Route 66
6-Meter 6-Element OWA Yagis in 9 Versions

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The low end of 6 meters has an appeal to many newcomers to the band and to amateur radio. In this region, communications is usually by way of CW or SSB with horizontally polarized beams operating point-to-point for everyday purposes and via skip during one of the band's many propagation phenomena. Unlike HF beams, Yagis for 6 meters have a reasonable size. One person can usually assembly, test, and install a 6-m beam with fewer worries about accidents or weather wreckage. As well, the smaller beam size reduces the cost of initial construction or repair. Although smaller than HF beams, 6-m Yagis are still large enough that the adjustments are less finicky than on 2-m or 70-cm versions. Hence, they make good projects for the less experienced builder.

Perhaps the one factor that inhibits home construction of 6-m beams is the builder's inability to obtain precisely the materials used in available designs in books and magazines. Although I would always recommend the use of 6063-T832 aluminum tubing (available from mail order sources such as Texas Towers and others), many first-time beam builders wish to obtain aluminum tubing from local hardware outlets. This tubing tends to have a slightly thinner wall thickness than 6063-T832. Hence, the fit from one size to the next is slightly looser than for the standard antenna material. However, it is otherwise serviceable and is durable for the light weight of 6-m beams. Given the ready availability of hardware outlet tubing, would-be builders want to translate published designs into their favorite local tubing size.

Of course, the process is fraught with dangers. Changes in element diameter create changes in the performance of any Yagi. With every change in the diameter of the elements, a Yagi requires redesign to re-optimize the performance. This requirement applies not only to the feedpoint impedance, but as well to the curves for gain and front-to-back ratio across a desired passband. There are some element-length adjustment programs available, but new builders usually are unaware of them.

So we have a quandary: how can we adjust the dimensions of a 6-m Yagi to suit local materials? The process is straightforward but daunting for the backyard builder. With a suitable antenna modeling program, we can adjust the element lengths and spacing to obtain the performance of an original design to match the proposed tubing size for the project. Since lack of building experience usually is matched by an equal lack of antenna modeling experience, we are no better off than when we started thinking about building a 6-m beam.

One Solution (of Many)

To ease the design process, I have taken a good design and performed the necessary redesign for a wide variety of tubing sizes. The basic design is a 6-element OWA Yagi, outlined in **Fig. 1**. The OWA design has some special features and limitations. The limitations apply to ideas one might have about modifying it.

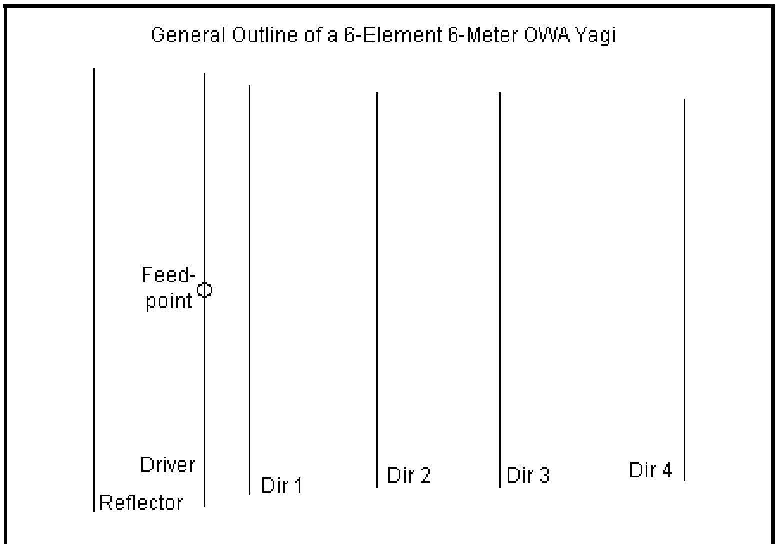


Fig. 1

The 6-element OWA has a little over 10 dBi forward gain in free space. (Add 5-6 dB further gain depending on the height over ground.) At the center of the passband the front-to-back ratio is well over 20 dB, regardless of whether we use the 180-degree front-to-back or the worst-case front-to-back figure. To avoid complex matching structures with many metallic junctions that increase their losses due to weathering, the feedpoint impedance is 50 Ohms. Finally, the design is broadband, that is, has a wide operating passband. This last quality is very useful to the new builder who likely lacks equipment to finely tune a narrowband beam. Hence, the design tends to assure successful replication, even allowing for all of the construction variables that arise as we move from one builder to the next.

The design depends on the use of the first director as a secondary (non-fed) driver to broaden the operating passband. The system also allows the designer to center the peak gain and the maximum front-to-back ratio close to the center of the operating passband. The simultaneous centering of these properties also depends upon the 2nd and 3rd directors. As a result, you cannot shorten the beam simply by removing a forward director. All 6 elements operate in concert to produce the performance curves. So these notes are relevant only if you need a 6-m beam with a boom length from about 12.5 to 13.5 feet.

All of the design specifications in the following tables apply to elements that are well insulated and well isolated from a conductive boom. At the beam size we are considering, an aluminum boom seems most appropriate. Non-conductive materials are either too heavy or sag too much for effective use. Therefore, you will have to consider obtaining suitable tubing for the boom and plate material on which to mount the elements. We shall look at element mounting in more detail toward the end of these notes. However, the aluminum boom should have a diameter of 1.25" to 1.5" with a wall thickness of about 1/8" You can create such a boom from normal (0.58" wall) stock by placing the next smaller size tubing inside the size you decide to use. Since tubing normally comes in sizes that are less than the required total boom length (adding a few inches to each end to hold the element mounting plates), you can use a staggered construction method. Suppose that you want a 14' boom. Cut outer 1/16" wall tubing lengths of 4', 6', and 4'. Cut inner sections of 6', 6', and 2'. After thorough cleaning to allow easy nesting of the two tubing sizes, mate them and secure with a few stainless steel sheet metal screws in places where the elements themselves will not go. (We do not want the sheet metal screws to interfere later with the element mounting plates or their hardware.)

