riw PRODUCTS
BOX 191, BABYLON, N.Y. 11702

HOMEBREW CONSTRUCTION SUPPLEMENT TO RIW 432-19 INSTRUCTIONS

The following information in conjunction with the assembly procedures for the production RIW 432-19 yagis should prove adequate for functionally duplicating the commercial model.

BOOM - Any material 7/8 to 1 inch diameter is O.K.; 6061-T6 aluminum alloy is recommended.

Element holes are 5/16" diameter and present the biggest difficulty in turning out a professional looking job. Perfect alignment of the element holes along a 13 foot boom without use of a drilling fixture is very difficult. But, perfect alignment is by no means necessary for proper performance, and deviations of 10 degrees would probably have immeasurable effect. The problem is really only one of appearance.

One way to assure reasonably good alignment is to use a 5/16" diameter rod stuck thru the first element hole drilled as a sighting guide for alignment with the drill for the remaining holes (we're sure there are better techniques and would like to hear of them). Holes should be located to within 1/4" of the element spacings given in Table I except for R1, DR, D1 and D2 which should be within 1/8".

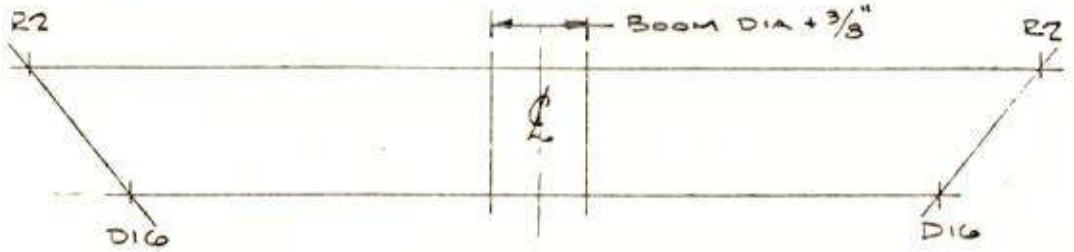
(Production antennas use two 7/8" O.D. sections that telescope into a central 1" O.D. section)

ELEMENTS - The Table I tabulations are valid only for 3/16" diameter elements. Elements should be cut to within 1/64" of the dimensions given for DR and D1, $\pm$ 1/32" for others.

To facilitate element centering on the boom during assembly it is a good idea to mark the retaining ring positions on the element. A deep scratch is suggested. A heavy pencil mark might do but be careful when handling not to rub it off. For one antenna assembly marking each element individually using a scale is tedious but manageable. For more than one it probably pays to make up a marking guide.

ELEMENTS (continued)

One way to make a guide is simply to draw a line on a piece of paper and place marks on the line spaced 13-1/4" apart, corresponding to the longest element. Draw another line parallel to and about 3" below the first. On the second line, place two marks spaced 10-3/4" and centralized between the marks made on the upper line. Draw connecting lines from top to bottom lines thru the marks. Draw two vertical lines spaced by your boom diameter plus 3/8" centralized on the horizontal lines. The 3/8" accounts for the 3/16" insulator projection on both sides of boom.



It is then a simple matter to centralize the element on the guide by eye and mark the element. Remember that perfect element centering is not necessary for proper performance.

(Production antennas are supplied with elements cut to size, marked and color coded for assembly)

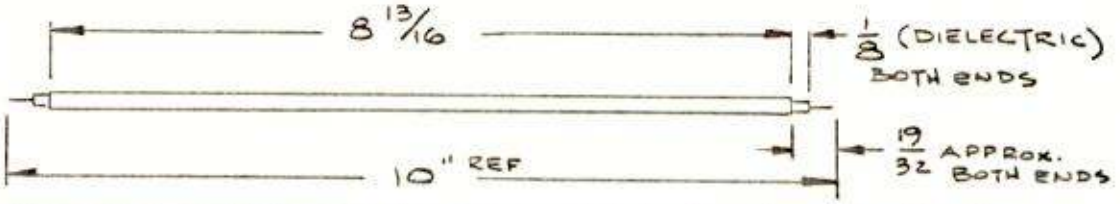
CONNECTOR ASSEMBLY - Study Figures 5 and 7 of the illustrated assembly instruction sheet carefully. Note that the connector is rear mounted to the connector bracket. The balun ground lugs mount under the T-match wire standoff terminals as shown. What is not clear in the illustration is the placement of lockwashers between the balun ground lugs and connector flange. The stackup is, screw / bracket / connector flange / lockwasher / ground lug / lockwasher / standoff terminal. Lockwasher placement is important to ensure reliable long-term grounding of the balun. Note also the orientation of the opening in the bifurcated (slotted) standoff terminals.

(Production antennas are supplied with the above preassembled)

BALUN - The balun is formed from .141 diameter semi-rigid coax cable. It has a solid copper jacket and Teflon dielectric with a silver plated copper center conductor.

BALUN (continued)

Balun trimming dimensions are shown below.



