Build Your Own Coils
Phil Salas – AD5X

Introduction

I really enjoy experimenting with different ways of making portable and mobile antennas. However, one big problem is finding reasonably priced coil stock. Recently I've been making my own coils and so I wanted to pass on my methods. Also described are neat ways to build coil supports for your home-made air-wound coils.

The Coil

The basic form for the coil is 2" PVC pipe. I start with a 1-foot length of pipe, and carefully mark four evenly spaced lines along the length of the pipe. See photo "Marked Pipe". To this PVC pipe, I tie-wrap four pieces of nylon edge trim available from McMaster-Carr (www.mcmaster.com, PN 85085K8, $10.50 for 25 12-3/4" strips). This nylon edge trim provides the support to provide for an 8-TPI coil. I used 14 gauge copper wire for the coil itself (McMaster-Carr 8873K51, $10.20 for 80-feet). But before connecting the nylon edge trim, you need to determine the length of the coil that you will need. I use the solenoid inductance equation to determine this:

$L_{uhy} = D^2N^2/(18D + 40\ell)$ Where D = coil diameter in inches
N = Number of turns
ℓ = coil length in inches

The actual coil diameter will be 2.5" (OD of the PVC pipe plus the nylon strips), and the number of turns/inch is 8 (when using the referenced nylon edge trim). So, rearranging the equation to solve for the coil length:

$\ell = 0.156\ N^2/L - 1.125$

I wanted 30 uhy of inductance, so I made my coil 4.5" long, which should ensure greater than 30 uhy.

To make the 4-1/2" long coil, I cut four pieces of the nylon edge trim to 5-inches each, and clipped off two of the serrated edges on each end to leave room for tie-wrapping the nylon strips to the PVC pipe. Then I aligned the four strips with the four lines marked on the PVC pipe, and tie-wrapped the strips in place. See photo "Nylon Tie Wrap". Drill 1/8" diameter holes at each side of the coil to hold the wire while you wind it. Then, wind the wire over the nylon strips. See photo "Coil On PVC". Once you are finished winding the coil, fill the nylon edge trim with epoxy or hot glue. I prefer hot glue, but your operating environment may dictate the more rugged epoxy. When cured, remove the tie-wraps and slide the coil off the PVC pipe. A finished coil is shown in photo "Final Coil".

Coil Supports

In previous articles, I've recommended sprinkler riser tubing (July 2002 QST "Portable Travel Antenna") and 3/8" diameter wood dowel as the top-to-bottom coil mounting

insulator. My preference is to use fiberglass, but I've had a difficult time finding 3/8" diameter fiberglass rods locally (a good mail order web site is The Deer Shock Depot at http://electric-deer-fence.com/). However, I've recently discovered ¼" diameter fiberglass bicycle flags! These give a great option if you can figure out how to use them in this application. So, I'll show how to use both 3/8" diameter and ¼" diameter rods as coil support insulators.

Note: Use care when cutting fiberglass rods! The little fiberglass shards (the "glass" in "fiberglass") can cause you a lot of grief. Goggles and gloves should be worn.

3/8" Diameter Support

With 3/8" diameter rods you can easily make rod interfaces using 1/8-NPT nipples and couplings. To do this, first screw a 1/8-NPT coupling on each end of a 0.7" 1/8-NPT CLOSE nipple. Use pliers and/or wrenches to screw these on tight**. Note: At this point you can ream out the couplers with a 3/8" drill bit if you don't want to thread the 3/8" rod (See "Reaming" photo). Be careful if you do this. I prefer threading the rod as discussed below.**

Now unscrew the couplings. One end will brake loose, and the other will stay tight in the remaining coupling. You'll now have a female and male end for each end of the 3/8" diameter rod. See "1/8-NPT couplings". If you'd like, you can solder the nipple/coupling assemblies together, however the nipple/coupling assembly tends to be very tightly secured.

