



INSTRUCTION MANUAL.

ORDER NO. 397S

Model 402BA-S

40-Meter, 2-Element Beam PN 801807-2

General Description

The Hy-Gain Model 402BA-S is an optimum spaced, two element beam. It incorporates principles of hairpin loading which results in lower loss and greater radiation efficiency than is possible with loading coils. The Model 402BA-S is designed to give maximum performance in a minimum amount of space. The 402BA-S now features stainless steel hardware and clamps on all electrical and most mechanical connections.

The Model 402BA-S utilizes Hy-Gain's beta match system to offer a perfect match to 50 ohm coaxial cable. An RG-213/u coax is recommended. It has higher power handling capabilities and lower losses. The VSWR will be less than 1.5:1 if the dimensions shown in the illustrations are met. Either a Hy-Gain BN-86 balun or a homemade RF choke will be required. Construct this choke by winding 12 turns of RG-213/u coax in a circle with a 14" diameter as shown in Figure 7.

WARNING

When installing your system, take extreme care to avoid any accidental contact with power lines or overhead obstructions. Failure to exercise this care could result in serious or fatal injury.

Specifications

Mechanical

Boom Length	16' 1 ³ / ₈ " (4.92 m)
Boom Diameter	2" (5.1 cm)
Maximum Element Length	47' 1 ³ / ₂ " (1441.5 cm)
Turning Radius	25' (7.62 m)
Maximum Wind Survival	80 mph (128 kmph)
Accepts Mast	1 1/2" to 2 1/2" (3.8 cm to 6.4 cm)
Wind Load @ 80 mph	152 lbs. (68.9 kg)
Wind Surface Area	6 sq. ft. (.56 sq. m)
Hardware	stainless steel, except for
.....	7 large bolts used in the boom-to-mast bracket

Electrical

Gain	4.9 dB
Front-to-Back Ratio	15 dB maximum
Maximum Power Input	maximum legal
VSWR (at resonance)	less than 1.5:1
2:1 VSWR Band Width	100 KHz
3:1 VSWR Band Width.....	150 KHz
Lightning Protection	DC ground
Input Impedance	50 ohms

Installation

The 402BA-S is designed to fit a 1 1/2" to 2 1/2" mast. The antenna support structure must be properly grounded for proper lightning protection and noise operation. To properly ground the support structure, drive a 1/2" x 8' copper ground rod into the ground approximately 12 inches from the support structure and connect the structure to the ground rod using #8 or larger copper wire.

NOTE: For total lightning protection it is recommended that you obtain Hy-Gain Model LA-1 Lightning Arrestor on your coaxial transmission line.

Remove the parts from the carton and check them against the Parts List drawings.

Select the boom-to-bracket clamp parts (Item Nos. 2 & 3). Loosely assemble them on the boom ends (Item Nos. 5 & 6), as shown in Figure 1. Line up the holes on both brackets and both boom ends. Secure the two brackets together with four (4) 1/4"-20 x 3/8" bolts, lockwashers and nuts (Item Nos. 37, 40 & 41). Secure brackets to the two boom ends using the 5/16"-18 x 2 3/4" bolts, lockwashers and nuts (Item Nos. 43, 46 & 47). Tighten these six (6) bolts.

Assemble the two cast aluminum brackets (Item No. 1) on the mast at the desired height above your tower. Secure the two brackets together using the two 5/16"-18 x 3 1/2" bolts, lockwashers and nuts (Item Nos. 44, 46 & 47). You may wish to drill a hole through your mast so that the remaining 5/16"-18 x 3 1/2" bolt may be inserted through the cast brackets and the mast and tightened. This bolt prevents the antenna from twisting on the mast in high winds. See Figure 2. The four (4) 5/16"-18 x 5" bolts (Item No. 45) will be installed when the antenna is installed on the mast.

