

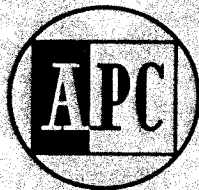
Bob Rowan
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TECHNICAL MANUAL
for
HI-ANGLE HF ANTENNA
TYPE LPH-15

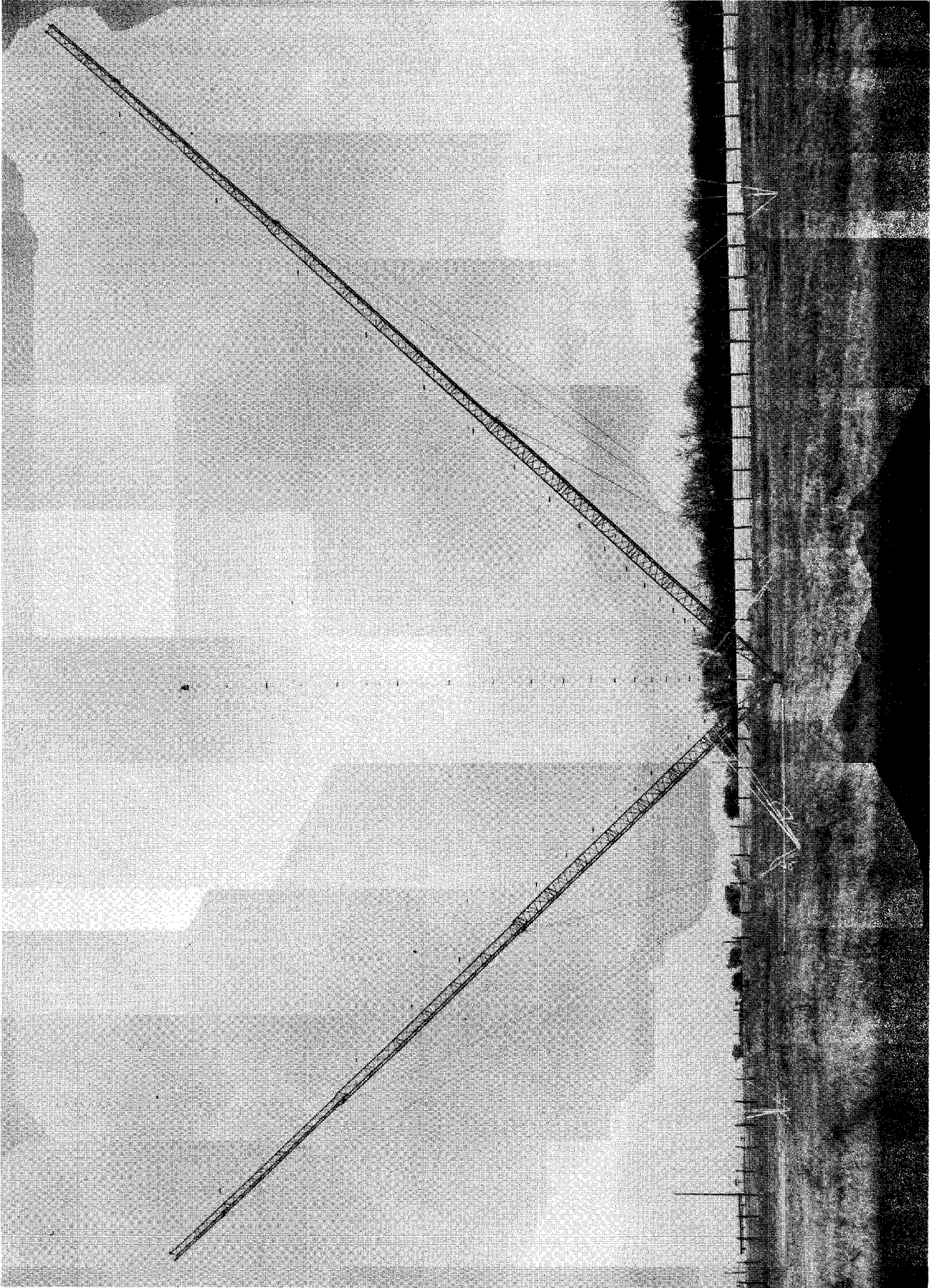
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ANTENNA PRODUCTS COMPANY
A Division of All Products Company
BOX 520 • MINERAL WELLS, TEXAS • FA 5-3301



HI-ANGLE HF ANTENNA
Type LPH-15
Figure 1.1

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TABLE 1.1
EQUIPMENT SUPPLIED

<u>APC P/N</u>	<u>PART NAME</u>	<u>DESCRIPTION</u>
1500 0076 001	Antenna System Kit	Consists of
0001 7146 001	Guy Kit	All tower guys with connecting hardware.
0001 7187 001	Erection Kit	Tag lines, winch and drive stakes, pulley, gin pole assy and hardware including sledge hammer.
0001 7177 001	Ground Hardware Kit	All anchors and drive stakes required for securing the guys and tower base.
1000 0318 001	Balun	An impedance matching transformer mounted at the tower base.
1000 0316 001	Tower Kit	Two supporting towers, complete with hinge base and connecting hardware.
1000 0319 001	Curtain Assembly	Elements and transmission line completely assembled with insulators and fittings.
0001 7261 001	Feed Assembly	A two-cable feed assembly connecting the balun to the antenna.
0001 7341 001	Tool Kit	Anchor bar for inserting screw anchor and open end hand wrenches.
0001 7315 001	Spare Hardware Kit	Additional hardware for installation losses.

HI-ANGLE HF ANTENNA
TYPE LPH-15

1.0 GENERAL DESCRIPTION

1.1 PURPOSE OF EQUIPMENT

The LPH-15 is a highly transportable bidirectional log periodic HF antenna designed for short range tactical communications in the 4 - 30 mHz frequency range. The antenna curtain is mounted vertically with the front end nearest the ground. It radiates skyward and uses ionospheric propagation to effectively circumvent the limitation of ground wave communication over rough terrain. Since the antenna provides efficient high-angle radiation, coverage to over 700 miles is accomplished.

The antenna is specifically designed for installation in areas where limited space is available. The two towers are mounted onto one pivot base utilizing only a minimum required installed area of 71 feet square.

The antenna is designed for use in hostile environments, is constructed of corrosion and fungus resistant materials, and contains no dissimilar metal joints.

1.2 EQUIPMENT DESCRIPTION

The LPH-15 is a one-curtain log periodic antenna supported by two 100 foot insulated aluminum towers utilizing Mylar[®] rope guys. The two towers are mounted onto one base and are positioned to approximately 45 degrees. The curtain is suspended between the towers and mylar rope guys are utilized at three positions attaching to four, six inch screw anchors. Four, three-way drive stake type anchors are also provided for use in soil that will not allow penetration of the screw anchors.

The antenna proper consists of phosphor bronze strand element wires, galvanized aircraft cable droppers, and fiberglass reinforced plastic insulators. The antenna proper is completely assembled and quick disconnect fittings are utilized at the element dropper to tower connections. The towers are constructed of 10 foot sections, insulated at the center by fiberglass reinforced plastic insulators. The insulators thus being at a fixed epoxied joint and not at the detachable joint. Two each quick disconnect pin assemblies are utilized at each tower leg joint.

The transmission line, which is a part of the antenna curtain, consists of phosphor bronze wires terminating at the tower base balun through an RG-17 two-cable feed assembly.

1.3 SPECIFICATIONS

Electrical

Frequency Range	4 - 30 mHz
Gain	8 db (minimum of 6 db) above free space isotropic source
VSWR	Not to exceed 3:1
Input Impedance	50 Ohms
Power Capability	2.5 kw average, 5 kw pep
Polarization	Horizontal

Mechanical

Environmental	100 mph winds without ice
Shipping Weight	2,000 lbs.
Shipping Volume	300 cu. ft.
Maximum Dimension of any Component	10 ft.
Materials	
Tower, Base Plate and Anchors	Aluminum
Transmission Line and Elements	Phosphor bronze
Hardware	Stainless steel and hot dip galvanized
Guys	Mylar® rope
Insulators	Fiberglass reinforced plastic

2.0 INSTALLATION

2.1 GENERAL

Erection of the LPH-15 antenna system is accomplished in two basic steps, using a falling gin pole and hand winch.

First: Erection of one tower using the 30 foot gin pole

Second: Erection of the second tower using the gin pole and first tower

The one erection guy utilizes an extra length of cable for erecting and is used as a permanent guy for the final installation. The tower base is anchored in place with four drive stakes. An erection screw anchor is utilized for raising the antenna. Either screw anchors or drive stake type anchors are utilized for guying the antenna. Since the antenna system is transportable, no part of the equipment is permanently installed in concrete.

2.2 SELECTION OF SITE

2.2.1 Electrical Considerations

If the antenna is to be used for receiving, consideration should be given to electrical interference emanating from nearby sources. High tension power lines, construction projects, electric motors, welding equipment, unshielded ignition systems, fluorescent lights, etc., are examples of objects which normally generate high levels of electrical noise. The greatest possible separation from objects of this sort will considerably enhance the operational reliability of the communication circuit.

The antenna should be located in a clear area as large as possible. Obstacles which have an appreciable conductor length in the horizontal plane, such as guy wires, other antennas, power lines, buildings with steel reinforcements, etc., are especially objectionable. Such obstacles located within a few hundred yards of the antenna may not only disrupt the radiation characteristics of the antenna, but can also have an adverse effect upon the impedance characteristics.

2.2.2 Mechanical Considerations

The area required for installation is approximately 71 feet square. This area should be as level as possible, well drained, cleared of tall vegetation and exhibit a minimum load bearing capacity of 650 pounds per square foot.

CAUTION

Since the balun is mounted to the tower base plate and near the ground, it is necessary to elevate the ground beneath the base plate sufficiently to insure proper drainage. The balun is oil filled and watertight. The electrical connections are located on top of the balun and if water is allowed to cause a "short circuit" between these terminals, the antenna will be disabled.

Six screw anchors are utilized for Class Six soil such as soft-plastic clay, loose coarse sand, clayey silt, or compact fine sand. If the soil will not allow penetration of the six inch screw anchors, the triple-rod drive stake type anchors should be utilized.

CAUTION

Do NOT use the drive stake anchors unless it is impossible to penetrate the soil with the six inch screw anchors.

2.3 PREINSTALLATION

Having selected the antenna site, the ground beneath the antenna should be cleared of all brush. This area should be approximately 100 feet long and as wide as required to allow assembly of the antenna prior to erection. Position the tower base in one end of this cleared area so there will be a 100 foot cleared distance on the erection side of the base. Refer to the erection details, Figure 2.11. Figure 2.11 and Anchor Layout Figure 2.1.

2.4 ASSEMBLY AND ERECTION

The complete assembled antenna system is shown in Figure 2.2. Detailed assembly and installation drawings are referred to from this assembly drawing. The assembly and erection of the LPH-15 is performed in four major steps as listed below and can be accomplished in three hours by a trained crew of five men. Figure 2.2 should be used in conjunction with the erection details beginning on Figure 2.11.

Step No. One (Figure 2.11)

1. Assemble the two 100 foot towers (Figure 2.4) and the 30 foot gin pole (Figure 2.13). Color code markings are utilized for assembling the tower sections together. Each tower section is ten feet long, insulated at the center, with color code markings on each end. Beginning with the tapered base section, assemble the next ten foot section having a matching red color code. Two captive pins are utilized on each leg at the tower joints.
2. Set the first tower on the base pin with the element attachment holes facing down. (Two legs up.)

NOTE

The towers may need to be partially erected to be positioned on the base pin or the ground may be dug out a few inches to allow the tapered base to set onto the base pin. A nut is utilized behind the tapered base plate of each tower section to secure the tower to the pivot base.

3. Connect the erection guy to the first tower and to the gin pole. As previously stated, the erection guy utilizes an extra length of cable and is also used as a permanent guy. Refer to Figure 2.13 for the attachment to the top of the gin pole.
4. Connect the winch and tag lines to the gin pole. Position the winch as shown in Figure 2.1, 2.11 and 2.14 and secure with drive stakes. The pulley is assembled onto the winch cable and a shackle (Item 37) is provided for attaching to the four inch screw anchor.
5. Set the gin pole assembly on the tower base pin (Figure 2.13) and tighten the winch cable.
6. Tie the gin pole tag lines to the side anchors.