Next, use a 1/8-NPT die and thread the 3/8" diameter rod (wood or fiberglass) on each end. Refer to Figure 1. Now screw the 1/8-NPT male/female coupling pairs over both ends of a 3/8" diameter wood or fiberglass rod, tightening them down snugly, but not tight enough to strip the threads. Next, drill 1/8" diameter holes completely through each of the 1/8-NPT brass couplings and rod as shown in Figure 1. Cut two 3" lengths of 1/8" diameter brass rod and insert one of these 3" sections through the holes on one brass coupling. Center the rod so that equal lengths are available on both sides of the coupling, and solder the rod to the coupling with a large soldering iron or Solder-it torch (be careful not to burn the wood dowel if you use a torch!).

Now position the desired length of the coil such that the 3" brass rod just installed pokes through the last two turns on the coil. Solder the coil turns to the rod. On the opposite end of the coil assembly, insert the remaining 3" brass rod through two adjacent turns on this end of the coil, through the brass coupling, and through the coil turns. Solder the coil turns to the brass rod, and then solder the brass rod to the coupling.

1/4" Diameter Support

Fiberglass bicycle flags are readily available and inexpensive. Generally, for about $5 you can purchase a 6-foot bicycle flag that will provide many coil supports. As it turns out, ¼-inch brass compression fittings are also readily available from your local hardware store (I found everything I needed at ACE Hardware).

Refer to Figure 2 and the photos for details of the ¼" diameter loading coil support section. Use 1/4-compression-to-1/8NPT male and female brass adapters for the coil support end pieces. The 1/4-compression ends of the adapters do a great job of securing the 1/4" diameter fiberglass rod as shown. After you assemble the adapters and fiberglass rod together, drill a 1/8" diameter hole completely through each of the brass adapters and fiberglass rod as shown in Figure 2.

The remainder of this assembly is exactly like the 3/8" diameter coil assembly. I.e., cut two 3" lengths of the 1/8" diameter brass rod. Insert one of these 3" sections through the holes on one brass adapter. Center the rod so that equal lengths are available on both sides of the adapter, and solder the rod to the coupling with a large soldering iron or torch. Position the coil such that the 3" brass rod just installed pokes through the last two turns on the coil. Solder the coil turns to the rod. On the opposite end of the coil assembly, insert the remaining 3" brass rod through two adjacent turns on this end of the coil, through the brass coupling, and through the coil turns. Solder the coil turns to the brass rod, and then solder the brass rod to the coupling. See the "1/4" fiberglass coil support" photos.

Conclusion

I've described a way for you to build low-cost high-Q air-wound inductors and coil supports. Give it a try, and save some money on coils for your homebrew antenna projects.