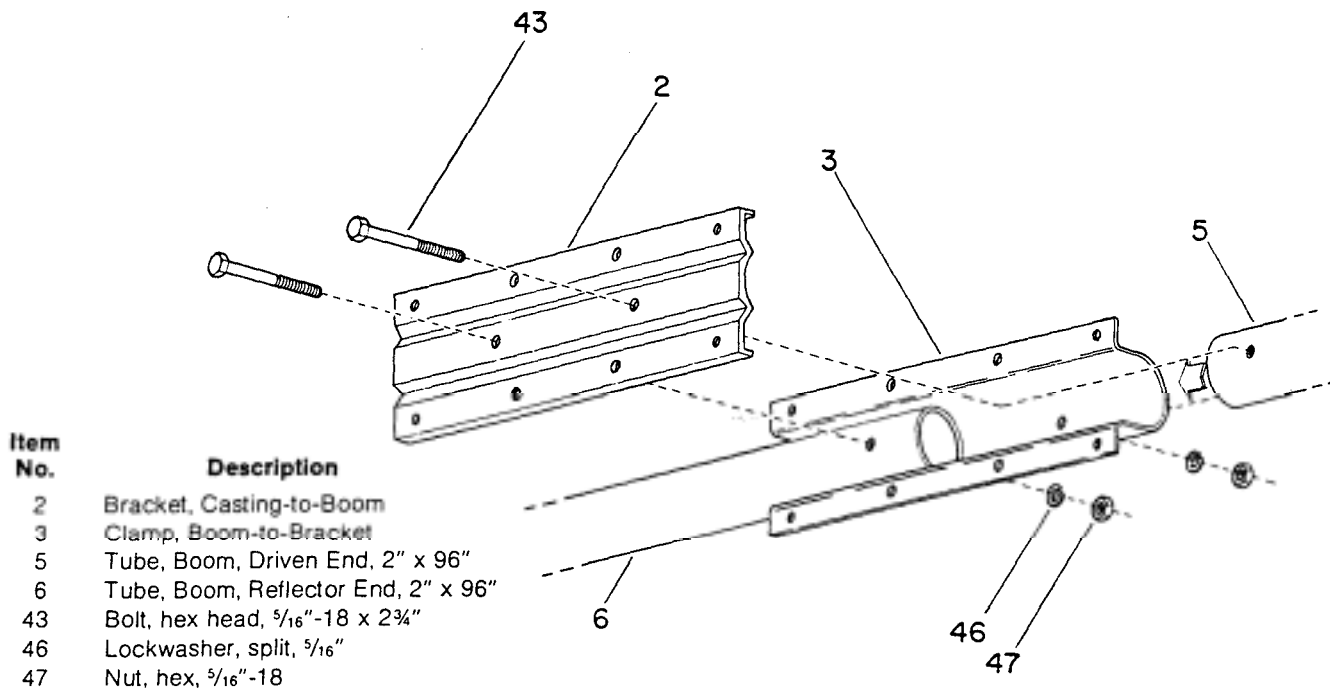
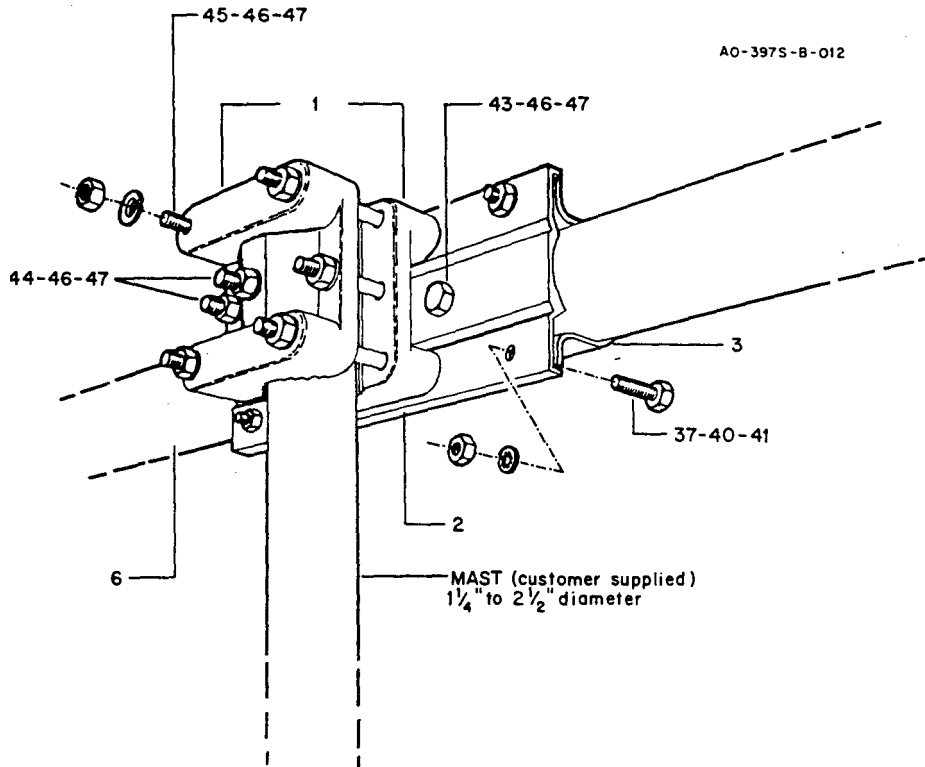


Figure 1 Assembly of Boom Tubes to Casting-to-Boom Bracket and Boom-to-Bracket Clamp



Item No.	Description	Item No.	Description
1	Bracket, Cast Aluminum	41	Nut, hex, 1/4"-20
2	Bracket, Casting-to-Boom	43	Bolt, hex head, 5/16"-18 x 2 3/4"
3	Clamp, Boom-to-Bracket	44	Bolt, hex head, 5/16"-18 x 3 1/2"
6	Tube, Boom, Reflector End, 2" x 96"	45	Bolt, hex head, 5/16"-18 x 5"
37	Bolt, hex head, 1/4"-20 x 3/4"	46	Lockwasher, split, 5/16"
40	Lockwasher, internal, 1/4"	47	Nut, hex, 5/16"-18