Trimming the jacket can be accomplished using a single edged razor blade or razor knife. It can be tricky business and care must be taken not to cut thru the jacket and dielectric possibly nicking or severing the center conductor. Actually the jacket is scored rather than cut, the intention being to deeply score or groove the jacket all the way around without cutting thru. This can be done by rolling the coax on a smooth surface with the blade edge and bearing down on the blade to do the scoring. As the coax is rolled using the blade, care must be taken to see that the blade retraces itself otherwise a diffuse series of shallow grooves will result rather than one sharply defined groove. When the groove is deep enough, the jacket can be separated by breaking along the groove with the fingers.

The balun can be shaped by hand into the "U" shape required. When mounting the balun the balun solder lugs should be formed around the balun jacket before soldering. The balun should be supported to the boom with a non-metallic clamp.

(Production antennas are supplied with balun trimmed and preformed)

TABLE I

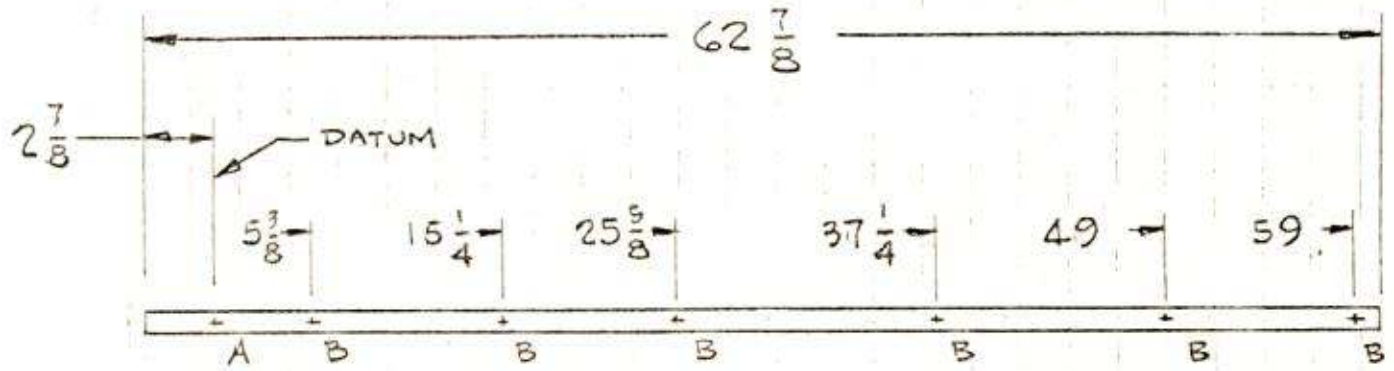
RIW 432-19 Element Lengths and Spacings. (All spacings measured from most rearward reflector, R2)

ELEMENT	LENGTH	SPACING	ELEMENT	LENGTH	SPACING
R2	13.250	00.000	D8	11.250	74.625
R1	13.093	13.500	D9	11.250	84.000
DR	12.531	19.250	D10	10.968	91.750
D1	12.656	22.750	D11	10.968	100.375
D2	11.875	28.500	D12	10.968	110.250
D3	11.500	34.250	D13	10.968	120.625
D4	11.593	40.000	D14	10.968	132.250
D5	11.500	49.000	D15	10.968	144.000
D6	11.250	57.625	D16	10.750	154.000
D7	11.062	64.750			

MAST CLAMP - Location is not critical. Keep it 3" or more from any element to avoid detuning. On the production antenna it is located between D7 and D8. That is behind the antenna's balance point in order to compensate for the weight of the coax to the feed point.

TUNING - Should not be required. However, variations caused by homebrew construction may cause the VSWR to be higher than normal (should be 1.2 or less at 432 MHz). This is corrected by adjusting length of driven element, DR. If VSWR is very high, check length of DR and D1 and also the 10-1/4" dimension across the driven element clamps. Check your VSWR measurement instrumentation!

Do not adjust any other elements. Unless you have cut virtually every element appreciably shorter or longer than the dimensions given or bolluxed up a number of spacings, your antenna should exhibit specified gain (16dBd) to within a fraction of a dB.



