A Frugal 6 Meter Yagi

Recently a set of several test antennas were constructed here from a tinker toy set of 8 pieces of 6' telescoping Al tubing (2 each of 3/4, 5/8, 1/2 and 3/8"). These were, in order: a 30 m two el parasitic vertical; a 17 m two el parasitic vertical; a 17m two el yagi; and a gamma match testing 22.1 MHz dipole. Some of these are described in other notes.

At the end of these tests, a final project was needed to use the tubes in a less temporary configuration. Holding back two of the larger tubes to augment my 80 m Inv-L, the remaining six have become a 6 meter yagi. Since cutting the tubes seemed an irreversible plan, the driver element is not broken and is fed by a gamma match. The parasitic elements consist of 1/2 + 3/8 tubes and the driver is from 3/4 + 5/8. Of course, the elements are not symmetrical

The design for the 3 el yagi is taken directly from the ARRL Antenna Book (306-06) using a six foot boom. Since the tube sizes are different from those in the original design EZNEC was called into service to determine if any length changes are needed to get elements with the individual design resonant values (also found by NZNEC). The driver was additionally shortened, as recommended, to get a better unmatched impedance (19-j18 for the model) for gamma matching. Spacing was kept from the original design. The final lengths are 103" director, 108.6" driver and 118" reflector

The tubes are round and conventional booms are round – this provides a serious mechanical problem for joining them, usually solved by multiple custom plates and many U-bolts. This problem provides a great opportunity for innovation. Looking around the garage and in the junk box, most anyone could find a length of pine 2X2, some old hose clamps and three 3" bolts – problem solved. As might be imagined from the picture below, 3 grooves were cut across one surface of the 2X2 at the element locations. If a person has a proper machine shop, perfectly shaped and oriented grooves can be done in a flash. Or, if your shop is sub-par, it is possible to break out your Dremel with a cutting wheel and work away. This requires some trimming of the groove and testing to get the elements to all run the same direction (and perpendicular to the boom, if possible) but it is not too painful. If needed, a final minor adjustment of the relative heights of the element ends can be achieved by altering the tension difference in the two hose clamps that hold each element to its bolt centered below the groove.

The gamma match is about 11" long with a 3 1/4" center-to-center spacing between the 3/8" gamma rod and the driven element. There is an bracket (insulated by electrical tape, probably not necessary and not touching the driven element) to hold the near end of the gamma rod in place.

The capacitor is a "gimmick" coaxial type consisting of a short length of 1/4 rod wrapped with three side-by-side pieces of plastic electrical tape making a few layers for a fairly close fit to the inside of the 3/8" gamma tube. Before assembly they look like this:

The best match was found by inserting the rod about 1 and 3/4 of the 3 tape pieces into the tube which (using an MFJ259) was estimated to provide about 18 pFd of capacitance. The match is pretty sensitive to the capacitance but less so to the length of the gamma rod. After some cut and try adjustments, the SWR is ~ 1.2:1 at the end of the coax feed over the lower end of 6 meters. This could probably could be improved with more experimentation but gamma matches are justifiably famous for the needed fiddling.

A crude radiation pattern measurement using the MFJ as a source, supported above the ground, at a few wavelength distance away from the antenna (at 20' high), suggested the F/B is about S9+10dB/S7 on the K3 meter which is perhaps a bit better than 20 dB, so this is a success. Off the ends of the elements, the signal was S8.

If you take the MFJ-found impedance at the end of 50' of RG8U (52+j11) along with the measured velocity factor, the TLW code suggests the impedance at the antenna is 64+j0 at 50.1 MHz. Working backward (see gamma match write up) from the standard gamma match equivalent circuit, you can estimate the raw unmatched antenna impedance to be 9-j29 as compared to 19-j18 calculated from the EZNEC model. This difference probably reflects both model and gamma match equivalent circuit uncertainties.