Figure 2 Assembled Boom-to-Mast Bracket

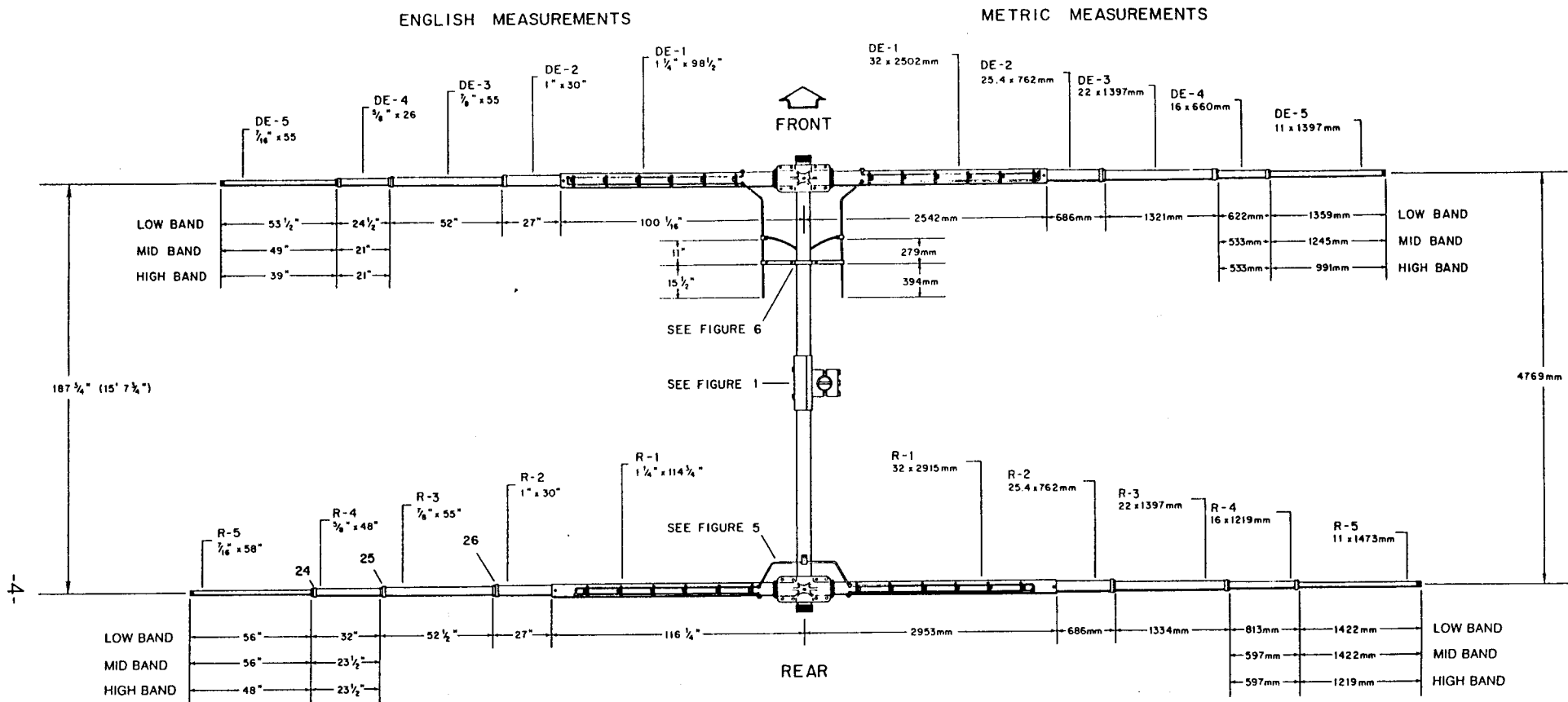
Select the two 2" boom sections (Item Nos. 5 & 6), the cast aluminum brackets (Item No. 1), the casting-to-boom bracket (Item No. 2), and the boom-to-bracket clamp (Item No. 3). Assemble as shown in Figure 2.

NOTE: One end of the boom has a small hole drilled approximately 6 inches from the end. This end of the boom is the reflector end.

Select a set of element-to-boom brackets (Item No. 4) and loosely assemble on the reflector end of the boom as shown in Figure 4. Do not forget the 1/4" anchor bolt and its associated square nut.

Select the R1 section (1 1/4" x 114 3/4", Item No. 12) and a set of element insulators. Slip the thick walled ends of the R1 sections into the insulators then slip the insulated end into the bracket assembled on the boom. Tighten the bolts to hold the element securely but do not tighten the anchor bolts at this time.

NOTE: There is a series of six (6) small holes drilled in the R1 section of tubing. These holes must point up (skyward) when the tubing section is inserted into the bracket. These holes will be used for attaching the loading hairpin in a later step as shown in Figure 5.



FREQUENCY CHART	
LOW BAND	7.0 TO 7.1 MHz
MID BAND	7.1 TO 7.2 MHz
HIGH BAND	7.2 TO 7.3 MHz

Item No.	Description
24	Compression Clamp, 1/2" (typical 4 places)
25	Compression Clamp, 3/8" (typical 4 places)
26	Compression Clamp, 1" (typical 4 places)

Item No.	Designator	Description
7	DE-1	1 1/4" x 98 1/2"
8	R2, DE-2	1" x 30"
9	R3, DE-3	3/8" x 55"
10	DE-4	5/8" x 26"
11	DE-5	7/16" x 55"
12	R1	1 1/4" x 114 3/4"
13	R5	7/16" x 58"
51	R4	3/8" x 48"

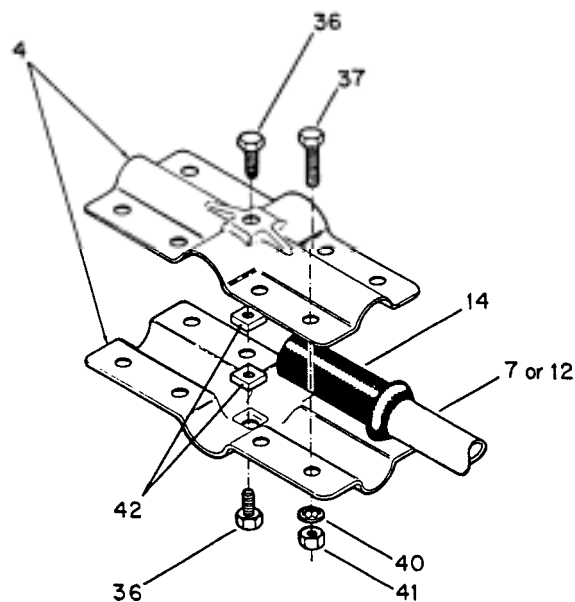
Figure 3 Top View of Assembled Antenna

Select 12 "Tombstone" insulators (Item No. 50) and install them on the R1 section using #6 Type T screws (Item No. 27), as shown in Figure 5. Select the reflector loading hairpins (Item Nos. 16 & 17) (approximately 98 1/2" long) and attach them to the "Tombstone" insulators as shown in Figure 5. Firmly press them into the slots of the insulators and splice the ends using a #10-24 x 1/2" bolt (Item No. 31). Insert this bolt from the bottom so the lockwasher and nut will be on the top. Attach the hairpin to the reflector near the element-to-boom bracket using a #8 Type T screw (Item No. 29), as shown in Figure 5.