6063-T832 aluminum tubing has a standard wall thickness of 0.058" or slightly under 1/16" (0.0625"). Hence, it nests well when clean, with a good tight fit. 6061-T6 tubing tends to use tolerances that are not quite a rigorous as the other material. If you have trouble nesting two tubes in the boom, warm one and cool the other. The hot summer sun and an air conditioning vent are usually sufficient to remove binding. In winter, place the inner tube in the outdoor chill and the outer tube over a heating vent to achieve the same effect.

While we are considering boom-tube nesting, let's note that most hardware store tubing has a wall thickness of 0.050". Hence, the nesting of successive sizes will be looser. Although that may ease the nesting process, it will also reduce the boom's strength.

You can use a single tube with a 1/8" wall thickness. However, there are some materials to avoid for both the elements and the boom. Do NOT use electrical conduit. The material has 2 drawbacks. First, it is soft and will bend easily. That property is desirable for its primary application in protecting electrical house wiring. However, for a Yagi boom, the softness can be a disaster. Second, the material is unnecessarily heavy for antenna applications. There is no need to stress a rotator assembly more than the amount needed to achieve a certain antenna strength.

As well, avoid 6061-T6 pipe. The same material used to make some tubes is more readily available as fence or railing material. However, in this application, the material meets piping standards of measurement. A specified diameter is the nominal (or minimum) inside diameter, with the wall thickness added to arrive at an outside diameter. In most cases, the wall thickness is greater than 1/8", adding unnecessary weight to the beam.

Uniform-Diameter Element Designs

One typical request that I receive contains the builder's intention to use a single tubing diameter for all of the elements. The longest element in a 6-meter OWA Yagi is under 10' total. We can link 2 5' tubing sections at the center by adding a short section of the next smaller size tubing inside the junction. Thus we preserve continuity and maintain a uniform element diameter. We shall tackle the feedpoint questions later on.

We shall look at tables of element lengths and spacings for uniform-diameter elements ranging from 3/8" to 1" in diameter. The tables will list the spacing values from the center of the rear element forward to the current element in the list. In fact, all spacing values are element-center to element-center. However, between element length and element spacing, spacing is the less critical. A spacing change of 1/4" will make no detectable difference to performance, but element lengths should end up as close as feasible to the listed value.

Element lengths appear in 2 forms for convenience. The half-length listing counts from the boom centerline outward to the element tip. The full-length listing goes from one element tip to the other. This method of measurement includes the driver. Since you will need to create a small gap in the driver for connecting the coax center conductor and braid, remove the material from the center without changing the tip-to-tip measurement. In effect, the true gap of an antenna is the spacing between the 2 conductors of the feedline. If you make a wider gap, then the leads from the coax or the coax fitting become part of the element. You will noeed only a quarter to a half inch gap in the tubing at the center.

Each table is actually 2 tables, one for dimensions and one for modeled performance. The design frequency for each beam is 51 MHz. Most horizontal Yagi activity on 6 meters occurs at the low end of the band. Many hams center the activity at about 50.1 MHz, while other cover the entire first MHz by centering the passband at 50.5 MHz. The beams in this collection will perform very well at 50 MHz. That is one reason for using a broadband design. However, you can scale the designs to a lower frequency by multiply the dimensions in the table by a proper amount. To center the passband at 50.5 MHz, multiple all element lengths and element-spacing values by 1.01. If you wish the performance peak to occur at about 50.1 MHz, multiply all length and spacing values by 1.018. In all scaling activities, we normally also use the multiplier on the element diameter. However, the 1% to 1.8% deficit in ideal tubing diameter will not affect performance in any way that you will be able to detect. As well, they fall within the range of normal construction variables, so you would not be able to tell the difference between a scaling error and some other kind of small variation during construction.

In fact, the designs are not optimized to the absolute limit. Rather, they are optimized to achieve the same performance curves and patterns, regardless of the element diameter--within the range shown in the tables. **Fig. 2** shows the free-space azimuth patterns for 50, 51, and 52 MHz. Note the transition of the rear lobes across the operating passband. Although the patterns are for the 5/8" diameter element version of the beam, all of the versions show the same evolution of the rear lobes and the same clean forward lobe with no sidelobes. Sidelobes begin to emerge as an antenna grows to a boomlength of 1 wavelength or more. They also appear at the highest operating frequency of some shorter boomlengths if we press a narrow-band design into wider operation.

