Random Wire Antenna Lengths

A so-called random wire antenna is an end fed antenna. As typically installed, it is a compromise antenna but great for portable use because it is easy to pack and easy to install. One end goes straight into the rig, often with no feedline, and the other end in the air attached to something as high as you can find. It is important to use a counterpoise. A standard recommendation (see QST, March 1936, p. 32, "An Unorthodox Antenna") is an 84' long end fed and a 17' long counterpoise (6.5' for 20m). While these lengths have been shown to work well on many bands, which is helpful if you're in a hurry to get on the air, read up on the topic and experiment. Here is an ARRL random wire page.

When on the trail, at Field Day, or whenever a good antenna is unavailable, a random wire can save the day, but it is important to understand its properties. At multiples of half wavelengths of the transmit frequency the impedance is so high that tuners in most rigs often can't match it. The trick, therefore, is either a more capable tuner - see AA5TB's excellent page for EFHW info - or, addressed below, to cut the wire so that it is not a halfwave multiple of any frequency you want to use.

NOTE: Rewording the previous paragraph, if you have a capable enough tuner the colored bands below are the **best** lengths as long as your wire is at least 1/4 wavelength. For typical tuners built into a rig, these are the **worst** lengths and you want to be as far from colored bands as possible. (Center fed is so appealing because you avoid this.)

Feeling a bit too lazy to calculate that by hand, however, I wrote a program or two to do all the dirty work.

- **C source code is here.**

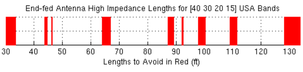
  Modify bands and frequencies for your country or favorite modes. For example, here are values for CW portions of the USA 40-30-20-15m bands for my 4 band Elecraft K1 qrp rig.

  Save program output in file named 'f', and use this gnuplot config file by typing `gnuplot rw.gnu`. A png image named g.png will be created.

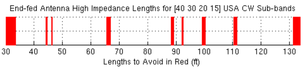
- **Matlab code is here.**

  Again, the bands are USA, so change them for your country and favorite modes of operation. Even easier than the C code, in Matlab or Octave get a plot by simply putting the bands you're intested in in a vector like the example below, by typing

```
>> rw([40 30 20 15])
```




```
>> rw([40 30 20 15], 'cw')
```



- Use a slide rule! It's an efficient way to get all the multiples doing the initial 468/f on C and D scales. Multiples are on C and answers on D - one setting.

The idea is that for a given ham band there are min and max frequencies which are easily converted to half wavelengths by the famous 468/f generally used by hams for dipole lengths. (QST, Oct 1926, "The Length of the Hertz Antenna" shows in line 2 of the table that a similarly installed random wire should use 423/f. W3EDP's results in the above referenced 1936 article, however, fall in line with 468/f and so is used here. Change the program to use 423 if desired.) In addition to multiples, wire lengths less than 1/4 wavelength of the lowest desired frequency are blocked out because an antenna should be at least that long.

Lengths to avoid are not always the same as ones recommended on VE3EED's page because I use all halfwave multiples, and of course different band combinations yield different results.

Wire Lengths for Various Band Combinations

The graph below shows lengths to avoid for different collections of bands. The fewer bands, the fewer high impedance regions to avoid. You also want the antenna to be at least 1/4 wavelength long for each band you plan to use. For instance, to work 40m be sure the antenna is at least 10m or 33' long. Use only the white gaps for your antenna lengths, and if you're using different ham bands than in these examples, modify and rerun the program as I did, above, for my K1. If you want all the bands from 80m up, W3EDP's 84' antenna, 17' counterpoise is probably the way to go. Notice from column f that there is no length giving low impendance for all US ham bands. You have to give up a band or two, like 60m and 6m, as shown in the column e.

Band combinations in graph:

Group	USA Bands
a	40-30-20-15
b	40-30-20-17
c	40-30-20-17-15-12-10
d	80-40-30-20-17-15-12-10
e	160-80-40-30-20-17-15-12-10
f	160-80-60-40-30-20-17-15-12-10-6