Select the reflector shorting hairpin (Item No. 15) and install as shown in Figure 5. Make certain the #10 x 1/2" splicing bolt (Item No. 31) is installed from the bottom so the lockwasher and nut will be on the top. When installing the hairpin shorting clip (Item No. 21), adjust the reflector element as necessary to insure

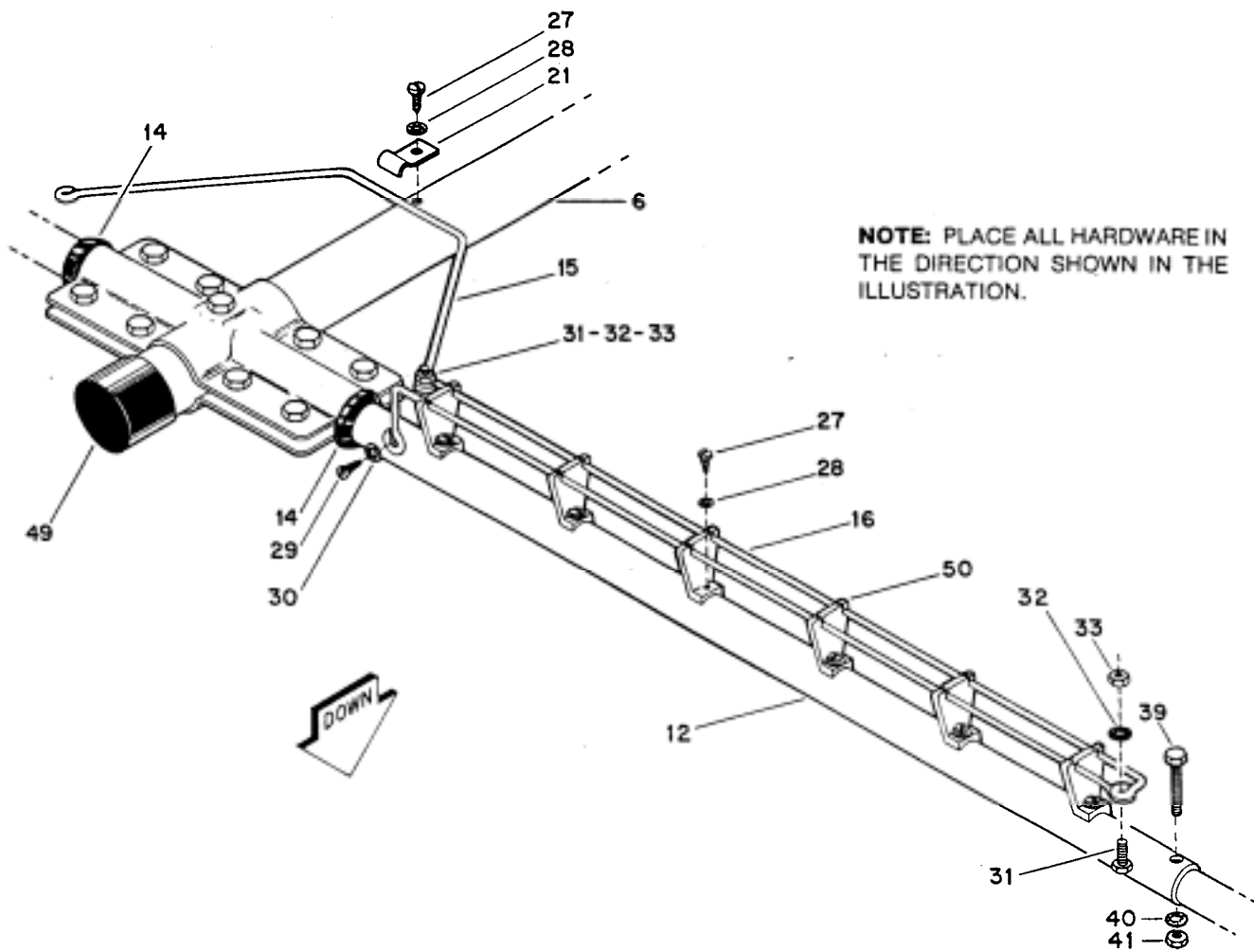
Now tighten the anchor bolts in the element-to-boom bracket securely.

NOTE: Use a 1/4" x 1 1/2" bolt with a 1" compression clamp, a 1/a" bolt with a 3/4" compression clamp and a #10 x 1" bolt with a 1/2" compression clamp. See Figure 5.



