



Low Cost HF Antennas & Accessories

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PVC Tubing

- ◆ PVC pipe: Considers the inside diameter (ID) of the pipe.
- ◆ For PVC pipe (schedule 40):
 - **1/2" PVC pipe has an ID of 0.6" and an OD of 0.85".**
 - **3/4" PVC pipe has an ID of 0.8" and an OD of 1.1".**
 - **1" PVC pipe has an ID of 1.05" and an OD of 1.3".**



Aluminum Tubing

- ◆ Aluminum tubing: Considers the outside diameter (OD) of the tubing.

<u>OD(in.)</u>	<u>ID(in.)</u>
0.375	0.259
0.500	0.384
0.625	0.509
0.750	0.634
0.875	0.759
1.000	0.884

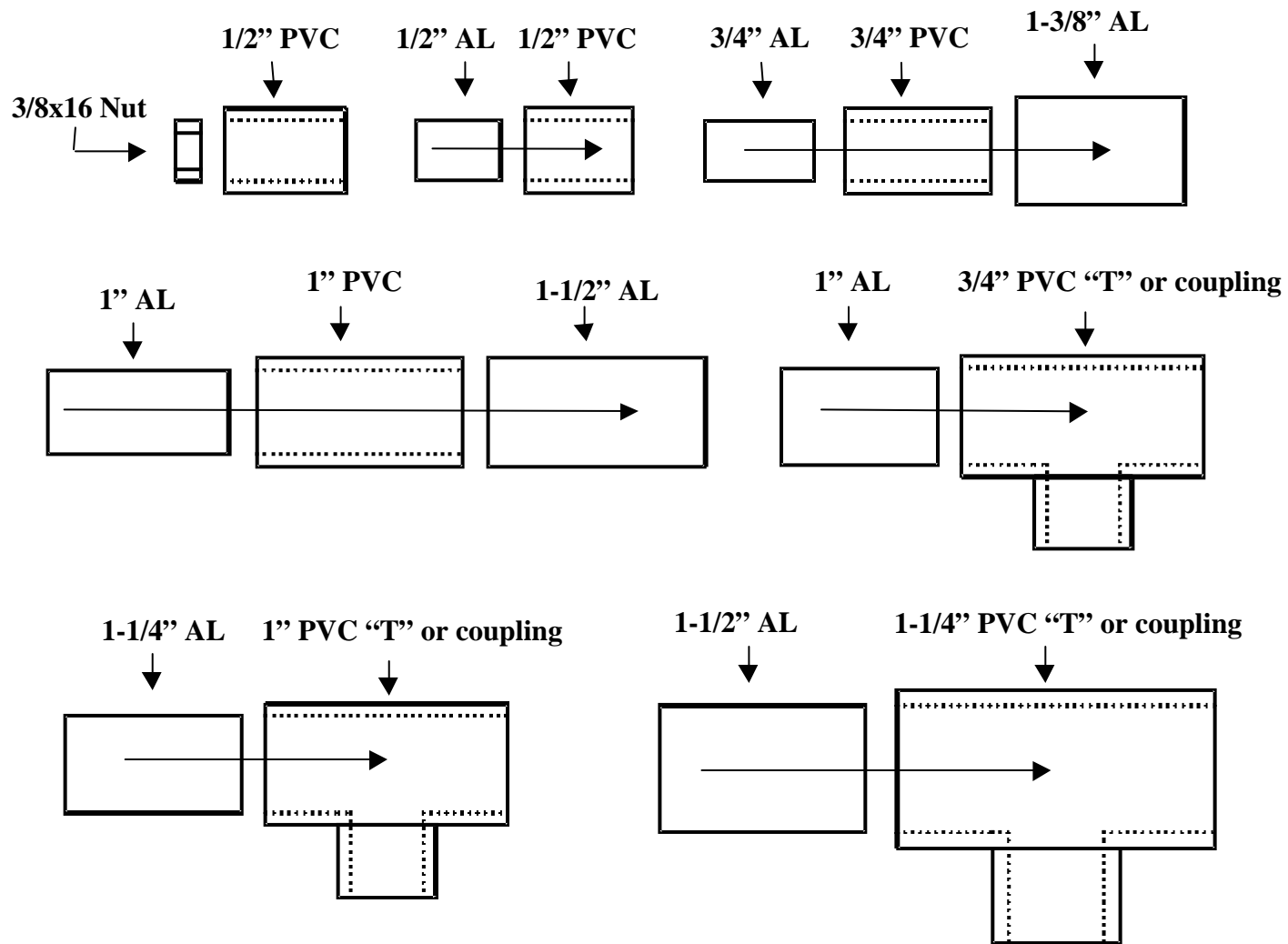


PVC/Aluminum Tubing Connection

- ◆ 3/8" Nut presses into 1/2" PVC pipe.
- ◆ 1/2" OD AL tubing slides into 1/2" PVC pipe.
- ◆ 1/2" PVC pipe slides into 1" OD AL tubing (0.884" ID).
- ◆ 3/4" OD AL tubing slides into 3/4" PVC pipe.
- ◆ 3/4" PVC pipe slides into 1.25" OD AL tubing (1.134" ID).
- ◆ 1" OD AL tubing slides into 1" PVC pipe.
- ◆ 1" PVC pipe slides into 1.5" OD AL tubing (1.384" ID).
- ◆ 1" OD AL tubing slides into 3/4" PVC "T" or coupling.
- ◆ 1.25" OD AL tubing slides into 1" PVC "T" or coupling.
- ◆ 1.5" OD AL tubing slides into a 1-1/4" PVC coupler or "T".



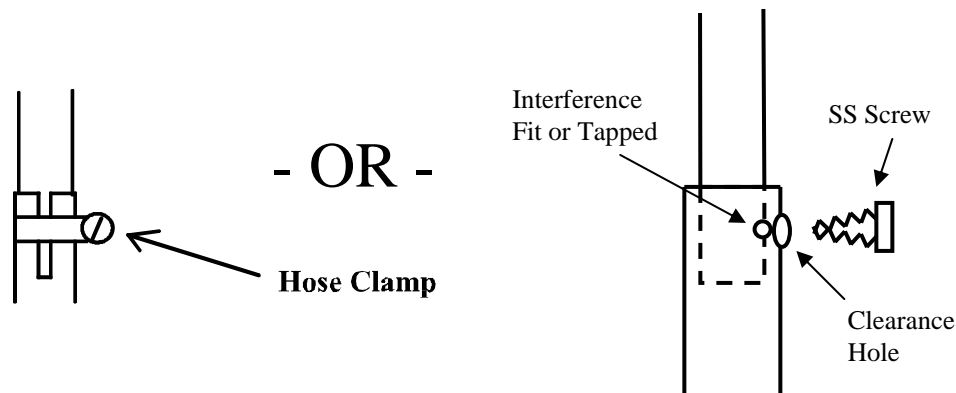
Aluminum/PVC Connection





Antenna Building Hints

- ◆ Use stainless steel hardware with aluminum.
- ◆ Use brass hardware with copper.
- ◆ Three ways to attach telescoping tubing together
 - Hose clamps (stainless steel)
 - Drill clearance & interference holes for SS sheet metal screws
 - Drill clearance & tapped holes for SS screws