Step No. Two (Figure 2.11)

1. Erect the first tower to a maximum height of five feet above ground at the top end. This will allow access to the underside for connecting the curtain.
2. Lay out and attach the curtain and guys to the tower. As shown in Figure 2.3, the curtain is completely assembled. Quick attaching tubes are utilized at the ends of the element droppers for attaching to the tower leg as shown in Figure 2.10.

CAUTION

It is possible to twist the transmission line and connect the elements to the wrong tower. The transmission line wires must not cross. They will zig-zag but always stay equal distance apart. The element on one tower side must alternately connect to the transmission line.

The guys as called out in Figure 2.11, Step One, must connect to the first tower before raising.

3. Erect the first tower to approximately 90° using the side guys to stabilize the tower.

NOTE

The gin pole will come loose from the tower base pin. Slide the gin pole across the ground as required.

4. Set the second tower on the tower base pin with the element attachment holes facing upward.

NOTE

As previously noted, the tower may need to be erected partially or the ground dug out to allow the tapered base to be positioned on the base pin.

Secure the tower to the base pivot with the nut provided.

5. Connect the curtain and guys to the second tower as previously explained. Connect the lower, intermediate and upper guys to the tower and their respective anchors. (Figures 2.7, 2.8 and 2.11)

CAUTION

The middle guys must be connected to their respective anchor before erection of the final tower. These guys should be kept taunt and manually adjusted thus keeping control of the towers and to stop erection when the towers reach the final position.

Step No. Three (Figure 2.12)

1. Continue pulling the winch cable until the gin pole (now disconnected from the tower base) reaches the erection screw anchor.
2. Pull the winch cable by hand until the antenna towers are at 45 degrees as shown in Step 4 of Figure 2.12. Attach the guys to their respective anchors with the rope snubbers as shown in Figure 2.8.

Step No. Four

1. Tension all guys to approximately 100 pounds. Sight up each tower while tensioning to prevent bending due to improper guy tensions.

This completes the erection of the LPH-15 antenna system.

2.4.1 Tower and Curtain

2.4.2 Balun

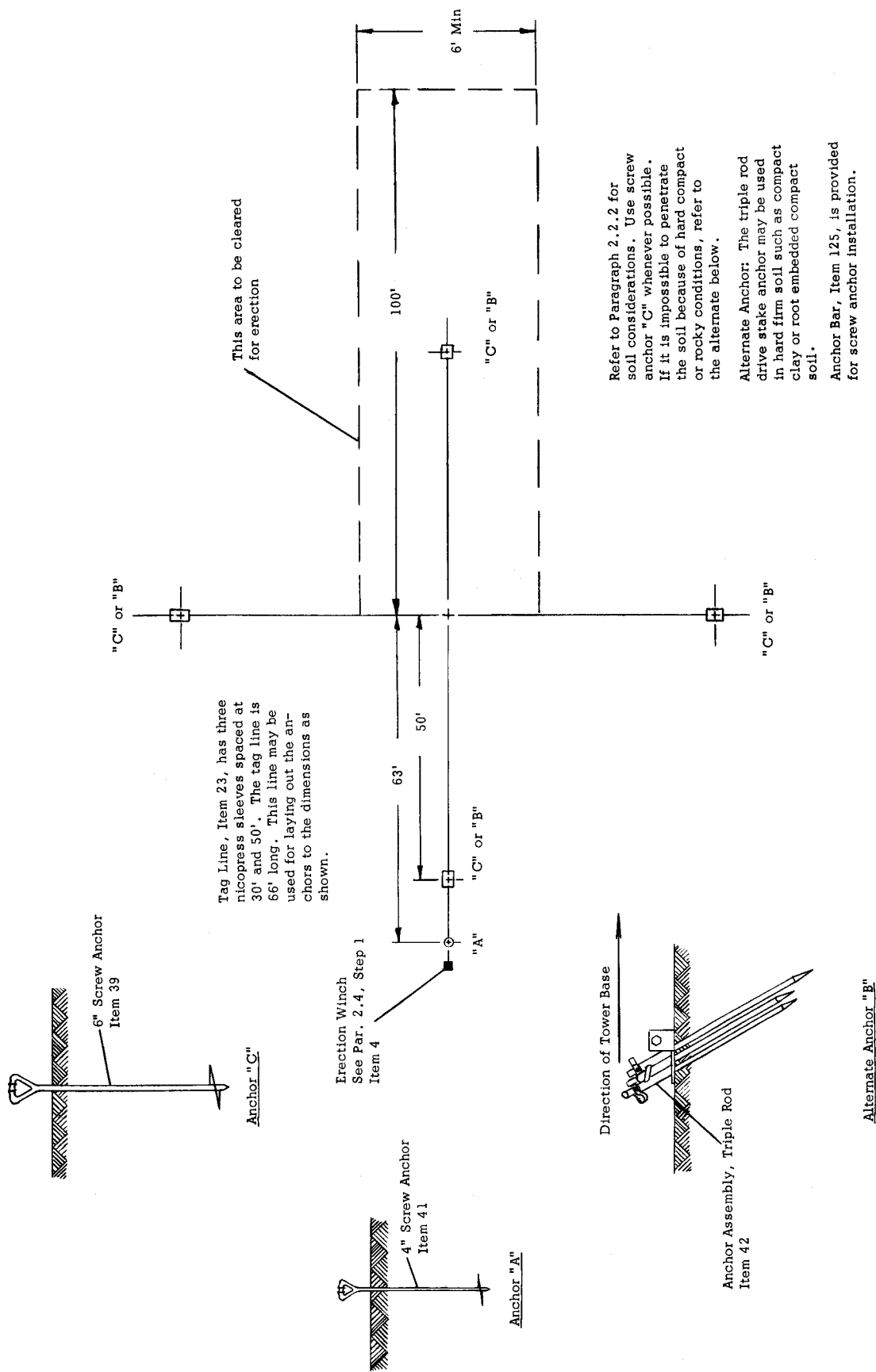
The balun, Item 52, is attached to the tower base plate with 3/8" galvanized hardware, Items 78, 79 and 81 as shown in Figure 2.6.

2.4.3 Feed Line

The feed line assembly, Item 117, attaches to the curtain transmission line as shown in Figure 2.6. The feed line terminals are different on each end and must be positioned as shown.

2.4.4 Conclusion

Visually inspect the antenna for element wire "kinks", correctness of connections, straightness of towers, tightness of feed line connections and proper guy tensions. This completes the installation of the LPH-15 hi-angle HF antenna system.

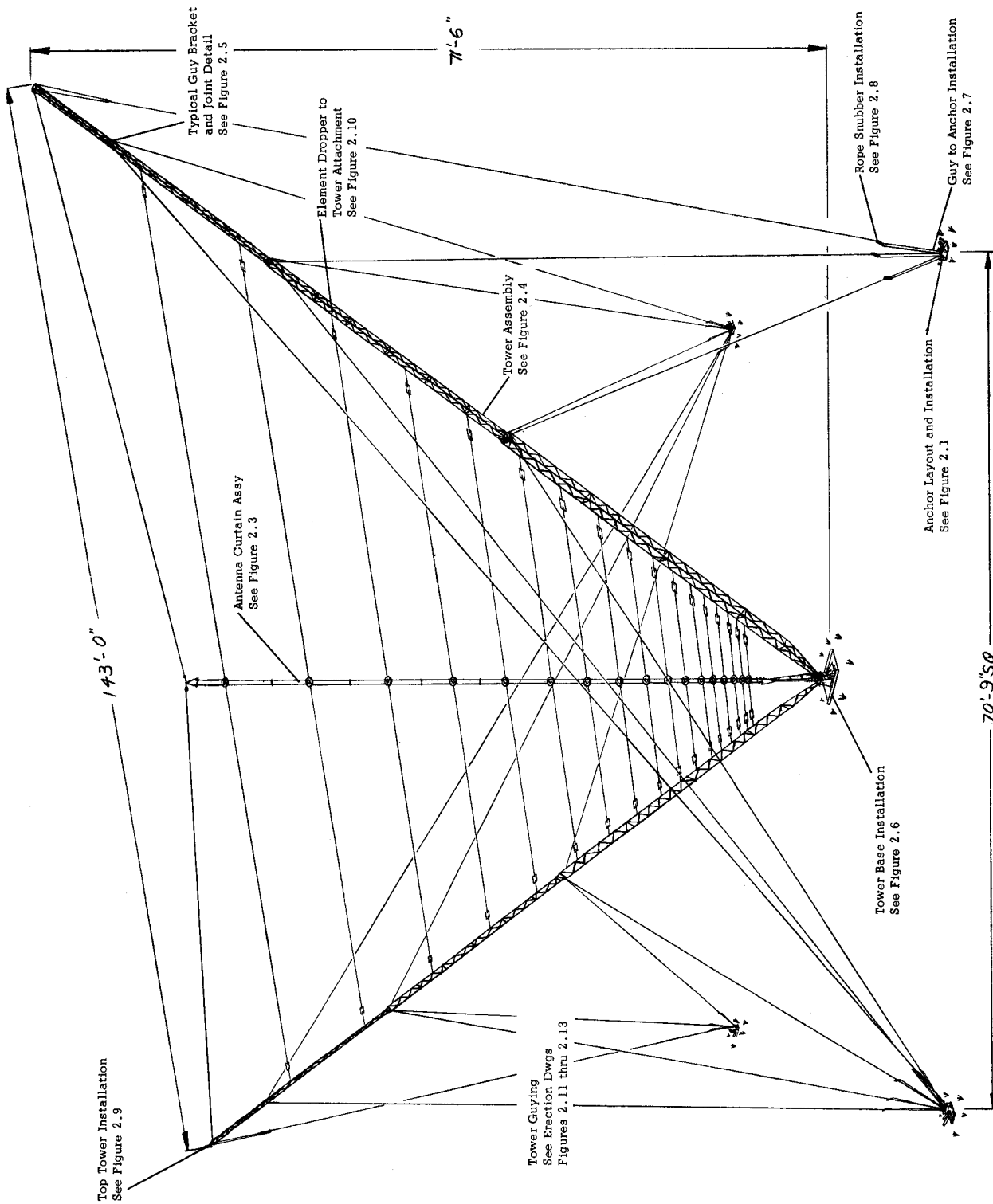


Refer to Paragraph 2.2.2 for soil considerations. Use screw anchor "C" whenever possible. If it is impossible to penetrate the soil because of hard compact or rocky conditions, refer to the alternate below.

Alternate Anchor: The triple rod drive stake anchor may be used in hard firm soil such as compact clay or root embedded compact soil.