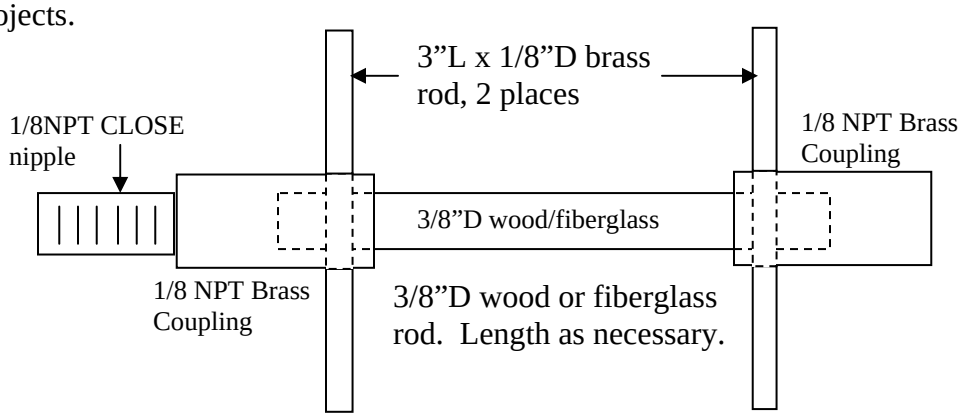


Figure 1 - Coil Support Section
3/8"D wood or fiberglass rod

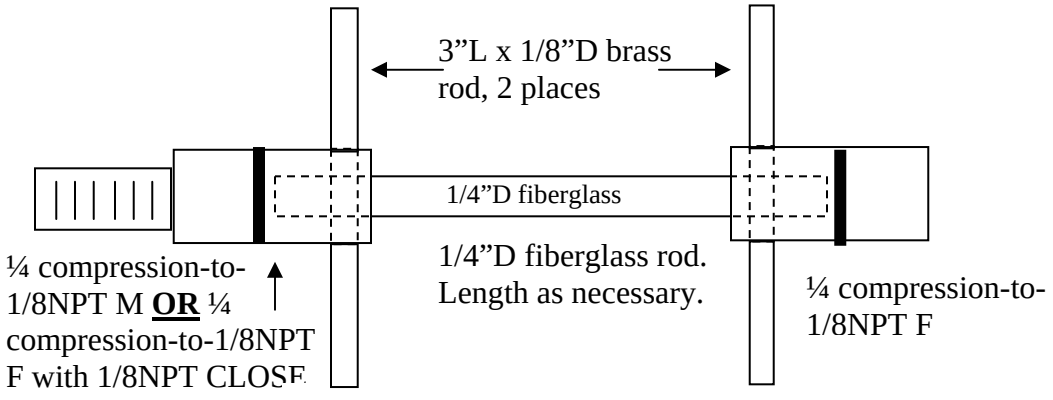
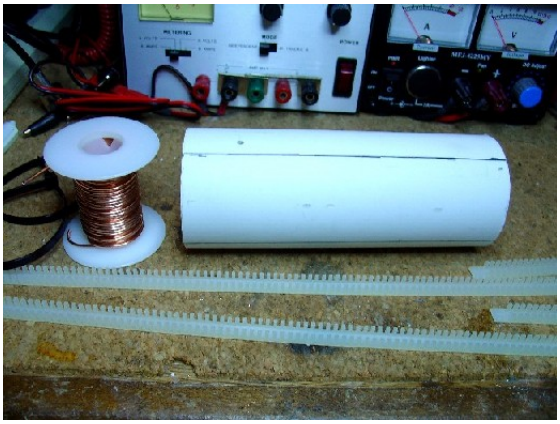
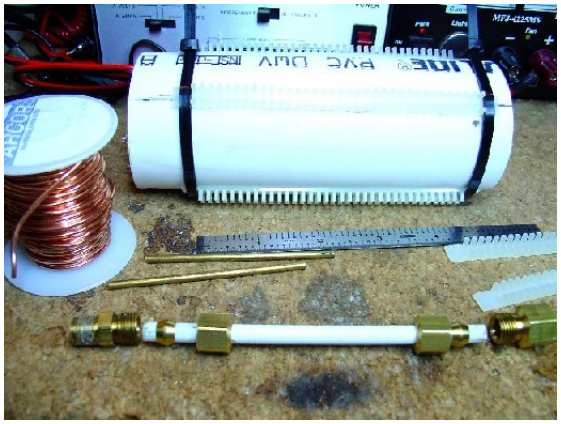


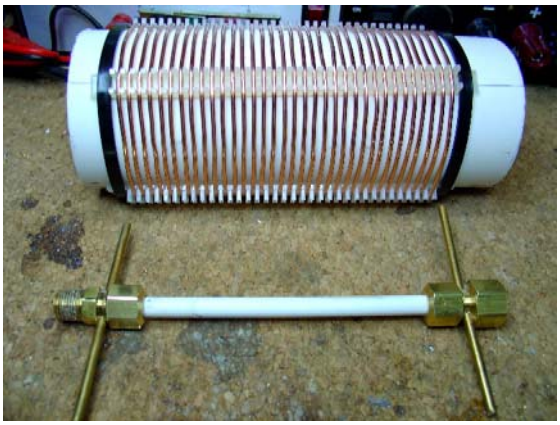
Figure 2 - Coil Support Section
1/4"D Bicycle fiberglass rod