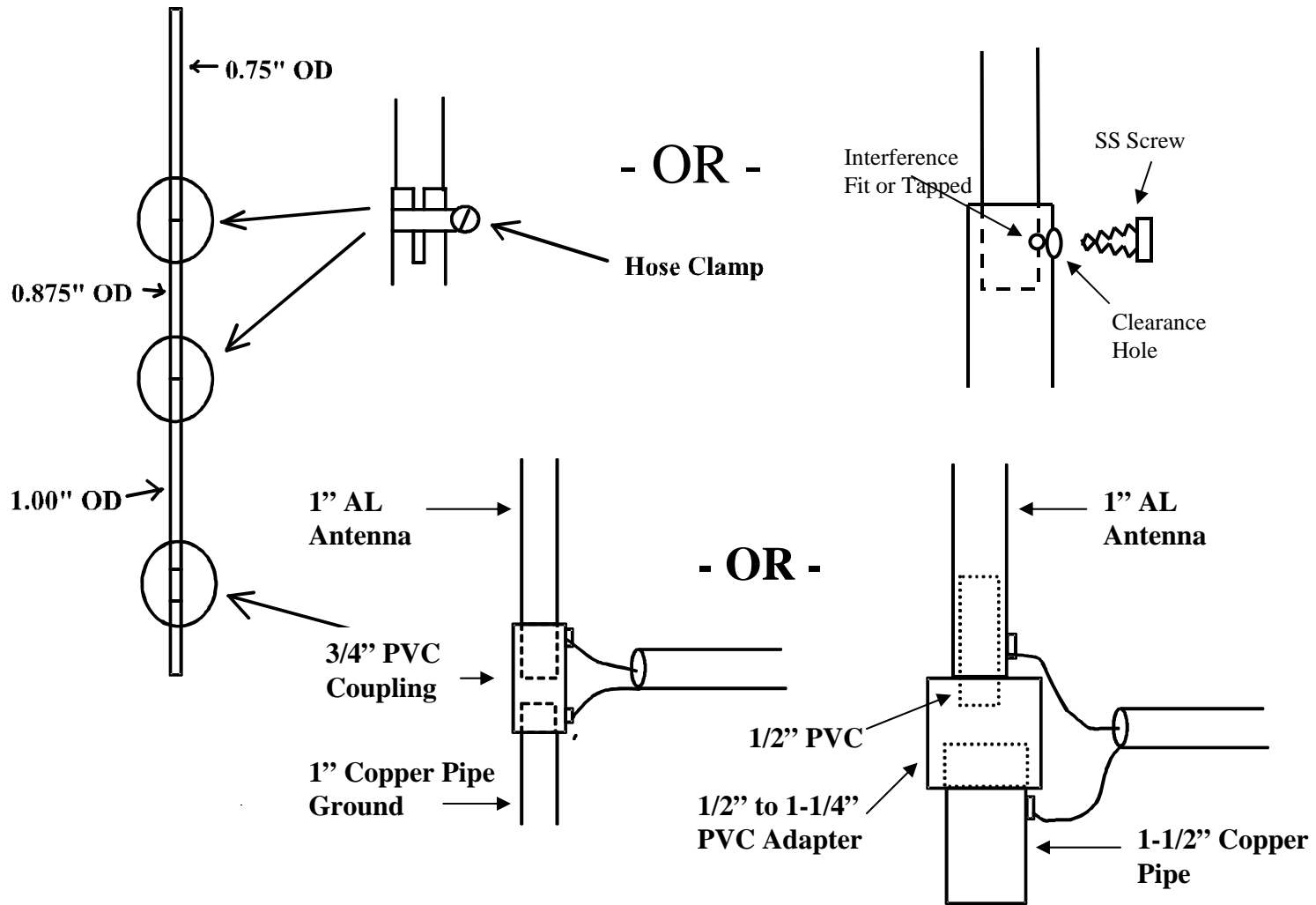


40/15 Meter Vertical

- ◆ 1/4 Wave on 40 Meters, 3/4 Wave on 15 Meters
- ◆ Need a total height of 33 feet.
- ◆ Use three 12-foot aluminum tubes
 - 1" OD, 0.875" OD, and 0.750" OD
- ◆ Or six 6-foot aluminum tubes
 - 1" OD, 0.875" OD, 0.750" OD, 0.625" OD, 0.500" OD, and 0.375" OD



Vertical Antenna Construction





40/15 Meter Vertical (Cont.)

- ◆ Use as many radials as possible
 - Radial lengths \geq vertical height
 - Many short radials are better than a few long radials
 - 500' 18 gauge bare stranded wire @ \$14 (Home Depot)
- ◆ Put RF choke across feed-point to bleed off static charges.
 - 40T #16 enameled wire on T200-2 torroid
 - High value resistor is also OK.
- ◆ Seal open coax ends with “Plasti-Dip” or “Liquid Electrical Tape” (Home Depot).



40/15 Meter Performance

- ◆ 40M - 1.5:1 VSWR worst case
- ◆ 15M - 2:1 VSWR worst case

- ◆ Other Bands
 - 20M - 16.5 feet
 - 17M - 12.9 feet
 - 12M - 28.2 feet (3/4 wavelength)
 - 10M - 24.8 feet (3/4 wavelength)