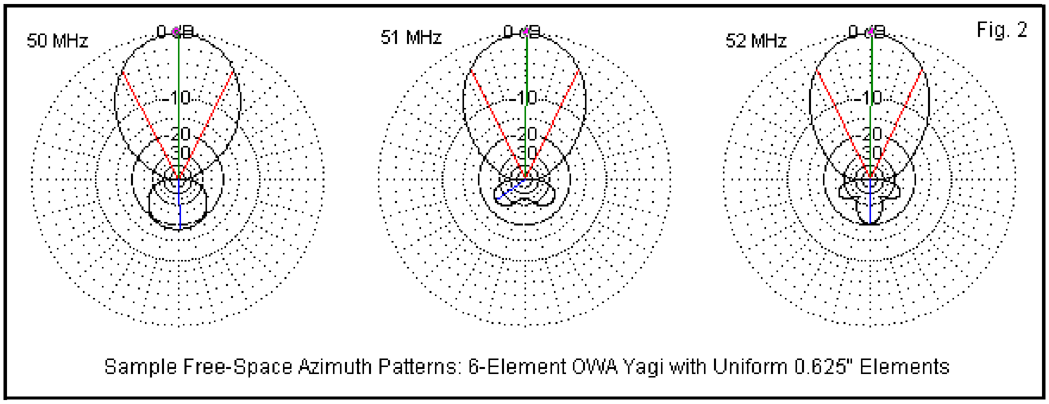
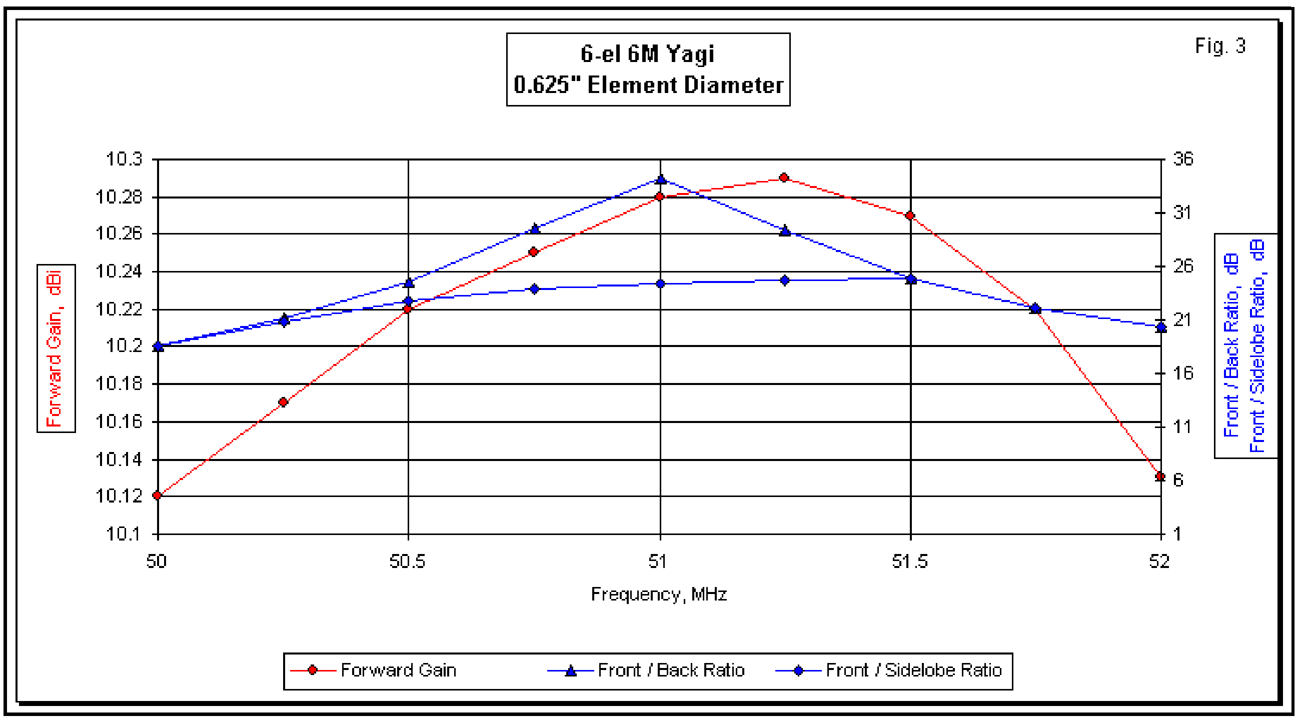
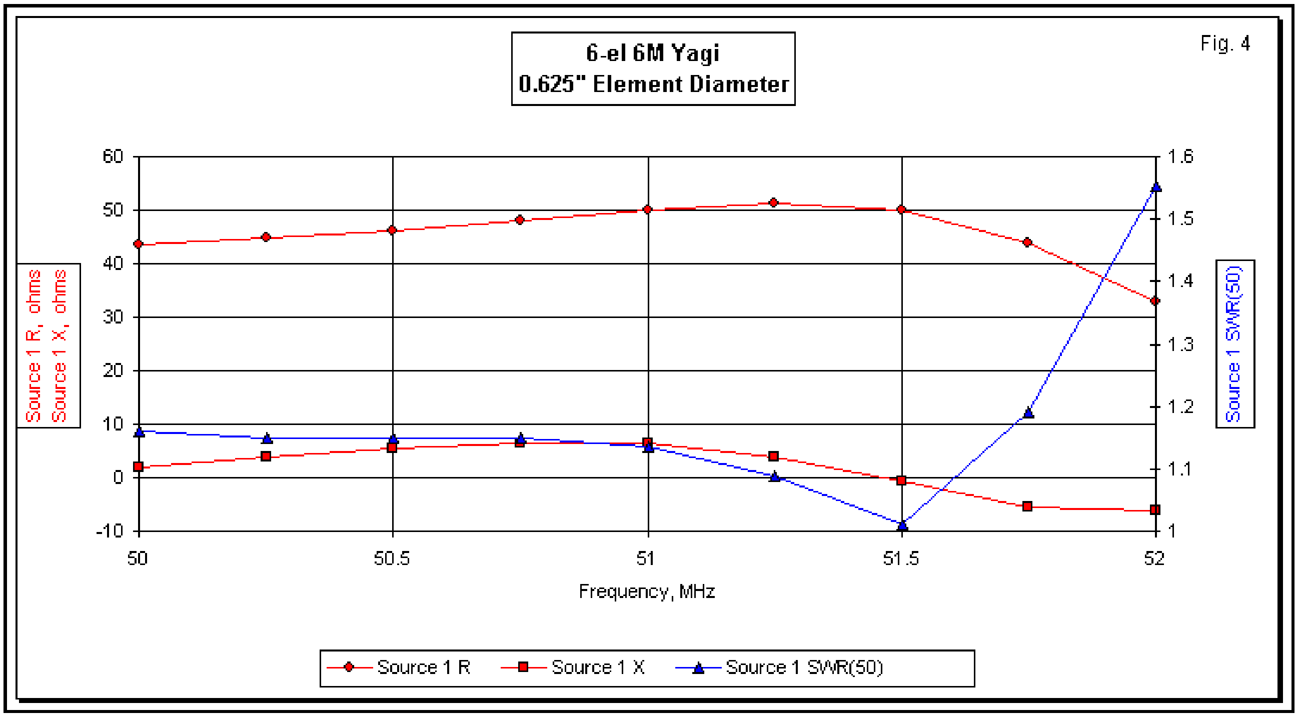


Fig. 3 gives us a broader picture of the forward gain and front-to-back ratio behavior of the antenna, again using the 5/8" element version as a sample of what is true for all of the versions. The forward gain curve looks steep, but notice the very small increment in the left-hand Y-axis scale. In fact, the maximum difference in gain across the 2-MHz passband is only 0.17 dB, an amount you could not detect in any kind of operation. Notice also that the peak value is within 0.25-MHz of the design center. That position is part of the reason for the very small change in gain across the passband. Other types of Yagi designs tend to show a rising gain curve across the entire passband, resulting in a much large total gain change from maximum to minimum.