HOLE LEGEND

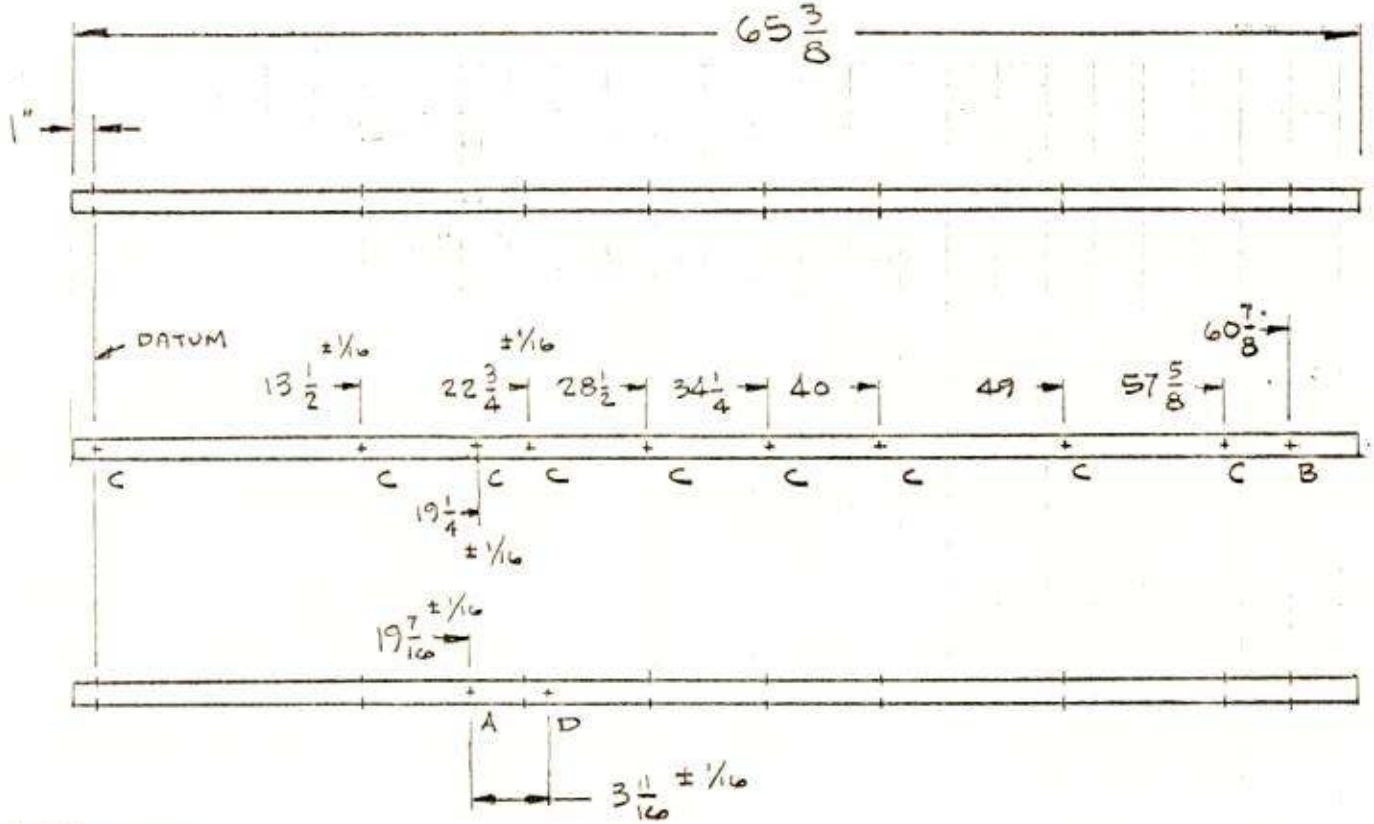
A .177 DIA (THRU BOTH WALLS)
B .312 DIA (THRU BOTH WALLS)

ALL SINGLE ARROWHEADED DIMENSIONS REFERENCED FROM DATUM.

MATL: AL. TUBING 6061-T6
7/8 O.D. X .035 WALL
TOL: ± 1/8

BOOM SECTION C

432-1904



HOLE LEGEND

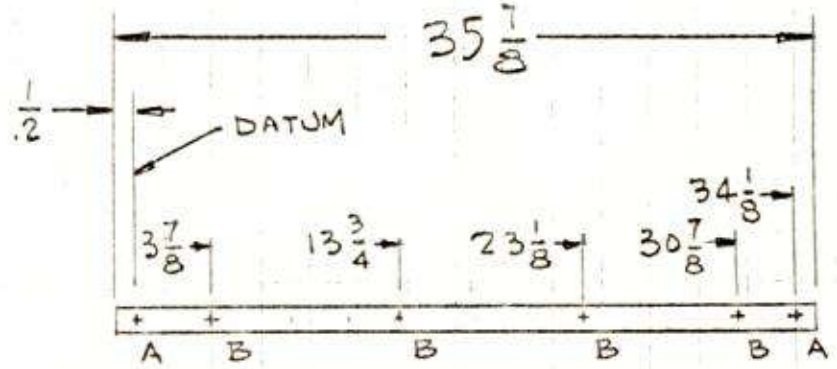
A	.144 DIA (THRU BOTH WALLS)	1. REQ'D
B	.177 DIA (THRU BOTH WALLS)	1 "
C	.312 DIA (THRU BOTH WALLS)	8 "
D	.101 DIA (ONE WALL ONLY)	1 "

ALL SINGLE ARROWHEADED DIMENSIONS REFERENCED FROM DATUM.

BOOM SECTION A

MAT'L: AL. TUBING 6061-T6
7/8 O.D. X .035 WALL
TOL: ±1/8

432-1902



HOLE LEGEND

A	.177 DIA (THRU BOTH WALLS)	2 REQ'D
B	.312 DIA (THRU BOTH WALLS)	4 REQ'D

ALL SINGLE ARROWHEADED DIMENSIONS REFERENCED FROM DATUM.

BOOM SECTION B

MAT'L: AL. TUBING 6061-T6
1" O.D. X .058 WALL
TOL: ± 1/8

432-1903

ASSEMBLY INSTRUCTIONS - RIW MODEL 432-19 ANTENNA

Assembly of your RIW 432-19 will proceed in 3 basic stages:

1. Assembly of elements to boom sections
2. Assembly of connector and balun to boom and driven element
3. Final assembly

CAUTION

PROTECT FROM EYE INJURY - Assembly, handling and installation of this antenna presents possible risk of eye injury. Wear eye protection!

