No. 36: 4- and 5-Element OWA Yagis

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The OWA (Optimized Wide-band Antenna) design for Yagis means different things to different designers. For some, it means simply a low SWR across a passband (like 28-29 MHz), regardless of the impedance. To others, it means a low 50-Ohm SWR across the passband. Since many 10-meter users are more comfortable with a direct coax feed (with a choke balun for protection from common-mode currents down the line), let's take the latter approach.

Last time, we looked at a 6-element 24' OWA using fairly thin elements. This time, let's look at some shorter designs using elements with larger diameters. In fact, in this episode and the next, we shall look at a total of 4 OWA design ranging from 13' to 36' long, all with the same element structure.

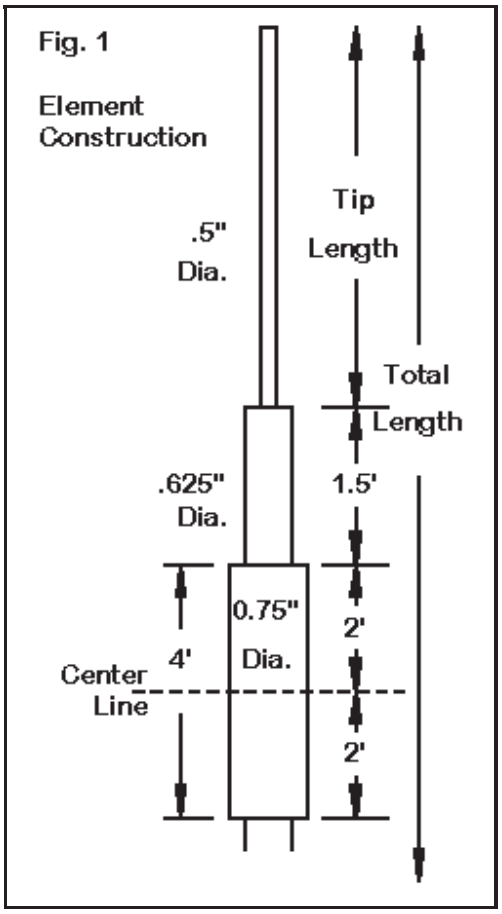


Fig. 1 shows the element structure that all of the beam designs will use. The 4' center section is 3/5" tubing, with a short 1.5' (plus 3" for overlap) section of 5/8" tubing following. The "tips" are 1/2" tubing. All this can be obtained from sources that advertise in QST or CQ. In the element length

tables, be sure to add 3" to the 1/2" tubing for overlap.

For higher wind loads, you can let the 5/8" tubing go all the way through the 3/4" element. For lesser winds, the 3" overlap will do well.

Of course, the driven element must be open at the center for the feedline connection. You can use a fiberglass tube or rod across the gap to keep the element aligned and to strengthen it.

A 4-Element OWA

OWA design requires one additional element to achieve the 50-Ohm feedpoint impedance compared to beams with feedpoint impedances in the 25-Ohm range. Shorter OWAs must also be a bit longer than their 3-element low-Z counterparts for the same performance. While a 3-element Yagi with about 8 dBi free space gain needs a 12' boom, our OWA will need a 13.5' boom.

