

Figure 5. Styrofoam spacer (3 or more needed).

Constructing the Collinear

Step 1. Determine the length of the ½-wave elements (brass tube or coax shield) using the following formula: 5904/F (MHz) x Velocity Factor. Use the manufacturer's velocity factor for the cable you plan to use. Solid polyethylene usually has a velocity factor of 0.66 while foam cable ranges from 0.79 to 0.83.

Step 2. If you desire a downtilt, cut the elements 2% shorter than calculated in Step 1. See Figure 6a for elevation patterns.

Step 3. Cut lengths of RG-11 (or RG-6) coax approximately ¾" longer than the element tubing.

Step 4. Remove the outer jacket and shield and slide the dielectric and center conductor into the brass tube.

Step 5. Using a knife, cut the dielectric so that it sticks out 1/16" past each end of the brass tube. This should leave approximately ⅜" of the center conductor exposed on each end. See Figure 1.

Step 6. Solder the center conductor of each element to the outer conductor of the next element, making sure to keep the whole antenna as straight as possible. With a small wire wrapped around the tube, you can hold the center conductor in place next to the brass tube. After soldering, remove the ends of this wire with cutters. See Figure 2.

Step 7. The last element is ¼-wave long, exactly half the measured length of the ½-wave element. Short out the top end of this section by bending over the center conductor and soldering it to the brass tube. The ¼-wave whip is attached at this point. The whip is a true ¼-wave (no velocity factor correction) and can be contructed out of any diameter brass rod. See Figure 3.

Step 8. The 50 ohm feedline can be any length. I used RG-213 or 214 coax with an N connector attached. Strip off at least a half wavelength of the shield on the other end of the feedline. Leave about an inch of the shield sticking out of the vinyl jacket. Cut back the dielectric to expose ⅜" of the center conductor. Slide a half-wave or longer brass tube