Assembly of elements to boom sections

See figure 1. Boom sections are identified as FWD, CTR and AFT. The elements are identified and coded by position.

Starting with FWD boom section, install element D16 as follows:

A. See figure 2. Insert a retaining ring into the shallow recess at the end of the spool - RETAINING RING FINGERS MUST POINT TOWARD SPOOL as shown. With one tip of element bearing against a stationary work surface, push retaining ring onto element with spool until ring is even with scribed line on element as shown in figure 3.

   NOTE: The exact position of the ring, which effects the centering of the element on the boom, is not critical; + 1/8" variation will not effect antenna performance. If ring is pushed too far it may be removed by continuing to push it along the element until it falls off the end opposite that onto which it was installed. It can not be removed by pushing back towards end from which it was installed.

B. See figure 4. Slide insulator onto element noting position of insulator shoulder. Insert element thru holes in boom, slide second insulator onto element, again noting shoulder position. With tip of element bearing against work surface as shown in figure, push second retaining ring onto element until it presses firmly against insulator, making sure that insulators are properly seated in boom holes.

Assembly of elements to boom sections (cont.)

Repeat previous steps A and B for remaining elements in all boom sections.

ASSEMBLY HINT: Holding the boom section horizontally and bearing element tip against a slender vertical surface such as a door jamb or column has been found very convenient as it allows clearance for elements already assembled.

Assembly of connector and balun to boom and driven element

A. See figure 5. Secure the connector assembly to the AFT boom section noting that connector faces forward. Insert ends of balun thru lugs on connector assembly and slide into position shown, securing balun to boom with plastic clamp.

B. See figure 6. Assemble element clamps and lugs to the driven element. Lugs are to fit between clamp tabs. Secure clamp hardware very tightly. Note that scribe marks have been placed on the element at the specified 10¼" clamp spacing.

C. See figures 5, 6 and 7. Solder the precut wire matching sections in place as shown. Solder balun leads to wire matching sections, and balun jacket to connector assembly lugs as shown.

Final Assembly

See figure 8. Assemble boom sections together and install mast clamp assembly as shown. Make sure boom assembly hardware is tightened securely.

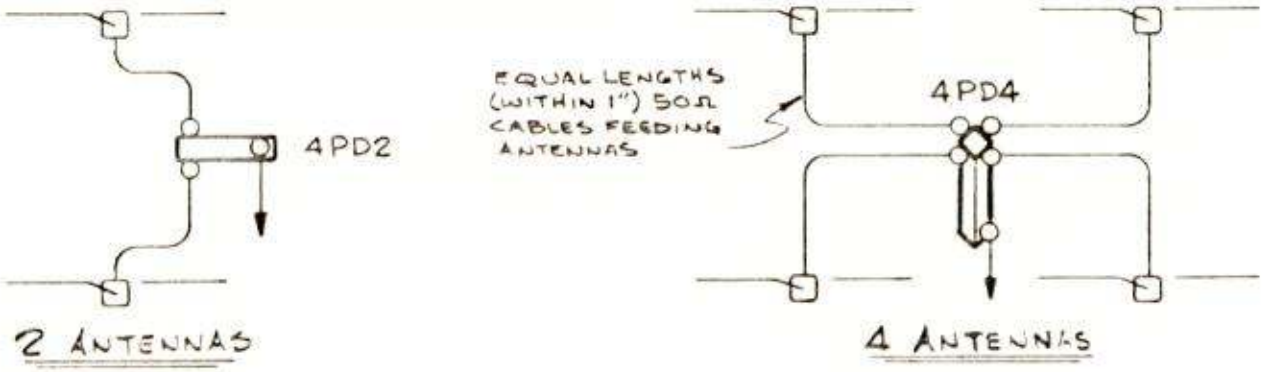
This completes assembly of your 432-19.

NOTE: The 432-19 driven element is ungrounded. It is recommended that the input of your receiver front end have a dc ground return to eliminate static charge build-up.

FEEDING

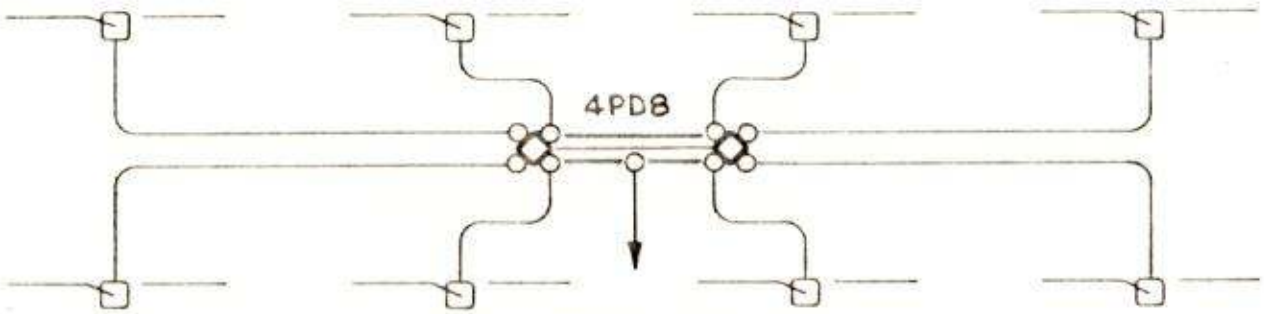
All antennas of an array must be properly phased. Individual antennas must be correctly oriented within the array, i.e., none mounted upside down with respect to the others (unless compensated by 180° phase shift of signal fed to it). All antennas must be fed in phase requiring feed cables to be matched in length to within 1 inch. However, cable lengths may differ by any multiple of a full wavelength in the particular cable used.* This allows length reduction of cables feeding inboard antennas of large arrays if desired.