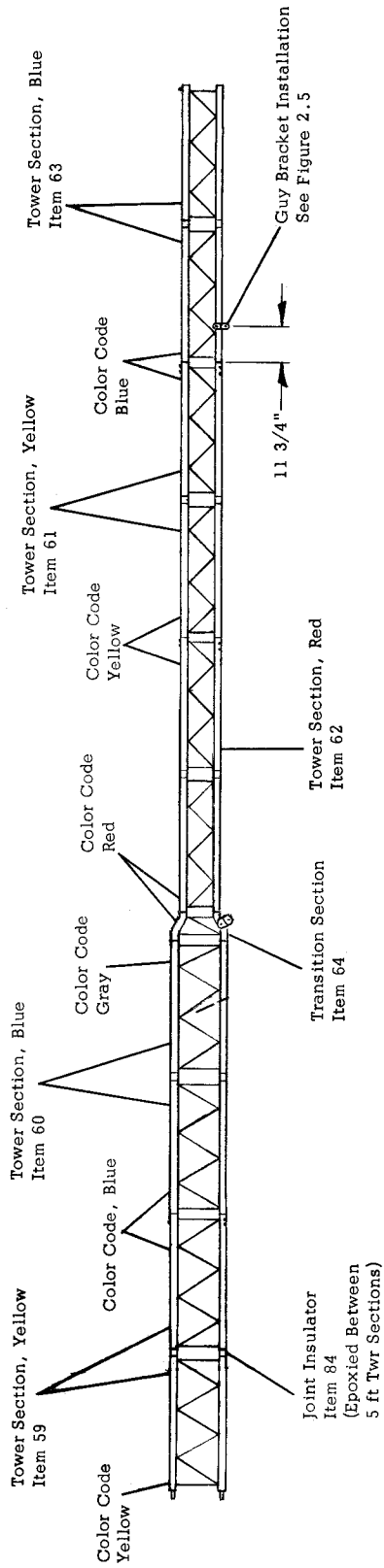
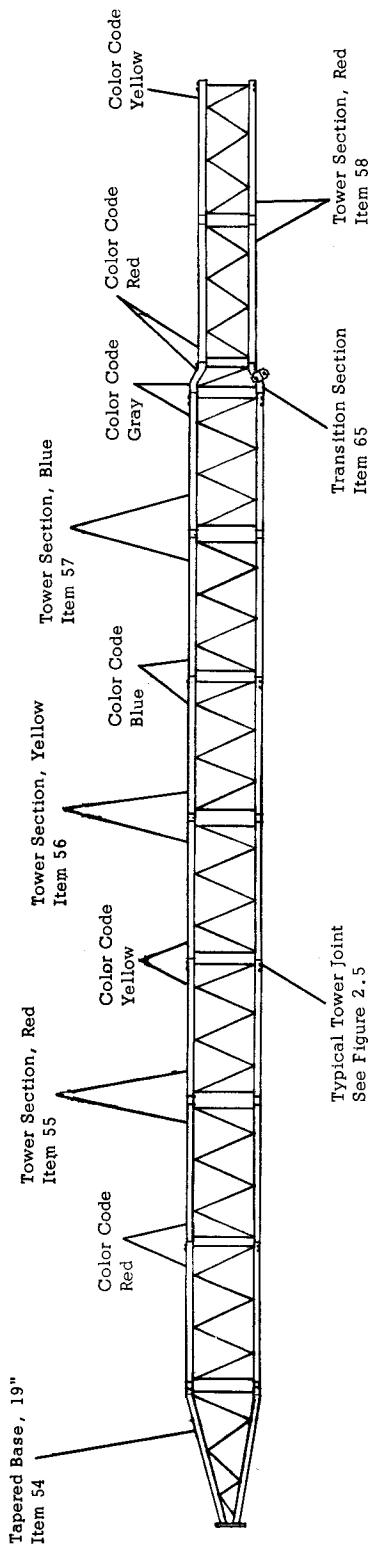
Anchor Bar, Item 125, is provided for screw anchor installation.

ANCHOR LAYOUT AND INSTALLATION
Figure 2.1



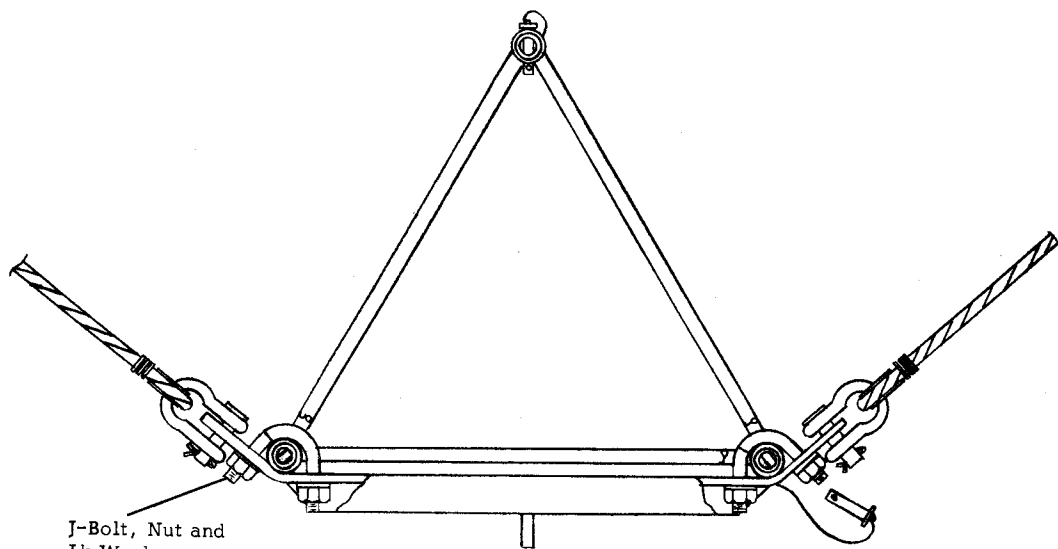
ASSEMBLED ANTENNA SYSTEM

Figure 2.2



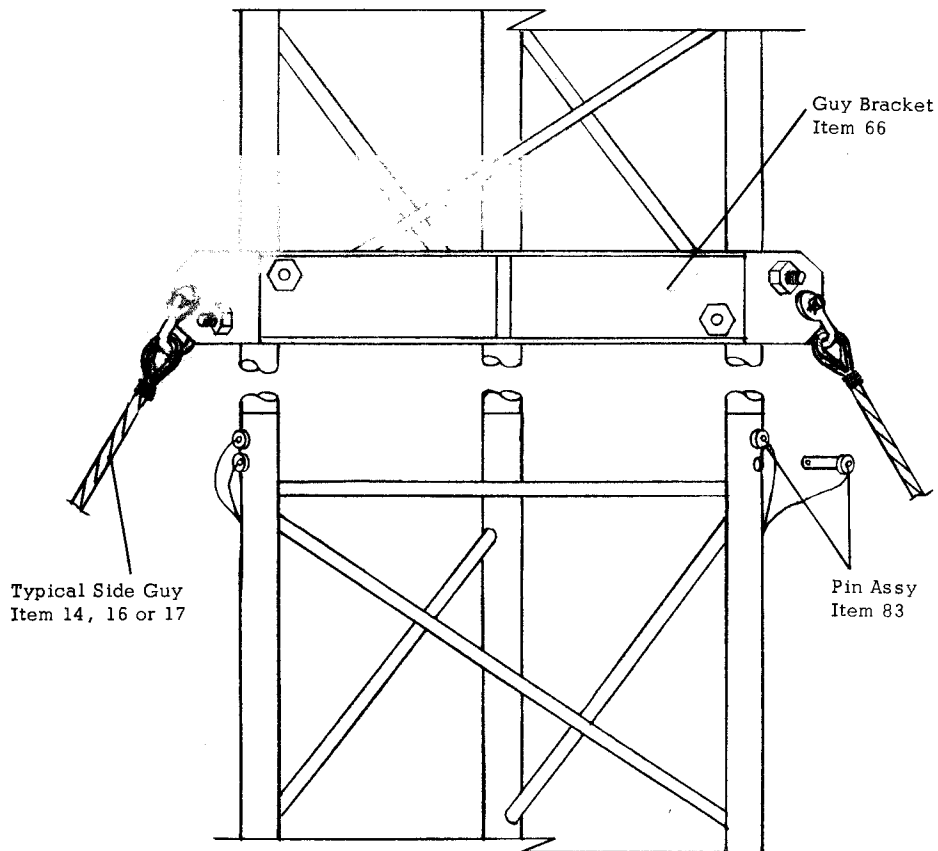
*Position all color codes together thus aligning tower.