Item No.	Description	Item No.	Description
4	Bracket, Element-to-Boom, #14	37	Bolt, hex head, 1/4"-20 x 3/4"
7	Tube, Element, DE1, 1 1/4" x 98 1/2"	40	Lockwasher, internal, 1/4"
12	Tube, Element, R1, 1 1/4" x 114 3/4"	41	Nut, hex, 1/4"-20
14	Insulator, for DE1 & R1	42	Nut, square, 1/4"-20
36	Bolt, hex head, 1/4"-20 x 3/8"		

Figure 4 Assembly of the Element-to-Boom Brackets



Item No.	Description	Item No.	Description
6	Tube, Boom, Reflector End, 2" x 96"	30	Lockwasher, internal, #8
12	Tube, Element, R1, 1 1/4" x 114 3/4"	31	Bolt, hex head, #10-24 x 1/2"
14	Insulator, for DE1 & R1	32	Lockwasher, internal, #10
15	Hairpin, Reflector Shorting, 1/8" x 16 1/8"	33	Nut, hex, #10-24
16	Hairpin, Reflector, 1/8" x 98 1/2" x 1 7/8"	39	Bolt, hex head, 1/4"-20 x 1 1/2"
21	Clip, Shorting	40	Lockwasher, internal, 1/4"
27	Screw, round or pan head, #6-32 x 1/2", Type T	41	Nut, hex, 1/4"-20
28	Lockwasher, internal, #6	49	Caplug, 2", black
29	Screw, round or pan head, #8-32 x 1/2", Type T	50	Rod Support, "Tombstone" Insulator

Figure 5 Installing "Hairpins" on Reflector Element

Select the R2 section (1" x 30", Item No. 8) and slip the drilled end into the R1 section. Align the holes and fasten securely with a 1/4"-20 x 1 1/2" bolt, lockwasher and nut (Item Nos. 39, 40 & 41).

Assemble a 1" compression clamp (Item No. 26) and slip it over the end of the R2 section.

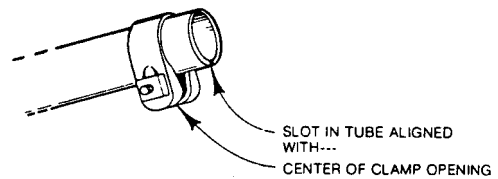
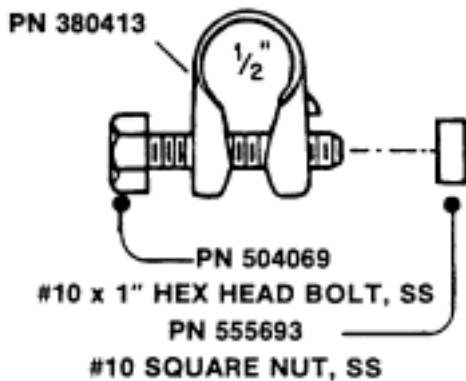
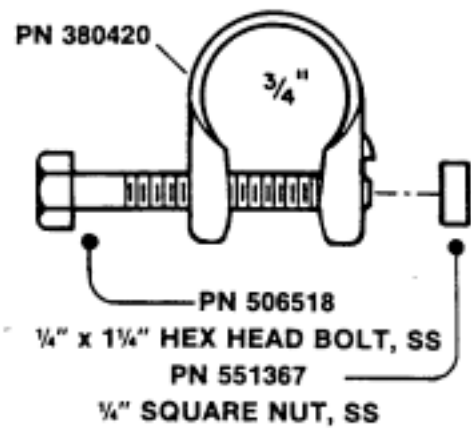
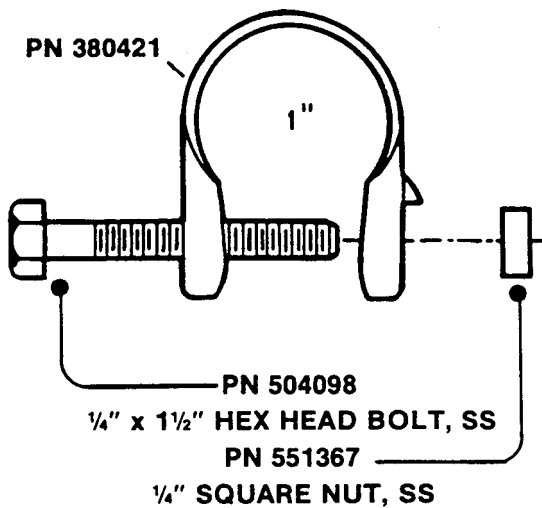


Figure 6 Compression Clamps
(Actual Size)

Select the R3 section (5/8" x 55", Item No. 9) and slip the unwaged end into the R2 section. Measure the dimensions shown in Figure 2, then tighten the compression clamp securely.

Assemble a 3/4" compression clamp (Item No. 25) and slip it over the R3 section.

Select the R4 section (5/8" x 48", Item No. 51) and slip the unwaged end into the R3 section. Decide at this time, which setting you wish to use for this antenna Low Band, Mid Band or High Band. Adjust the R4 to the dimensions shown in Figure 3. Tighten the compression clamp securely.

NOTE: See Figure 8 for typical VSWR performance at each setting. Because this is a 40-meter antenna, both the VSWR at resonance and the band width is greatly affected by the height above ground and the proximity of nearby power lines. You can expect slightly lower VSWR and a narrower band width if this antenna is mounted at less than 50 feet above the ground.

Assemble a 1/2" compression clamp (Item No. 24) and slip it over the end of the R4.

Select the R5 section (1/16" x 58", Item No. 13) and slip it into the R4 section. Adjust the R4 section to the dimensions chosen from Figure 3. Tighten the compression clamp securely.

NOTE: Low band covers 7.0 to 7.1 MHz, mid band covers 7.1 to 7.2 MHz and high band covers 7.2 to 7.3 MHz.

Place a 1/16" caplug (Item No. 48) on each end of the reflector.

Select the remaining set of element-to-boom brackets and loosely assemble on the boom 15' 7³/₄" from the center of the reflector bracket to the center of the driven element bracket.