40/20 Meter Trapped Antenna

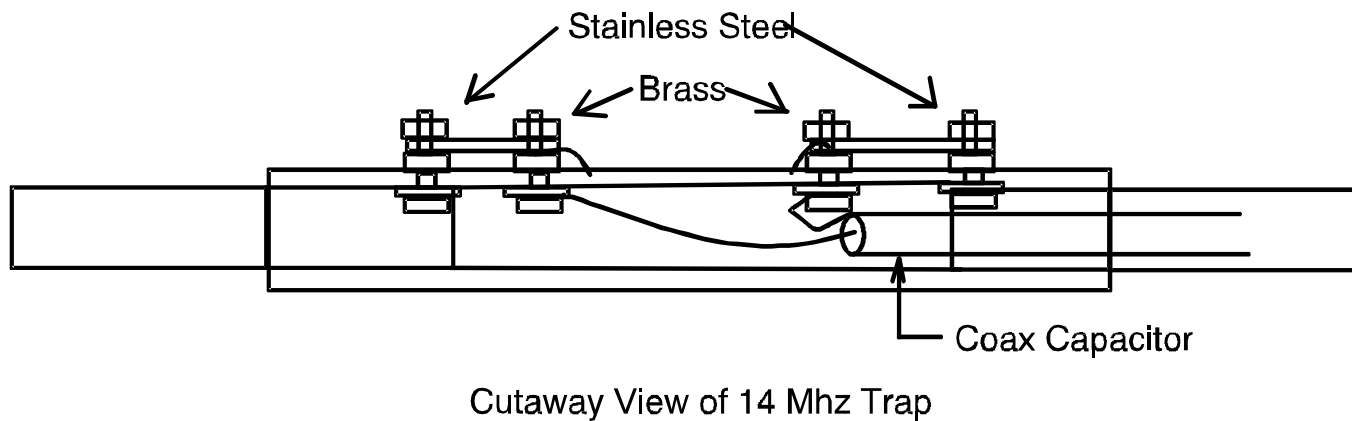
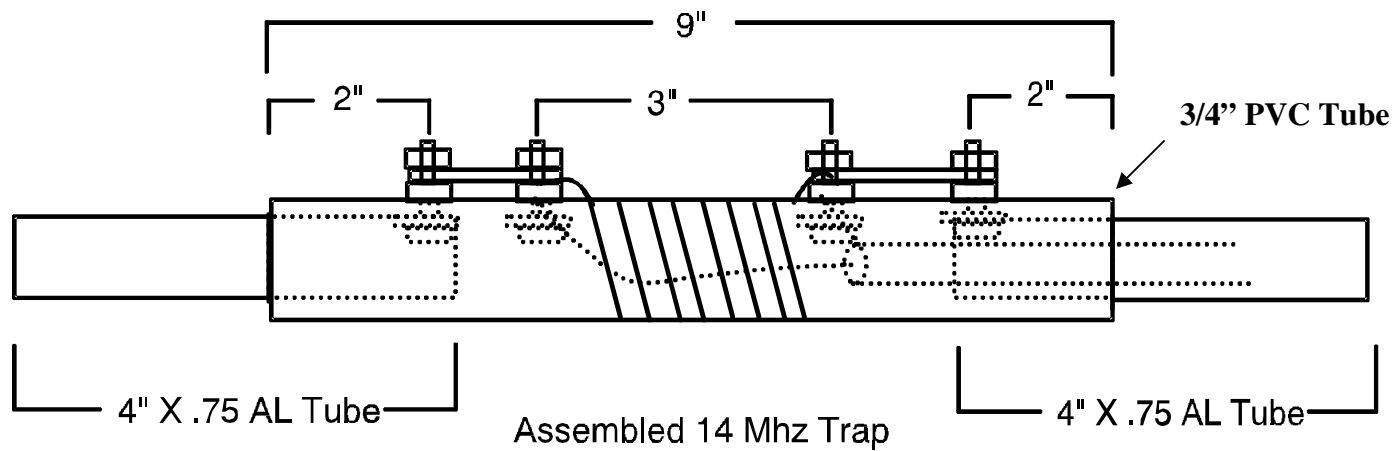
- ◆ Wanted to operate these two bands without changing the antenna length.
- ◆ Need a trap to “disconnect” the upper part of the antenna so it will work on 20 meters.
- ◆ The trap also provides inductive loading on 40 meters thereby shortening the antenna.



20 Meter Trap Construction

- ◆ 4.7 uhy inductor with 27 pf parallel capacitor
 - Inductor: 23 turns #18 insulated wire
 - Capacitor: 1-ft length of RG-58
- ◆ Both measured with Autek RF-1 SWR analyzer
- ◆ Grid dip final assembly
 - Adjust inductor turns or trim coax
- ◆ Coat with “Plasti-Dip”

20 Meter Trap Details





40/20 Meter Performance

Resonance/VSWR

7.13 MHz/1.3:1

14.2 MHz/1.1:1

Band-Edge VSWR

1.8:1 @ 7.3 MHz, 1.5:1 @ 7.0 MHz

1.3:1 Worst case across the band

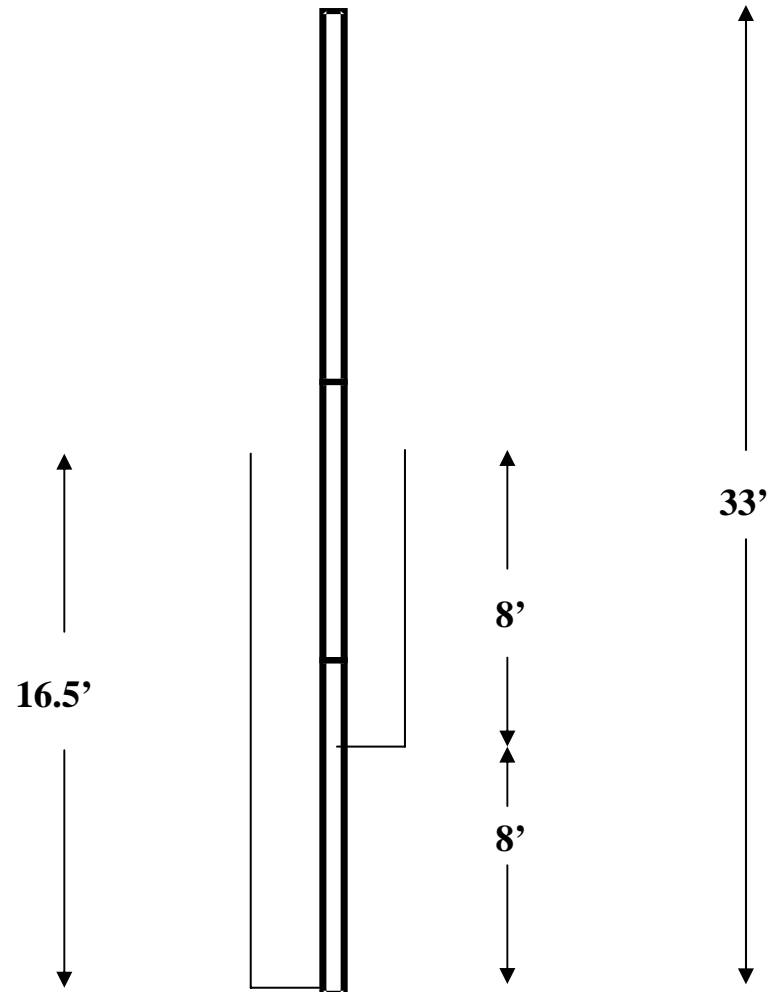


No-Trap Multi-band Vertical

- ◆ Start with basic 40/15 meter 33-foot vertical
- ◆ Parallel feed a 20 meter 16.5-foot wire vertical
 - Only $1/8\lambda$ on 40 meters
- ◆ Add 10-meter $1/4\lambda$ decoupling wire as shown
 - Couples 10-meter $1/4\lambda$ fed section to upper $1/2\lambda$ 10-meter section



40/20/15/10 Meter Vertical



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160 Meter Antenna

- ◆ **How about 160 Meters?**
- ◆ **Want CENTER-LOADING to improve radiation resistance**
 - **33 Feet is only 1/16 wavelength on 160 meters**
 - **Radiation resistance: 1.3 ohms base loaded, 3.5 ohms center loaded**

