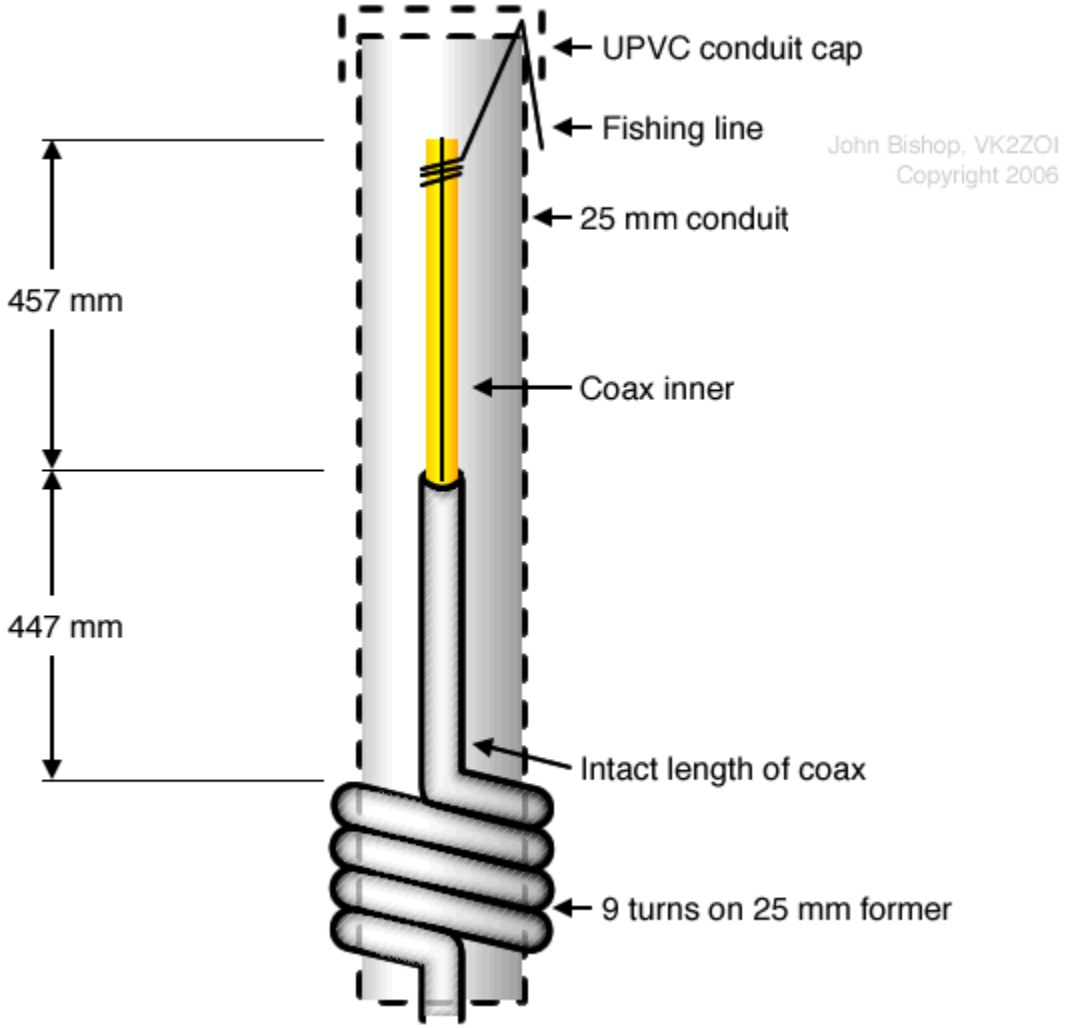
Half-Wave Flower Pot Antenna by VK2ZOI *(WO7T Refined Instr.)*

Materials List:

- 48” long thin-wall ¾” white PVC pipe 200PSI – Lowes
- ¾” PVC Tee
- Minimum of 90” RG-58A/U coax – Copper braid shield (no foil)
- Couple feet of Aluminum foil – kitchen variety
- Aluminum Foil Tape
- Electrical Tape
- Metric Tape Measure
- Drill Bit – 7/32
- Round File

