

Appendix: Is the Free-Space Dipole Standard A Fair Comparator?

The fairness or technical appropriateness of using free-space antenna models to determine the allowable power on 60 meters is divisible into two questions, one each for horizontal and vertical antennas.

Horizontally Polarized Antennas: The alternative to using the free-space comparisons set forth as initial guidelines involves comparing a dipole and some other proposed antenna at the same height over real ground. To do a preliminary test of the consequences of using this method, I modeled a #14 copper dipole at 20' intervals from 20' through 200', passing the 1-wavelength height of 183.229'. I then selected the 2-element Yagi for the same test, because it exhibits a large degree of difference between its TO angle and that of the dipole at lower heights. The results of the modeling exercise appear in **Table A-1**. The table has an additional column based upon an alternative premise. Since the TO angles vary so widely at low antenna heights, why not take the gain values at a reasonable but arbitrary elevation angle? 20 degrees seemed to match likely propagation angles. So the last two columns record the modeled and calculated results for that test.

The supplementary data in the table show averages of gain differential between the dipole and the Yagi both with the abnormal 20' results and without them. Regardless of which method one uses to average the results, the allowable power falls within 5 watts of the calculated value based on a free-space comparison of gain levels. As noted early on, 5 watts falls within the limits of accuracy of most power meters accessible to radio amateurs. Since a 5-watt variation represents only about 0.5-dB of antenna gain, the free-space comparison remains a valid method of setting power in order to remain within the 50-watt ERP requirement for 60 meters.

Vertically Polarized Antennas: The comparator for vertical monopoles in the main text is a 1/2-wavelength dipole of #14 copper wire with its base 5' above average ground. This antenna yielded a gain of 0.00 dBi at 17-degree elevation angle, a convenient value for other

comparisons. We need only to raise the question of whether one may fairly use a free-space comparison for vertically polarized antennas and arrays that require no radial system. Such antennas include all of the side-fed loops and the open-ended half square and bobtail curtain.

The most extreme case among this group of antennas is the half square. The free-space analysis of the half square yields a gain differential of 2.56 dB, with a resulting allowable power of 27.7 W. If we place the half-square about 5' above average ground, we obtain a maximum gain of 3.41 dBi at 20-degrees elevation. The calculated allowable power level is 22.8 W. The difference between the two analyses is within (but just barely) the 5-watt limit of recommended allowable rounding. Since gain variations for these antennas will track within close limits as we change soil quality and make minor changes in the height of either the dipole standard or the proposed vertically polarized antenna, further refinement of values is not warranted within the context of this exercise.

However, wherever you, as an individual operator, can develop more exact data about your own antenna, you should use it in lieu of the very general guidance provided by these notes.

Table A-1. Comparison of gain and calculated allowable 60-meter power based on horizontal dipoles and 2-element Yagis above average ground.

Dipole Height (feet)	Max. Gain (dBi)	TO Angle (degrees)	Gain @ 20 degrees (dBi)		
20	5.04	88	-2.40		
40	6.15	76	0.90		
60	6.04	43	3.19		
80	6.93	32	5.59		
100	7.92	25	7.49		
120	7.88	21	7.85		
140	7.30	18	7.21		
160	7.21	16	6.60		
180	7.68	14	6.02		
200	8.04	13	4.65		

2-Element Yagi Height (feet)	Max. Gain (dBi)	Delta Gain dipole (dB)	TO Angle (degrees)	Gain @ 20 degrees (dBi)	Delta Gain dipole (dB)
20	5.09	0.05	56	0.38	2.78
40	8.44	2.29	45	5.12	4.22
60	9.64	3.60	36	7.60	4.41
80	10.59	3.66	30	9.59	3.99
100	11.25	3.33	24	10.94	3.45
120	11.33	3.45	21	11.32	3.47
140	11.29	3.99	18	11.16	3.95
160	11.39	4.18	16	10.69	4.09
180	11.62	3.94	14	9.84	3.82
200	11.72	3.68	13	8.21	3.56

Average Gain differential					
Using 20' values		3.22 dB			3.77 dB
Allowable power		23.8 W			21.0 W

Average Gain differential					
Without 20' values		3.57 dB			3.88 dB
Allowable power		22.0 W			20.4 W

Free-space comparison gain differential:			4.03 dB		
Allowable power:			19.8 W		