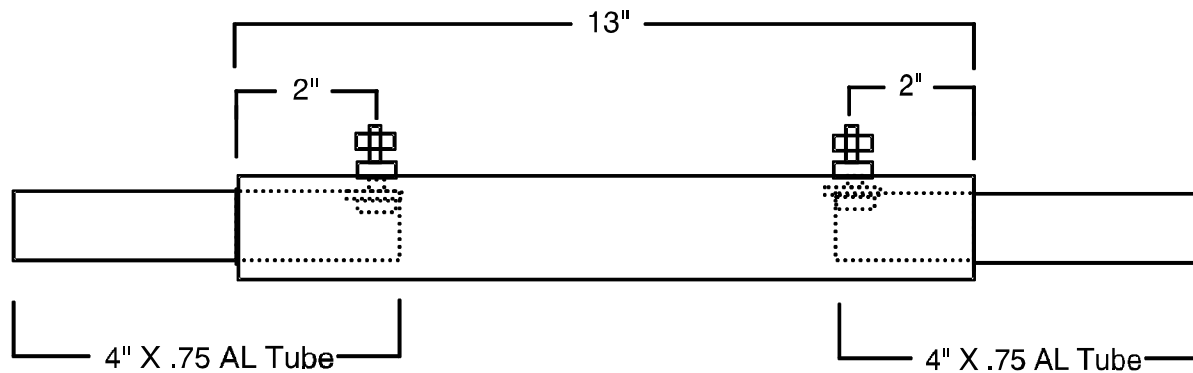


Center-Loaded 160 Meter Coil

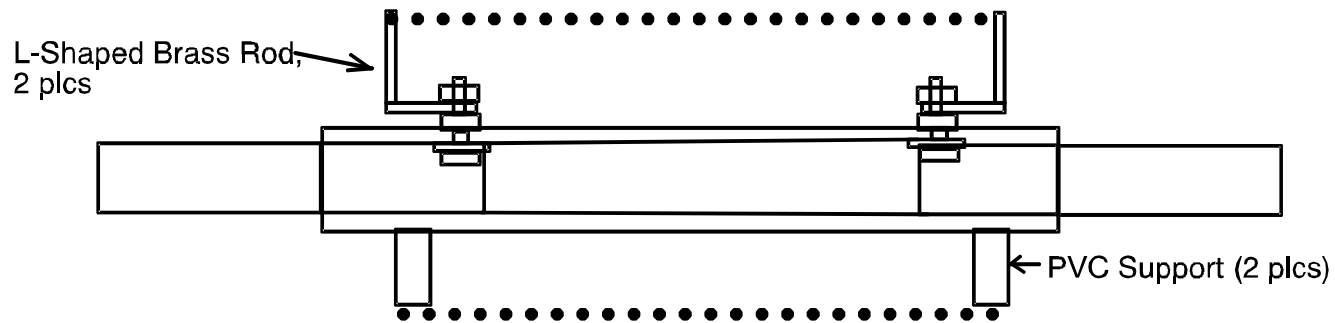
- ◆ Need ~ 125 uhy
- ◆ Used B&W 3031 coil (2-1/2”D, 10TPI, 10”L)
 - \$19 from Surplus Sales of Nebraska
- ◆ Strengthen the 3/4” PVC pipe with a 3/4” wood dowel dipped in varnish.
- ◆ Will need base capacitive matching
 - Needed 2700 pf (1000VDC minimum)



160 Meter Loading Coil



160 Meter Coil Assembly (Coil not shown)



Cutaway View Of 160 Meter Coil Assembly



160 Meter Performance

◆ 160 Meter Performance

- 1.2:1 VSWR at resonance (1817 KHz).
- 2:1 VSWR Bandwidth = 10 KHz
- Calculated efficiency: 16%
- Base loaded efficiency: 8%

◆ How about 80 Meters?

- 25 uhy coil required

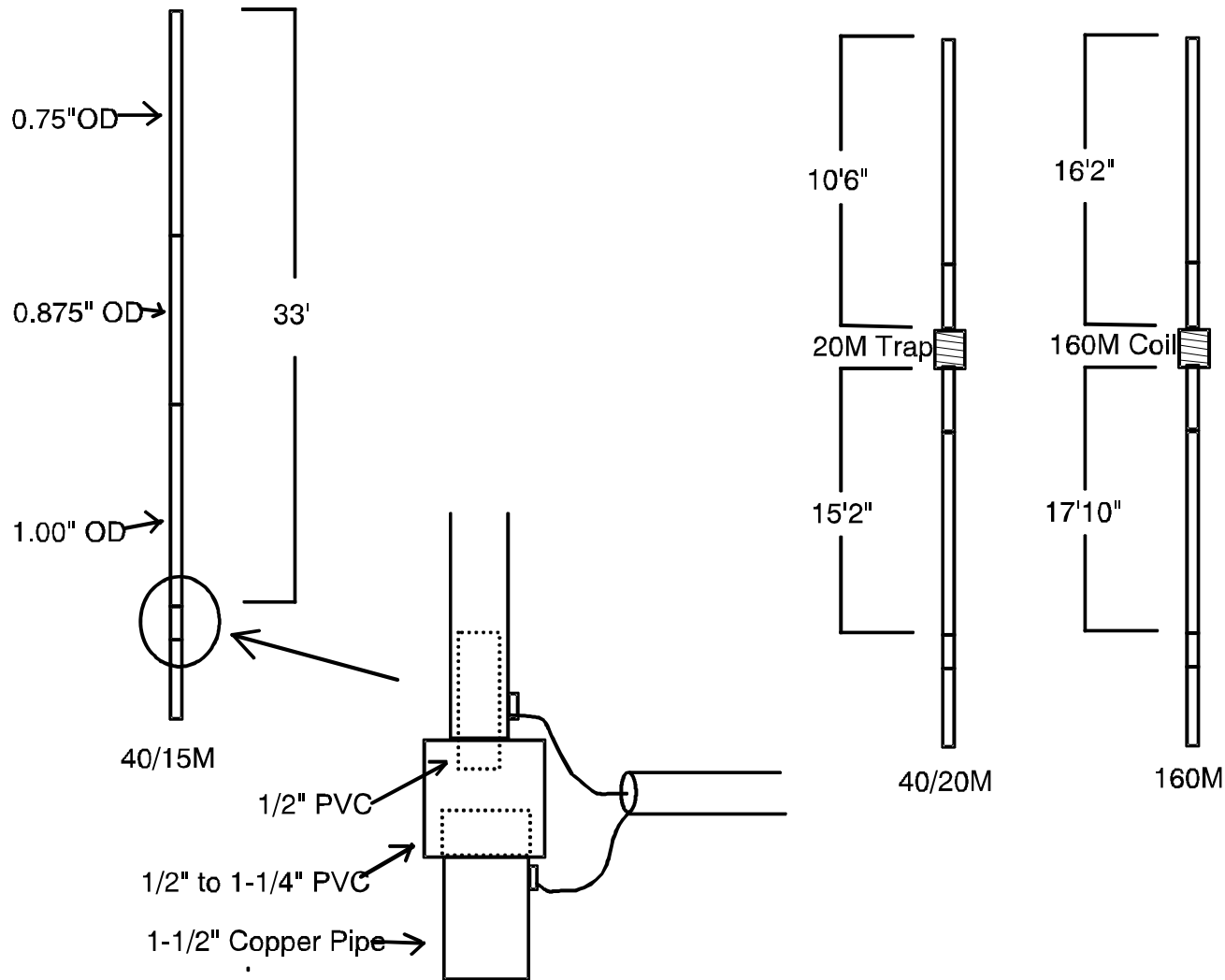
◆ Don't tap 160 meter coil

- Reduces "Q"