TOWER ASSEMBLY
Figure 2.4



J-Bolt, Nut and
Lk Wash
See Item 66

Top View

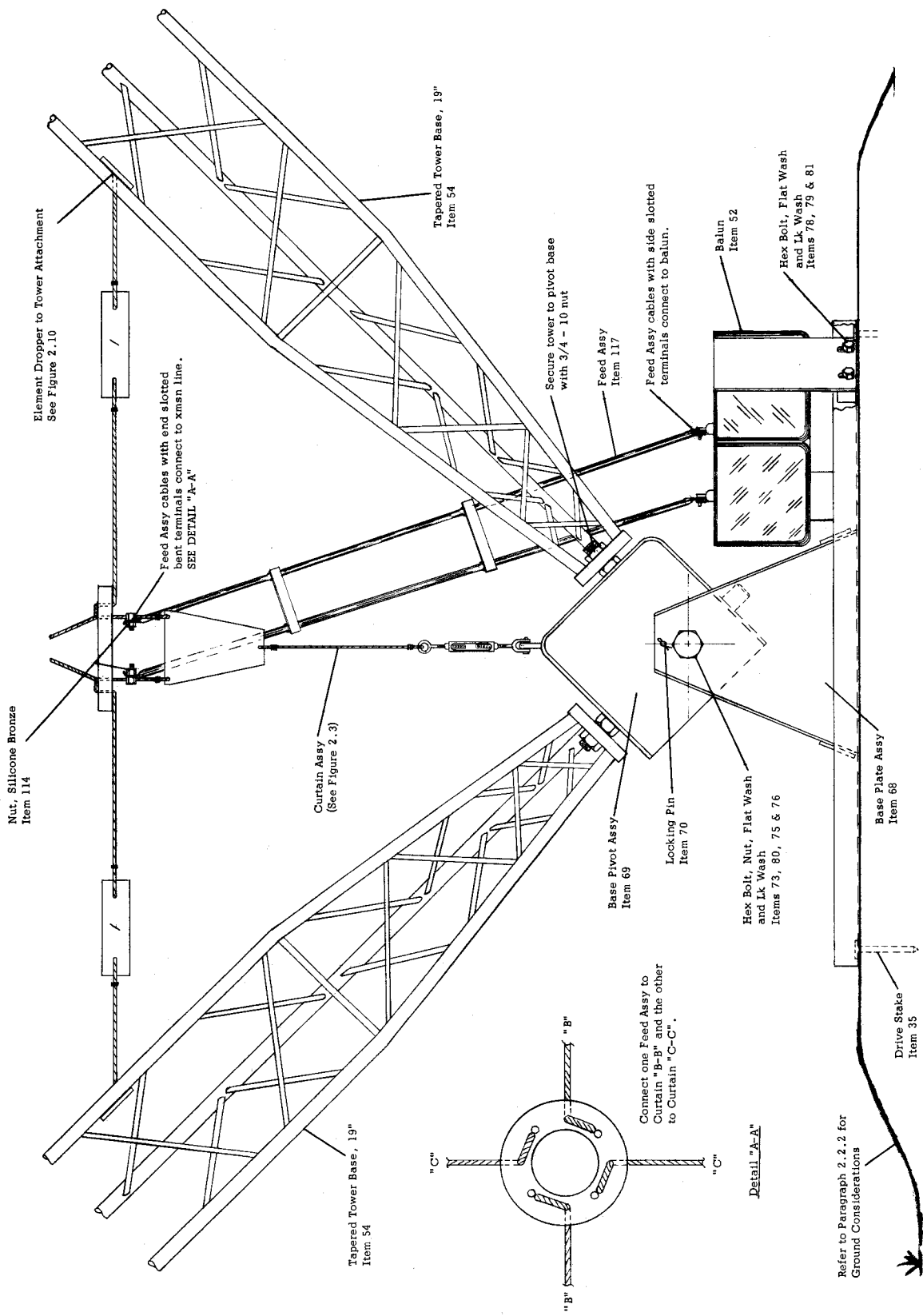


Guy Bracket
Item 66

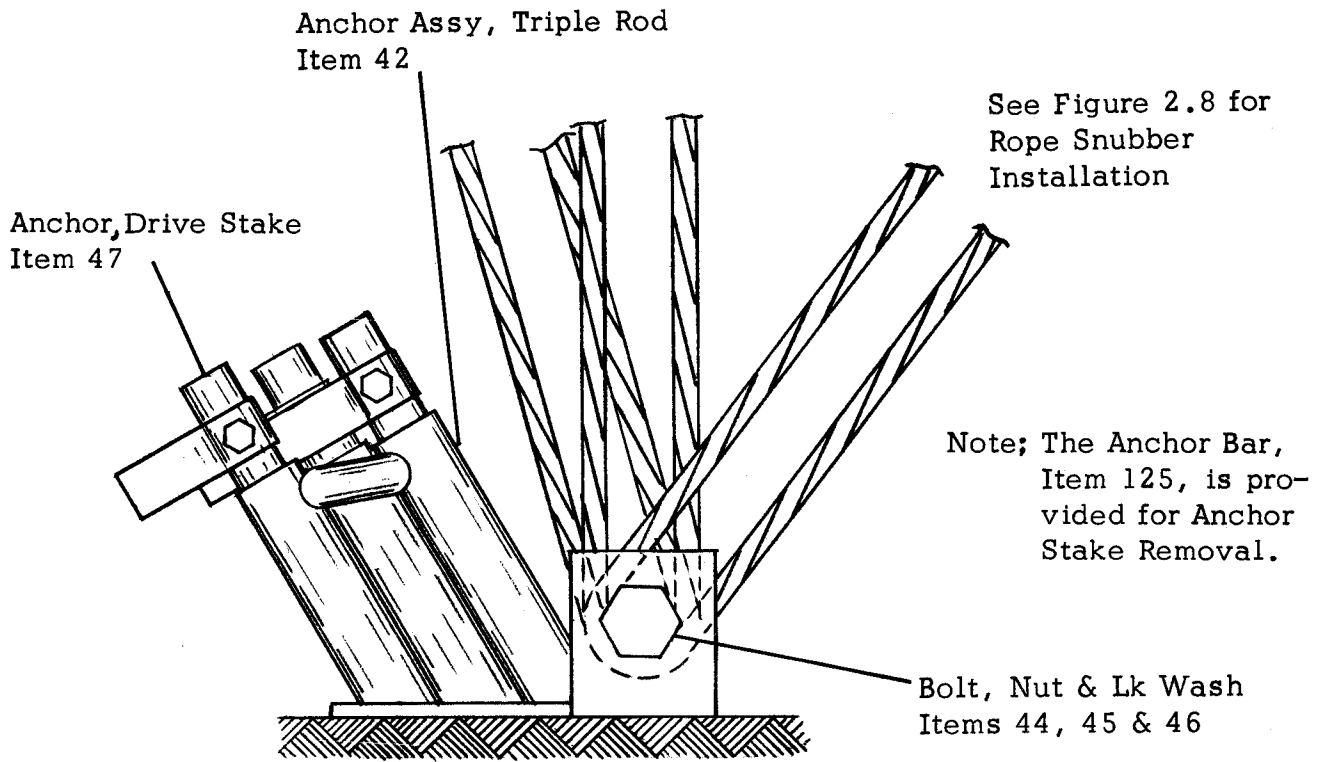
Typical Side Guy
Item 14, 16 or 17

Pin Assy
Item 83

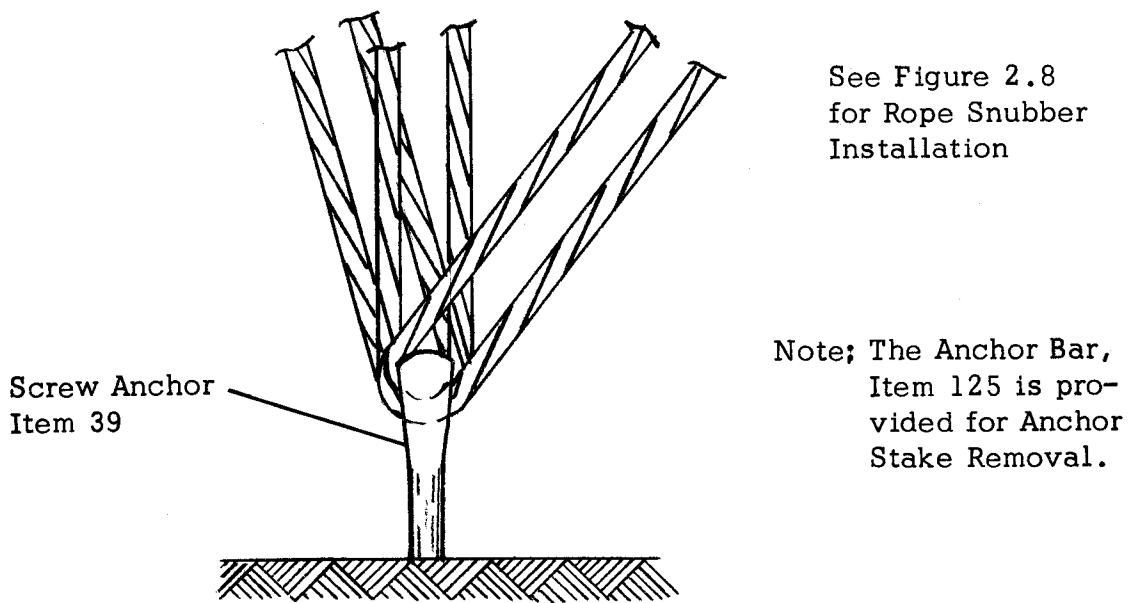
GUY BRACKET AND
JOINT DETAILS
Figure 2.5