There are two blue curves, one labeled front-to-back ratio and one labeled front-to-side ratio. The front-to-back ratio curve is for the 180-degree front-to-back ratio. Since the forward lobe has no side lobes, the front-to-sidelobe ratio in EZNEC actually records the worst-case front-to-back ratio. In **Fig. 2**, notice the angled line in the rear lobe for 51 MHz. That is the program's way of recording the strongest lobe other than the main forward lobe--which for our beams is the worst-case front-to-back ratio. As you might expect, the ratio is lower than the 180-degree value. At the passband center, the value is still well above 20 dB. At the band edges, the two ratios are virtually the same, given the shape of the rear lobe(s). Note that there is a 0.25-MHz offset between peak gain performance and peak front-to-back performance. Both curves are well centered, but do not expect absolute perfection from a mere mortal designer.

Fig. 4 provides a view across the entire passband of the feedpoint resistance and reactance, as well as the 50-Ohm SWR. These curves are typical for any OWA design. Because we are pressing the limits of the design, the SWR at the high end of the passband reflects the rapid decrease in feedpoint resistance. Below about 51.5 MHz, SWR values range from 1.1:1 to 1.3:1. Because the resistance drops rapidly above the final crossing of the 50-Ohm mark, we tend to design OWA Yagis for peak gain and front-to-back performance at a lower frequency, as shown in **Fig. 3**. Although the curves shown apply to the 5/8" diameter version of the beam, the curves for every size element are remarkably similar.



The dimension table (**Table 1**) below provides the dimensions, with the guidelines for understanding them in accord with the notes near the beginning of the article. One facet of the dimensions not given earlier applies only to a few readers who may not be used to working with dimensions given as decimal inches. In the U.S., we typically work with rulers providing inch subdivisions in 16ths. Therefore, the following brief table provides a convenient conversion for moving the dimensions from the tables to your rulers. The differences will not make a difference to antenna performance.

Conversion of Decimal Inch Subdivisions to the Nearest 16th Inch

10th	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
16th	**2**	**3**	**5**	**7**	**8**	**9**	**11**	**13**	**14**
	(1/8)				**(1/2)**				**(7/8)**

6-Meter OWA 6-Element Designs			
Dimensions			
Uniform: 0.375"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	58.25	116.5
Driver	29	57.5	115
Dir 1	41	53.75	107.5
Dir 2	74.2	52.25	104.5
Dir 3	106.7	52.25	104.5
Dir 4	155.2	50.25	100.5
Uniform: 0.5"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	58	116
Driver	30	57.5	115
Dir 1	42	53.5	107
Dir 2	75.2	52	104
Dir 3	107.7	52	104
Dir 4	156.2	50	100
Uniform: 0.625"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	57.8	115.6
Driver	31	56.9	113.8
Dir 1	43	53.25	106.5
Dir 2	76.2	51.75	103.5
Dir 3	108.7	51.75	103.5
Dir 4	157.2	49.75	99.5
Uniform: 0.75"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	57.5	115
Driver	32	56.6	113.2
Dir 1	44	53	106
Dir 2	77.2	51.5	103
Dir 3	104.7	51.5	103
Dir 4	158.2	49.5	99
Uniform: 0.875"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	57.3	114.6
Driver	33	56.3	112.6
Dir 1	45	52.75	105.5
Dir 2	78.2	51.25	102.5
Dir 3	110.7	51.25	102.5
Dir 4	159.2	49.25	98.5
Uniform: 1.0"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	57.1	114.2
Driver	34	56	112
Dir 1	46	52.5	105
Dir 2	79.2	51	102
Dir 3	111.7	51	102
Dir 4	160.2	49	98
Notes:			
Spacing = distance from reflector in inches			
1/2-Length = element half-length from tip to			
	boom centerline		
Full Length = element length from tip to tip			
Table 1			

6-Meter OWA 6-Element Designs			
Performance			
Uniform: 0.375"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.02	10.19	10.08
F-B dB	18.34	33.08	21.49
Feed R	46.04	50.62	32.83
Feed X	7.59	11.64	3.59
SWR-50	1.2	1.26	1.537
Uniform: 0.5"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.08	10.24	10.1
F-B dB	18.37	34.01	20.87
Feed R	44.52	50.32	32.57
Feed X	4.68	8.84	-1.68
SWR-50	1.165	1.193	1.538
Uniform: 0.625"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.12	10.28	10.13
F-B dB	18.53	34.2	20.41
Feed R	43.41	50.1	33.03
Feed X	2.04	6.35	-6.1
SWR-50	1.159	1.135	1.553
Uniform: 0.75"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.14	10.31	10.17
F-B dB	18.16	33.7	20.25
Feed R	42.19	49.75	34.28
Feed X	-0.09	4.48	-9.86
SWR-50	1.185	1.094	1.56
Uniform: 0.875"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.17	10.34	10.2
F-B dB	18.32	33.57	20.2
Feed R	39.26	47.21	34.9
Feed X	-0.52	5.39	-8.97
SWR-50	1.274	1.133	1.518
Uniform: 1.0"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.18	10.36	10.24
F-B dB	18.14	32.65	20
Feed R	40.58	48.74	38.07
Feed X	-4.45	0.91	-15.71
SWR-50	1.26	1.032	1.566
Notes:			
Gain = maximum forward gain in dBi			
F-B = 180-deg. front-to-back ratio in dB			
Feed R = feedpoint resistance in Ohms			
Feed X = feedpoint reactance in Ohms			
SWR-50 = 50-Ohm SWR			Table 2

