

## TUNING A MARINE DIPOLE ANTENNA

This discussion is intended for those planning to build a marinized dipole antenna such as that discussed on this Board recently. The principles, however, also apply to any resonant wire antenna.

**OBJECTIVE:** To obtain a very low SWR (1.2:1 or better) at the operating frequency by successively shortening the dipole by trimming its ends in equal small amounts. Progress is to be monitored using a good SWR meter.

**NOTE:** this is a bit of a chore to do in practice with the “marinized dipole” described, since it’s the 1/8” insulated lifeline that’s to be trimmed back, and each time reformed into a small loop through a Nicopress sleeve. So, pick a nice day, open a bottle of beer and plan to spend a little time doing it right. Don’t hurry this process, because if you cut off too much, you’ll essentially render the dipole worthless...at least without a tuner.

**RESULT DESIRED:** A dipole which can be used without a tuner, connecting directly to the transceiver (preferably through an antenna switch and a good SWR meter).

**PRINCIPAL FACTORS AFFECTING SWR:** There are four which are of major concern here: (1) overall length of the dipole and its physical characteristics; (2) length of coax feedline; (3) orientation of dipole and its coax feedline, including height; and (4) other metallic structures nearby, including your boat’s rigging AND nearby boats and structures. In reality, you’re tuning an entire antenna system, of which the dipole itself is a major but not the only component.

### CONDITIONS FOR TUNING & TRIMMING.

- (1) Boat on a mooring or at anchor, NOT in a marina.
- (2) At least 2’ of ½” Dacron or Polyester line tied through small loops at each end of dipole. This line will serve as end insulators. The small end loops are formed using the Nicopress sleeves which will be pressed into place when tuning is complete.
- (3) Coax feedline in place and run back to a good SWR meter adjacent to radio; coax should be pulled taut and tied off at mast at least 6-8’ above deck, and should be led below by same route to be used in permanent installation.
- (4) Dipole hoisted with spare halyard, with lower end tied off near deck about halfway between mast and forestay. Don’t pull too hard, as the Nicopress loops are only temporary at this stage and you don’t need to climb the mast to retrieve a lost halyard today!

**PROCEDURE:** You’re going to be checking for SWR at various frequencies, determining that the dipole is still a bit too long, and trimming each end the same amount -- one or two inches at a time – successively until SWR is low and you’ve determined the resonant frequency of this antenna setup. A good antenna analyzer would make this a piece of cake, but these are expensive and not found in most hamshacks (including my own...wish I had one). So, we’re gonna do this the old fashioned way, by trial and error.

A vertical dipole at resonance tends to be shorter than the formula  $468/\text{Freq-in-MHz}$  dictates. It’s best to cut the dipole according the formula, then trim it back until it’s resonant at the desired frequency (low SWR). For a 20m dipole, the overall length according to formula is 32.73 feet or 32’ 9”. Each leg of this dipole will be therefore 16.37’ in length. Don’t forget the small loops needed at each end, so add a foot when you make the dipole. In other words, for a 20m dipole aiming for 14300 KHz you’ll want to cut each leg to 17’ 4”. You know from the start that this is

too long and will need trimming, not lengthening. It's always good to know on which side the error lies (old navigational trick: aim intentionally to one side of your destination, then you'll know which way to turn when you get near. I was almost killed by a novice pilot in Nepal once: running low on fuel we reached the only road in the area, and he didn't know which way to turn to reach the landing strip!).

OK, we're ready to begin. You need to find a way for your radio to transmit a continuous signal AT LOW POWER. Many rigs have a power output control, or a tuning mode. Those which don't can be made to transmit at low power by putting the mic next to a steady low noise source. Humming softly isn't great, but it will probably work OK for this purpose, especially if you're good at humming at exactly the same volume.

Now, tune to the LOWEST frequency in the band (e.g., 14001 for 20m), transmit at LOW POWER, and watch the SWR needle. If your radio has a VFO, tune up the band while transmitting and watch the SWR. If it goes UP, this means that your antenna is still too long. If it goes DOWN, this means that your antenna is already resonant at a higher frequency. Continue up the band until you find the lowest SWR.

Most likely, the antenna will be resonant below the band (i.e., out of band). Remember, it's illegal to transmit out of band, but I know some brave folks who VERY QUICKLY tune down until they find the lowest SWR. This gives them an idea of where the antenna is now resonant, and approximately how much they have to trim off the ends to bring the resonance up into the desired range.

Now it's time for a sip of beer, then up on deck, lower the antenna, open the loop at each end, trim off an inch or two, reform the loop through the Nicopress sleeve, and rehoist the antenna. Back below to repeat the process. You should see the resonant point of the antenna INCREASING in frequency. Tune each side to verify you've found the lowest SWR point. When it gets within a few hundred KHz of the desired frequency, be careful not to trim too much more. This takes patience, because you're gonna be tempted to make the final cut quickly so you can finish and deploy the antenna. Have another beer, and go slowly. Actually, Mt. Gay and coke works better for me. Hey, like I can trim this antenna all day ☺

When you finish and are sure you've got the right length, press the Nicopress sleeves in place permanently. And run the coax permanently. I strongly recommend that you get and keep a good SWR meter with cross needles in line next to your rig. This will tell you that all is well, or that something weird is happening like some 90' motorsailer pulled in next to you and is screwing with your SWR (in which case you can just tell him to move!).