**longer if intending to feed directly into rig without connector and barrel at the feedpoint*

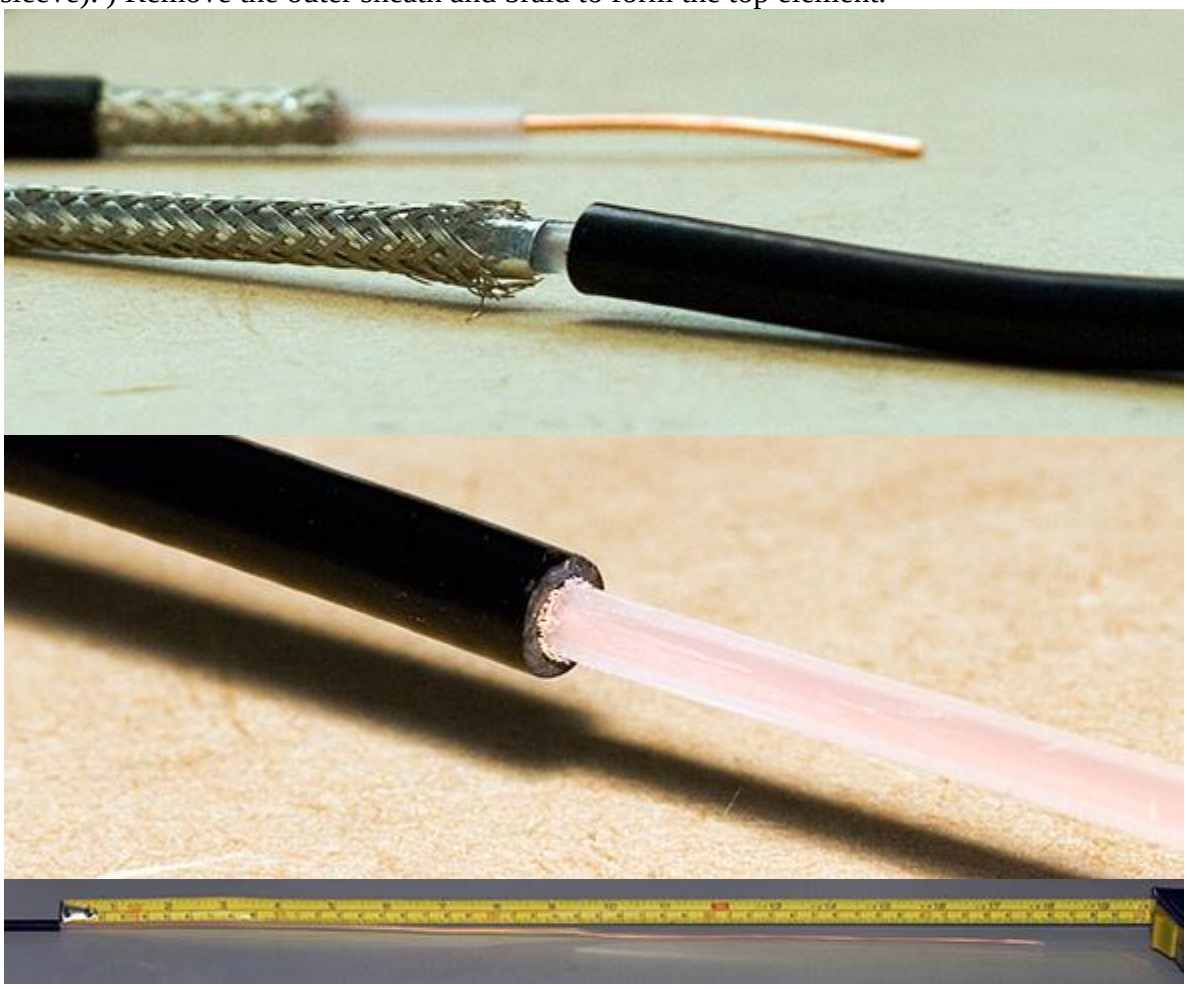
The diagram below shows the basic arrangement of the 2m Half-Wave version of the antenna. To construct the antenna, first select a suitable length of white ¾” thin-wall conduit (I use 4’ piece but if you make it longer, you will have more room below the coil to attach to your antenna support).



Basic arrangement of the 2m Half-Wave version

First prepare the RG-58U cable for the antenna construction

Then take a suitable length of co-ax (I make mine using the one piece of cable, about 5 to 6m long, to reach from the antenna to the transceiver – the length is your choice but suggest 100” minimum). From one end, strip off 457mm (actually start at 467mm for a dual-band version, so you have a little trim latitude after placing sleeve).) Remove the outer sheath and braid to form the top element.