The dimension table provides 6 different 6-element OWA Yagi designs centered on 51 MHz. **Table 2** provides spot modeled performance values for each design. Note that in each case, the increasing element diameter results in a numerically noticeable but operationally insignificant improvement of gain at the design center. As well, each design centers the peak gain and peak 180-degree front-to-back ratio close to the design center. With increasing element diameter we also find that the total gain change across the band goes down. However, the band-edge front-to-back ratio tends to remain constant or dwindle just slightly. This phenomenon occurs because the element spacing remains fairly constant from the driver forward. As I noted earlier, the optimizing process ceased when each version of the Yagi with uniform-diameter elements achieved the desired set of curves.

The SWR curves change shape slightly as the element diameter increases. The key factor in this process was keeping a relatively constant 50-Ohm SWR value at the upper edge of the passband. Since the beams become slightly more broadbanded with increasing element diameter, this factor brought the 51-MHz impedance values slightly closer to the last crossing of the resistance curve with 50 Ohms. As well, the driver and director 1 (the secondary unfed driver) do not change their relative lengths. Hence, the increasing spacing of the reflector can only go so far in yielding an ideal OWA SWR curve over the 4% passband. Nevertheless, for a large region on either side of the design frequency (51 MHz), the curves and numbers indicate excellent 50-Ohm performance.

Stepped Diameter Element Versions of the 6-Element OWA Yagi

For a variety of reasons--ranging from available materials to increased wind ratings--some builders prefer to use stepped diameter elements. Therefore, I created 3 variations on this theme. For each element, there is a 24" inner half element (full inner length = 48"). The remainder of the element, often called the "tip section," uses the remaining length of the half-lengths listed in **Table 5** plus 2" for overlap (insertion into the inner section). **Fig. 5** shows the general scheme for each element.

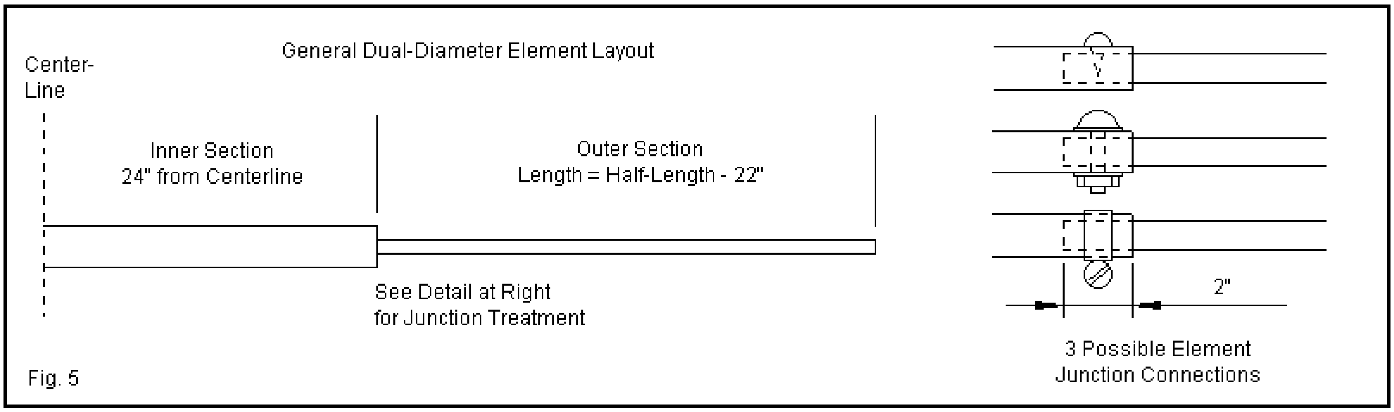
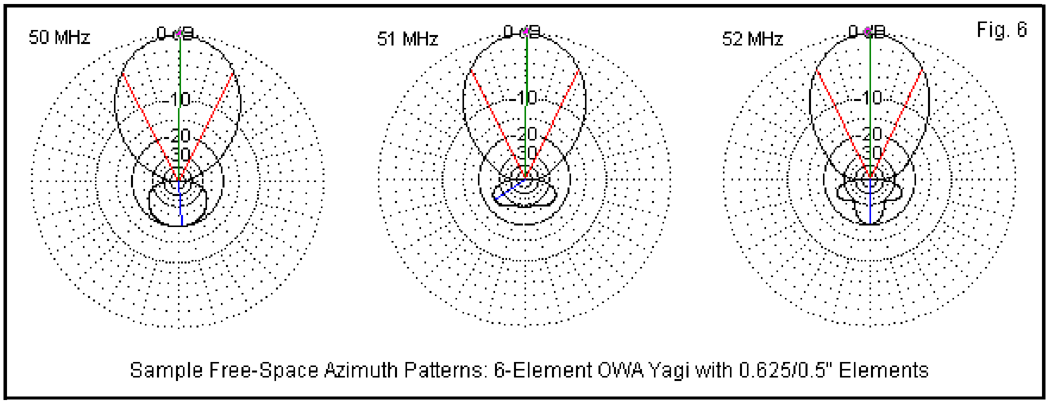


Fig. 5

The right side of the sketch shows 3 methods of pinning the element sections together. For most purposes, a pair of stainless steel sheet metal screws about 1/2" inward from the end of the inner tube and 1/2" from the limit of the inserted tip tube will provide a satisfactory junction with durable continuity. When constructing elements in this fashion, clean the mating surfaces well, but without materials that might inhibit electrical continuity. If you uses a scrubbing pad, you will have less chance of bi-metallic corrosion that might result from doing the same job with steel wool. Parasitic elements will use a continuous 48" section of inner tubing. We shall address the split driver and its gap in more detail in the final notes on construction.