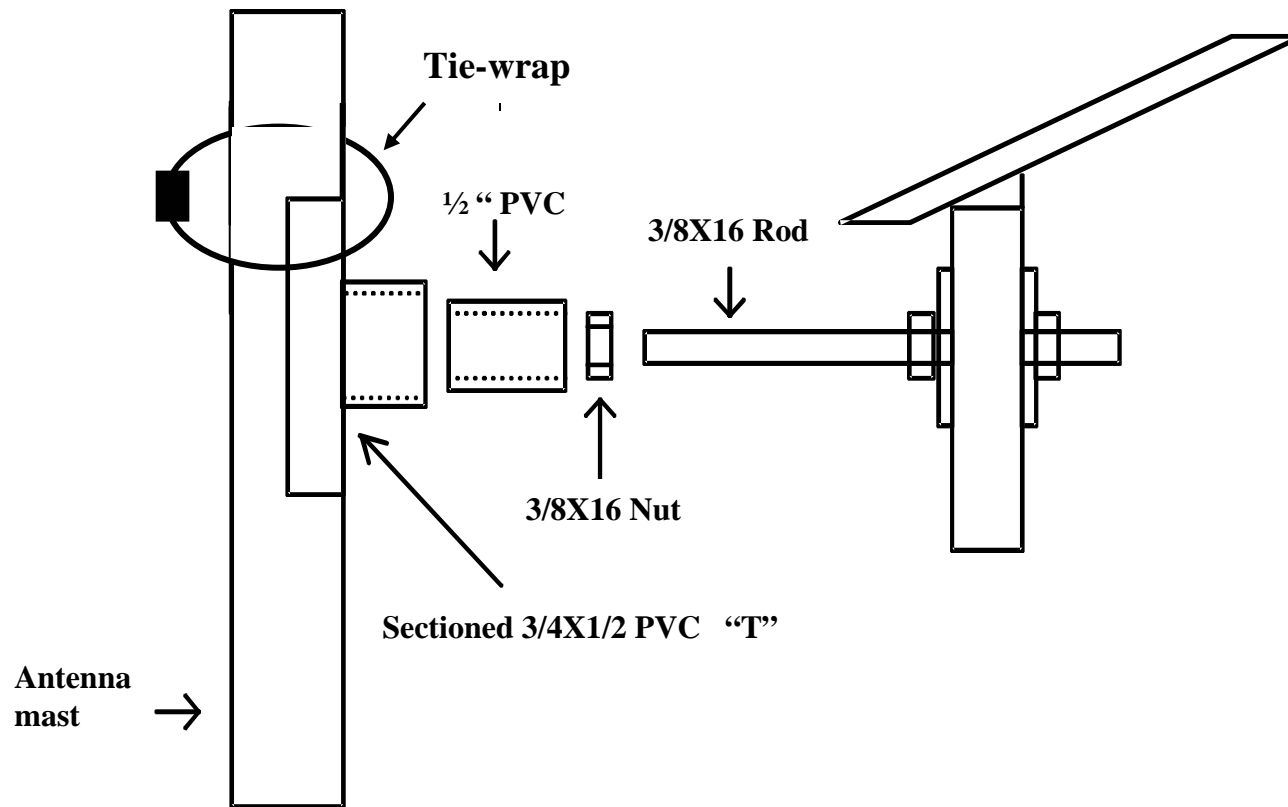
◆ Use 680 pf base matching capacitor



40, 40/20, & 160 Meter Antennas



Roof/Fence Support





Eve Support



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Fence Support



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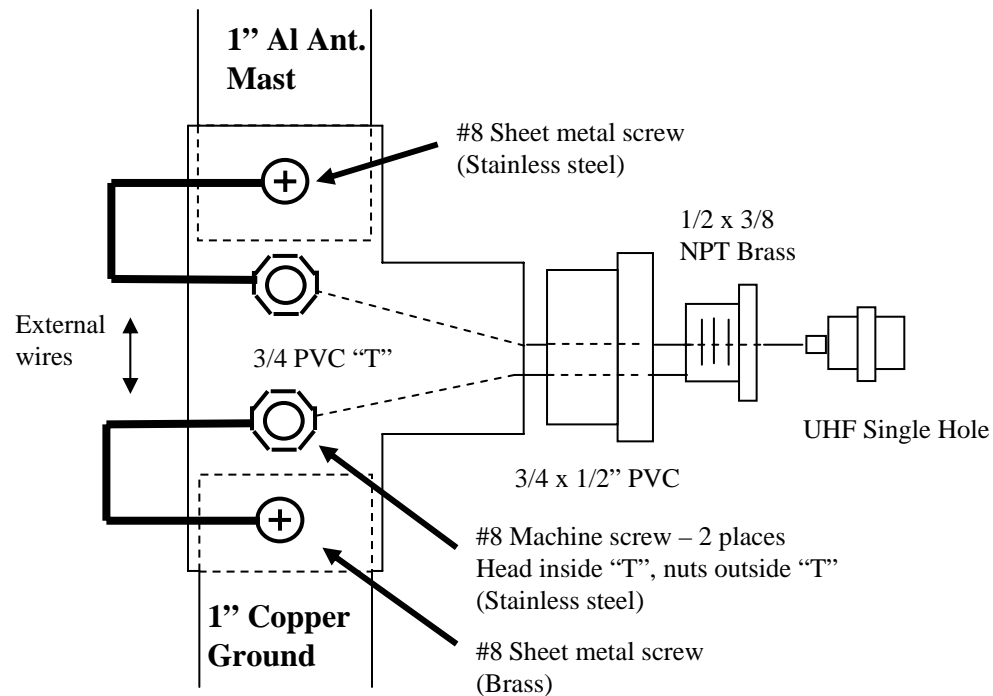


NPT-to-Ham Connection

- ◆ 1/8 NPT plumbing thread is really a tapered 3/8 X 24 thread - the "standard" thread for most mobile antennas.
- ◆ Since it is tapered, you can chase it with a 3/8 X 24 tap.
 - Not really necessary. 3/8x24 stud screws into it.
- ◆ Also, a single-hole SO-239 UHF connector screws nicely into a 3/8 NPT thread!



