A Practical guide to building a portable HF antenna, oh, and it works too!

If you are hoping to be engrossed in formulas, interesting mathematics conundrums and a technical debate about standard wire gauges then I am sorry to disappoint. This is a practical article for people who would rather "do" than wish they had… In this article I am going to attempt to guide you the reader through building a practical working antenna that has evolved through my own mistakes and misconceptions for portable use. Ok, hands up, a dipole is not the most ground breaking, earth shattering piece of news to hit the amateur radio press for at least 90 years, but built well, it will out perform the antennas of those who never actually transmit, and instead prefer to correct and snipe at the people who do. So do-er's, grab your Weller's (other soldering irons are available from all good stores!), mind your fingers now, and follow me on a journey of discovery. The rest can watch one foot in the grave, and sympathise with Victor Meldrew, you know who you are!
This project came about, because like many I live in a typical less than ten year old house, nice to look at, but for practical amateur radio purposes pretty useless. The garden is too small, the trees are not mature and the planning restrictions prevent television and satellite aerials, caravans on drives and people undertaking any type of enjoyment what so ever. As a result, activity from the "shoe box" is limited to say the least. I do have room for a 40m invisible loop, just, but that is a story for another day. The upshot of all this Council/wife/ neighbourly intervention, and a job that takes me round the World required an easily transportable antenna to accompany me and the FT857 (other radios are available from all good stores, getting tired with all this political correctness now!) on my travels and portable excursions. Airlines are pretty strict about what they carry these days, so fantastically complex loading coils and clever collapsing elements are out of the question. Due to having lost baggage several times in the last couple of years the aerial had to be cheap to replace, nothing to do with been a penny pinching, typical tight fisted Yorkshire man, honest, quick to build, and actually radiate the frugal amount of power I could generate whilst un-connected from the luxury of mains power. As wire is cheap, easy to transport, erect and deal with, it just had to be. I decided that my best chances at working the DX were on the HF bands where beams and or mega power were not the norm, this effectively cancelled out 160, 80, 40, and 20m, the present openings on 10,12, and 15 are rarer than hens teeth so that left 17m, which is also my favourite band. I originally cut a dipole for 17m, connected coax, strung where I could and worked a good number of stations. It looked a mess, was constantly in need of repair and was always the wrong band. Faced with the dilemma of buying or building a tuning unit, wasting power doing so and adding to the weight and bulk of portable operation I decided to go down the multi-frequency antenna route. Next up was a G5RV, great antenna on 20 (as this was what it was originally designed for). The "RV" travelled round with me for a while. I found it cumbersome for hotel use due to the fifty odd feet of 300 Ohm feeder, that also radiated, and could be seen on the TV in the room, and probably the entire Hotel. 20m was not ideal as stated earlier. Dipole's appeared to fit the requirements quite nicely, are efficient, had very little complication, are easy to prune-and-tune and actually worked! More importantly these are resonant antennas that radiate the majority of energy fed into them (see side bar for slightly deeper explanation) I had to find a way to carry a good number of mono band dipoles, associated feeders, connectors and spares around, and that as they say is how this started. Most of my portable operation at this time was car based, or Hotel room, but as I also walk, mountain bike and rock climb too, I decided that the aerial should also

be back-packable to the wilds and wastelands. Back packing in the areas I normally go usually means no people, trees, handy posts etc so consideration also had to be given to how the get the thing in the air. A single centre support is easier to transport than two end supports, although this would make the aerial into an inverted “V”, as a do-er, this was a compromise, but I figured pressing the ptt/key and actually radiating RF energy gave me a better chance of communicating than sitting at home worrying because the ends of the aerial were near the ground. This proved to be not worthy of Worry in September 2007 when testing a 40m wire on the portable system when I worked VK7AS at 5/5 both ways on SSB, yes friends, Australia on 40m with a total aerial price including the support for less than £25!! Success I think. So how do we do it?
Summary of criteria
Cheap to build/loose and use.
Efficient.
Very simple.
Single central mount position.