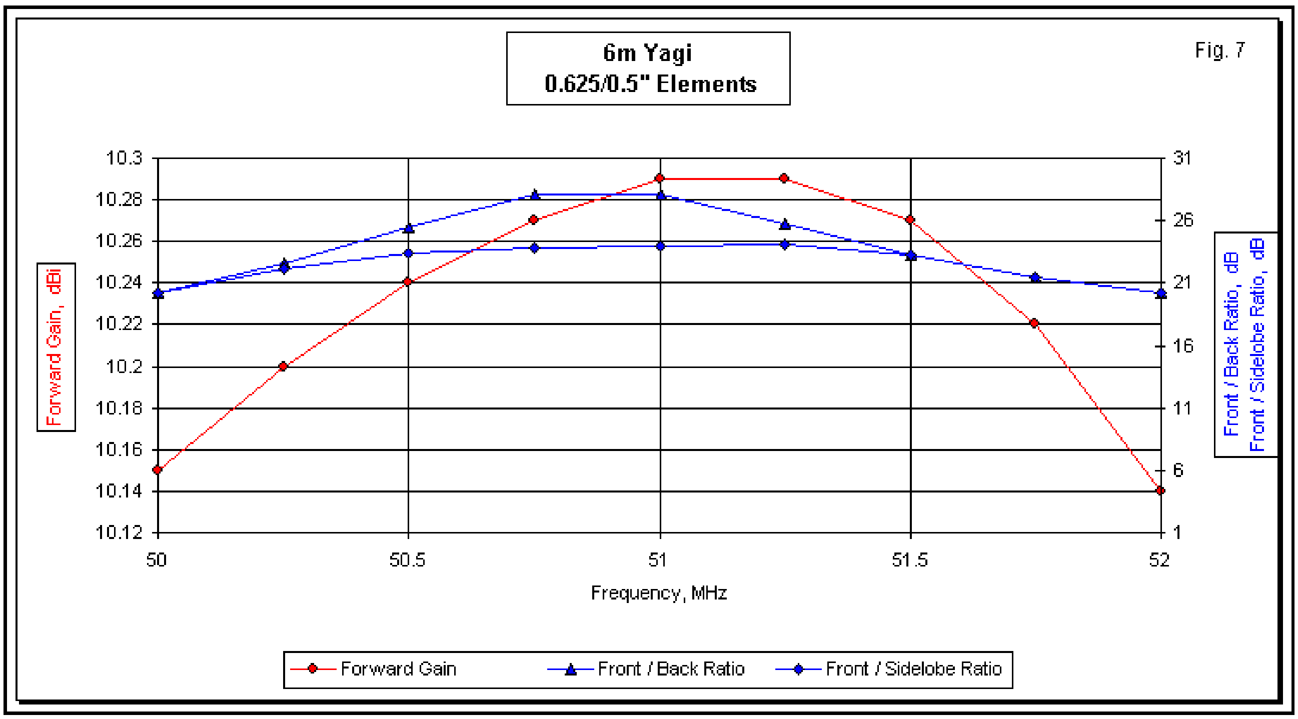
The tables will consider beams using the following combinations of tubing diameters: 1/2" inner with 3/8" tips, 5/8" inner with 1/2" tips, and 3/4" inner with 5/8" tips. Even minor cases of diameter stepping result in physically longer elements for the same performance as uniform-diameter elements. Therefore, using the reflector as an example, the fattest stepped diameter element requires a longer physical length than the thinnest uniform-diameter reflector. Diameter stepping also results in slight changes in the element interactions. Hence, the curves for the stepped-diameter versions of the 6-element OWA Yagis will show some subtle differences relative to those for the uniform-diameter versions.

To sample the performance of the stepped-diameter Yagis, I used the mid-sized model with 5/8" inner sections and half-inch outer or tip sections. **Fig. 6** provides 3 free-space azimuth patterns. In general, the 50- and 52-MHz patterns are virtually identical to those for the uniform-diameter models, but the 51-MHz design shows slightly less 180-degree front-to-back ratio. Because the front-to-back ratio at 52 MHz holds up better in this wide passband, I was able to slide the gain and front-to-back curves downward to achieve a 20-dB front-to-back ratio at 50 MHz. This move lowered the frequencies of both the peak gain and the peak front-to-back performance levels slightly. Hence, the deep (>30 dB) front-to-back ratio occurs slightly below the design frequency.