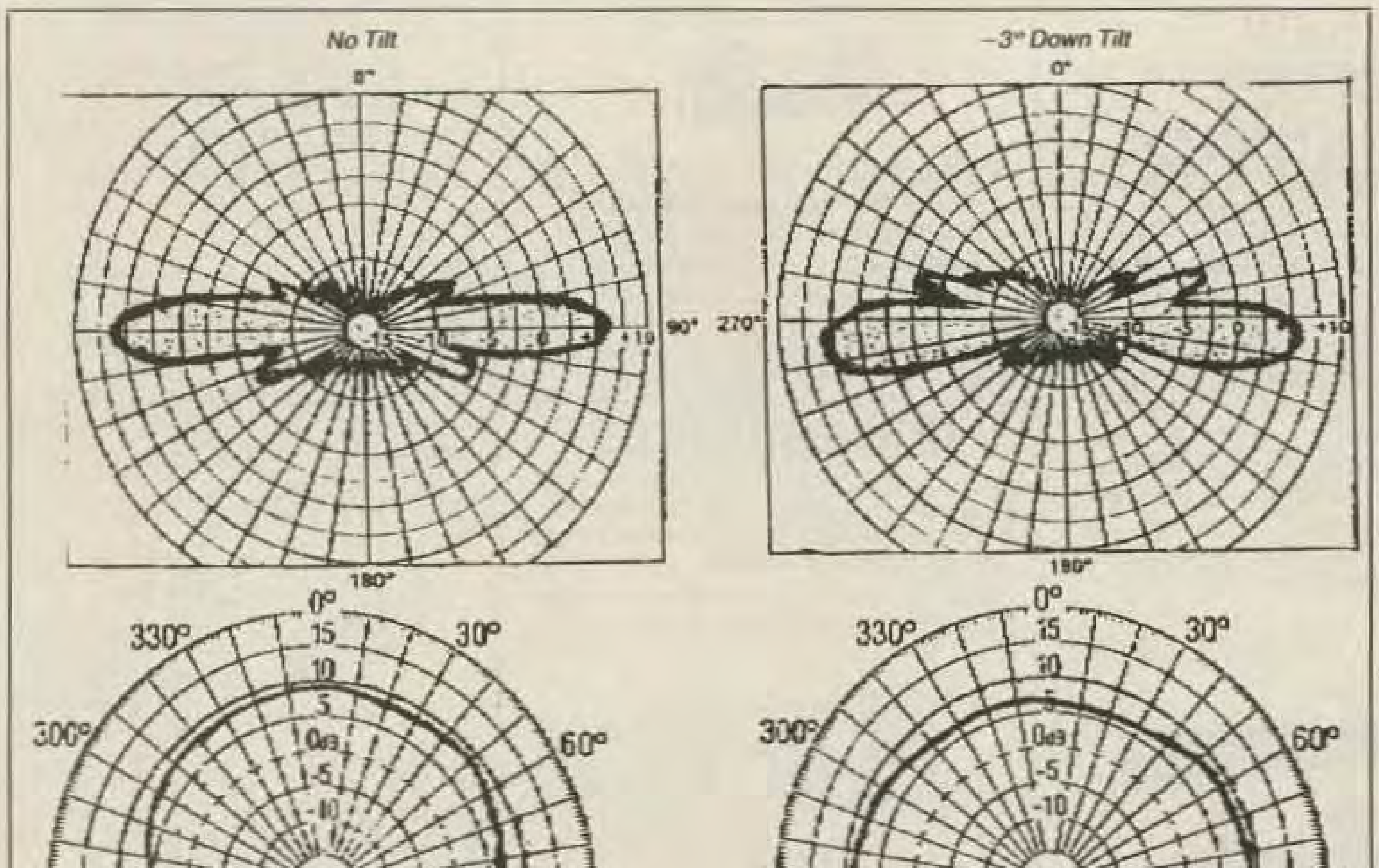

Figure 6. a) Elevation patterns for 6 dB antenna; b) Azimuth patterns for 6 dB antenna.