A dipole is a self contained half wave antenna that has been around for ever, this is not the time or the place to get deeply involved in radiation patterns, polar diagrams blah blah blah. Suffice to say, half a wavelength long, split in the middle, fed with coax, and you have yourself an aerial, or so I thought. Consideration must be given to how to build this simple radiator. My first attempt was nothing more than a centre piece made from electrical “choc block”, insulation stripped back on the coax, inner to one side, outer to the other, a couple of ¼ waves of wire on the opposite side, a quick wrap of insulation tape and away. This proved to work ok until disaster…On a particularly rainy day in the lake district, first the coax/connector block filled with water, then the radiating element broke. After peeling off the tape, the connector block was rusted up due to several prior coastal trips, end of mobile operations and a three hour hike back to the car. Generation two was a plastic box, with the same arrangement inside. Better resilience to the elements but still only single band use. While out running in a half marathon the present solution wafted into my head, and I made a mental note that if I was still breathing at the end of the race I would pursue the idea and try it out. In essence the solution is a box to which two removable antenna elements can be fitted, with a removable coax feed on the other end **(pic1)**.

Pic 1.

All internal connections are soldered **(pic2)**, and the box filled with silicon rubber to keep the great outdoors, err, outdoors. The connectors for the aerial elements are made from aluminium, and use brass screws to join to the main body. The elements are held onto the box with wing nuts making it easy to change bands. The centre support incidentally is nothing more elaborate than a fibre glass, collapsible fishing pole. I have 5m for backpacking and an 8m example for car-portable. As the sections on the pole I use have a ridge when extended, the highly technical mounting solution is to use a tie wrap, sufficiently tightened to stop it sliding over the chosen knuckle!

So where do we start? You have three parts to this project, feeder, centre box, and wire elements.

The elements in my example (wait for the sharp intake of breath from the non-do-ers) are 16/0.2 plastic coated wire, in English this translates to, 16 strands of 0.2mm wire wound together as a single wire and then insulated with a plastic coating. I have tested this with 400 watts, I know, I know, in theory you shouldn't do this, but as this is a practical article, and I needed to know, I gave it a try and all appears well. Each element has an M4 Eyelet soldered to one end **(pic4)**

don't make the same mistake I did and use a crimp, however well done it will come off or break at some point, usually when you hear exotic DX, have an audience, or have just walked all day to activate a rare square, sods law I believe its called.

On the other end I have allowed an extra 6 inches (oh, ok then 15cm or 150mm just so we all understand) to pass through a split ring, and then be wound back on itself to form the mounting loop, secure the loose end with a tie wrap **(pic5)**.

I made the mistake of tying a loop on the early examples; this puts a weak point into the design, and a place that if it can, will break. The extra length when treated in this way brings the aerial on to a mid band 1:1 or very close swr point on all the examples I have made. If you need to alter the centre frequency, either shorten or lengthen the loop and re-tie wrap in place whilst looking at the SWR bridge, aim for 1:1, but in reality anything under 1.5:1 is very adequate. This is true all bands from 160m to 10m using the lengths in table 1. The easiest and most versatile method I have found of securing the far ends of the aerial are to use dog clips **(pic6)**

which snap onto the split rings, and then run a length of nylon string (sold in Wilko etc as gardening string, £0.69 for 100m) to a convenient rock, tree, tent peg etc, this way you can dictate the angle of the “V”. This type of string is very narrow gauge and very strong.

Don’t let go of it though as it will try its hardest to resemble a birds nest in about 2 seconds of freedom (I found out the hard way..).
Mine is wound on a plywood kite style former **(pic7)** that keeps things tight and confined.