Using several “half-hitches”, tie a piece of fishing line (or similar, thin nylon line), say about half a metre long, to the top of the upper element leaving 6-8mm trim above the tie point for resonance trimming. After tying tight, I superglue/epoxy the conductor and fish line. The other end of this line will be used to pull the radiator taut, it will clip over the top of the conduit and be clamped by the end cap.

Now measure exactly 447mm down from the feedpoint (the point where the braid/outer sheath now starts); this is the distance to the start (or top) of the choke coil and mark this position on the coax very precisely with a piece of tape, string, paint spot finger nail polish, or whatever, so as to be a reference/stop point when inserting the cable into the conduit.

Move now to the preparation of the PVC pipe, which when completed will allow the antenna to be assembled by inserting the radiating portion (together with the piece of nylon line) through the top coil hole and pushing it upwards until the aforementioned reference/stop point just disappears into the hole. The photo below has it

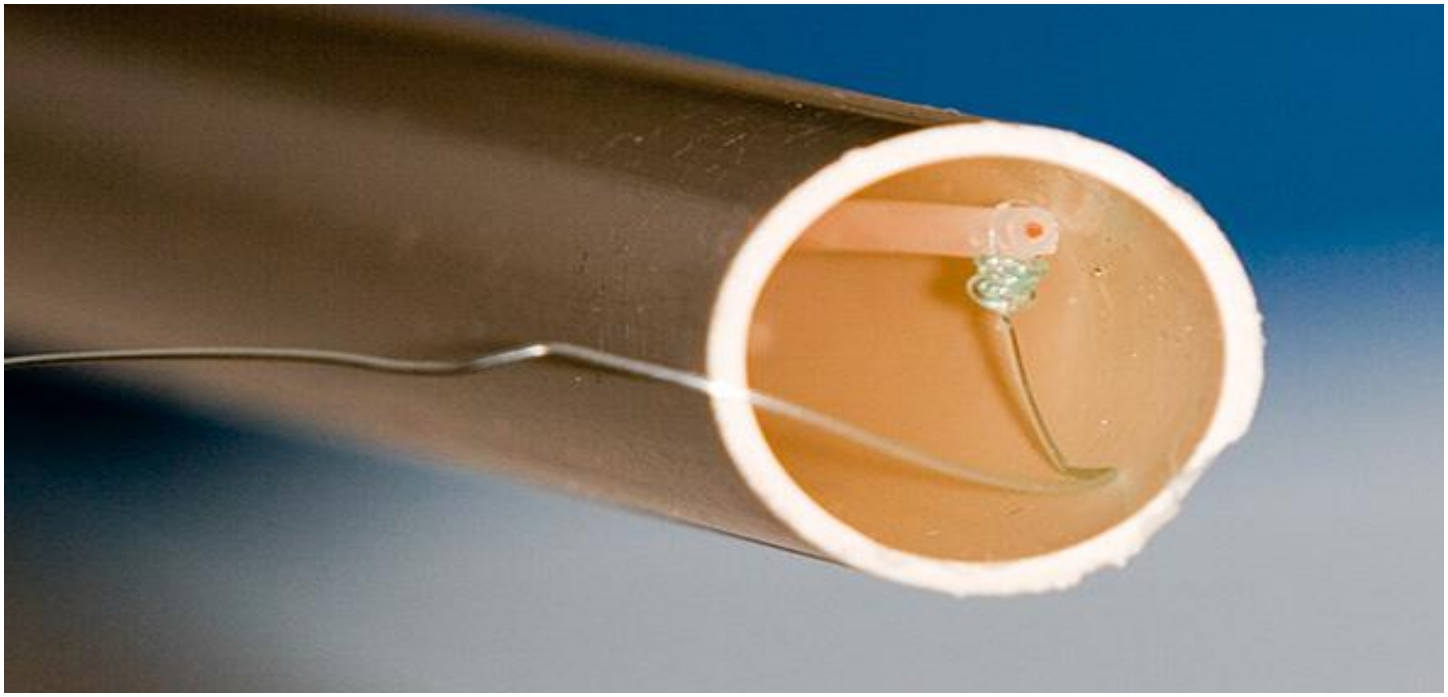
pushed further than mark point to ease the tie off and gluing process. It will drop back down inside as the marker tape or mark is recovered.

