Antenna Workshop

David Butler G4ASR, a very keen v.h.f. operator and VHF DXer columnist, describes five antennas for the very much under used 70MHz band.

This time around I'll describe a set of five antennas for the 70MHz band ranging in size from a diminutive two element beam on a 560mm boom, to a much larger six element Yagi with a boom length of 3915mm. So, if you're interested in DXing with c.w. or s.s.b., chatting to locals on a.m. or f.m. or playing with digital modes there may be a 70MHz antenna here to suit your requirements.

The mechanical construction of a Yagi array depends largely on the weather conditions you are likely to experience in use. For portable use in the summer a lightweight form of construction can be used.

However building a Yagi to survive several years of winters in exposed locations is quite another matter. The Yagis described here all use 25.4mm (1in) square booms and 12.7mm (0.5in) diameter elements. These construction materials should be adequate for most purposes.

I've found the materials used are light enough for portable use but they will also stand up to the rigours of winter in most of the UK. Indeed I constructed the six element Yagi shown in the photograph **Fig. 1** over six years ago.

When I checked the antenna after six years, apart from some superficial discolouring (which was easily cleaned off) the antenna had stood up remarkably well. My location, located some 230m above sea level (a.s.l.) near the Black Mountains on the Welsh border, is often subject to gale force winds during winter.

Same Materials

The Yagi designs described and shown here, all use the same materials and method of construction. The **only difference** between each model is the element lengths and element spacing. With each of these designs the element spacing remains constant and the elements reduce in length from back to front.

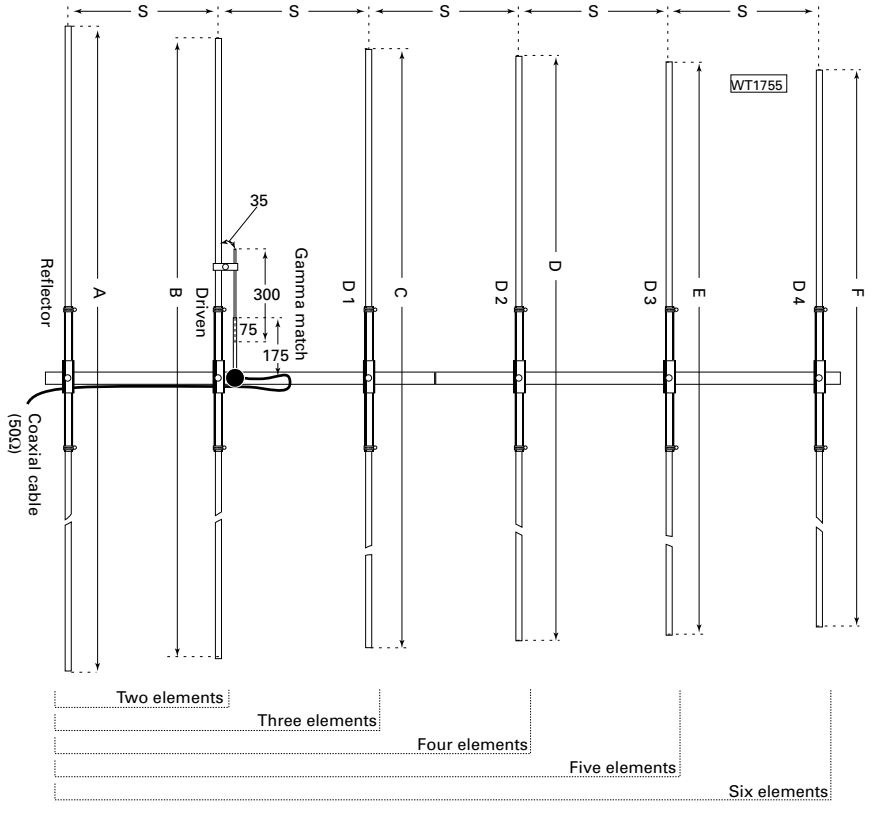
As you would suppose, the reflector is the longest element and the final director the shortest. The diagram, **Fig. 2**, shows all the antenna designs combined into just one diagram. The legend at the bottom of the diagram shows which elements are needed for each design.

The table of dimensions, **Table 1**, should be read in conjunction with Fig. 2, which shows the general layout of the antennas. Read the table for all the dimensions, element lengths, spacing and boom length, then you can make a start!

● This table provides the dimensions for each design that in in Fig. 1 (see text).

Table 1

	Ref	2-ele	3-ele	4-ele	5-ele	6-ele
Gain (dBd):		5	7	8	9	10
Reflector (mm):	A	2013	2197	2197	2197	2185
Driven (mm):	B	1892	2013	2013	2013	2013
Director 1 (mm):	C		1898	1898	1898	1880
Director 2 (mm):	D			1880	1892	1842
Director 3 (mm):	E				1880	1803
Director 4 (mm):	F					1765
Spacing (mm):	S	520	795	795	806	775
Boom length (mm):		560	1630	2425	3264	3915



● Fig.2: The overall designs formed into just one diagram. (See Table 1 for the various dimensions.)

Square Tube

Let's start the construction with the boom which may need to be fabricated from one, two or even three pieces of square tube joined together. When measuring the length of the square aluminium tubing, you should allow a 20-25mm as overhang at each end of the boom.

The smaller, two, three and four element Yagi designs use a single length of square boom. However, the two designs for the five and six element versions will require two (or even three lengths) of square tubing joined together with boom joints.

The boom joints consist of a 200mm length of 22mm (7/8in) round (or square if available) tubing inserted inside the 25mm boom and fixed with self-tapping screws. If using round tubing as a joiner, then you must make sure that the flats of the outer, square tube, form a single plane. Otherwise the plane of the elements will not be 'true'.

