How to Make a Tiger Tail
by NM3S

A tiger tail is a ¼ wavelength antenna wire that “completes the dipole” for HTs, giving them a vertical dipole antenna that works much better than the ¼ wavelength vertical “rubber duck” antenna (without a ground plane) that generally comes with HTs.

Single Band Tiger Tail: The single band tiger tail is very simple to make as it consists of only a single wire and a ring connector. You can even leave off the ring connector (see “Alternative Single Band Tiger Tail” below).

To add a tiger tail to your HT, unscrew the rubber duck antenna and find a ring connector (available at electronics, hardware or auto parts stores) that will fit over the outside of the antenna mount. You want to find a ring connector that fits snugly over the antenna mount without a lot of slop, but which can be installed or removed easily. Cut a wire (recommended 16-20 gauge) about ½ inch longer than the sizes indicated below. Strip about ¼” of the wire and solder or crimp it to the ring connector (solder is recommended). Then measure from the INSIDE edge of the ring connector along where the wire is attached to the ring connector and cut the wire off at the appropriate length for the band you’re using as shown below. Place the ring connector over the antenna mount on your HT and screw the rubber duck antenna back on. Drape the wire as straight down from the antenna as you can. It’s generally best to drape it down the FRONT of the radio so your hand doesn’t touch it when operating.

440 Tiger Tail: Wire length from inside of ring connector 14.2 cm (5.59 in, 5 9/16 in)
2 meter Tiger Tail: Wire length from inside of ring connector 44.3 cm (17.44 in, 17 7/16 in)

For a single band tiger tail, you’re done. It’s really that simple!

Alternative Single Band Tiger Tail: If you don’t have a ring connector and need to install a tiger tail *right now*, you can just cut a wire about 2 inches longer than indicated above, then strip about 1 to 1½ inches of the wire and wrap the wire around the antenna mount, then twist the wire until it is tight against the antenna mount. Cut off any excess wire at the antenna mount. Then measure from the antenna mount out the appropriate length from the chart above and cut the wire. This is not as good as using a ring connector because it can’t easily be changed for a different band tiger tail, and the wire can come unraveled, but will work temporarily.

Note: Do not use a 2 meter tiger tail when working the 440 band! Yes, it will match impedance, but it will create a distorted emission pattern which is actually very weak in the direction you want the strongest signal. Most of the energy from your antenna will go into the sky or the ground. When using single-band tiger tails, always use the appropriate tiger tail for the band you’re working.

Dual Band Tiger Tail: This version allows you to use a single tiger tail that works correctly on both the 2 meter and 440 bands. It works by using a trap to stop UHF signals at the end of the UHF section of the tiger tail. Two meter signals will use the full length of the tiger tail.

A dual band tiger tail has three sections:
440 (UHF) section : 14.2 cm (5.59 in, 5 9/16 in), exactly the same as above for a 440 tiger tail. To that we add:
440 Trap: (size to be computed) and
Enough wire to complete the 2 meter tiger tail: (size to be computed)

The first step is to make a 440 single band tiger tail for the UHF section. Go ahead and do that.

Compute the 440 trap:

To do this, we first need to select the coax we will use for the trap. For this example, I've used RG-58 C/U coax, which is cheap, small and flexible.

A strange thing about feed line is that it has *two* lengths: the physical length, and the electrical length. This dichotomy happens because the speed of a signal traveling in a feed line is significantly slower than the speed of light. On the other hand, in regular plain wire, insulated or not, the signal travels at virtually the speed of light, so the physical and electrical lengths are essentially the same, so with plain wire we don't distinguish between electrical and physical length.