RIW's 2, 4 and 8-way Power Dividers (models 4PD2, 4PD4 and 4PD8 respectively) provide the lowest-loss and most trouble-free method of feeding multiple antennas. Typical feed arrangements are shown below.



2 ANTENNAS

4 ANTENNAS



8 ANTENNAS

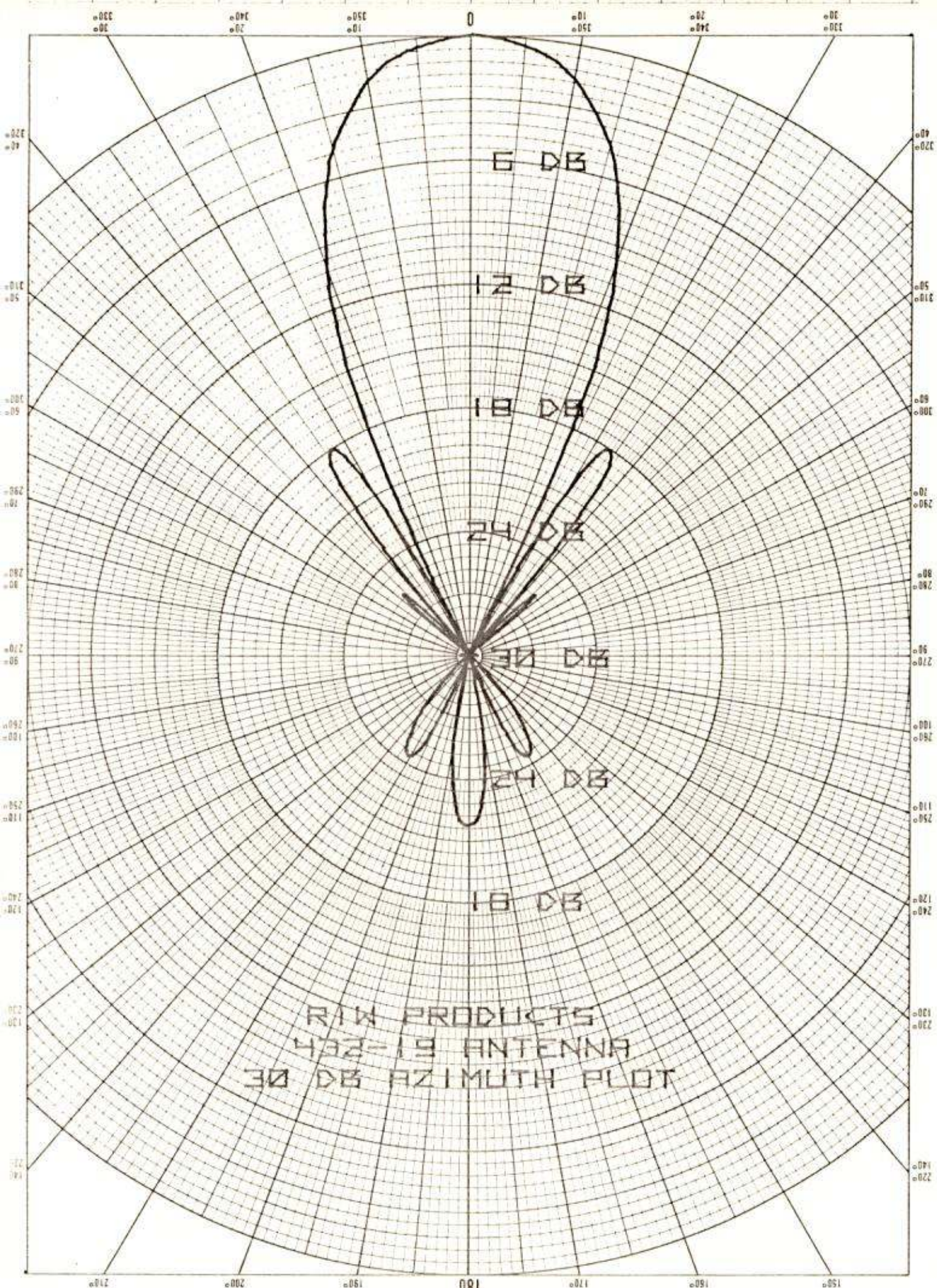
Alt. 8 Ant. feed: 2 4-ways fed by 2-way thru eq. lngth cables