Aerials can then be swapped very quickly and bands changed as needed. As the elements are pre tuned, they don’t need an ATU and you are on the air in no time.
The centre section is made from a Maplin box, part number xxxx, mount a BNC socket on one end and two pieces of 20mm aluminium or brass angle stock.
Use shake proof washers here, and stud lock as you will not be able to get in once the inside is potted to tighten loose nuts (my mistake #17 I believe). Behind each mounting nut you wall also need a solder eyelet, this looks like a washer with a tail, to which you will solder a wire, right side to the inner of the BNC socket, and left to the ground portion of the BNC socket. This is done so that you will always know which side of the antenna is connected to the inner or hot side of the coax. Useful to know when sloper or dogleg mounting is used. Always put the hot end at the highest point (mistake #18!). I have marked this side with a dymo label, for those senior moments when things are fuzzy and you forget the basics. The next job to do is to drill through the angle stock for the aerial connections. I used 20mm M4 brass bolts for this with a keeper nut above, then two washers, and finally the M4 wing nut. Without the keeper nut you take the wing nut off and, yep, you have guessed it, loose the M4 bolt in the grass (mistake #19), carry spare wing nuts and washers by the way…final job fill with silicone, not the stuff that makes your eyes water as it contains acetic acid, this corrodes copper very quickly too (mistake #20), the odourless is fine, and screw the lid on **(pic 9)**.

Last but not least you will need a piece of coax, I use 20m of RG58 for car portable, and 10m for backpacking. The pole is 8m high, the "box" sits at 7m, giving me 3m spare to wind into a choke (coil) or distance myself from the pole. All clever stuff eh? Well logical at any rate. You will need to fit a BNC plug on one end and a PL259 on the other to connect to your SWR meter/radio. I have found ease of portability, cost and weight swing heavily in the favour of RG58, UR67/H100 are too heavy and offer very little practical advantage over the 58 for the lengths and frequencies we are talking about here. I bought a nested aluminium case set from B and Q, and use the "blue" box to carry the coax, centre and individually bagged elements around. Using 16/0.2 wire it contains all elements 160 to 10m, coax, spares and the guy wires **(pic 10)** .

So there you have it, not new by any means, but this works and more importantly keeps on working. I also use this method to feed a 40m loop in the shoe box garden, and a 40/30/20m ¼ wave vertical using the 8m pole holding a wire radiator, it has also been used on kite suspended aerials and has helped me speak to interesting people all over the World. Well, what are you waiting for, get out there and give it a go.
73's and good DX
Tim
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Table 1
Aerial element length table

Band	Centre Frequency	Total length (m)	Element Length(m)
10m	28.500	5.16	2.58
12m	24.100	6.10	3.05
15m	21.250	6.92	3.46
20m	14.200	10.35	5.18
30m	10.100	14.55	7.28
40m	7.050	20.85	10.43
80m	3.600	40.83	20.42
160m	1.750	81.97	40.84

(Note element lengths include 150mm to wrap back for securing the split ring)

Side Bar
What is resonance?
You have heard the Word, now what is it about.
Everything has a characteristic resonant frequency, that is the rate at which the item self oscillates, or vibrates. Once vibrating, or resonating very little energy is required to sustain the vibration or oscillation. A good example of this is to run a wet fingertip round the rim of a crystal glass. You will hear the vibration as the applied energy is converted to sound. If you alter any of the physical characteristics, ie de-tune, by touching the body of the glass with a second finger you will stop the ringing. The same principals can be applied to radio energy and I quote from an anonymous author "Thus a dipole operated at its resonant frequency is very efficient in that most of the power fed into it is radiated as electromagnetic waves. Off the resonant frequency efficiency drops noticeably". Better authors than me can explain this in a highly technical way using many formulas…happy searching.

Additional notes.
It may be worth your while adding a wide band balun close to the centre point of the aerial, it stops RF sneaking back down the feeder and making the electronics in your radio have a fit. Some have reported problems, I use a long feeder, and wind the excess into a coil and have not had a problem with my Yeasu FT857. if you do, a balun will sort it out. Up to you which you choose, some good designs are available commercially, otherwise have a surf. I may just look into this myself and type a follow up article. Good yah?

Tim

G4YTD March 2008