Measure, mark out and drill holes for the elements as shown in the tables. **Note:** A tip here is to measure all spacing dimensions from the reflector position rather than measuring separately between each element. By referencing all dimensions to one starting position you greatly reduce inaccuracies along the length of the boom.

Another tip is to mark out all the positions first before drilling the holes for the antenna. Then I suggest you go away and

have a coffee (or tea). After the break, check the measurements again and if all is well, then drill out the various holes to size.

Various Elements

Now let's turn to making the various elements needed for the antenna. Each element is made from two lengths of 12.7mm (0.5in) outside diameter aluminium tubing telescoped into a 380mm (15in) centre section of 15.9mm (5/8in) tubing for strength.

Four short slits (25-30mm) are cut in the ends of the centre sections with a hacksaw and the joints secured with hose clamps. (This permits easy adjustment for frequency if required.) Alternatively, you can cut each element to the overall length and fix through the centre section with two self-tapping screws.

The element (saddle) clamps used to join 12mm elements onto 25mm square booms, shown in the photograph **Fig. 3**, are commercially available from a number of sources. But I've found that Sandpiper Communications‡ one of the best suppliers for these relatively specialised parts.

Gamma Matching

The driven element is matched to the 50Ω coaxial feeder cable by a gamma matching system shown in the photograph **Fig. 4**. Additionally, to provide the necessary series capacitance a length of 3mm (1/8in) diameter rod 300mm long is partly telescoped inside a 6mm (1/4in) diameter tube 175mm long.

Fig.1: Pointing the whole antenna skywards by clamping it to a wooden workbench makes adjusting the matching arrangement fairly easy.

The tube is lined with p.t.f.e. sleeving which acts as a dielectric and provides a sliding fit. The sleeving can be obtained from a model shop or from Sandpiper. Failing that I have successfully constructed a gamma match by carefully wrapping plumbers p.t.f.e. tape around the rod until it is a snug fit inside the tube. Then insert 75mm of the gamma rod into the tube.

The outer end of the gamma matching rod is clamped to the driven element 250mm from the centre line of the main boom. The spacing between the rod and the driven element is set at 35mm by the fixing clamp. Coaxial cable is connected to the gamma rod in a waterproof junction box and the outer of the cable is securely connected to the centre line of the boom as close as possible to the driven element mounting.

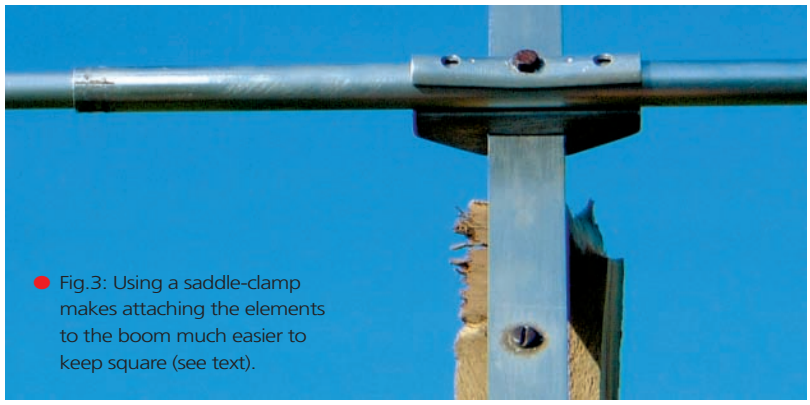


Fig.3: Using a saddle-clamp makes attaching the elements to the boom much easier to keep square (see text).

Shorting Clip

The position of the shorting clip and the length of rod inside the tube are adjusted for the lowest reflected power. The easiest way to carry out matching adjustments is with the antenna pointing straight up as shown in the photograph, Fig. 1.

After carrying out the matching adjustments, any excess gamma rod cut may be cut off. Finally, the joints between the tube and the rod should be waterproofed with heatshrink sleeving. Now all that remains to do, is to install the antenna on the mast with a suitable clamp located at the balance point.

The shorter designs are self supporting, but the five and six element Yagis will probably require some support to prevent drooping of the main boom. For these designs an inexpensive yet effective method is to use a draylon cord, tied to front and back of the boom and passed over a small clamp one metre or so above the main boom on the stub mast.

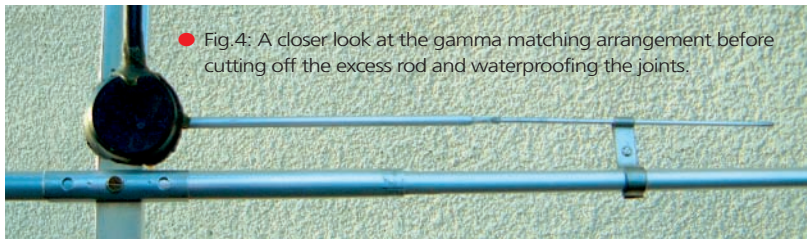


Fig.4: A closer look at the gamma matching arrangement before cutting off the excess rod and waterproofing the joints.

To do a complete job of finishing off, I suggest that rubberised caps can may be fitted to the ends of the boom and the antenna elements if you want to. So, that's all there is to it, you're ready to go. And don't forget that Tuesday evenings are activity nights on 'Four'. *PW*

Sandpiper Communications of **Unit 5, Enterprise House, Cwmbach Industrial Estate. Aberdare, Mid-Glamorgan CF44 0AE, Tel: (01685) 870425**, can supply element fixing clamps, aluminium tubing, gamma match assemblies and other antenna mechanical items. Please check with **Jane, Chris** or **Mark** for prices and availability of individual items for the antenna you make.