16 Antenna feed: 2 8-ways fed by 2-way thru eq. lngth cables

Alt. 16 ant. feed: 4 4-ways fed by 4-way thru eq. lngth cables

* Wavelength in Cable (inches)= Wavelength in Air times Cable Velocity Factor

= 11803 x V.F./ freq (MHz)


0
6 DB
12 DB
18 DB
24 DB
30 DB
24 DB
18 DB
180
RAW PRODUCTS
432-19 ANTENNA
30 DB AZIMUTH PLOT

riw PRODUCTS
BOX 191, BABYLON, N.Y. 11702

NOTES ON ARRAYING MULTIPLE ANTENNAS

STACKING

Arrays of 2, 4, 8 or 16 antennas are the most common stacking configurations, each providing a nominal 3 dB gain over the preceding.

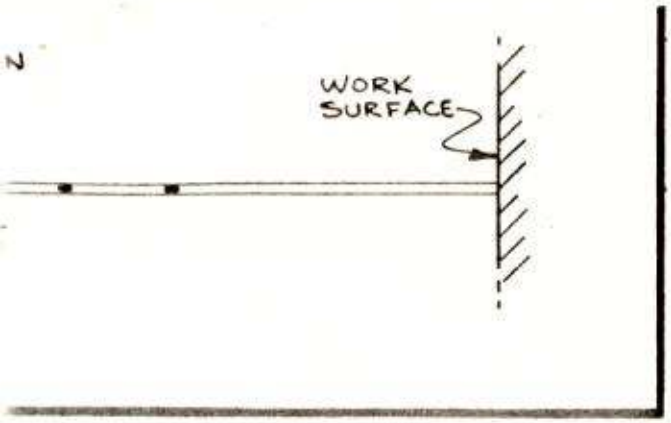
Suggested 432-19 vertical and horizontal stacking distance is 5½ feet which is slightly less than the antenna's capture area diameter of 6.1 feet. Spacing closer than 4½ feet will result in significant gain loss.

The plane of the array (an imaginary plane, normal to the axis of the array, that passes thru the driven elements of the array's constituent antennas) must be true to within 2 inches (most rearward to most forward) to prevent appreciable gain loss. Care must be exercised when designing and constructing the array to maintain this accuracy. Support structure must be rigid enough to withstand external loads from wind and ice without suffering permanent deformation beyond this limit. Particular attention must be given to array plane distortion in large EME arrays where the support structure is rotated in elevation.

It is interesting to note that the axis of the array main lobe (boresight) is, within wide limits, independent of the direction in which it's constituent antennas are pointed, provided the driven elements remain on the plane of the array. This means that even relatively large amounts (5°) of skewing or motion of individual antennas will result in only negligible gain variations and not affect array boresight.

Non-resonant structures may intrude into the antenna's capture area with little effect other than possibly casting a shadow, but should be avoided if possible. Resonant structures such as 2 Meter antennas (3rd harmonic resonant) should be positioned 4 feet or more from the 432 antennas to avoid possible distortion of the 432 pattern.

It must also be noted that one inescapable consequence of arraying antennas is the emergence of secondary lobes not present in the pattern of the individual antenna (and often of much greater magnitude!). This is the result of phase cancellation and reinforcement, occurs in the plane of stacking, and is primarily dependent on array configuration, not the pattern of the individual antenna. So, if your array exhibits a whopping sidelobe, don't blame it on your 432-19's!