Select the DE1 sections (1 1/4" x 98¹/₂", Item No. 7) and two element insulators (Item No. 14). Insert the thick walled end of the DE1 sections into the insulators then slip the insulated ends of the DE1 sections into the bracket assembled on the boom. Tighten the bolts to hold the element securely but do not tighten the anchor bolts at this time.

NOTE: The DE1 section has six (6) small holes drilled for attaching the loading hairpins. These holes must face up as shown in Figure 7.

Carefully recheck the 15' 7³/₄" measurement and make certain the driven element will lie in the same plane as the reflector element. Now tighten the anchor bolts securely.

Select the remaining 12 "Tombstone" insulators (Item No. 50) and install on the DE1 sections as shown in Figure 7.

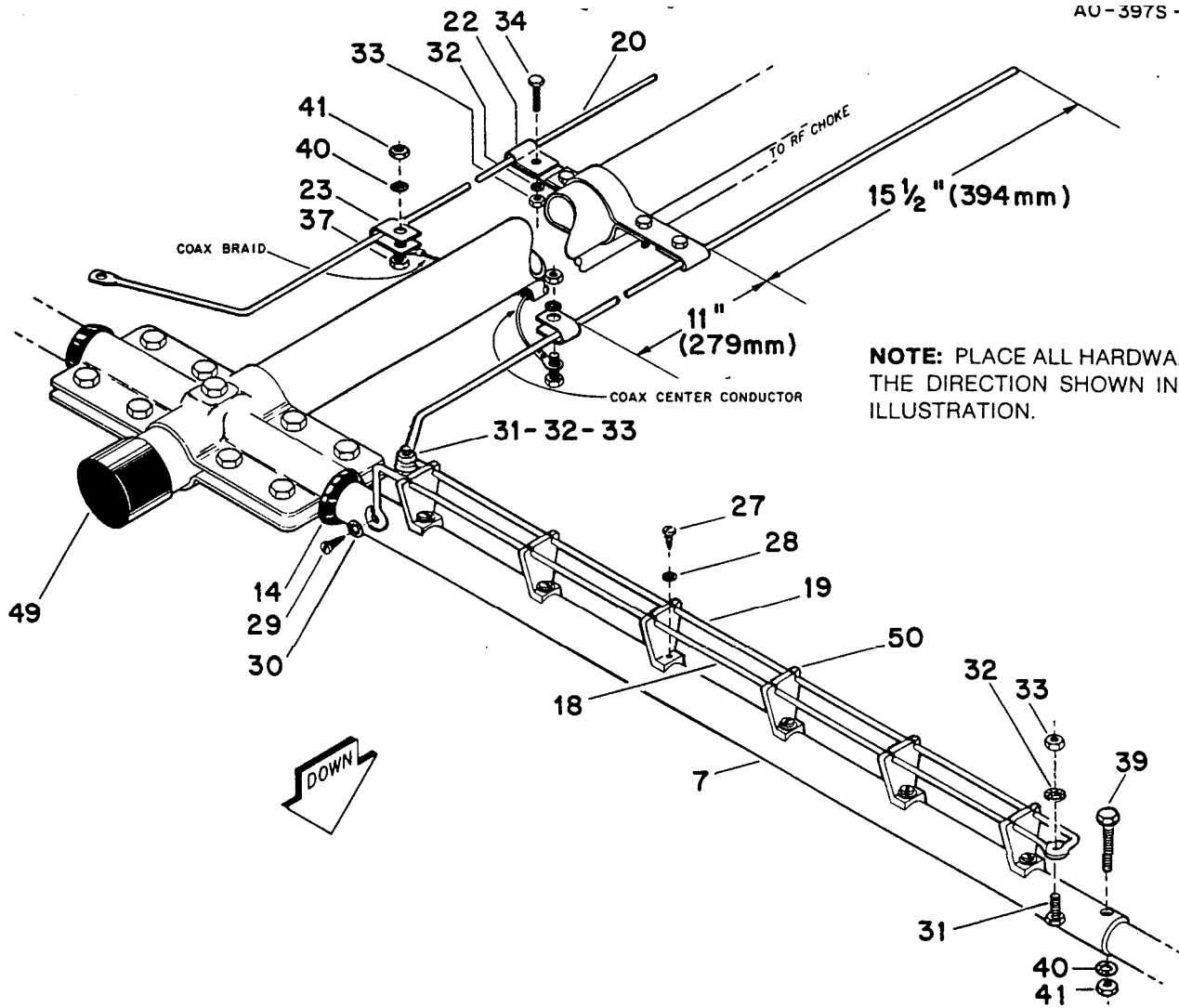
Select the driven element loading hairpins (approximately 91¹/₂" long) (Item Nos. 18 & 19) and install them on the driven element in the same manner as those installed on the reflector. Refer to Figure 5. Make certain the splicing bolts (Item No. 31) are installed from the bottom so the nut and lockwasher will be on the top.

Select the beta rod (Item No. 20) and beta clamps (Item No. 22) and install the beta match as shown in Figure 7. Adjust the beta clamp so it is exactly 15¹/₂" from the end of the rod to the edge of the clamp as shown in Figure 7. Tighten all bolts securely.

Assemble the remainder of the driven element in the same manner as the reflector. Refer to Figure 3 for tubing description and dimensions. Place a 1/16" caplug on each end of the driven element.

Place a 2" caplug (Item No. 49) on each end of the boom.