Preparing the PVC pipe for the antenna is straight-forward. The pipe is around 4’ or 1.2M long. You will need to drill two holes (3/16” bit) into the side of the conduit for the choke coil. The ‘top’ hole will be 920mm from the end that will eventually be capped at the end of this project Do not cap or measure with cap in place.. The spacing between the holes should be such that the 9 coil turns will be firm and secure (1-7/8” or 48mm center to center as seen in photos for my actual pipe and cable) Actual hole diameter and spacing will depend on the cable brand and/or where it was manufactured. It will be close to measurements shown in photos but drill the top most hole first, feed through antenna up to your marked/taped line and temporarily wind 9 snug turns on the conduit and take measurements and mark to drill the bottom-most hole to insure coil ends up wound tight and every turn up against the next. (Note:you should not see any white of PVC between any turns)

Take a circular file after drilling and file off the sharp edges and file in a slope into the hole to ease the stress presented to the coax as it goes in or comes out of holes. A pocket knife may suffice for same, but be careful not to slice ones hand.

Cable is fed into antenna in this picture, up to the 447mm point. When properly placed so the white tape has nearly disappeared into the hole, on the other end the tip of the top conductor end should be within 1-1/2” of the pipe end.

Fish-out (pun intended) the nylon line and by pulling it taut, temporarily straighten the radiator to “set” the bend at the choke coil top.



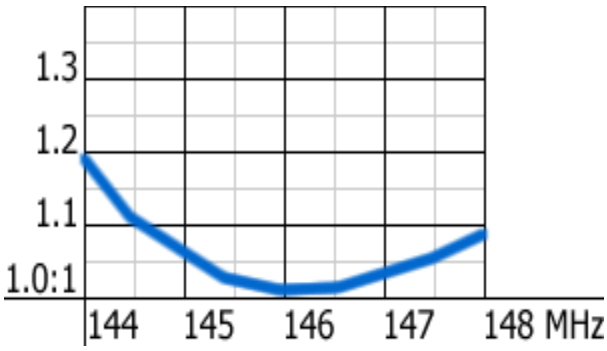
The coil is then wound on the outside of the conduit and the remainder of the cable inserted through the bottom coil hole and pushed down. Using firm but careful manipulation, the cable is pushed and tugged through the exit

hole until the coil is tightly wound and secure. This must be done without altering the bottom radiator length of the antenna within the pipe (e.g. you should continue to just see your ‘mark’ through the top hole.

At the top, cut a small (thin, narrow) notch in the edge of the conduit, pull the nylon line taut and nip the nylon line into the notch. Later, when an end cap is fitted, the cap will clamp the nylon line solidly in place and hold the radiator straight.

Fit a connector, measure the VSWR, if necessary trim the top element ever so slightly 1.5mm at a time, so resonance is at the 146 Mhz point, and presenting the least reflected power there, unless building the dual-band version, in which case, fine-tune the final 2M resonance after completing sleeve for 440mhz.

You should find that very little trimming, if any, will be necessary for single band 2M version. If you dual band the antenna, the 2m resonance will appear to shift upwards slightly from sleeve on outside of PVC, so it is ideal to resonate the antenna on 144mhz as starting point on 2M. The VSWR plot of the 2m Half-Wave antenna should look like the following with 457mm upper element:



VSWR plot of the 2m Half-Wave antenna

When you are happy with the VSWR, finally, cap the top, securing the nylon line and the radiator in place.

Don't block or seal the bottom end of the conduit. This is to allow condensation etc to drain away.

Additional Tips

Heatshrink the feedpoint to seal against water entry. Also heatshrink the coil's entry and exit points to minimise water entry.

Heatshrink the bottom end to provide a buffer for the exiting coax and neaten the base.

Fit a ¾" to ¾" coupler and the feedpoint end of your pipe and drill an exit hole at an angle for the feedline to exit out back to the outside. Now you can slide a 10' piece of heavy-duty Schedule 40 3/4"' pipe to this end, and you have a suitable mast to get up in the air on portable jaunts.

The type of Co-Ax is Important. Use braided co-ax only.

Do not use co-ax with a foil shield as the foil tends to break during assembly especially at the sharp bends at the choke entry/exit points. Obviously if this happens, your antenna will not work!

Painting

You may paint all or parts of the antenna after all construction is completed. If painting is going to be pursued, give a good sanding to the outside of the PVC pipe prior to all the assembly, then it is roughed up enough that spray enamel paint will stick fine. Two coats should suffice. Tape off the coax coil and do not spray paint it, as it is of flexible material that will expand and contract in the weather and crack the paint. For longevity you may wish to tape off and spray the coil with a product called PlasticDip spray on rubber coating.