Base Station Antenna Mount



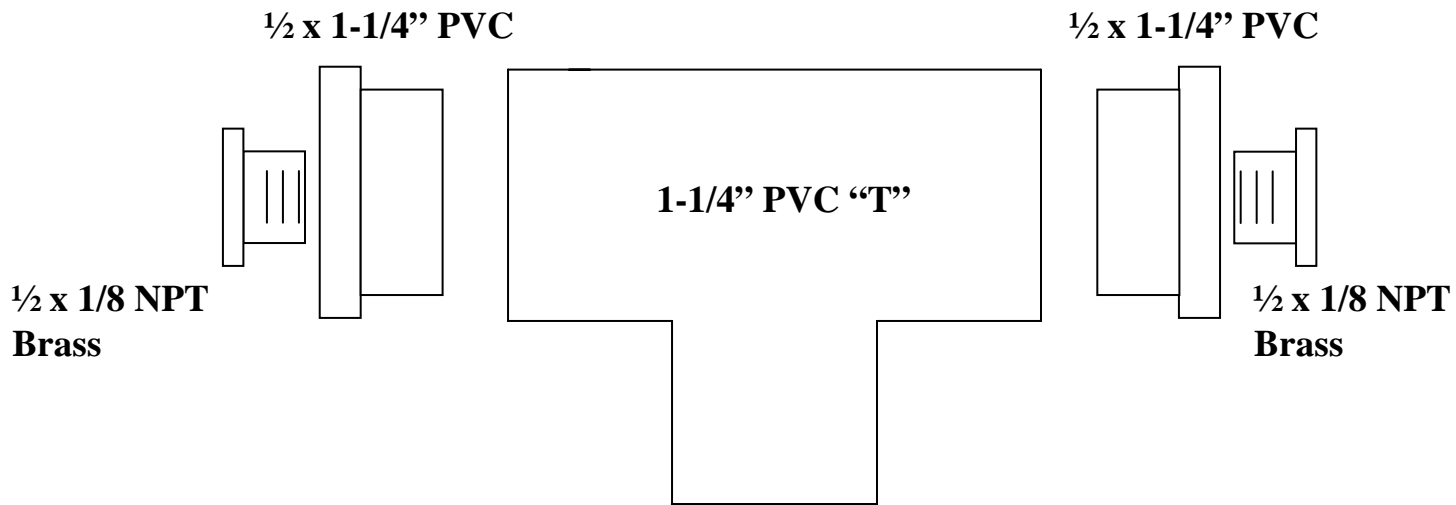


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Dipole Center Insulator





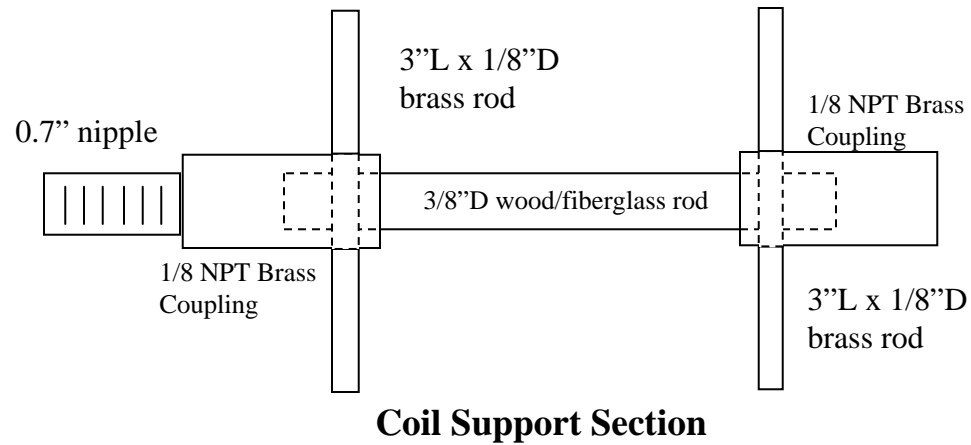
Building Loading Coils

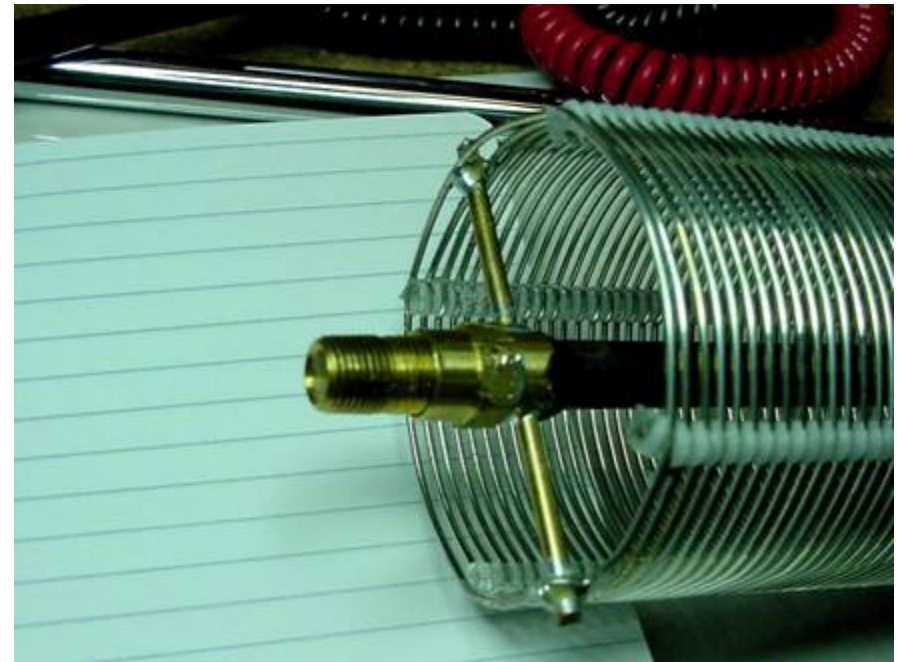
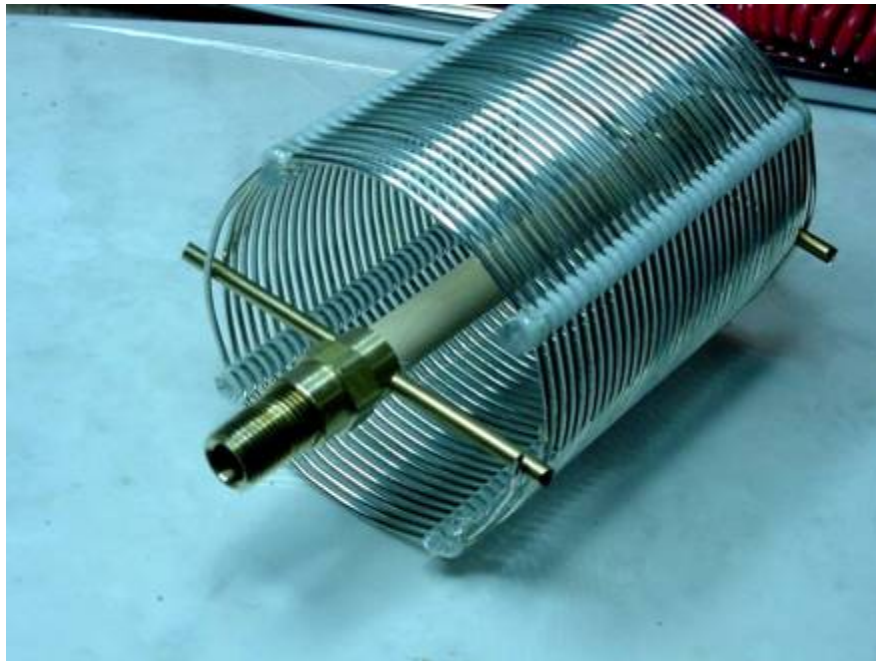
- ◆ Use 3/8" diameter wood dowel or fiberglass rod for the coil support.
- ◆ 1/4"D fiberglass Bicycle Flags are also good.
 - Use 1/4" compression-to-1/8 NPT Male/Female brass adapters
 - ***Be careful when working with fiberglass!***
- ◆ B&W 3027 Coil (~60 uHy)
 - 2"D x 10"L
 - Surplus Sales of Nebraska (www.surplussales.com)
 - \$15 ea
- ◆ MFJ-404-008 (~60 uHy)
 - 2.5"D x 5"L
 - \$15 ea.