TOWER BASE INSTALLATION
 Figure 2.6

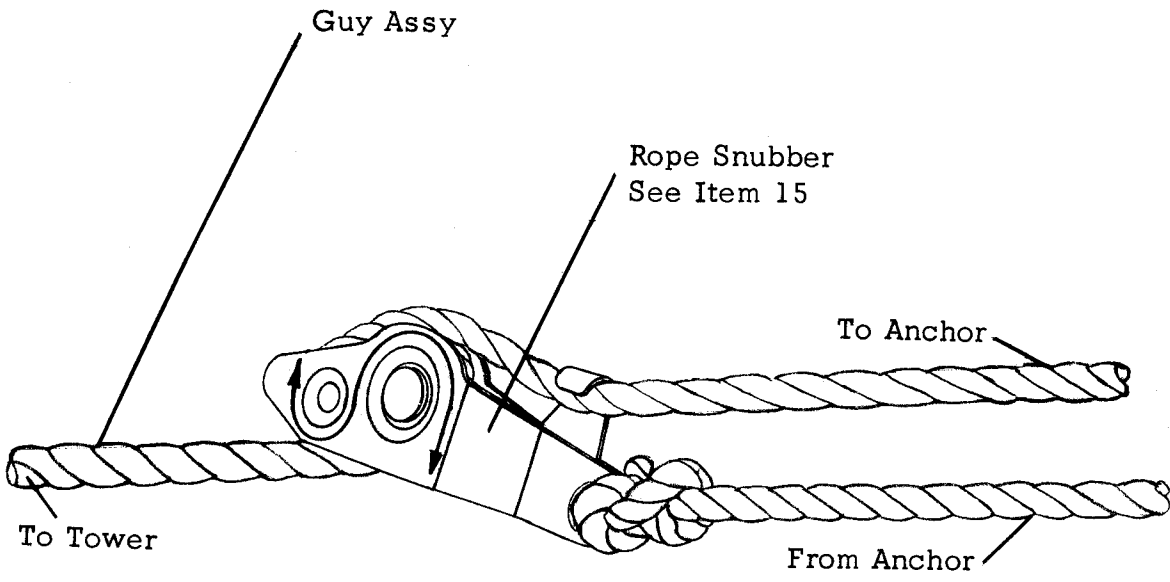


Drive Stake Anchor

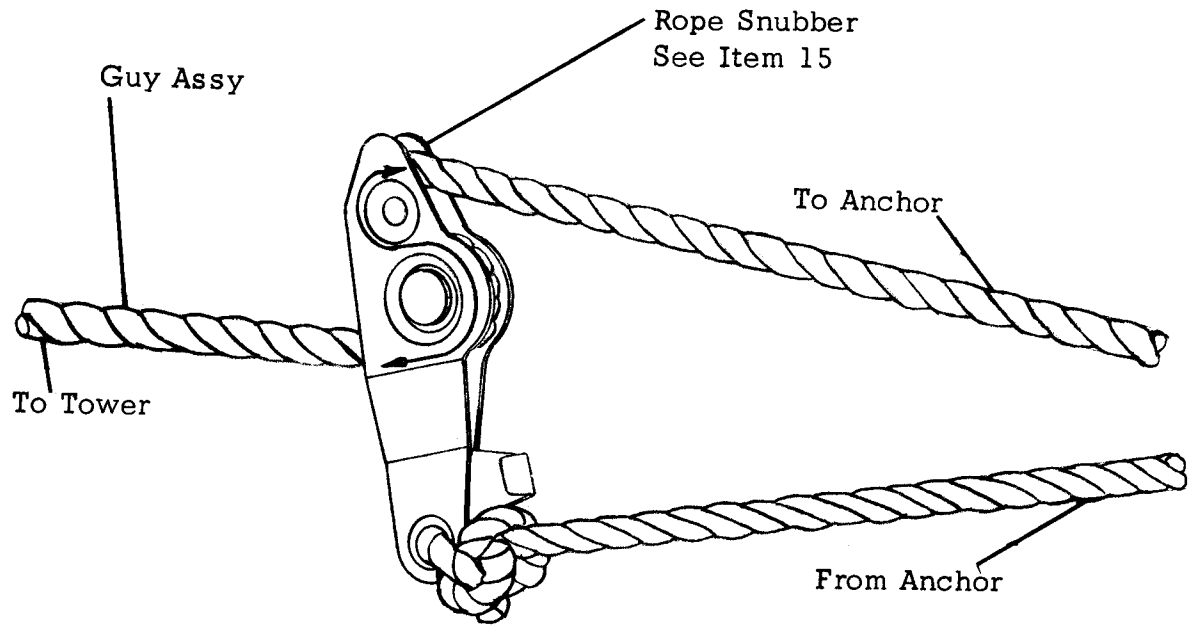


Screw Anchor

GUY TO ANCHOR INSTALLATION
Figure 2.7

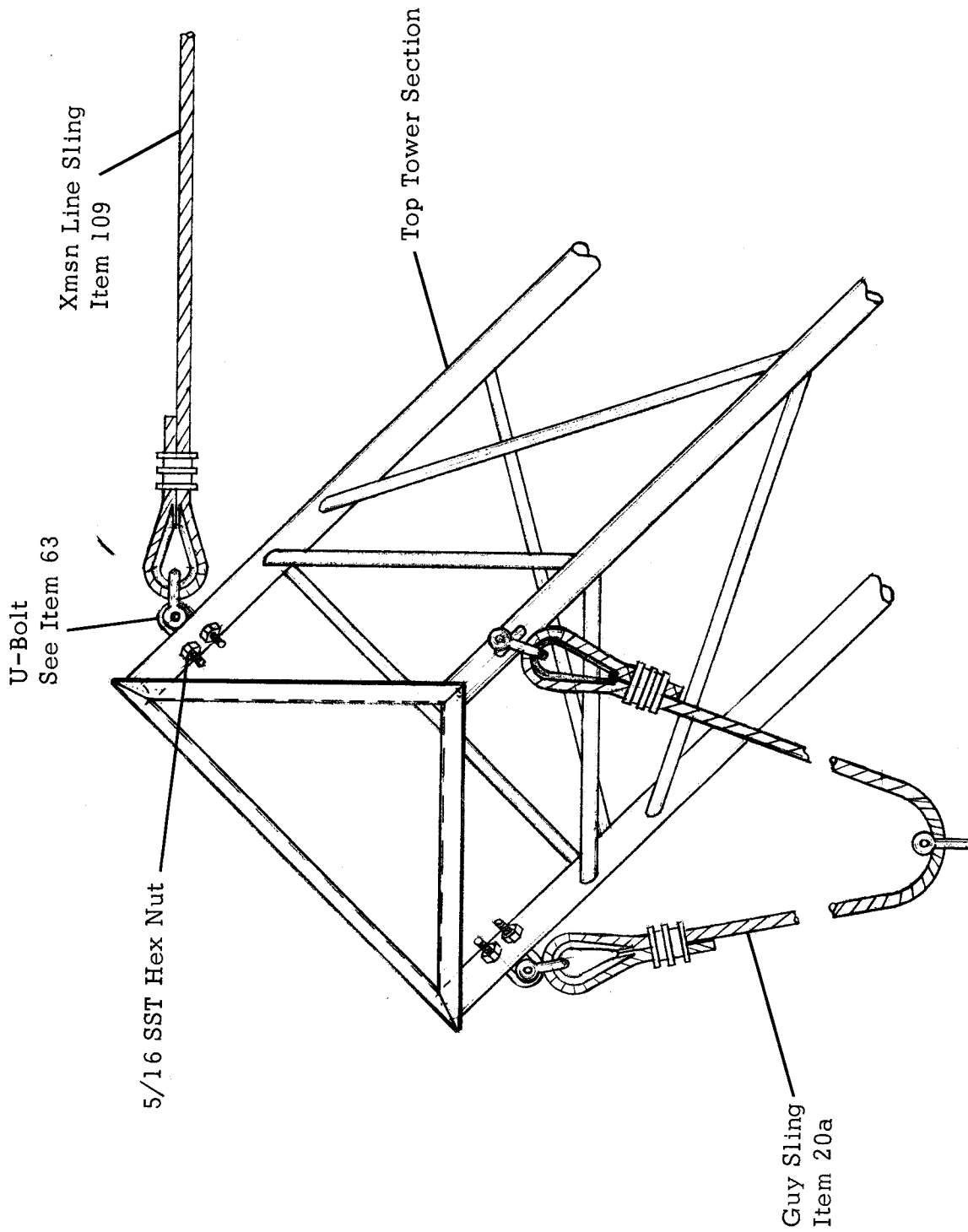


Lock Position

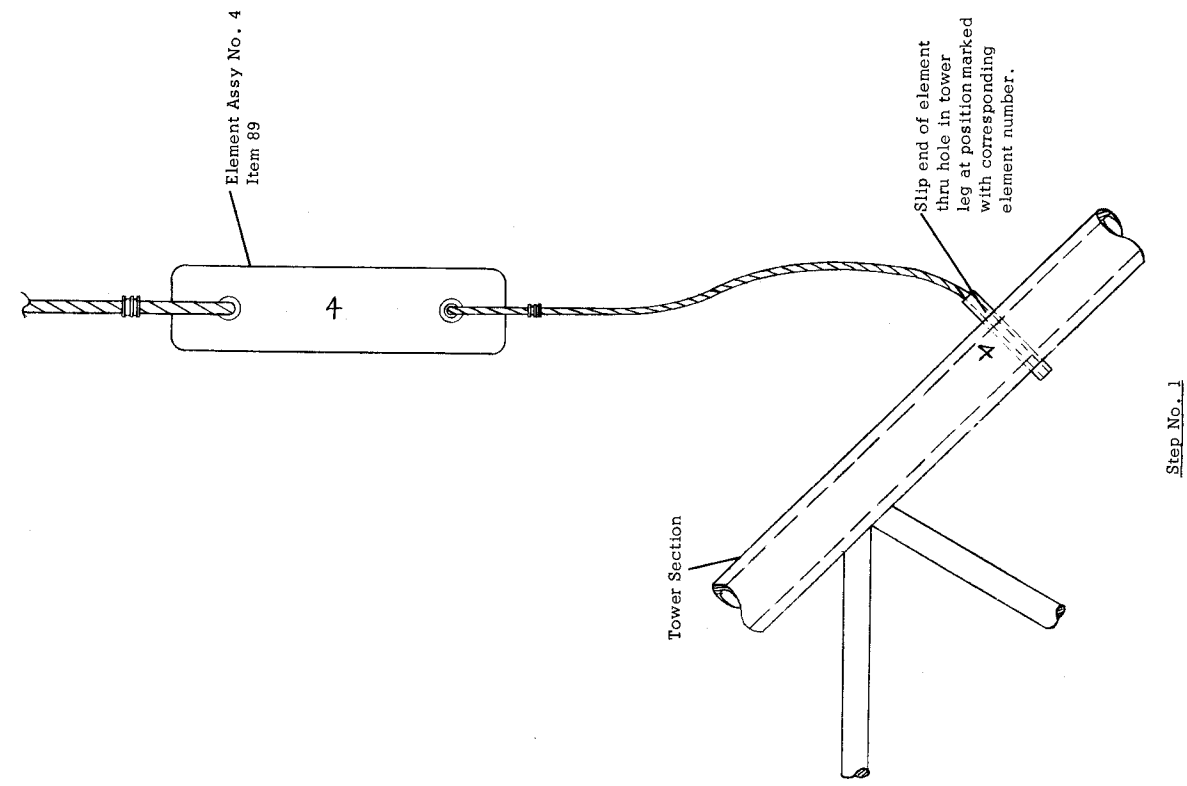


Free Position

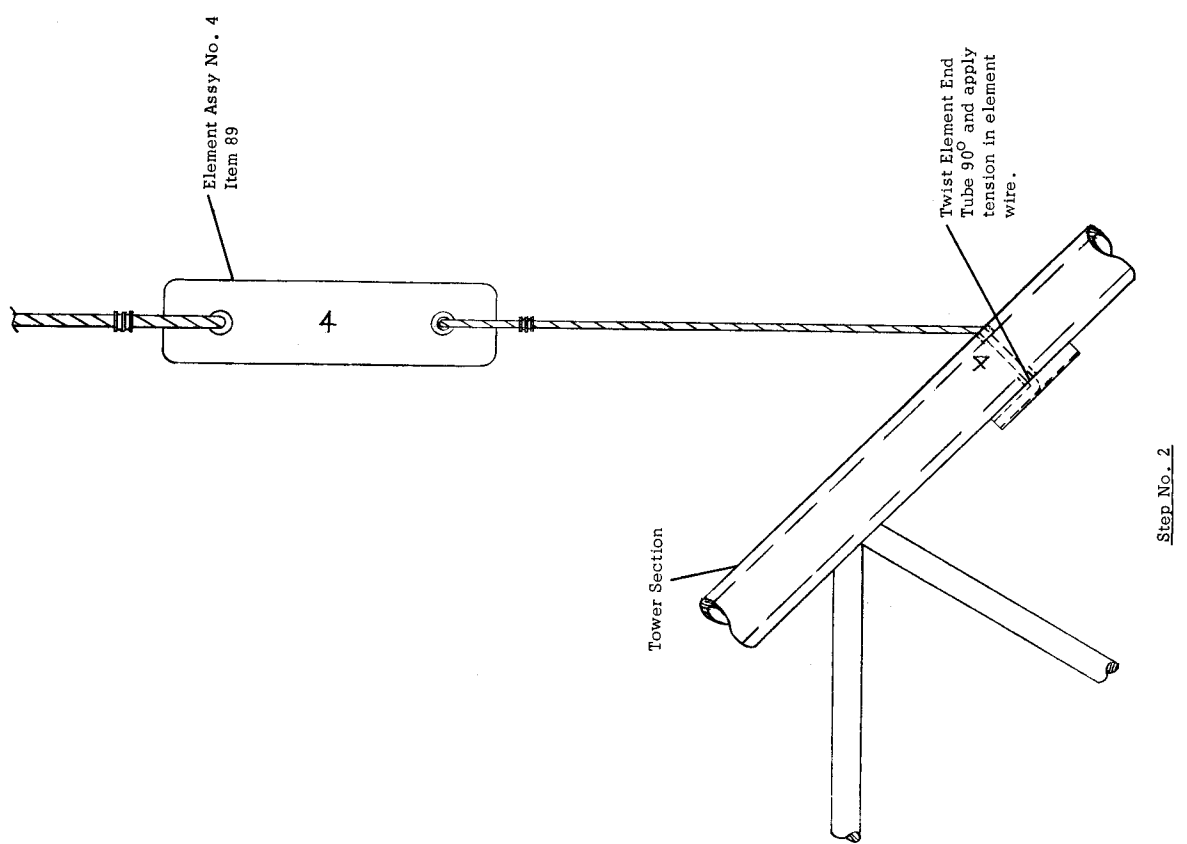
ROPE SNUBBER INSTALLATION
Figure 2.8



TOP TOWER INSTALLATION
 Figure 2.9

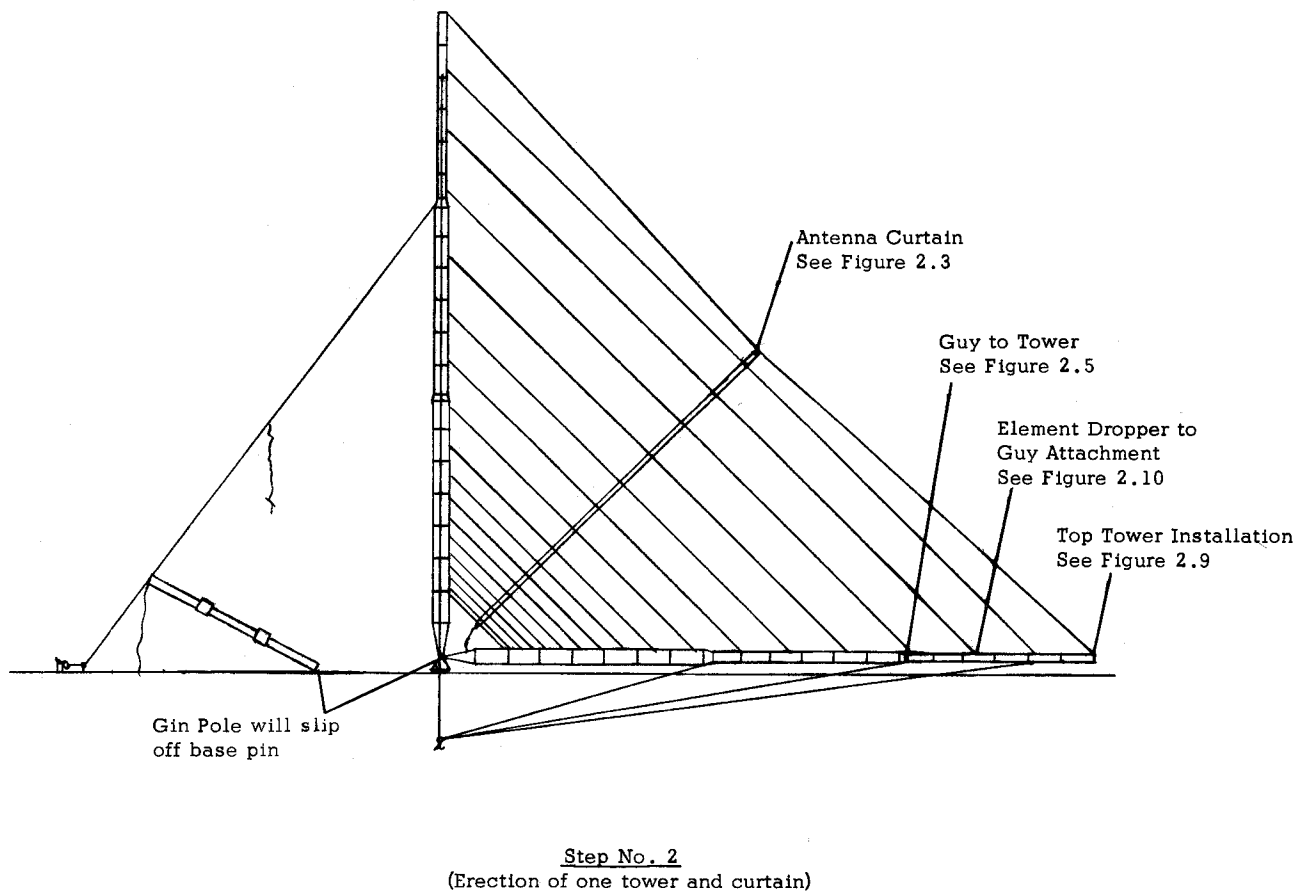
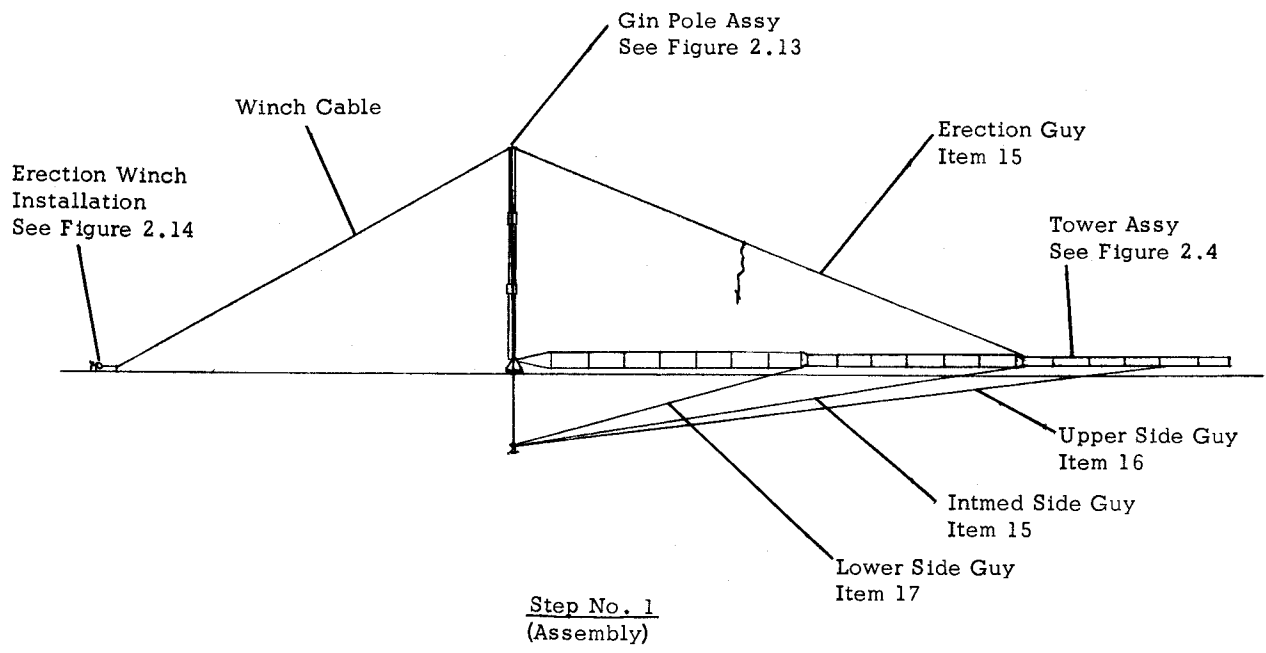