However, with feed lines, coax or ladder line, due to the signal slowdown, we get the relationship shown below which is the basic way of calculating the speed at which signals travel in the feed line. We call this speed the velocity factor (VF) of the feed line, and it is written as a percentage of the speed of light (such as 66%) or as a decimal (such as .66). Velocity factors of various feed lines range from approximately 66% to over 90%.

$$\frac{Physical\,Length}{Electrical\,Length}=Velocity\;Factor(VF)$$

We can directly measure the electrical length of a feed line with an instrument called a time domain reflectometer (TDR). Many antenna analyzers have a TDR built in, so we can compute the VF by measuring the physical size of a piece of coax with a tape measure, then measuring the same coax with the TDR function of an antenna analyzer to get the electrical length, then divide the physical length by the electrical length. (Note: do make sure both measurements are the same units. They must *both* be in feet or both be in meters.)

If you don't have a TDR available, you can look up the VF of coax: vendors and manufacturers publish this information on the Internet. However, if you do have a TDR, it's best to measure the VF yourself, because manufacturers occasionally make mistakes in their published specifications.

Consider this real-world example. If I took a piece of RG-58 C/U coax that was 66 feet long physically, and I measured it with a TDR, the TDR would tell me the coax was electrically 100 feet long. We take our formula for calculating the VF of a feed line,

$\frac{Physical\,Length}{Electrical\,Length}=Velocity\;Factor(VF)$ which in this case gives us:

$\frac{66\,feet}{100\,feet} = .66$ which is the VF of our coax. We could also write the VF as a percentage of the speed of light, which in this case would be 66%.

From the equation we just used above, we can algebraically derive this one:

$$Electrical\ Length \times VF = Physical\ Length$$

This gives us a way to calculate the physical length of our trap if we know the electrical length and the VF. Getting the electrical length is easy: the regular antenna length calculations we do all the time **actually give us the electrical length**. We don't normally think about this because, as mentioned above, the regular wire we make antennas from has a VF so close to 1 that any difference between electrical and physical length is unimportant. However, the fact that we are using a piece of coax for the trap combined with the significant signal propagation slowdown that happens with coax means we must consider the velocity factor when designing our trap. Once we compute 1/4 electrical wavelength, we will need to multiply that electrical length of the trap by the VF of the coax we're using to get the physical length of the trap as indicated by the equation above.

So, let's compute our trap. We start with deciding what frequency to use. 440 repeaters run about 441 MHz to 449 MHz, so we'll use 445 MHz, the center of the band, for the trap frequency.

(Note: If you're familiar with making HF traps, this may seem strange. HF traps are are normally "out of band," designed to be resonant **outside** of the band, about 600 KHz +/- 200 KHz below the bottom of the band we're blocking. However, this UHF trap is an "in band" trap and targets the **center** of the band we're blocking.)

To compute electrical wavelength, we will start with a standard equation for computing antenna length. This formula gives us the electrical wavelength. We divide 300 (from 300,000,000 meters per second, the approximate speed of light) by the frequency of the signal in megahertz, and this gives us the wavelength of the signal in meters.

$\frac{300}{f(MHz)} = \lambda(meters)$ Standard equation for computing antenna lengths.

To compute the trap length, we first compute a full (electrical) wavelength on 445 MHz:

$$\frac{300}{445} = 0.674157303\,meters$$

Our trap is to be ¼ electrical wavelength, so we need to divide the full wavelength we just computed by 4 to get ¼ electrical wavelength.

$$\frac{0.674157303}{4} = 0.168539326\,meters$$

We now have the **electrical** length of the trap. We now need to calculate the **physical** length of the trap.

$electrical\,length \times VF = physical\,length$ so

$0.168539326 \times .66 = 0.111235955\,meters$ or, after converting meters to centimeters by multiplying by 100, we get 11.1 centimeters , (4.38 in, 4 3/8 in). **This is the physical length of our trap.**

NOTE: if you're using a different coax than RG-58 C/U, it may have a VF different from .66. If you are using a coax with a different VF, you need to use that coax's VF, instead of .66, in the calculation just above. Be sure to check!