Note: Reinforce ends of coils with Home Depot 2-part quick setting clear epoxy.



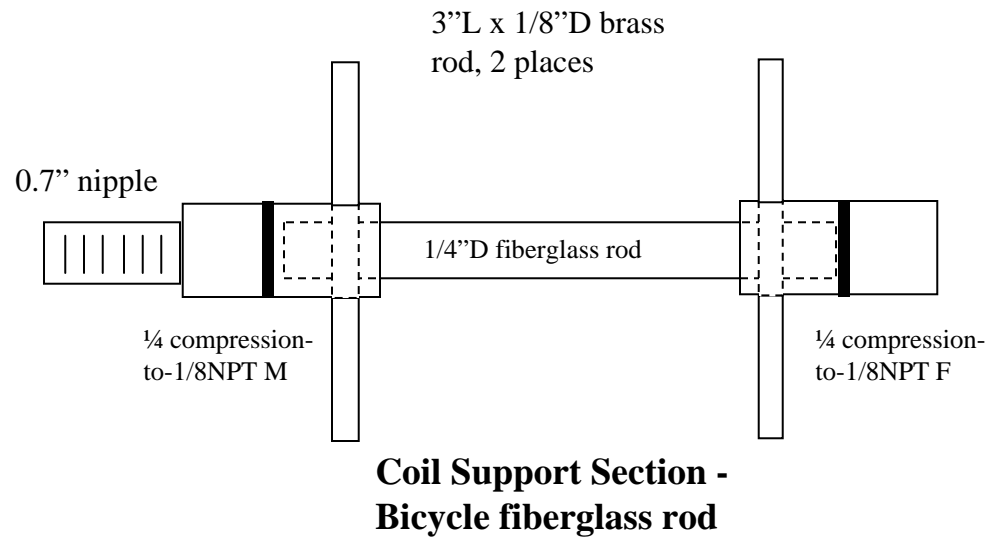
3/8" Dia. Rod Coil Support





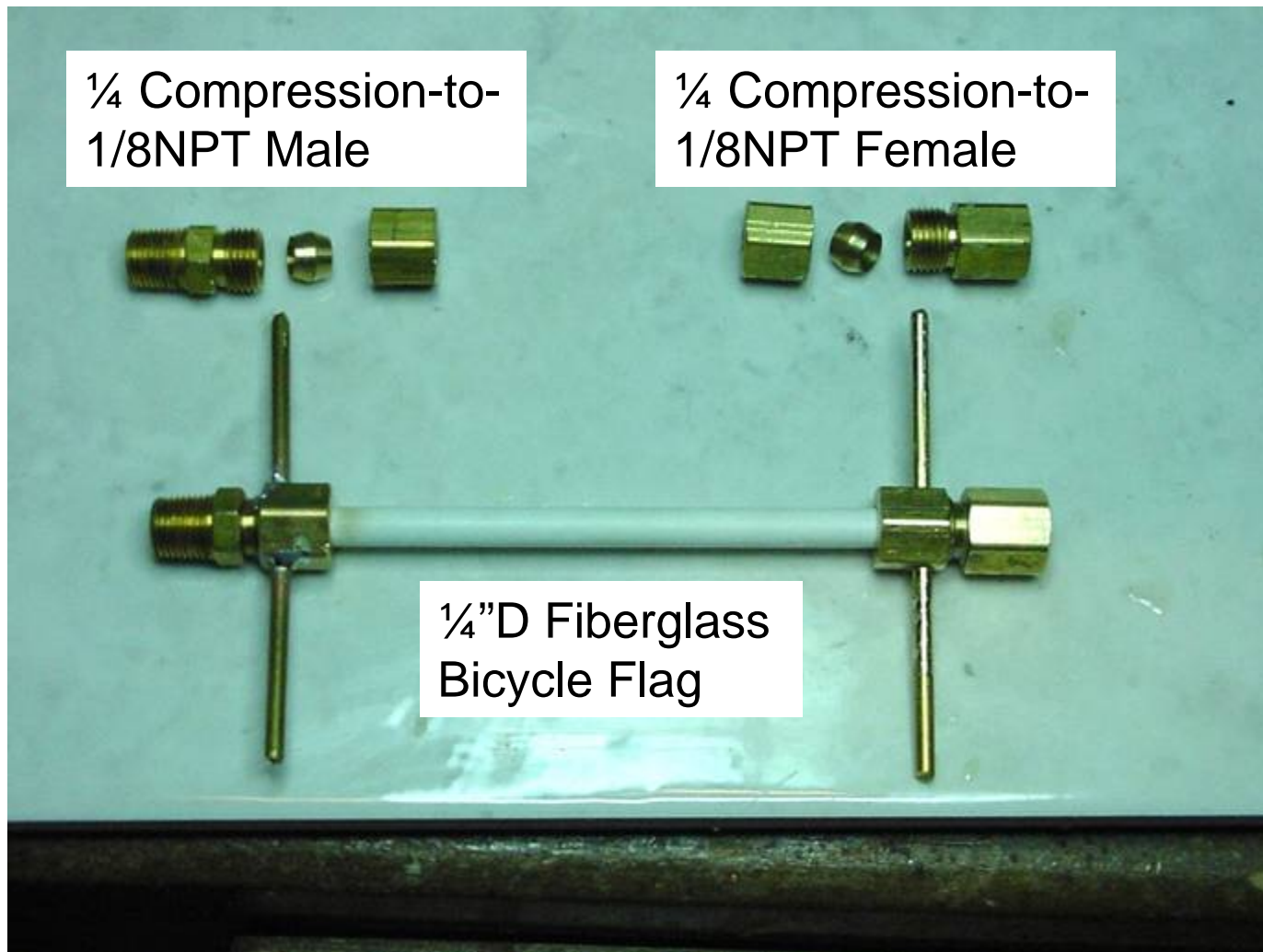
Coil: MFJ-404-008 @ \$14.95
2.5"D x 5"L

AD5X 1/4" Fiberglass Rod Coil Support





1/4" Fiberglass Coil Support



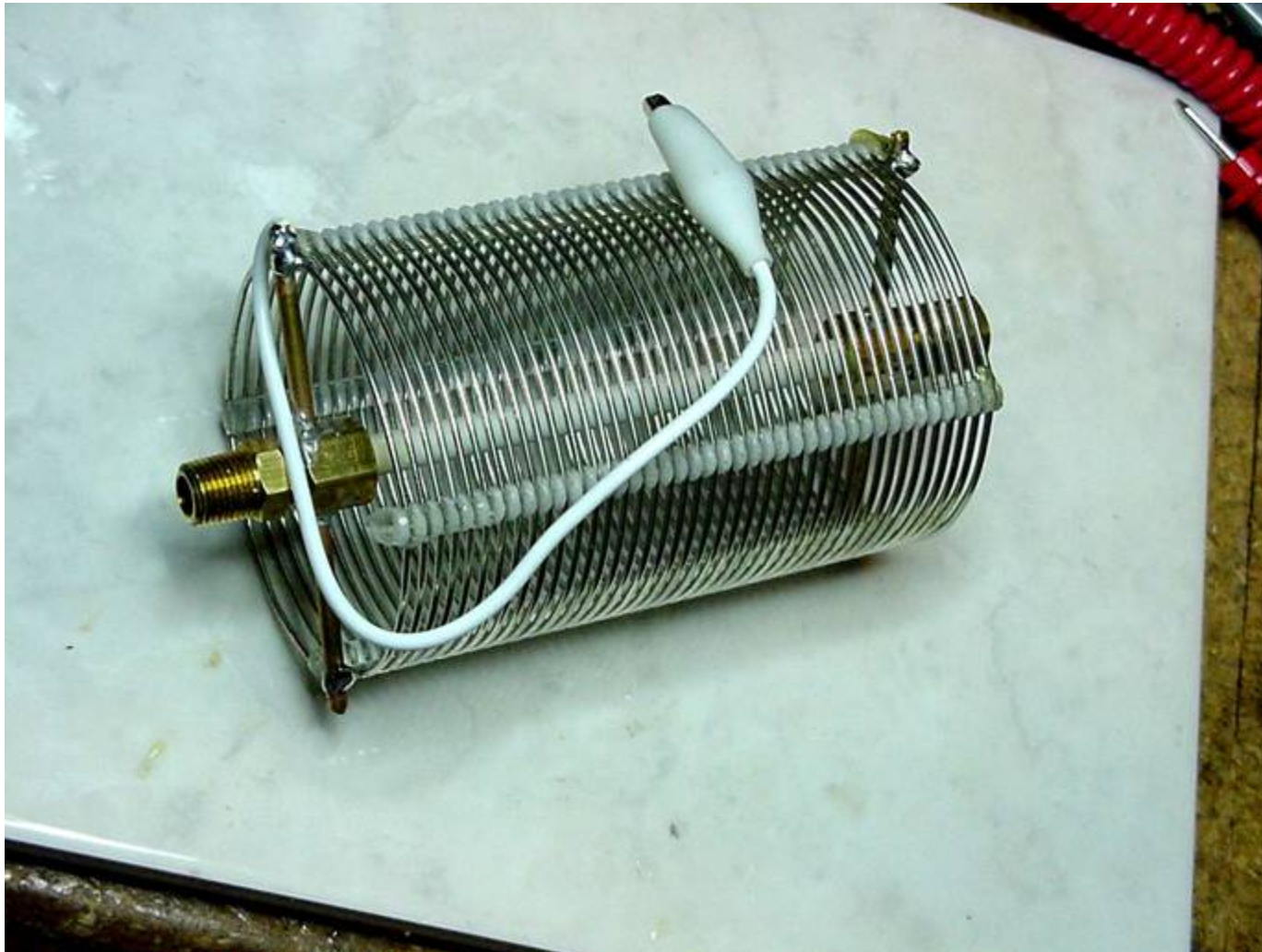
1/4 Compression-to-1/8NPT Male

1/4 Compression-to-1/8NPT Female

1/4"D Fiberglass Bicycle Flag



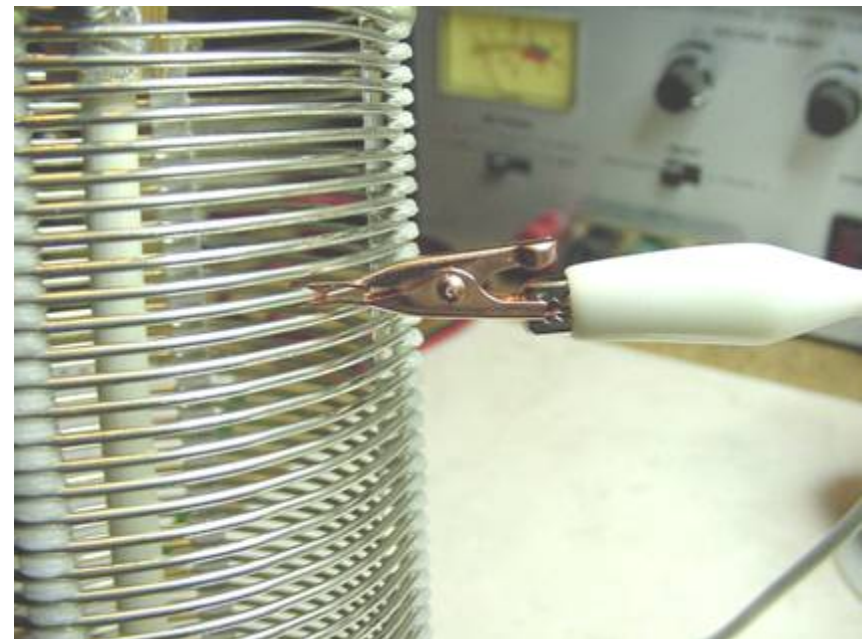
1/4" Fiberglass Support Coil



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Find the Tap Point



Final Tap Point





Build your Own Coil

◆ Items needed:

- Desired PVC pipe form (OD and length)
- Nylon Edge Trim (8-TPI)
 - McMaster-Carr 85085KB, \$10.29 for 25x12-3/4” strips
- 14 Gauge bare copper wire
 - McMaster-Carr 8873K51, \$10.20 for 80-feet
- Tie Wraps
 - To hold ends of Nylon Edge Trim to PVC pipe
- Hot Glue

Build Your Own Coil



Build Your Own Coil



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$$L(\text{uhy}) = d^2n^2/(18d + 14l)$$

where:

d = diameter (wire center to wire center in inches)

n = number of turns

l = length of coil (inches)



Conclusion

- ◆ You can build very effective, low cost antennas.
- ◆ Most parts are readily, and locally, available.