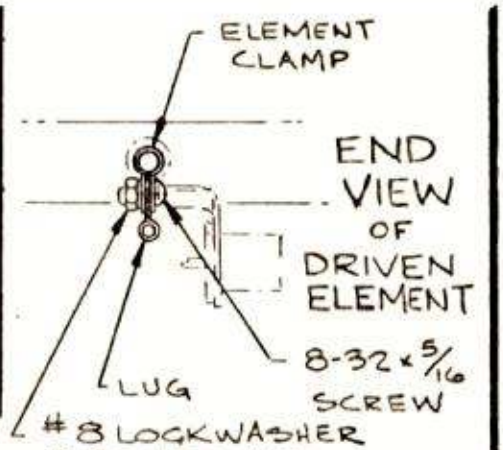
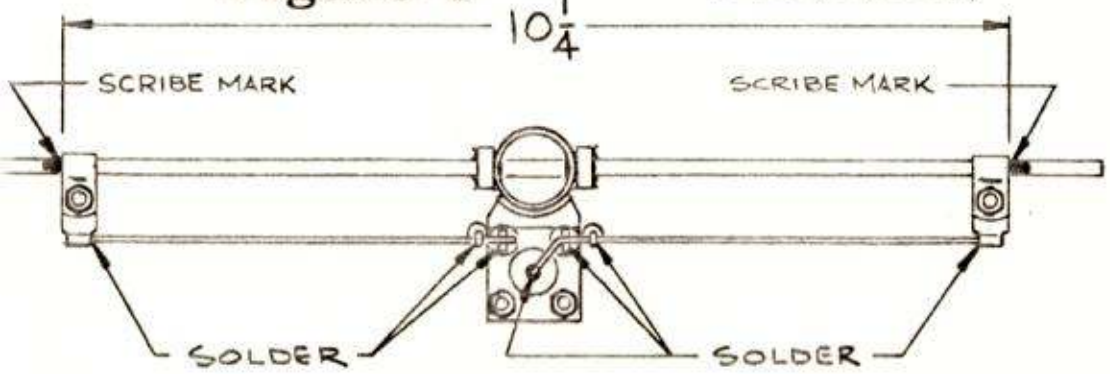
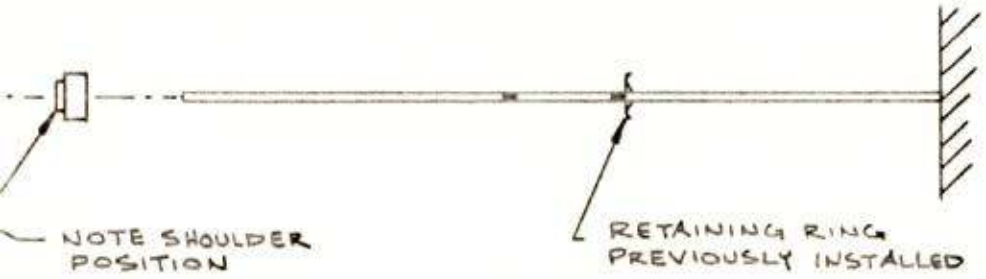
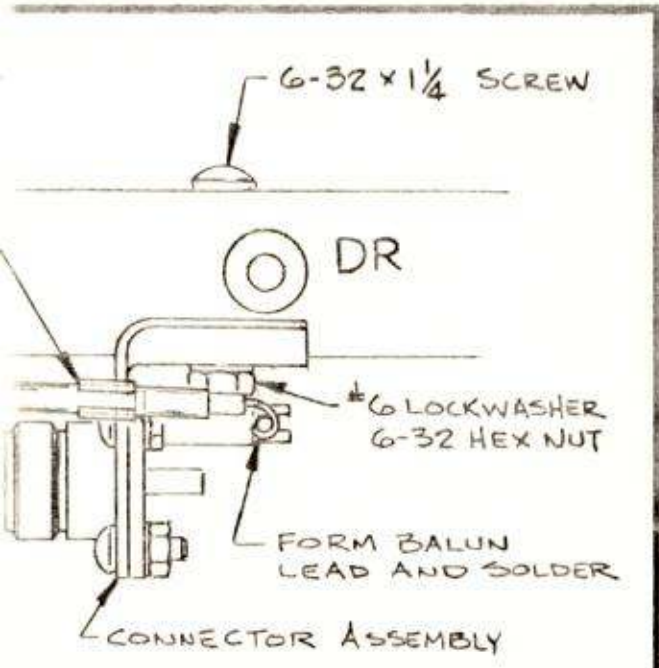
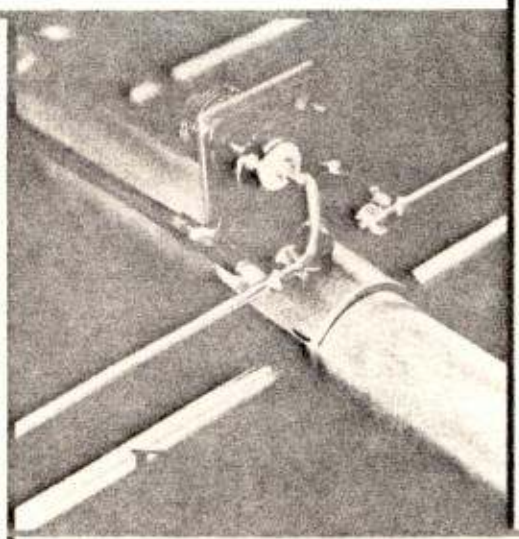