Build the trap:
Since we need leads on our trap, we'll cut a piece of coax a bit longer than this. So we cut a piece of coax around 17 centimeters long, or about 7 inches long.

NOTE: The trap length does NOT include wire for the leads sticking out from the ends of the coax, only the coax itself, and only the coax where it has the outer sheath intact. Ignore any other parts of the coax when measuring the trap length.

Next pick a spot about 2-3 cm, roughly 1 inch, in from the end of the coax. We'll take our wire strippers and strip away the outer jacket on this side. Then we want to fan out the outer braid (a small, straight screwdriver works well for this). Once we have the braid fanned out, cut off the outer braid flush with the coax, getting it as short as possible without damaging the rest of the coax. We want as little outer braid on this side as possible. Then strip all but about 1 cm, about 3/8 inch, of the insulation from the center wire. Be sure to leave some insulation on the center wire to avoid any possible short between the center conductor and braid on this side of the trap. This will be the *source* or *radio* side of the trap.

Completed source (radio) side of trap

Now, measure carefully from where the outer sheath starts on the side of the trap we just finished and measure towards the other end of the coax as closely to the computed trap length as you can get (in this case 11.1 cm, 4.37 in, 4 3/8 in). Mark the spot and remove the outer sheath from this point to the end of the coax. This should leave you with the trap right at the computed length (11.1 cm in this case).

We’re now ready to work on the termination side (opposite of source/radio side) of the trap. We want to fan out the outer braid again, but this time we DO NOT cut it off. Instead, trim it so that we leave the outer braid about 1 cm (3/8 inch) long. We will be shorting the outer braid to the center conductor on this side of the coax. So remove all the insulation from the center wire flush with the outer sheathing on this side of the coax so we have a bare center wire sticking out. WARNING: When you strip the center wire of smaller coaxes like RG-58, it’s easy to pull the entire center wire out of the coax. To avoid this problem, after you’ve cut through the insulation but before you try pulling the insulation off the center wire, take a pair of pliers and grab the center wire on the OTHER (source/radio) side of the trap on the spot where you left a little insulation on the center wire. Hold that wire still while you strip the insulation from the center wire on the termination side of the trap. That way the center wire won’t pull out of the coax!

Now, on the termination side of the coax, twist the outer braid directly onto the center conductor wire and solder it to make a nice short. The trap is finished!

Almost completed termination (non-radio) side of trap, just add solder

The next step is to solder the trap to the 440 single band tiger tail you made previously.

IMPORTANT: make sure to attach the 440 section to the NON-shorted (source or radio) side of the trap. You must attach it so that the length measured from the inside of the ring connector to the beginning of the outer sheath on the trap is the exact length of a 440 single band tiger tail, 14.2 cm (5.59 in, 5 9/16 in).

Once that’s done, all we need to do is to add a piece of wire to the other side of the trap to complete the 2 meter conductor. To compute this, we do the following:

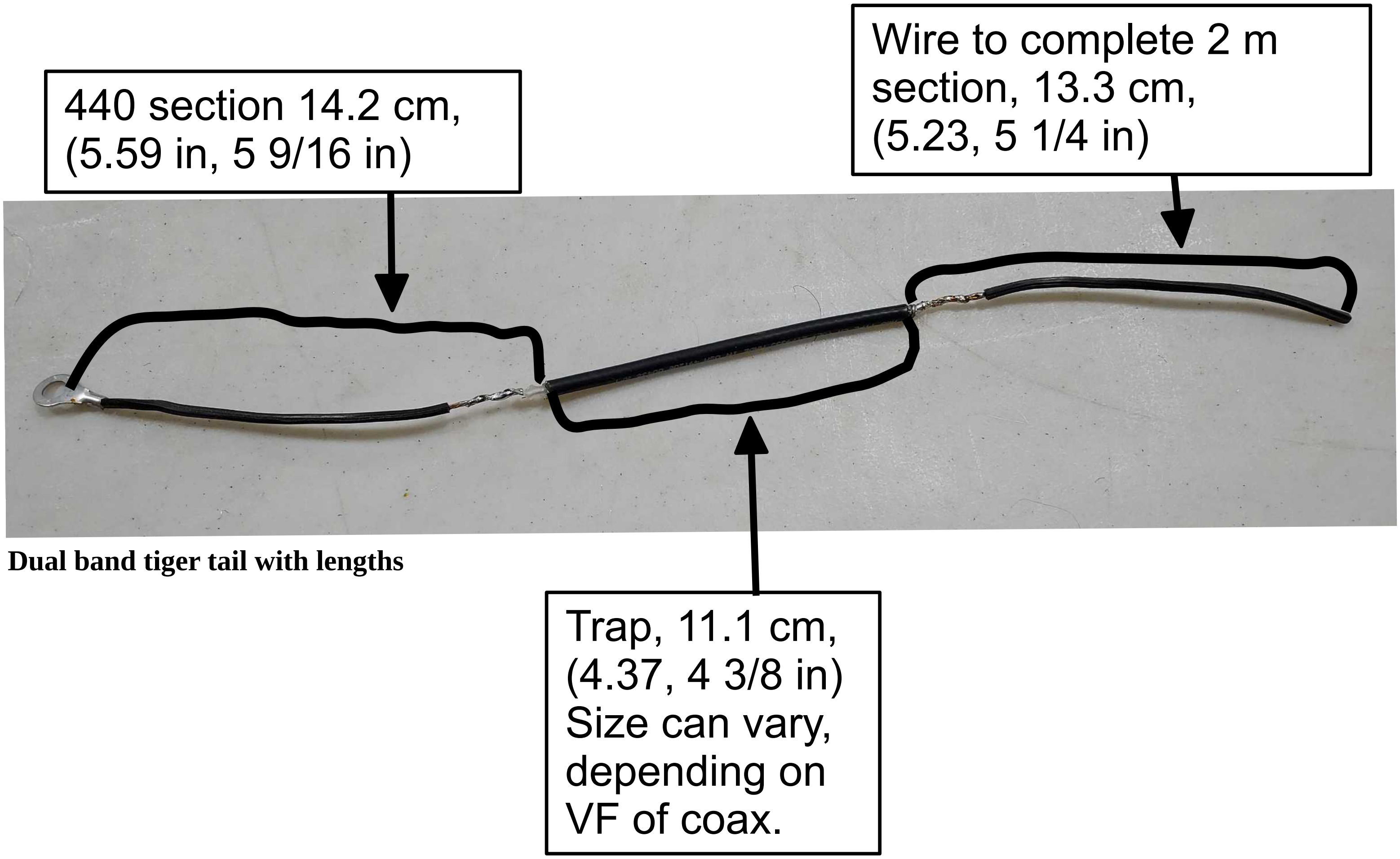
Size	***Description***
44.3 cm	Size of 2 meter tiger tail
-14.2 cm	Subtract length of 440 section
-16.8 cm	Subtract ***electrical*** length of trap (NOT physical length)
13.3 cm	**Size of wire to be added to complete 2 meter section**

The wire to be added is 13.3 cm (5.23, 5¼ in). **This length will not change,** even if we use a coax with a different velocity factor. A different VF may make the trap *physicall*y longer, but it will always be the same size *electrically*, so the wire to complete the 2 meter section will always be 13.3 cm (5.23, 5¼ in) long.

To add the wire, cut a piece a bit longer than we need and solder it on to the *shorted* side of the trap. Then measure from the outer sheath of the coax on the termination (shorted) side of the trap out 13.3 cm (5.23, 5¼ in) and cut the wire.

For the final touch, put 2 pieces of heat shrink tubing on the bare wires on each side of the trap and shrink it on.

Attach the tiger tail to the radio, and you're done.



Dual band tiger tail with lengths