Hy-Gain's BN-86 balun is recommended for use with the 402BA-S antenna. When mounting the BN-86 balun on this antenna, position it beneath the boom between the beta clamp and the attachment points. The leads from the BN-86 to the beta rods should be #12 AWG insulated wire no longer than 4 inches. Weatherproof the connection between the coax and the balun with Coax-Seal@.



Item No.	Description	Item No.	Description
7	Tube, Element, DE1, 1 1/4" x 98 1/2"	31	Bolt, hex head, #10-24 x 1/2"
14	Insulator, for DE1 and R1	32	Lockwasher, internal, #10
18	Hairpin, Driven Element, 1/8" x 91 1/2" x 1 1/8"	33	Nut, hex, #10-24
19	Hairpin, Driven Element, 1/8" x 91 1/2" x 1 1/8"	34	Bolt, hex head, #10-24 x 1"
20	Rod, Beta	37	Bolt, hex head, 1/4"-20 x 1/4"
22	Clamp, Beta	39	Bolt, hex head, 1/4"-20 x 1 1/2"
23	Clamp, for 1/4" rod	40	Lockwasher, internal, 1/4"
27	Screw, round or pan head, #6-32 x 1/2", Type T	41	Nut, hex, 1/4"-20
28	Lockwasher, internal, #6	49	Caplug, 2", black
29	Screw, round or pan head, #8-32 x 1/2", Type T	50	Rod Support, "Tombstone" Insulator
30	Lockwasher, internal, #8		

Figure 7 Installing "Hairpins" on Driven Element and Beta Match on Boom

A homemade RF choke may be constructed and used in place of the BN-86 balun. However, this may allow some skewing of the main lobe of the radiation pattern. The RF choke should consist of 12 turns of RG-213/u coaxial cable wound in a circle with a 14" inside diameter. See Figure 8.

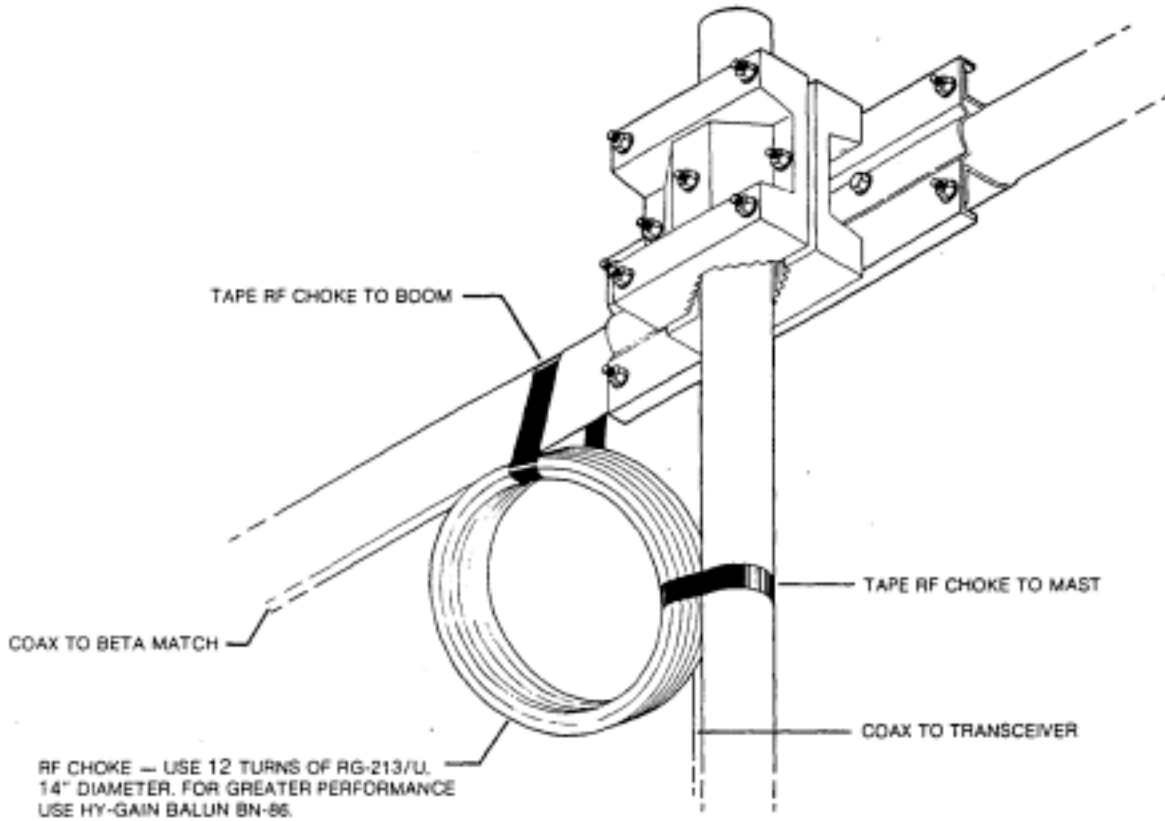


Figure 8
RF Choke

Strip back approximately 6" of the coax extending from the rf choke. Separate the . braid and the center conductor and place a solder lug on each. Insulate the braid using waterproof tape. This will prevent the braid from shorting out on the antenna

Install the 1/4" clamps (Item No. 23) on the beta match as shown in Figure 7. Attach the center conductor to one clamp and the braid to the other clamp. Carefully adjust the 1/4" clamps to the 11" measurement as shown in Figure 6. Then tighten the bolts securely.

Securely tape the coax to the antenna boom about every six inches and weatherproof the coax connection using Coax-Seal[®] or some similar substance.

Mount the antenna on your mast and drill a hole in the mast corresponding to the remaining hole in the boom-to-mast bracket. Securely tape the rf choke to the mast using waterproof tape.

