20 METER ROTATABLE DIPOLE ANTENNA PROJECT

Design Goals and Objective:

Construct a compact, 20 meter rotatable dipole antenna of durable weather worthy components supported at a single point obviating the need for multiple supports and multiple support ropes crossing the yard. It shall be easy to adjust (i.e., tune) by simply adjusting the length of the tubular elements. This design presents lower visual impact than a typical wire dipole supported at its far ends, leaving remaining air space for additional antennas. The antenna shall be installed on a 35 foot galvanized push-up steel mast.

Observation: Cost is intentionally sacrificed to maximize the above stated goals of 1) durability, and 2) single center support.

20 Meter Aluminum Dipole Antenna Parts List:

Parts ordered from DX-Engineering:

Quantity	Part No.	Description	@ Price	Total Price
1		.		
1	DXE-SEI-1	Split Element Insulator Designed for a 3/4 in. O.D. Aluminum Tube Being Used For a Driven Element	$.6.49	$6.49
4	DXE-RSB-I12500	1-1/4 in. Resin Support Block Clamp	$4.70	$18.80
4	DXE-RSB-DP-5	Stainless Steel RSB Reinforcement Plate	$4.90	$19.60
2	DXE-CAVS-1P	V-Saddle Clamp, 1/2 in. to 1-3/4 in. O.D. Applications - DXE-CAVS-1P	$9.95	$19.90
2	DXE-AT1211	Aluminum Tubing 6' x 1.250" x 0.058" wall, one end slit	$9.65	$19.30
2	DXE-AT1210	Aluminum Tubing 6' x 1.125" x 0.058" wall, one end slit	$8.45	$16.90
2	DXE-AT1200	Aluminum Tubing 6' x 1.000" x 0.058 wall", one end slit	$7.85	$15.70
2	DXE-AT1189	Aluminum Tubing 6' x 0.375" x 0.058" wall, 6063-T832 drawn, no slits	$2.95	$5.90
2	DXE-ECL-060	Element Clamp for 3/4 and 7/8 in. tube	$1.90	$3.80
3	DXE-ECL-040	Element Clamp for 5/8 in. tube	$1.90	$5.70
2	DXE-ECL-10SS	Element Clamp for 1” and 1.125 tubing	$1.90	$3.80
2	DXE-ECL-12SS	Element Clamp for 1.25” tubing	$1.90	$3.80
4	DXE-ECL-060	Element Clamp for .75” and .875” tubing	$1.90	$7.60
		TOTAL (Less Shipping) :		$106.59

Incidental Parts and Components:

Quantity	Part No.	Description	@ Price	Total Price
1		Aluminum Element-to-Mast Plate	$32.50	$32.50
8		3" 1/4 -- 20 Stainless steel bolts for element clamps	$5.00	$5.00
8		1/4 -- 20 SS nuts for above bolts	$1.00	$1.00
2		Size 2" 6 - 32 SS bolts, nuts, and lock washers for securing vertical tubing to horizontal tubing	$2.00	$2.00
2		Size 2" 6 - 32 SS bolts, nuts, and lock washers for securing feed line to tubular elements	$2.00	$2.00
2		Stainless Steel hose claims - to secure balun to mast	$1.00	$2.00
		TOTAL (Including Shipping) :		$44.50

Two 2" - 6-32 combo round machine screws with nuts and lock washers connect the leads from the balun to the tubular antenna elements. Closed-end crimp lugs secure the balun wires to the machine screw connectors on the antenna elements. Stainless steel hose clamps secure the balun to the mast. Multiple plastic cable ties secure the feed line to the mast.

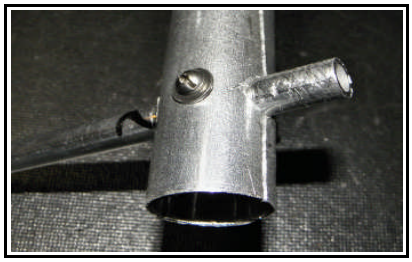
Construction Notes and Photos

Front Side: This is the constructed .25" aluminum element-to-mast plate depicting the saddle clamps holding the tubular elements, providing support and separation between the two dipole elements. The aluminum dipole elements are separated by about 3/4 inch. The balun leads is connected to the tubular elements with two 2-inch, 6-32 screws first installed with 6-32 nuts, and then with wing nuts.

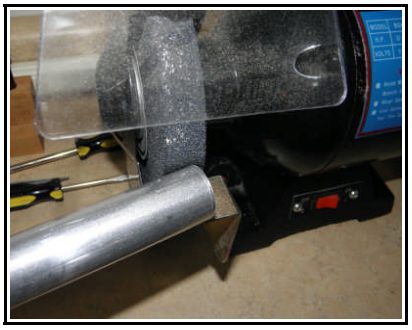
Back Side: The element-to-boom plate is attached to the supporting mast with two 1.5" saddle clamps which are designed to accommodate a mast with a diameter of ½ inch to 1¾ inch in diameter. The original design called for 1¼ inch saddle clamp – but second thoughts compel me to use a clamp that might be more flexible to accommodate a variety of mast diameters.