Step No. 1

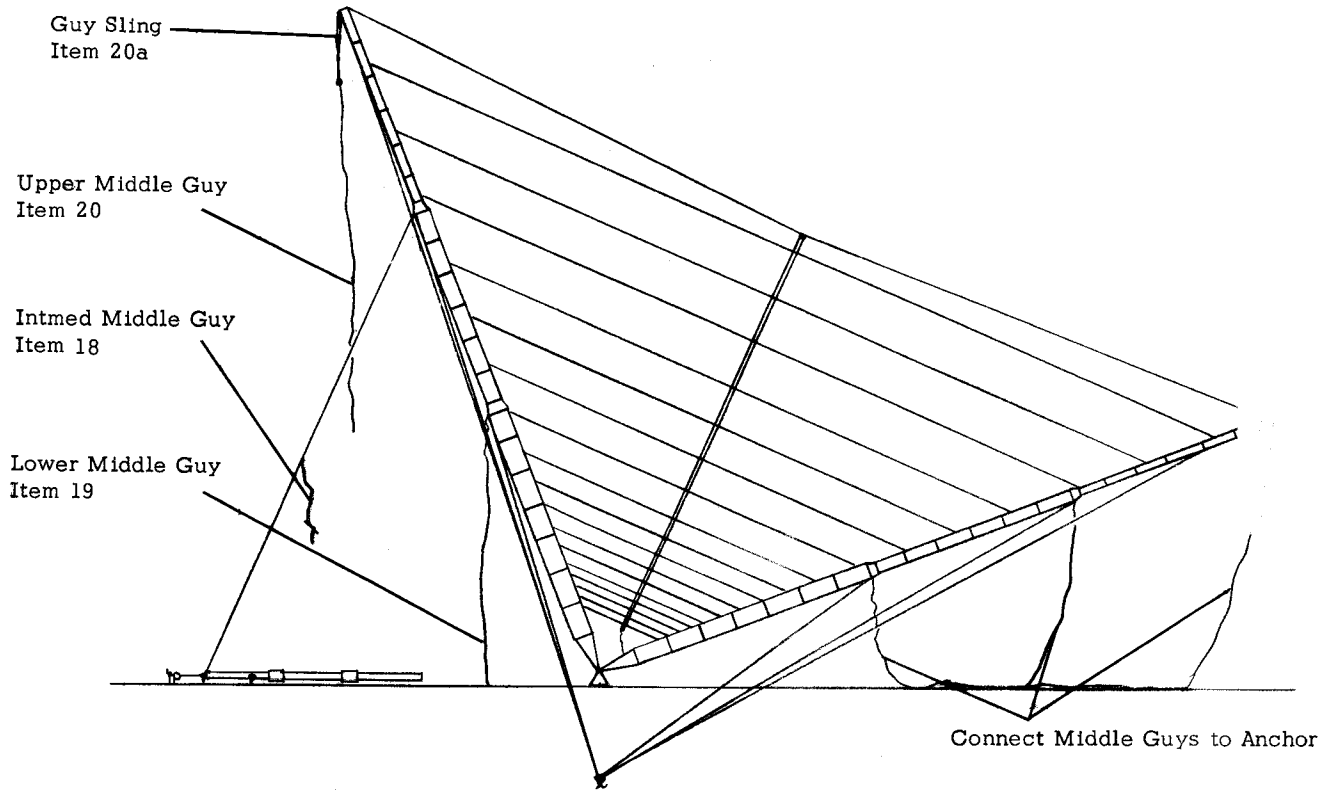


Step No. 2

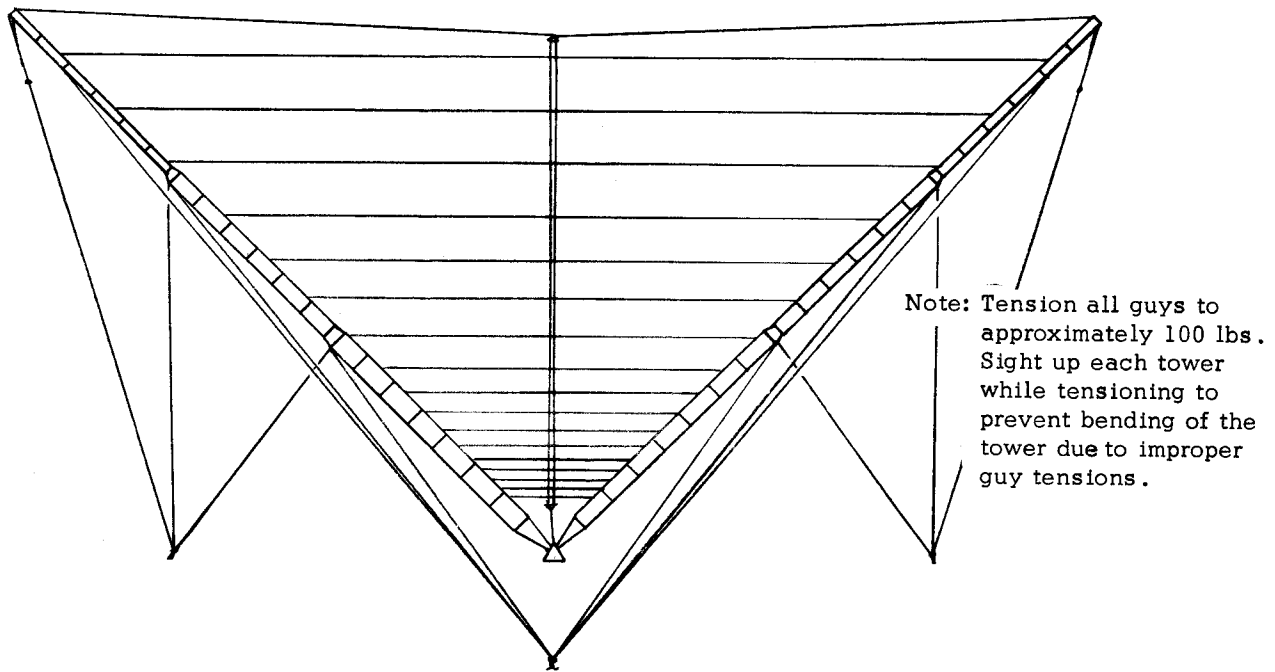
ELEMENT DROPPER TO TOWER ATTACHMENT
Figure 2.10



ERECTION DETAILS
Figure 2.11

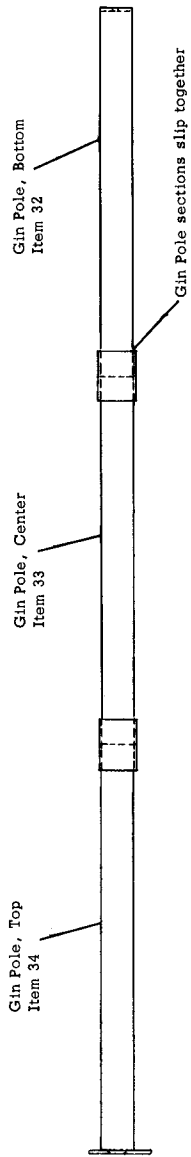


Step No. 3
(Final Erection)

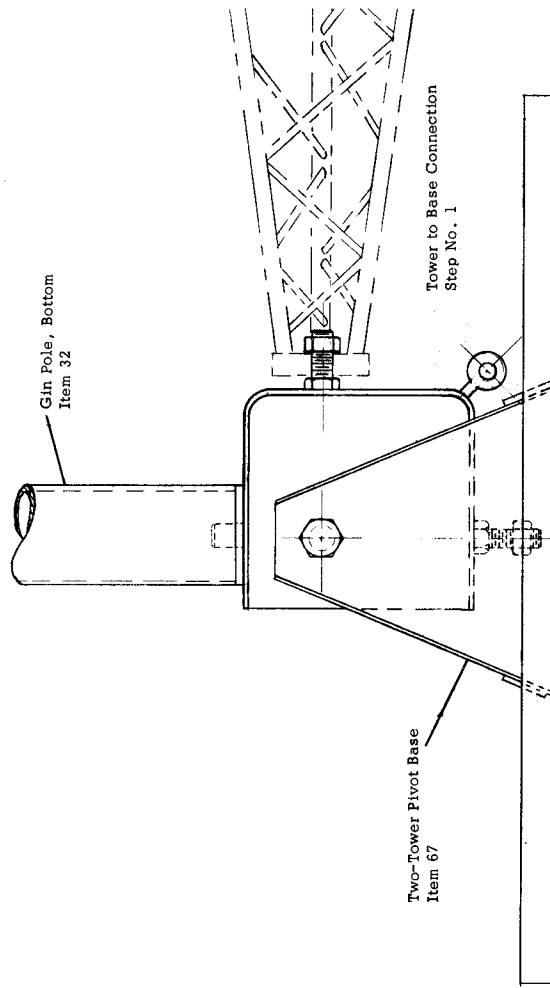
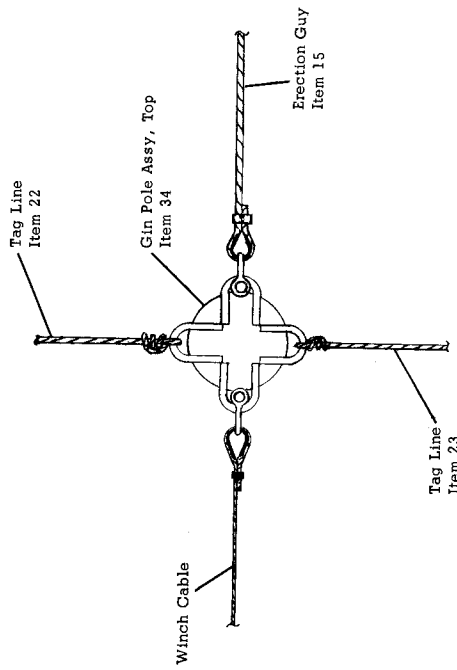