- ◆ Normally, only standard hand tools are necessary.
- ◆ ***There is no reason why your home-built antenna can't operate at least as well as the expensive commercial antennas!***
 - Quality is often better when you build it yourself.



Parts Suppliers

- ◆ Aluminum tubing – Texas Towers, ACE, Home Depot, McMaster-Carr (www.mcmaster.com).
- ◆ Fiberglass rods/tubes
 - Max-Gain Systems: <http://www.mgs4u.com/>
 - Walmart/Bicycle shops: ¼” diameter fiberglass bicycle flag
- ◆ PVC, brass plumbing parts, tubing, stainless steel hardware
 - ACE/True Value/Home Depot/Elliott’s/McMaster-Carr
- ◆ Air-wound coil & coil taps
 - MFJ-404-008 coil, MFJ-605-4001 coil tap
 - B&W coils (Surplus Sales of Nebraska)



Parts Suppliers (Cont.)

- ◆ **Tools: Solder-It Company: <http://www.solder-it.com/>**
 - SolderPro torches (SolderPro 50 is \$19.95 @ Radio Shack)
 - Aluminum Solder Paste
 - Silver Solder Paste (Silver Solder Paste is \$4 @ Radio Shack)
- ◆ **Hand Tools**
 - Harbor Freight 39391-0VGA Tap & Die Kit @ \$12.99
 - 11/64" cobalt drill bit (for drilling #8 clearance hole in stainless steel): ACE Hardware store
- ◆ **Stainless Steel hardware**
 - Jacob Schmidt & Son (www.jschmidtstainless.com)
 - Also sells drill bits for stainless steel
 - ACE Hardware store
 - McMaster-Carr (www.mcmaster.com)