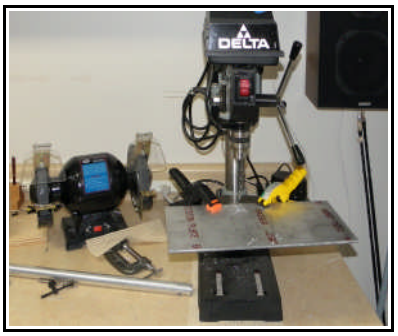
Dipole Elements: The horizontal elements are comprised aluminum tubing, starting with a 6-foot long 1.25 inch diameter tube, and then a 6-foot long 1.125 inch diameter tube, tubing, and then a 3-foot long 1.00 inch diameter tube. When assembled, the three tubes measure approximately 12 feet long with an approximately 1 foot overlap that provides sufficient variation in the overall length to facilitate tuning in the field. Just telescope or collapse the tubing to change the length and that easily adjusts the resonant length.

The design calls for two vertical elements hanging down from the ends of the horizontal elements, making the antenna an "inverted U" shape. The vertical elements are each 6 foot long .375" diameter aluminum tubes, which are attached by a unique method. A .375 inch hole is drilled approximately 1 inch from the end of the tube end. A two inch slit is cut along the tube, running each side of the hole, and the slits are pinched together with two stainless steel hose clamps. This arrangement pinches the vertical tube and holds it in place. A 2-inch long 6-32 stainless steel machine screws, which keeps the tube from falling through, providing an additional method of keeping it in place. The two slits were cut by hand with a standard hack saw. Ugly, but effective.

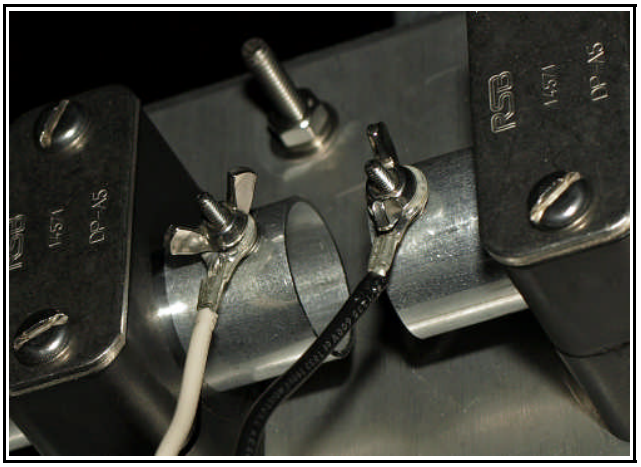


The ends of cut tubing were rounded off on a grinder to avoid injury-causing burrs, and all holes in the aluminum element-to-mast plate were all done on a moderately competent drill press.





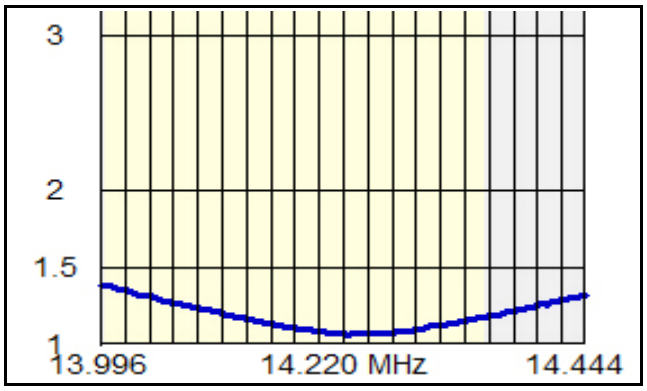
Two small holes are drilled approximately .5” inch from the “center” ends of each element to accommodate a small 6-32 x 2” machine screw that is secured with a nut. Outside of that is a wing nut to attach the lugs on the leads from the 1:1 line isolation choke/balun.



The to wires leading to the line isolation transformer/balun were trimmed. The ends were stripped and two closed-end lugs were crimped and soldered on the end of each lead wire. The balun is attached to the mast with a 2” diameter steel hose clamp. The coax cable will be attached to the mast with black plastic cable ties to provide a neat finish, and provide cable strain relief.