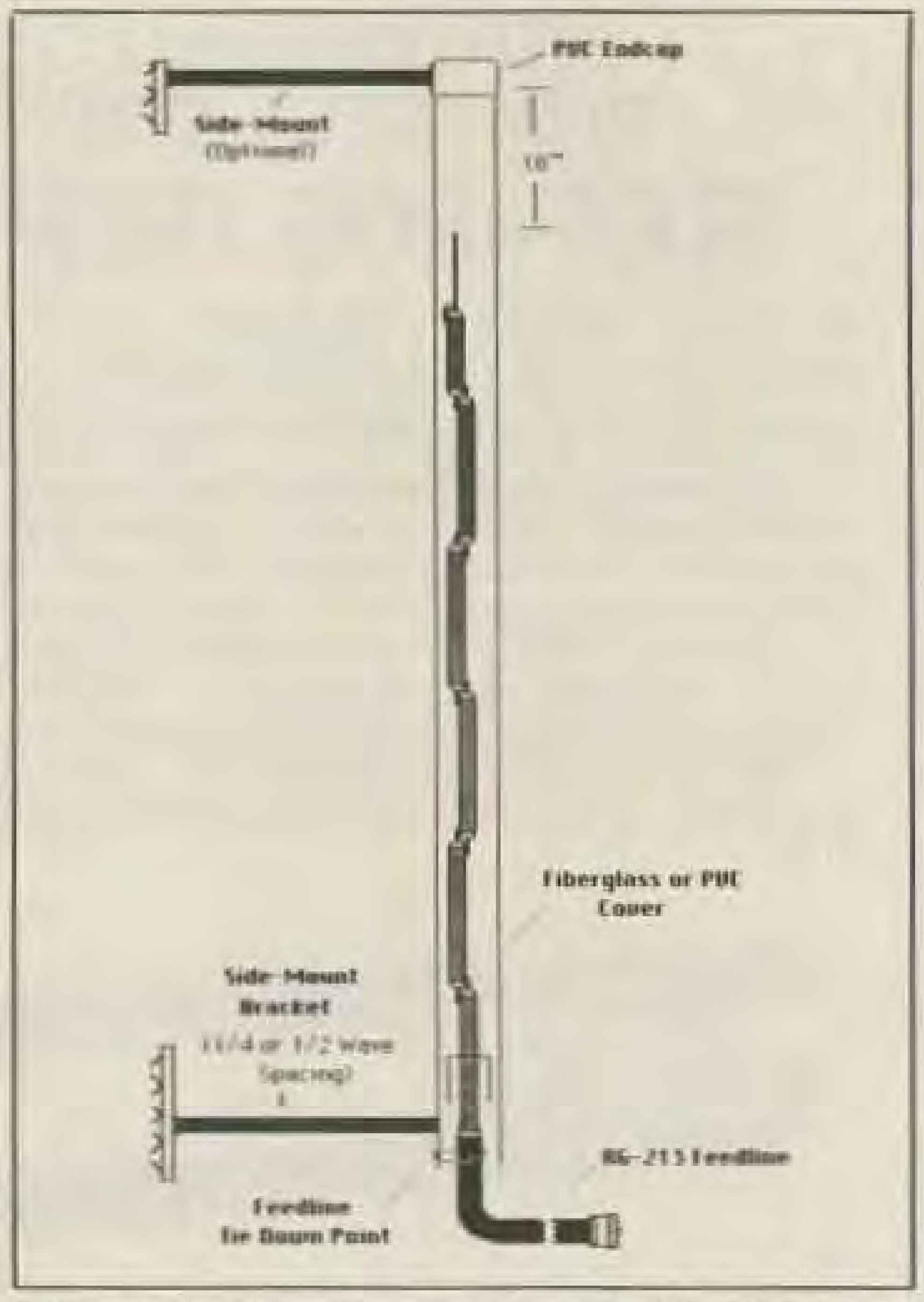

Figure 7. Completed collinear (four ½-wave elements).

over the end of the feedline so that the 1" length of braid can be placed over the bottom of the tube. Solder the feedline braid to the bottom of the brass tube.

Step 9. Next, make a true ¼-wave (no velocity factor correction) long decoupling sleeve out of a ¾" diameter brass tube. Using some of the excess shield material, solder the decoupling sleeve to the feedline outer conductor at a point exactly ¼-wavelength down from the point where the feedline attaches to the antenna. See Figure 4.

Step 10. Attach the exposed end of the feedline to the bottom of the collinear (center conductor of feedline to outer conductor of the antenna).

Step 11. Make at least 3 styrofoam spacers to slip over some of the antenna elements. Cut the spacers for a diameter slightly less than the inside diameter of the radome pipe. Space them out to evenly support the antenna when you place it in the fiberglass (or PVC) radome cover. The spacers should be attached to the midpoint of the element with a small amount of epoxy. See Figure 5.

Step 12. Cut a piece of fiberglass pipe (or PVC) so that 18 inches or more extend past the top of the whip and below the decoupling sleeve. Slide the antenna carefully into the fiberglass pipe and cap off the top of the pole. Drill two holes near the bottom of the radome pipe and pass an insulated wire through and around the feedline (below the decoupling sleeve). Twist the wire until it holds the feedline tightly against the radome cover. Place another styrofoam spacer on the very end of the pipe and glue it in place. Make sure to poke a few small holes or notches in the spacer to allow the end of the antenna to breathe. You're now ready to fire up your collinear! See Figure 7. *[Ed. Note: You can obtain economical fiberglass tubes custom made to your dimensions from: Lightning Bolt Antennas, RD #2, Route 19, Volant PA 16156. Telephone 1-412-530-7396].*

Tune Up and Operation

Find a clear area, free of obstructions, in your back yard. Mount the antenna to a pole, making sure to clamp the antenna to the mast at a point below the decoupling sleeve area. Attach a wattmeter or VSWR meter at the antenna. If the SWR is over 1.5:1 you can adjust the decoupling sleeve slightly up or down the feedline for the best reading.

If you've designed the antenna for a downtilt, you can check it by observing the signal strength of a nearby repeater. Tilt the antenna until the signal peaks, then measure the angle of tilt with a protractor. If it checks out, you're ready to mount to your tower!

Mounting the collinear on top of your tower will give you an omni-directional pattern. If you desire a cardioid pattern, or if your only option is side-mounting, you can mount the antenna to the side of the tower with one or two brackets. Make sure the bottom support is attached to the antenna below the decoupling sleeve, and that the top support is mounted 18" or more above the top of the whip. Mounting the collinear ¼-wavelength away from the side of the tower will give you about a 2 dB increase in the frontal lobe of the pattern. A spacing of ½-wavelength will increase the signal 2 dB at 90 degree angles to the frontal lobe. Both patterns give a null in the direction of the tower. See Figure 6b.

This antenna should handle the worst Mother Nature can throw at it. It has performed admirably at the ATV repeater site on 5670-foot Santiago Peak for many seasons. Mounted on the tower, it blends right in with the commercial antenna installations. Apparently it was convincing enough to attract antenna marauders, as it was recently stolen! Guess it's time to design the Mark III version complete with a burlar alarm. . .

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