Cocky Proofing

To protect the choke coil from bird attacks especially from the White Cockatoos, the coil needs to be covered with a 'Cocky' shield. An empty Silicone Sealant cartridge (enlarge the hole at the top and cut the barrel to length) neatly fits over a 2m antenna coil. A PET soft-drink bottle can be used for larger coils which, when

heated with a hot-air gun (but don‘t melt the conduit), will act like heat shrink tubing and become a very tough shield. Before fitting the shield, wrap PVC tape over the coil and the entry/exit holes to minimise water entry.

Using something other than white PVC water pipe.

Many of these antennas have been built with white plastic PVC thin-walled water pipe using all enclosed dimensions, and then painted for protection from the elements.

To the purist and his microwave oven, grey electrical conduit is considered lossy. It is, however, very UV resistant. The design compensates for the affect of the conduit by shortening the elements (by about a 2% factor) but otherwise the conduit appears to have little effect on the radiation efficiency over water pipe.

An unenclosed antenna will have longer elements (probably 2% or maybe 3% longer).

Scaling to Other Frequencies

The above design will scale to other frequencies, the limitation being the mechanical properties of the conduit. To make an antenna for other frequencies, a suitable choke coil can be determined from this table.

RG58 Co-ax Self Resonant Frequency (MHz)

Coil Turns	PVC Conduit Former Diameter		
	25mm	32mm	50mm
4	-	160	-
5	150	136	85
8	142	106	65
9	135	100	60
10	129	95	57
12	117	84	52
15	105	75	47

As a suggestion, construct a series of graphs from the data to make it easier to interpolate. Ideally, the choke should consist of unit turns. Half turns are OK but do not wind a choke coil using other than full or half turns. If your design is for a single operating frequency (or very narrow band) then chose the lowest half turn (ie the choke frequency is closer to the operating frequency); if, however, a broader-band antenna is required, chose the nearest higher half turn.

The choke needs to be resonant about 5 to 6% below the desired operating frequency. Closer spacing will sharpen (and deepen) the VSWR response; wider spacing flattens but raises the VSWR. curve.

Just dual-band the thing

The antenna goes onto the 70cm band so easily, and causes no perturbation of the 2M match or pattern that I suggest completing the build with an aluminum collar sleeve that will go on the outside of the ¾" PVC pipe and present a near perfect match on the higher band, and thus be ready for dual-band duty, even if only using on 2M for time being. Begin the following work after you have resonated the antenna on 2M at about 144.00 mhz.

Sleeve material started with is common variety kitchen aluminum foil. Heavy duty foil may be easier to work with yet I have used common variety stock, very successfully It is intended to be a sleeve that is exactly 235mm long. I fold the foil to these exact dimensions. I then wrap one full turn around the PVC pipe snuggly and tape the foil with electrical tape to keep it snugged as a sleeve.

There is a mark on the top most side of the PVC antenna (closest to top of antenna). This mark is 457mm from the top of the radiator held by the fishing line. Note this measurement is not from the end of the PVC pipe, but the end of the radiator wire, which is mostly likely several millimeters inside from the pipe end. If perchance you trim the top element to fine-tune desired 2M resonance point, you may have to re-measure the sleeve location. Note: In all cases trimming top element or re-positioning of the sleeve is done each time with no more than 2mm of precise change at any one time, and then checking SWR meter readings.

The sleeve is on the pipe, just snug enough to slide up and down, although movement more than 5mm in either direction should not be warranted to net a better SWR match. If measured precisely from wire ends, it should present a very low SWR on 70cm band just as built. When satisfied, tape up sleeve securely in place, or afix in your preferred fashion. Heatshrink tubing can be shrunk over the top if it as well.

An alternate and perhaps more permanent and stable than foil shield used for final tuning can be found at home improvement hardware, and even some dollar stores which sell adhesive aluminum tape about 50mm wide. Two strips of 235mm each are then suitable to cover the PVC pipe lengthwise at the position previously marked with the makeshift kitchen aluminum foil removed. Orienting squarely against curved pipe will be your biggest challenge, so consider some pencil guide marks or masking tape on an edge to serve as guide.

After build and tuned, I spray-paint the whole thing with some cheap Walmart Spray paint, and mount it where I need it, or tote it along for portable use. It could even serve as a hiking pole while heading for a SOTA expedition.