Initial Testing and SWR :

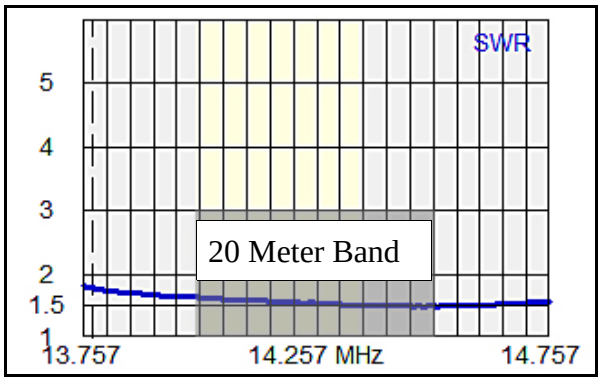
The completed rotatable dipole antenna was temporarily affixed to a galvanized push up steel mast and was tested and adjusted for best SWR using a MFJ-259B antenna analyzer, and a Rig Expert AA-230 antenna analyzer to fabulous results as shown by the following images.



FINAL INSTALLATION :

Finally, the antenna was affixed to a galvanized push up steel mast and secured to the rear deck and also braced against the rafters with a bracket I fashioned from three (3) large steel “L” brackets - attached using 2 inch lag bolts.

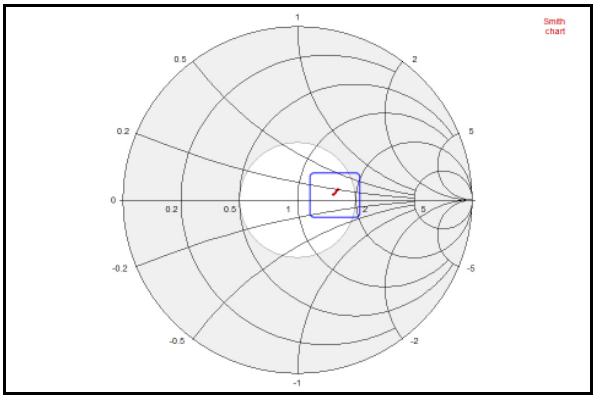
POST- INSTALLATION SWR TEST :



Installed 30 feet over ground, and as far above the roof as practicable, considering the strength of the push up mast, the antenna was tested for in-place SWR using a Rig Expert AA-230 antenna analyzer.

In-place **SWR** measured **1.4 : 1**.

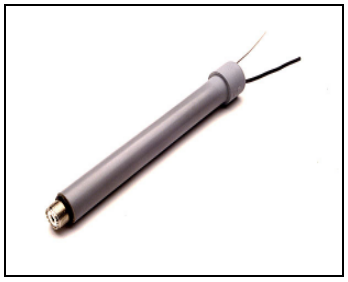
The Smith Chart is very difficult to read -- the only datamark is highlighted by the blue box.



It is assumed, without knowing, this rise in SWR is attributable to the antenna's proximity to the roof and the metal gutters surrounding it, and its proximity to a nearby 50 foot galvanized steel push-up mast which holds three other antennas, viz., a 2-meter vertical, a 40-10 Meter Off Center Fed (OCF) Dipole, and a 10-meter rotatable aluminum dipole.

Line Isolation / Choke Balun:

A line isolation balun isolates the antenna elements from the coaxial transmission line so that power is radiated by the dipole antenna elements and not by the feed line. This is a current-type balun. The dipole should have equal RF currents at the feed point. This type of transformer is often called a "common mode choke."



In this case I employed a Cal-AV EB-2 Line Isolation Choke – Balun, described and depicted blow.

Specifications and Reasonable Expectations Concerning the Efficacy of the Isolation / Choke Balun:

The EB-2 Line Isolation Balun is constructed of a length of Teflon coaxial cable surrounded by a number of ferrite beads. At one end of the cable is a SO-239 UHF coax connector which accepts a common PL-259 connector. At the other end are two wire leads to which I installed round lug connectors to facilitate connecting the balun to the antenna elements. The wire leads are color-coded for ease of phasing in multi-element arrays.) This balun is vacuum impregnated and sealed against the weather. The balun is enclosed in gray PVC pipe, which can be painted.

Note - This balun is not expected to improve SWR, as it is not part of a matching network. Also, this Balun is not expected to act as a lightning arrester, because the winding inductance is too low.

Some operators installing a line isolation transformer or at the transmitter end of a coaxial cable transmission line to avoid providing a ground path for RF current induced by the antenna's radiation field on the coaxial feed line. The length of the coax will be a factor in determining whether, and to what extent, RF might be induced on the feed line. A detailed discussion of this application is beyond the scope of this work.

This writer is not fully convinced this sort of line isolation transformer is as efficacious as some manufacturers and operators claim. On the other hand, he is fairly certain it won't have a deleterious effect on transmission or reception, and speculates its expected benefits are greater than its potential detriments, which are believed are de minimis. In other words, it *might* help, but *probably* won't hurt.

James / K8JHR