Step No. 4
(Installed Position)

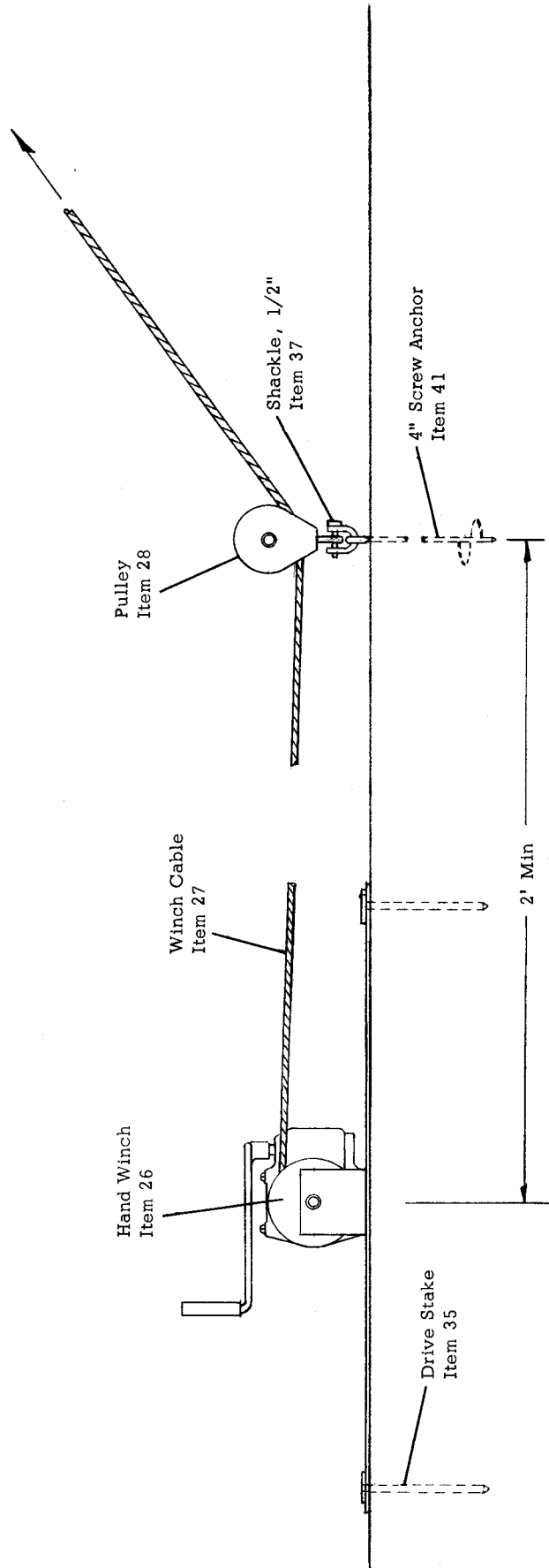
ERECTION DETAILS
Figure 2.12



Gin Pole Assy



GIN POLE INSTALLATION
Figure 2.13



ERECTION WINCH INSTALLATION
Figure 2.14

3.0 ANTENNA THEORY

3.1 INTRODUCTION

The LPH-15 is basically a log periodic antenna having the characteristics of a dipole antenna. Paragraph 3.2 describes the theory of a hi-angle antenna. Paragraph 3.3 describes the theory of a log periodic antenna.

3.2 HI-ANGLE ANTENNA

The LPH-15 bidirectional antenna is mounted vertically with the front end of the antenna curtain nearest the ground. At the low frequencies, the active region of the antenna is near a $1/4$ wave length above ground; hence, radiation is upward as would be expected from a dipole at the same height. Therefore, the antenna exhibits omnidirectional characteristics for short range operation. The design parameters and mounting height of the array are such that at the high frequencies, the active region is greater than a $1/2$ wave length above ground; hence, the radiation pattern becomes bidirectional (radiation is normal to the plane of the array) with a take-off angle less than 30 degrees, again as would be expected from a dipole at the same height. These radiation characteristics are ideally suited for path lengths varying from zero to over 700 miles. Figures 3.1 and 3.3 are provided for a better understanding of this discussion. Since a log periodic antenna curtain is utilized on this antenna, broadband coverage is accomplished. Refer to Figure 3.4 for the VSWR readings over the 4 to 30 MHz frequency range.

3.3 LOG PERIODIC ANTENNA

The LPH-15 log periodic antenna is formed of 17 dipole elements, each of which is a different length. These elements are attached to a balanced transmission line in order of length. The arrangement is such that the length of each element is a fixed percent of its next larger neighbor and the spacing between any two elements is this same percent of the next larger neighboring space. This means that any portion of the antenna is simply a scale model of any other portion.

If such a group is taken, as the group of elements which are near resonance, and therefore, active, it can be seen how the antenna can have constant characteristics over the frequency range for which it is designed. For this ideal situation to be achieved, it is necessary that each element become active only once as the frequency is varied over the band; otherwise, the scaling principle, explained above, will not be adhered to.

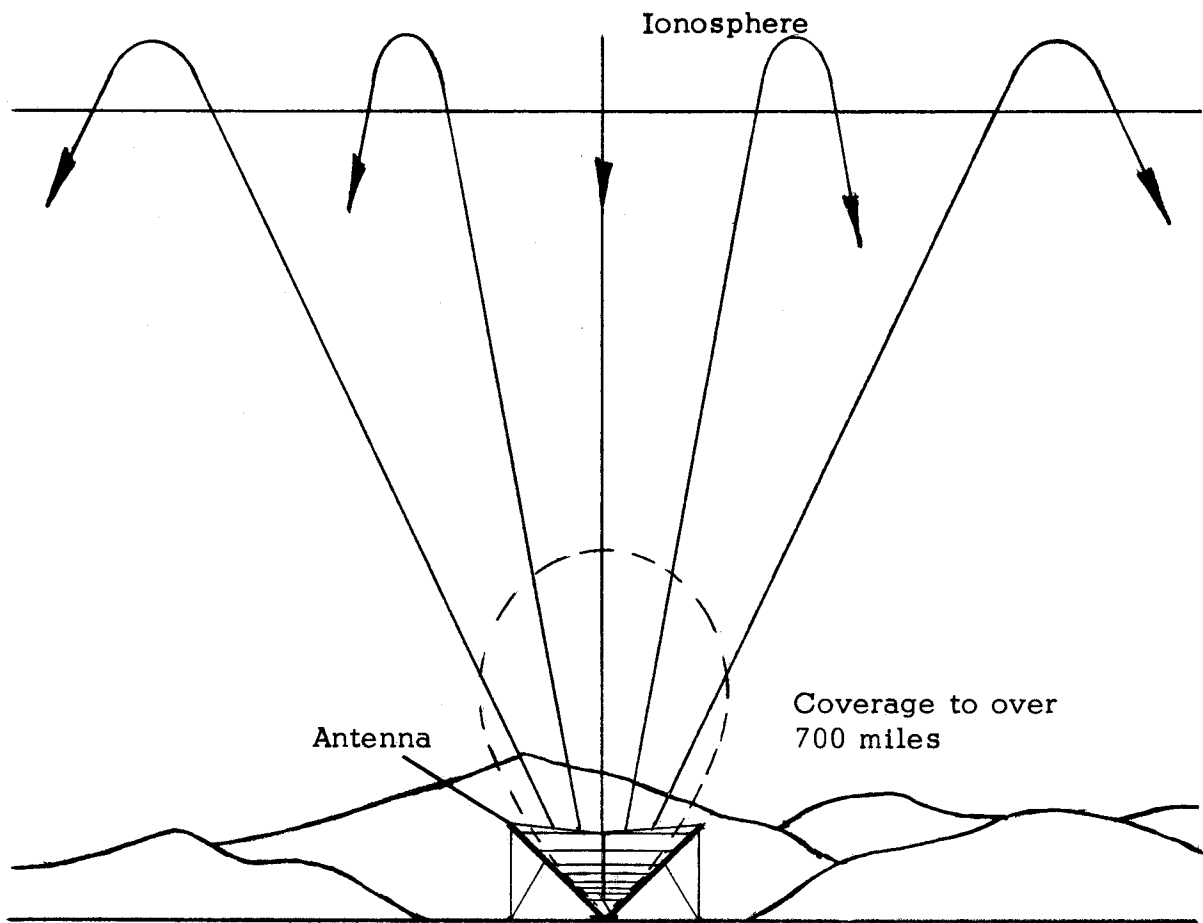
Dipole antennas can have multiple resonance or "modes" that will capture or radiate RF energy. The slightest (first order) mode is the half wave mode. The dipole can resonate in higher modes such as $3/2$, $5/2$, $7/2$ wave lengths, etc. The radiation patterns of these higher modes are not the same as that of the $1/2$ wave length mode. The active elements of the LPH-15 antenna operate in the $1/2$ wave mode.

Because of the possibility of higher mode resonance, it is necessary that no energy sweep past the elements which are larger than $1/2$ wave length, via the transmission line or by radiation. To meet this condition, no energy must enter or leave the antenna by the rear (large element) end.

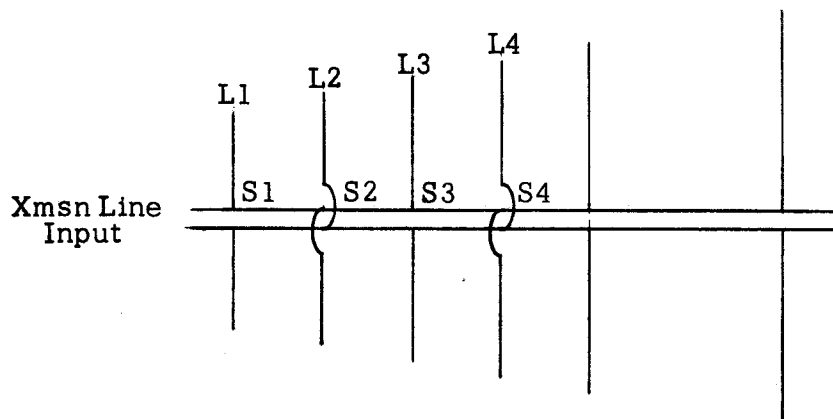
On the other hand, elements which are shorter than $1/2$ wave length cannot resonate and, therefore, have little, if any, effect on a passing RF wave. This means that a frequency independent log periodic antenna must be fed from and radiate toward the small element end.

Energy is transmitted from the front of the antenna to the radiating elements by the balanced transmission line. Because the phase is reversed between each element pair (by crisscross connections), the direction of radiation is directed toward the front of the antenna, as shown in Figure 3.2. Thus all the basic requirements for frequency independence are met.

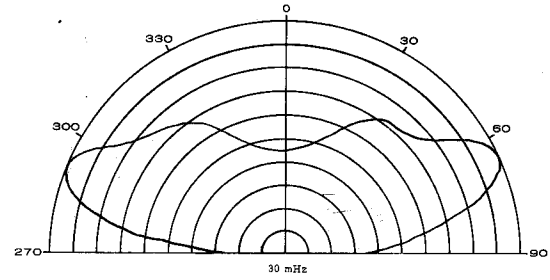
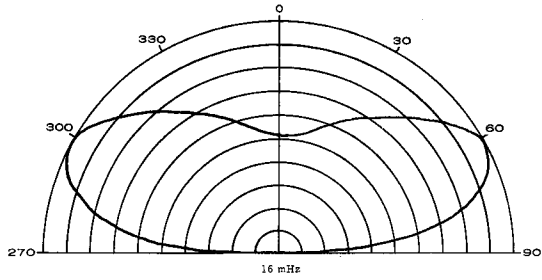
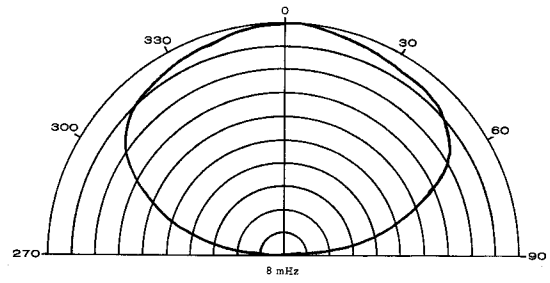
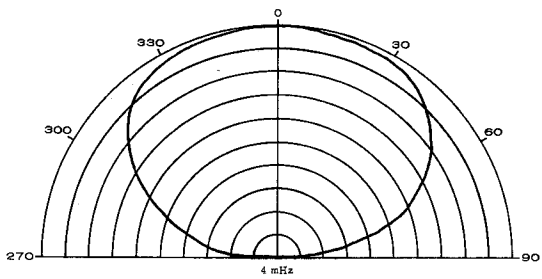
The balanced feed point impedance of the antenna is approximately 200 ohms. In order to match this impedance to the desired 50 ohm input, a balun transformer is incorporated, which provides an impedance match for 50 ohms to 200 ohms over the broad frequency range covered by the antenna.