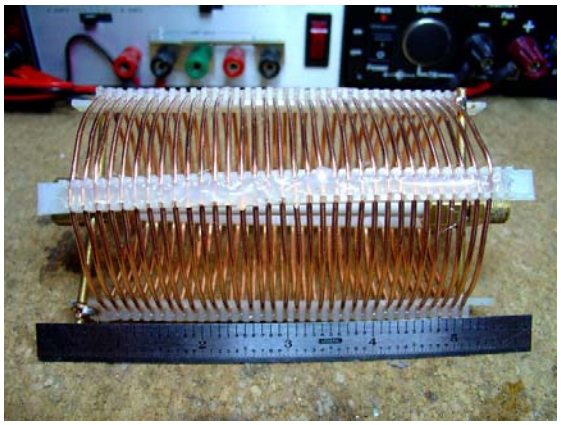
Marked Pipe



Nylon tie-wrapped in place



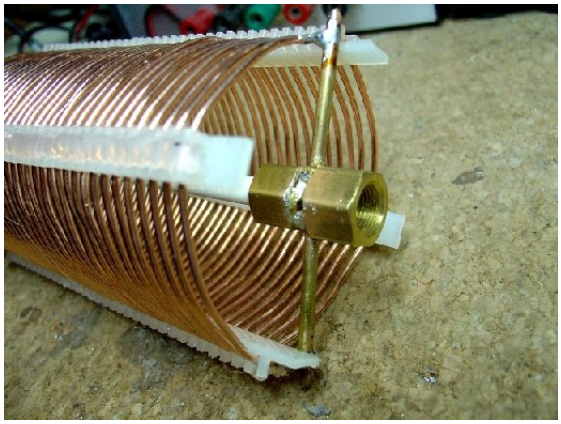
Coil on PVC and ¼” fiberglass support



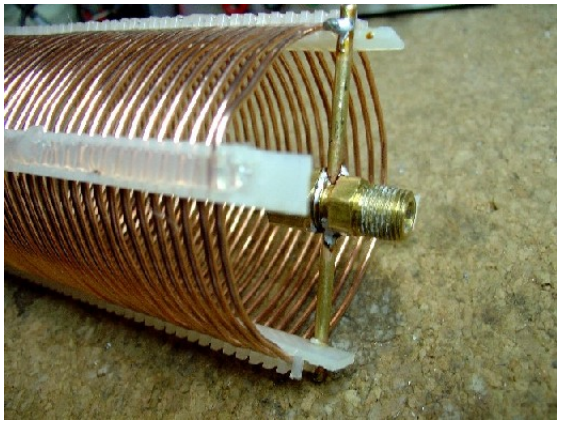
Final Coil

Male & Female 1/8-NPT Couplings

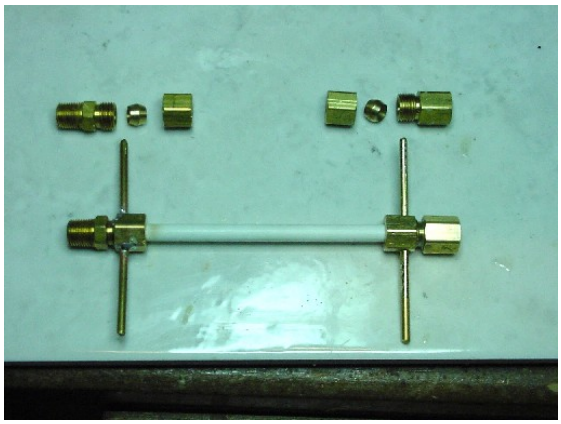
Non-preferred reaming of connectors



Final coil: Female end



Final coil: Male end



¼” diameter fiberglass pieces