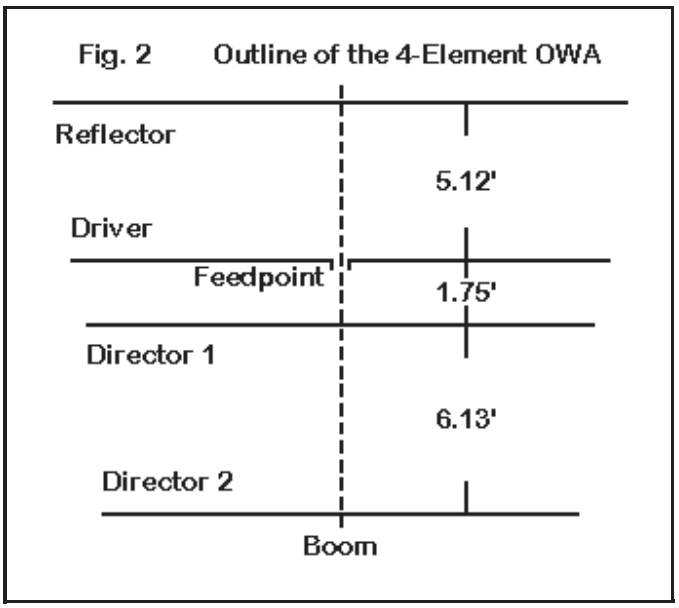


Fig. 2 provides the outline of the 4-element version, with the spacing between elements shown. The following table lists the element spacing from the reflector, the tip length, and the total element length from tip-to-tip for reference, all in feet.

Element	Space from Reflector	Tip Length	Total Length
Reflector	0	5.34'	17.68'
Driver	5.12'	5.10'	17.20'
Director 1	6.87'	4.57'	16.14'
Director 2	13.00'	4.10'	15.20'

The elements are designed to be insulated from the boom. If you change materials or element structures, an entire redesign will be needed. Do not be casual in your construction of Yagi designs you find in handbooks. They simply will not perform up to the original design if you alter the element diameters or the tapering schedule.

The 4-element OWA provides an average gain of over 8 dBi (free-space). The front-to-back ratio is above 20 dB across the 28-29 MHz span. The 50-Ohm SWR is exceptionally low. Hence, the beam is a fit candidate for reproduction in the home workshop.

A 5-Element OWA

If we add about 6' to the boom and one more element (respacing all of the others), we can add about 1 dB to the overall gain of the OWA Yagi. A 19' boom will hold the elements, which use the same construction as the 4-element version.