These VSWR charts are typical for this antenna mounted 35 and 70 feet above ground, horizontally polarized. Similar curves can be expected for this antenna mounted between 30 and 100 feet above ground. Do not try to tune this *antenna* for low VSWR at *ground* level!

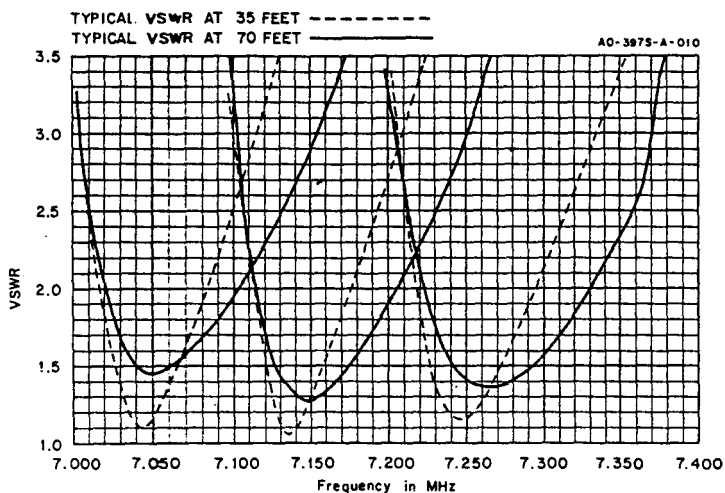


Figure 9
VSWR Chart

Converting English Measurements to Metric

Use this scale to identify lengths of bolts, diameters of tubes, etc.. The English inch (") and foot (') can be converted to centimeters in this way.

$$1 \text{ inch (1 ") = 2.54 cm}$$

$$1 \text{ foot (1') = 30.48 cm}$$

Example:

$$42" \times 2.54 = 106.7 \text{ cm}$$



PARTS

Item No.	Part No.	Description	Qty
1	102734	Bracket, Cast Aluminum	2
2	172735	Bracket, Casting-to-Boom	1
3	172732	Clamp, Boom-to-Bracket	1
4	165920	Bracket, Element-to-Boom, #14	4
5	171253	Tube, Boom, Driven End, 2" x 96"	1
6	171254	Tube, Boom, Reflector End, 2" x 96"	1
7	872029	Tube, Element, DE1, 1 1/4" x 98 1/2"	2
8	171252	Tube, Element, DE2 & R2, 1" x 30"	4
9	190206	Tube, Element, DE3 & R3, 7/8" x 55"	4
10	190006	Tube, Element, DE4, 5/8" x 26"	2
11	174939	Tube, Element, DE5, 7/16" x 55"	2
12	872028	Tube, Element, R1, 1 1/4" x 114 3/4"	2
13	171533	Tube, Element, R5, 7/16" x 58"	2
14	465833	Insulator, for DE1 & R1	4
15	178846	Hairpin, Reflector Shorting, 1/8" x 16 1/8"	1
16	171111	Hairpin, Reflector, 1/8" x 98 1/2" x 1 7/8"	2
17	171113	Hairpin, Reflector, 1/8" x 98 1/2" x 1 1/16"	2
18	171112	Hairpin, Driven Element, 1/8" x 91 1/2" x 1 7/8"	2
19	171114	Hairpin, Driven Element, 1/8" x 91 1/2" x 1 1/16"	2
20	173547	Rod, Beta	2
	871950	Parts Pack 397S, Stainless Steel Clamps	1
21	163266	Clip, Shorting	1
22	163371	Clamp, Beta	2
23	163376	Clamp, for 1/4" rod	2
24	380413	Clamp, Compression, 1/2" <i>358759</i>	4
25	380420	Clamp, Compression, 3/4" <i>358756</i>	4
26	380421	Clamp, Compression, 1" <i>358757</i>	4
	871951	Parts Pack 397S, Stainless Steel Hardware	1
27	520034	Screw, round or pan head, #6-32 x 1/2", Type T	26
28	565889	Lockwasher, internal, #6	28
29	520007	Screw, round or pan head, #8-32 x 1/2", Type T	4
30	560035	Lockwasher, internal, #8	6
31	500158	Bolt, hex head, #10-24 x 1/2"	8
32	565697	Lockwasher, internal, #10	28
33	554071	Nut, hex, #10-24	14
34	504069	Bolt, hex head, #10-24 x 1"	8
35	555693	Nut, square, #10-24	6
36	500156	Bolt, hex head, 1/4"-20 x 3/8"	4
37	505266	Bolt, hex head, 1/4"-20 x 3/4"	22
38	506518	Bolt, hex head, 1/4"-20 x 1 1/4"	4
39	504098	Bolt, hex head, 1/4"-20 x 1 1/2"	8
40	562961	Lockwasher, internal, 1/4"	33
41	554099	Nut, hex, 1/4"-20	26
42	551367	Nut, square, 1/4"-20	12
43	506968	Bolt, hex head, 5/16"-18 x 2 3/4"	2
44	500154	Bolt, hex head, 5/16"-18 x 3 1/2"	3
45	500153	Bolt, hex head, 5/16"-18 x 5"	4
46	564792	Lockwasher, split, 5/16"	9
47	555747	Nut, hex, 5/16"-18	9
	872390	Parts Pack B, 402BA-S	1
48	455644	Caplug, 7/16", black	4
49	455625	Caplug, 2", black	2
50	463642	Rod Support, "Tombstone" Insulator	24
51	190000	Tube, Element, R4, 5/8" x 48", swaged	2