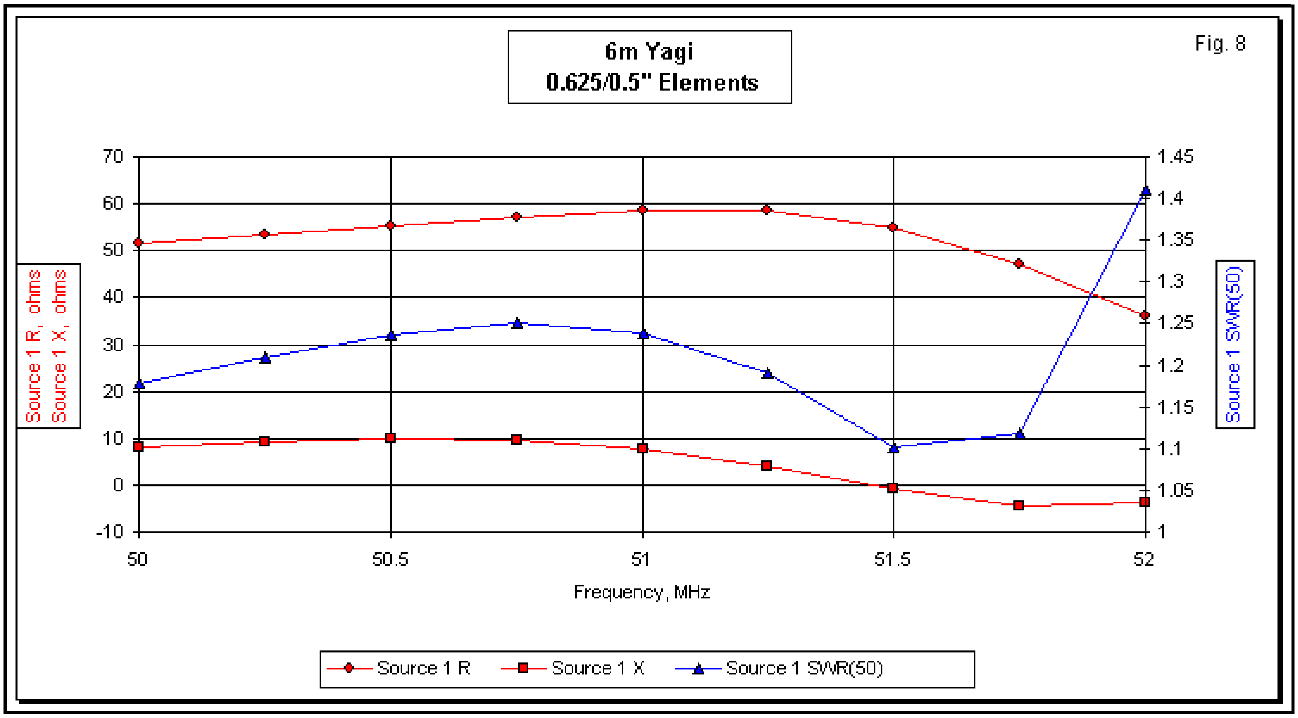


Sample Free-Space Azimuth Patterns: 6-Element OWA Yagi with 0.625/0.5" Elements

Fig. 7 shows the gain and front-to-back curves for the same sample beam. You may compare the curves to those in **Fig. 3** to see the slight differences from the uniform-diameter models. Despite the slight movement in the curves downward in frequency, the total gain change across the band is comparable to the change for the uniform-diameter versions of the Yagi. The overall 180-degree front-to-back curve is slightly flatter than the corresponding uniform-diameter element curves, but the band edges show slightly superior performance (although nothing that you could measure from on-the-air performance).



To obtain the very good OWA-type performance curves for gain and front-to-back ratio, the SWR curves suffer slightly. The values for 50 and 51 MHz shows a decrease in 50-Ohm SWR as we increase the element diameters. However, the value for 52 MHz show increases with larger elements. However, the highest value modeled is comparable to the highest value modeled for the uniform-diameter elements. See **Fig. 8**.



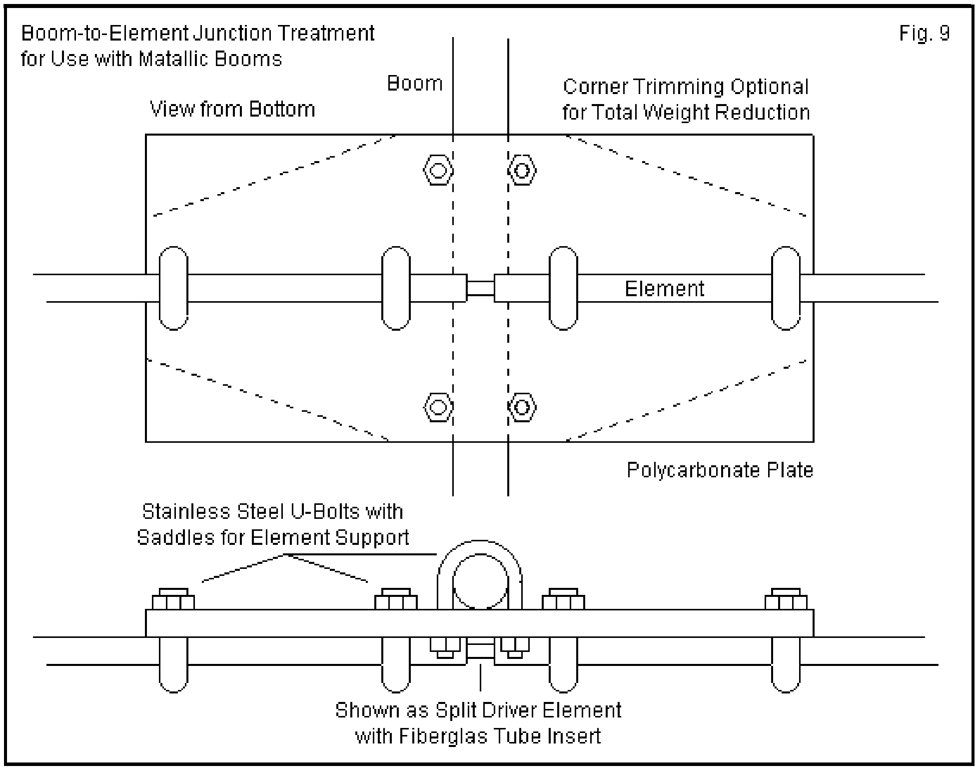
To scale the designs down to 50.5 or to 50.1 MHz, use the same factors applied to the uniform-diameter elements (1.01 and 1.018, respectively). Apply these only to the tip sections, leaving the inner sections at 24" for a half length (or 48" for a full length). In fact, a 1%-2% change in the length of the inner sections will make no noticeable difference to beam performance. Remember to scale the element spacing as well as the element lengths.