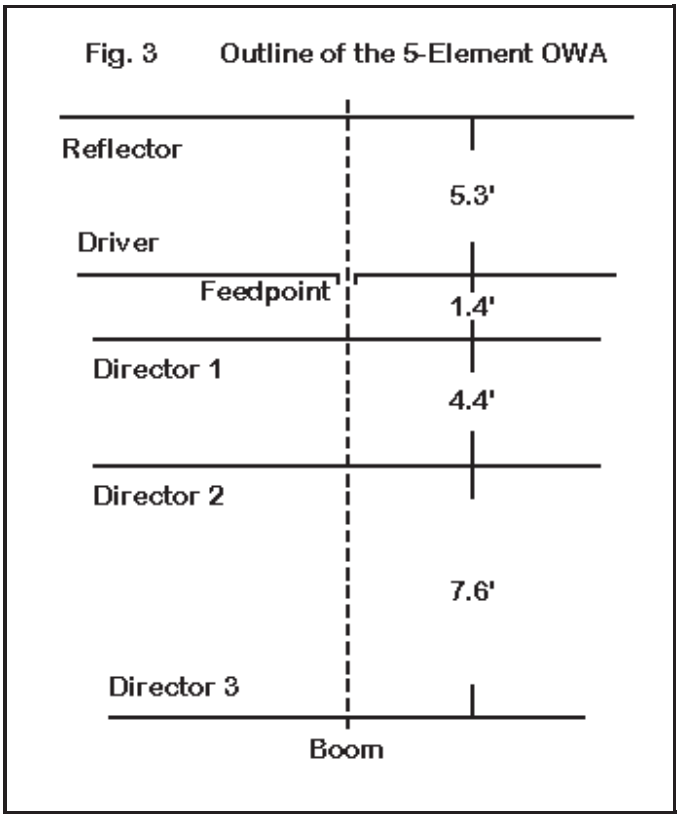


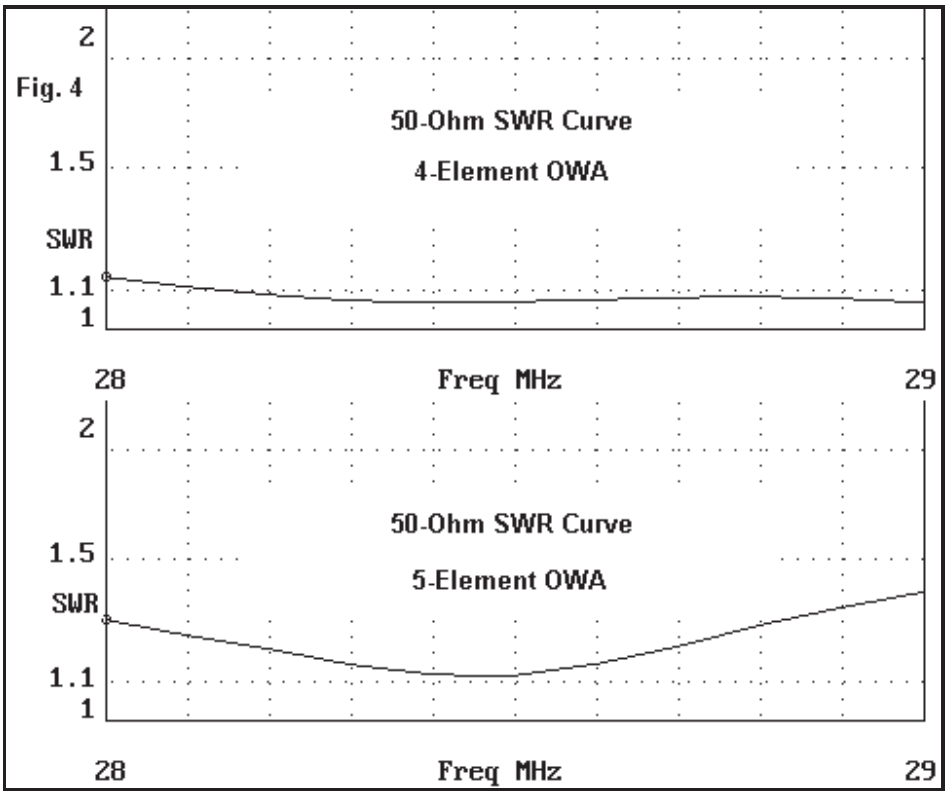
Fig. 3 gives us the outline of the 5-element OWA, as well as the inter-element spacing. The following table provides the structural details.

Element	Space from Reflector	Tip Length	Total Length
Reflector	0	5.52'	18.04'
Driver	5.30'	5.16'	17.32'
Director 1	6.70'	4.70'	16.40'
Director 2	11.10'	4.65'	15.30'
Director 3	18.70'	4.13'	15.26'

For the extra element and boom length, we get a gain that ranges from 9.1 to 9.4 dBi (free space) across the 28-29 MHz span. The front-to-back ratio is close to or above 20 dB over that same frequency range. The SWR is quite smooth across this range.

Once more, the design is for elements insulated from the boom. There are many systems for mounting elements to the boom. I tend to prefer 6" by 12" plates of polycarbonate (a generic name for the material sold as Lexan), which has good sun (UV) resistance, good RF properties, and is very strong. 1/4" thick material works well at 10 meters. It is much more durable and maintenance-free than plywood (which needs periodic varnishing) or more common acrylics (which become brittle after a season or two in the weather). I also use stainless steel hardware throughout, including U-bolts with saddles for the elements and the boom. Other systems also work well, but

this one satisfies my experimental needs, meaning that antennas are always being reconstructed into new configurations.



For reference, **Fig. 4** shows the SWR curves for the two antennas from 28 to 29 MHz. These are for direct connection, using only a 1:1 choke or balun to move from the balanced feed element to the unbalanced coax cable. You can purchase a balun, make your own choke from coiled coax, or obtain a choke that uses ferrite beads.

Be sure to weather seal all connections. For coax connectors, a wrapping of 3-M #33 electrical tape starts the job, followed by one of the black butylate sealants. Some folks like to cover the butylate with one more #33 tape coating. Do not stint on weather protecting connections, since water leakage into the feedline can ruin the performance of an otherwise great antenna system.

In a future column, we shall go over some of the good practices to follow in building your own antenna. However, we must first finish our designs for 3/4-5/8-1/2" elements. Next time, we shall look at 6 and 7 element versions of the OWA, both with a flat 50-Ohm Feedpoint impedance, and with an extra dB or so every time we add an elements.