Figure 6









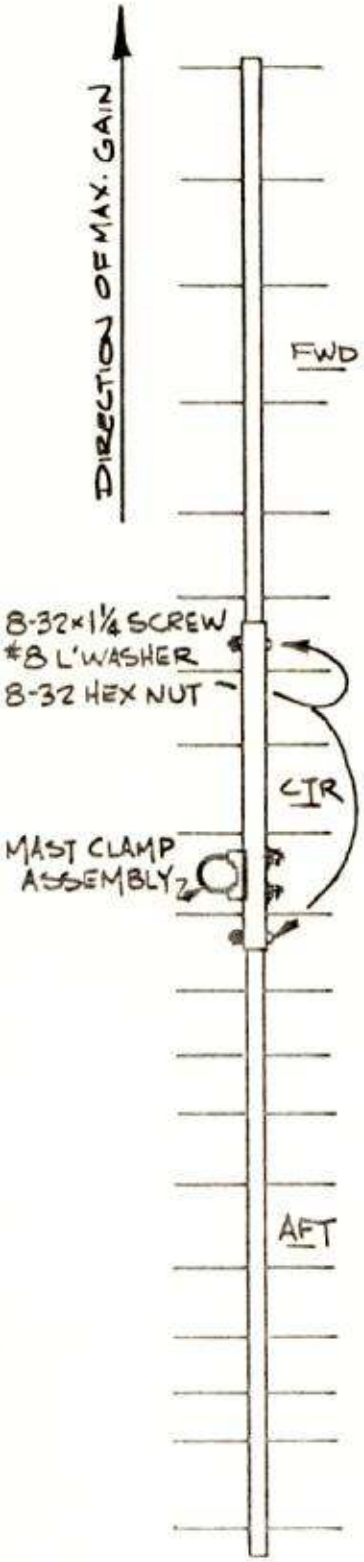


Figure 8

RIW 432-19

NOTE: ELEMENTS HAVE ALSO BEEN CODED AT ENDS FOR IDENTIFICATION AFTER ASSEMBLY

Figure 1

FWD BOOM

D16	Blu-Blu	☐
D15	Vio-Vio	☐
D14	Vio-Vio	☐
D13	Vio-Vio	☐
D12	Vio-Vio	☐
D11	Vio-Vio	☐

NOTE SMALL HOLE ON THIS END

CTR BOOM

D10	Grn-Blu	☐
D9	Grn-Grn	☐
D8	Grn-Grn	☐
D7	Red-Vio	☐

NOTE POSITION OF MAST CLAMP HOLES.

NOTE SMALL HOLE ON THIS END

AFT BOOM

D6	Red-Blu	☐
D5	Red-Red	☐
D4	Red-Grn	☐
D3	Red-Red	☐
D2	Blk-Vio	☐
D1	Blk-Blu	☐
DR	Blk-Grn	☐
R1	Blk-Red	☐
R2	Blk-Blk	☐

IMPORTANT - TO AVOID CONFUSION, IT IS RECOMMENDED THAT ELEMENTS BE CHECKED OFF AS THEY ARE INSTALLED

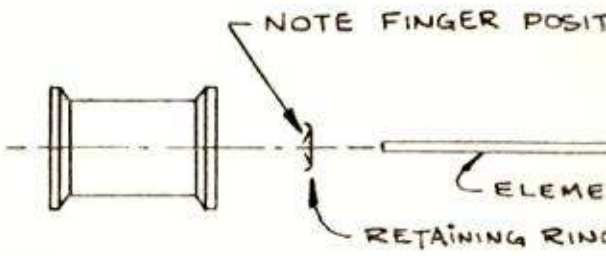


Figure 2

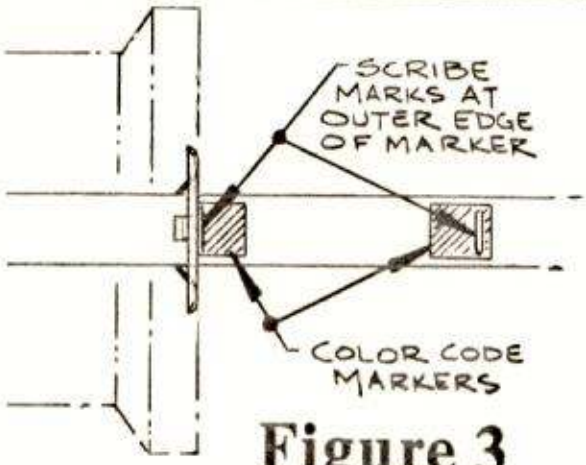


Figure 3

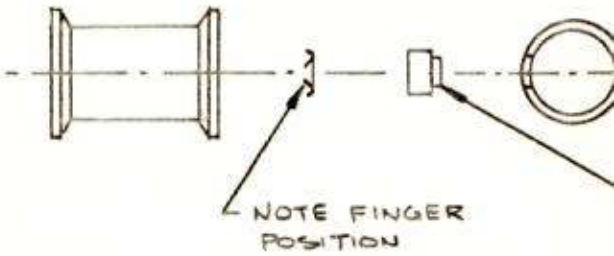


Figure 4

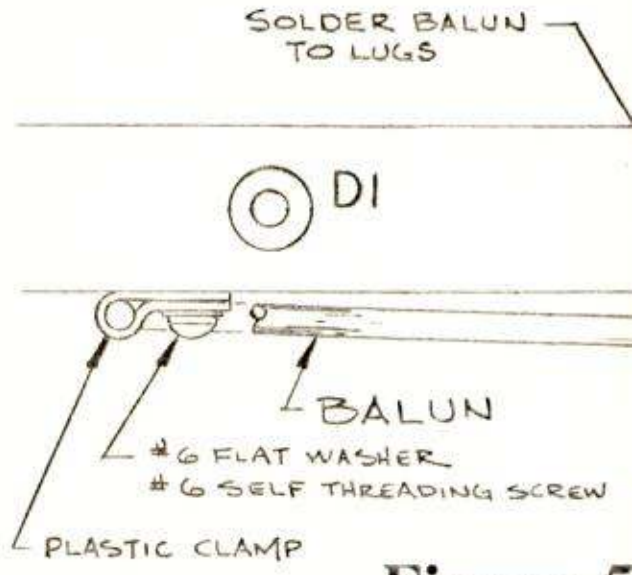


Figure 5