6-Meter OWA 6-Element Designs			
Dimensions			
Inner: 0.5"; Outer 0.375"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	59.5	119
Driver	29.6	58.6	117.2
Dir 1	41.8	54.4	108.8
Dir 2	75.7	53	106
Dir 3	108.8	53	106
Dir 4	158.1	50.7	101.4
Inner: 0.625"; Outer 0.5"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	59.1	118.2
Driver	30.6	58.2	116.4
Dir 1	42.8	54	108
Dir 2	76.7	52.6	105.2
Dir 3	109.8	52.6	105.2
Dir 4	159	50.25	100.5
Inner: 0.75"; Outer 0.625"			
Element	Spacing	1/2-Length	Full Length
Reflector	0	58.8	117.6
Driver	30.6	57.9	115.8
Dir 1	42.8	53.75	107.5
Dir 2	76.7	52.3	104.6
Dir 3	109.8	52.3	104.6
Dir 4	159	49.9	99.8
Notes:			
Spacing = distance from reflector in inches			
1/2-Length = element half-length from tip to			
	boom centerline		
Full Length = element length from tip to tip			
Inner section half-length = 24"; full length =			
	48" for all element sizes		
Outer element tubing length = 1/2-length -			
	22" for 2" overlap (insertion)		
Table 3			

6-Meter OWA 6-Element Designs			
Performance			
Inner: 0.5"; Outer 0.375"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.11	10.26	10.13
F-B dB	20.13	27.87	20.24
Feed R	52.56	59.75	37.53
Feed X	10.57	10.72	-1.36
SWR-50	1.236	1.303	1.334
Inner: 0.625"; Outer 0.5"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.15	10.29	10.14
F-B dB	20.15	28.12	20.26
Feed R	51.43	58.55	35.9
Feed X	8.22	7.83	-3.917
SWR-50	1.179	1.239	1.41
Inner: 0.75"; Outer 0.625"			
Parameter	50 MHz	51 MHz	52 MHz
Gain dBi	10.18	10.31	10.12
F-B dB	20.23	28.38	20.4
Feed R	49.82	56.73	32.21
Feed X	6.57	4.94	-5.01
SWR-50	1.141	1.169	1.578
Notes:			
Gain = maximum forward gain in dBi			
F-B = 180-deg. front-to-back ratio in dB			
Feed R = feedpoint resistance in Ohms			
Feed X = feedpoint reactance in Ohms			
SWR-50 = 50-Ohm SWR			Table 4

Table 3 and **Table 4** present the data on dimensions and on spot performance for the 3 stepped-diameter versions of the 6-element OWA Yagi. The dimensions confirm the relationship of stepped diameter element lengths to uniform-diameter versions. As well, the element spacing differs slightly, but grows at the same rate as for the uniform-diameter Yagis in this collection. The performance tables show the same general characteristics as their uniform-diameter counterparts.

Along the way, we have covered aspects of beam construction, including the best materials, boom construction, and stepped-diameter element construction. We should add one more element to the notes, even though there may be almost as many construction methods as there are builders. I have strongly recommended that you insulate and isolate the elements from the boom. Direct connection has 2 major problems, even for parasitic elements. First, the boom represents a major swelling in the element diameter at that point, one that modeling cannot show. Therefore, directly connected elements must be refigured--as best possible--relative to the insulated/isolated elements shown in the designs. Second, directly connected elements tend to weather at the junction of boom and elements, ultimately resulting in increased noise on reception. Since most of the elements and element combinations in this exercise are too large for insulated through-boom construction, the use of a mounting plate for each elements is perhaps the best method for construction. **Fig. 9** shows one good way to implement the scheme.



The heart of the mounting system is a polycarbonate plate at least 1/4" thick. I have omitted exact length and width dimensions, since they will vary with the element size. To save a bit of weight, you may trim the plate corners. Each plate requires U-bolt holes for the boom fasteners. Although the sketch shows 4 U-bolts holding the element in place, 2 will normally do the job toward the long ends of the plate. The stainless steel U-bolts should all have saddles to reduce the chances of boom or element crushing and to increase the surface area in contact with the boom or the element.

The version of the mounting system shown in the sketch applies to the split driver. Leave (trim) a gap (without changing the required tip-to-tip length) and insert a section of non-conducting material. The material may be a polycarbonate, Fiberglas, or PVC rod or tube. The insert does several jobs. It keeps the gap in place, especially when we add stainless steel through-bolts for connections from the coax cable or the connector. The insert also aligns the element so that a single pair of stainless steel element-fixing U-bolts will provide the required mounting. Finally, if we make the insert as long as the plate, it aids us in preventing element crushing.

For uniform-diameter parasitic elements, simply bring the tubing ends together with a short section of the next smaller tubing diameter to form the insert and electrical link. Fasten the exposed tubing to the link insert with stainless steel sheet metal screws. If you use a continuous section of tubing--as you well might for the inner sections of stepped diameter elements--simply use great care not to crush the element under the stainless steel U-bolts.

Did I mention that all metal hardware should be nothing less than stainless steel? Not only does it prevent corrosion, it also is largely immune to bi-metallic contact electrolysis.

Well, there you have it: 9 versions of a 6-element OWA Yagi for 6 meters. Among the collection may be a design that you can build. However, if you want more or fewer elements, you are on your own. If you want a significantly different stepping schedule for the eleet diameters, you are also on your own. Even in these cases, the kinds of changes that occur from one element size to another might serve as resonable starting guides to your own efforts to use modeling software to create a custom design for your needs and your materials. Besides getting you on the air with a usable 6-meter beam of fairly considerable size, these notes have also tried to show by example some of what you can accomplish by designing antennas with a suitable modeling package.

Addendum

Since writing these notes, I have had several reports of successful construction, each one a bit different from all the others, embodying the special skills and preferences of the builder. Lenny Wintfeld, W2BVH, sent me some photos of his version. **Fig. 10** shows the element-to-boom plate used while in the construction process.

Fig. 11 gives you a good idea of the antenna size during the mounting process. The installers and the long boom 2-meter antenna provide a good perspective on the antenna.

Your own 66 beam may differ in detail, but since this is not a commercial beam that you just assemble from supplied parts, you should be suitably proud of your own craftsmanship.