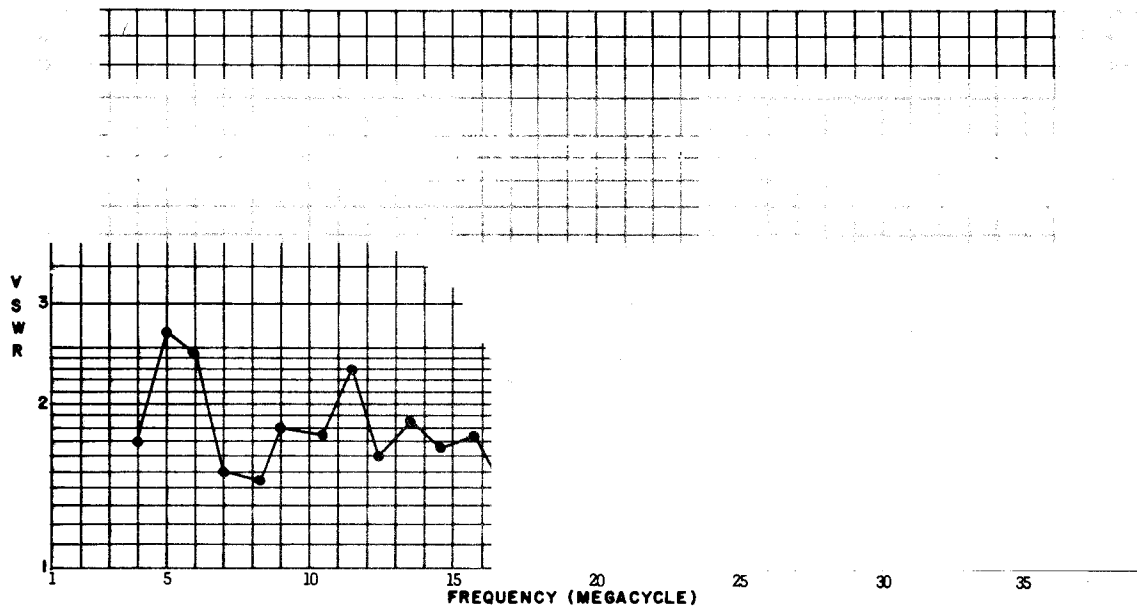
HI-ANGLE ANTENNA THEORY
Figure 3.1



LOG PERIODIC ANTENNA THEORY
Figure 3.2



ELEVATION FIELD PATTERNS
Figure 3.3



VSWR CHART
Figure 3.4

4.0 INSPECTION AND MAINTENANCE

Due to the simplicity of the LPH-15 antenna, all necessary maintenance can be performed in the field as either corrective or preventive maintenance. A periodic inspection should be performed every three to six months. The following inspection points should be performed and corrected as necessary.

4.1 GUYS AND ANCHORS

Guys should be inspected for proper tensioning and broken or damaged rope strands. Anchors should be inspected for corrosion above the ground line and any evidence of slippage. Slippage will often be detected by loose guys and a ground line mark can often be detected on the anchor rod itself. Loose guys should be retensioned to approximately 100 pounds as specified in Paragraph 2.4, Step No. 4, Item 4.

4.2 TOWERS

The towers should be inspected for tightness of hardware, evidence of corrosion, bending due to improper guy tensions or settling of the base plate.

4.3 ANTENNA

The antenna curtain should be inspected for corrosion and tightness of all connections. The insulators should be inspected for accumulation of conductive debris such as soot, smoke, dirt or salt. Any evidence of destructive corrosion should be corrected by cleaning. If possible, this debris should be removed with plain water. If this will not loosen the deposits, solvents may be used which are in themselves non-conductive such as carbon tetrachloride or trichloroethylene. Conductive cleaners which may become an electrolyte when wet, such as soap or compounds which may contain an acid or alkali, should be particularly avoided. Any evidence of destructive corrosion should be corrected by cleaning and coating with a suitable preservative.

4.4 BALUN

The balun is an oil filled, watertight assembly, utilizing an aluminum housing. This housing should be inspected for corrosion damage that may result in the loss of oil.

CAUTION

The connectors located on the top of the balun should also be inspected for corrosion and tightness. Internal parts of the balun are very critical and should not be disturbed. Since the movement of one of the internal wires could result in a disturbance of VSWR, it is suggested that the balun be returned to the factory for repair.

5.0 REPAIR PARTS LIST

The following repair parts are listed by item number and are referred to on each illustration, Where it is desirable to know what items make up an assembly, the "dot indention method" is utilized. All items that are a part of the assembly are listed below having one "dot" in front of the item name.

For example:

38	06032	0001 7178 001	Ground Hdw Kit: Consists of
39	73569	6346	. Anchor, Screw - Tripleye: 6" Galv
40	06032	0001 7235 001	. Drive Stake: See Item 35
41	73569	4345	. Anchor, Screw - Tripleye: 4" Galv
42	06032	0001 7247 001	. Anchor Assembly, Triple Rod: Consists of
43	06032	0001 7247 003	.. Anchor, Welded Assy: An alum welded assy consisting primarily of three tubes for containing the drive stakes.

Abbreviations used herein are as follows:

Galv	Hot Dip Galvanized	Assy	Assembly
SST	Stainless Steel	No.	Number
Hex	Hexagon	W/	With
Hd	Head	W/O	Without
J & E	Jaw and Eye	RH	Round Head
dia	Diameter	FH	Flat Head
Intmed	Intermediate	RH	Right Hand
LH	Left Hand	Wash	Washer
Lk	Lock		

A cross reference between manufacturer's code identification number and manufacturer may be found on page 5.9.

ITEM	MFR'S CODE	MFR'S P/N	DESCRIPTION	QUANTITY ASSY / SYSTEM
1	06032	1500 0077 001	Systems Kit: Consists of	1
2	06032	0001 7161 001	. Guy Kit: See Item 11	1
3	06032	0001 7206 001	. Erection Kit: See Item 21	1
4	06032	0001 7178 001	. Ground Hdw Kit: See Item 38	1
5	06032	1000 0318 001	. Balun Transformer: See Item 52	2
6	06032	1000 0317 001	. Tower Kit: See Item 53	1
7	06032	1000 0320 001	. Curtain Assy: See Item 85	1
8	06032	0001 7261 001	. Feed Assy: See Item 117	2
9	06032	0001 7314 001	. Tool Kit: See Item 124	1
10	06032	0001 7315 001	. Erection Spare Hdw Kit: See Item 130	1

ITEM	MFR'S CODE	MFR'S P/N	DESCRIPTION	QUANTITY ASSY / SYSTEM	
11	06032	0001 7146 001	Guy Kit: Consists of	1	1
12		Blank			
13		Blank			
14		0001 7151 001	. Guy, Intmed Side: A 1/2" dia mylar rope assy 97' long having a thimble and 7/16" shackle nicopressed to one end. A rope snubber, APC P/N 0001 7153 001, is a part of this guy.	4	4
15		0001 7156 001	. Guy, Intmed Erection: A 1/2" dia mylar rope assy having three sections of rope nicopressed around a 3/8" thk steel ring. Two of these rope sections have a thimble and 7/16" shackle nicopressed to their opposite ends. The other rope section 22' long contains a rope snubber, APC P/N 0001 7153 001. The distance between the two shackles is 74'.	1	1
16		0001 7150 001	. Guy, Upper Side: A 1/2" dia mylar rope assy 117' long having a thimble and 7/16" shackle nicopressed to one end. A rope snubber, APC P/N 0001 7153 001, is a part of this guy.	4	4
17		0001 7152 001	. Guy, Lower Side: A 1/2" dia mylar rope assy 73' long having a thimble and 7/16" shackle nicopressed to one end. A rope snubber, APC P/N 0001 7153 001, is a part of this guy.	4	4
18		0001 7145 001	. Guy, Intmed Middle: A 1/2" dia mylar rope assy consisting of 57' of mylar rope, a thimble and 7/16" shackle nicopressed to one end and a rope snubber, APC P/N 0001 7153 001.	1	1
19		0001 7147 001	. Guy, Lower Middle: A 1/2" dia mylar rope assy consisting of 42' of mylar rope, a thimble and 7/16" shackle nicopressed to one end and a rope snubber, APC P/N 0001 7153 001.	2	2
20		0001 7149 001	. Guy, Upper Middle: A 1/2" dia mylar rope assy consisting of 75' of mylar rope, a thimble and 7/16" shackle nicopressed to one end and a rope snubber, APC P/N 0001 7153 001.	2	2
20a		0001 7509 001	. Guy Sling: A 3/8" dia mylar rope assy 17' long having a thimble and 7/16" shackle nicopressed to one end.	2	2
21		0001 7206 001	Erection Kit: Consists of	1	1
22		0001 7207 001	. Tag Line: A 3/8" dia mylar rope 66' long	1	1
23	06032	0001 7391 001	. Tag Line Assy: A 3/8" dia mylar rope assy 66' long having three stop sleeves spaced 30' and 20' apart. This tag line will be used for laying out the anchors.	1	1

ITEM	MFR'S CODE	MFR'S P/N	DESCRIPTION	QUANTITY ASSY / SYSTEM	
24	06032	0001 7219 001	. Winch Assy: Consists of	1	1
25	06032	0001 7216 001	.. Channel, Winch: A 3 x 1 1/2 x 1/4" alum channel 36" long having two 13/32" dia holes and two 1 1/8" dia holes.	2	2
26	06550	W-100-6	.. Hand Winch: A worm gear hand winch having a gear ratio of 20:1 for heavy duty hand operation.	1	1
27	06032	0001 7219 003	.. Cable Assy: A 3/16" dia (7 x 19) hi-strength galv aircraft cable 75' long having a thimble and 7/16" shackle nicopressed to one end and a loose 3/16" nicopress stop sleeve for attaching the cable to the winch drum.	1	1
28	76257	8" HF-5	.. Pulley: A two ton hot dip galv 8" sheave w/swivel eye.	1	1
29	06032	2077 6808	.. Bolt, Hex Hd: 3/8 - 16 x 1 1/4" Galv	4	4
30		2100 0123	.. Nut, Hex: 3/8 - 16 Galv	4	4
31		2300 0153	.. Washer, Split Lock: 3/8" Galv	4	4
32		0001 7166 001	. Gin Pole Assy: A 6" alum pipe assy 10' long having a sleeve welded on one end and a plug on the other.	1	1
33		0001 7167 001	. Gin Pole Assy, Center: A 6" alum pipe assy 10' long having a sleeve welded on one end.	1	1
34		0001 7168 001	. Gin Pole Assy, Top: A 6" alum pipe assy 10' long having a plug w/four guying eyes welded to one end.	1	1
35	06032	0001 7235 001	. Drive Stake: A 1" dia alum rod 24" long having a 3/8" alum plate welded to one end and tapered on the other end.	4	8
36	87541	850H - 8 lb	. Sledge, Double-face, W/Handle:	1	1
37	06032	2350 1255	. Shackle, Anchor: 1/2" Galv	1	1
38	06032	0001 7178 001	Ground Hardware Kit: Consists of	1	1
39	73569	6346	. Anchor, Screw - Tripleye: 6" Galv	4	4
40	06032	0001 7235 001	. Drive Stake: See Item 35	4	R
41	73569	4345	. Anchor, Screw - Tripleye: 4" Galv	1	1
42	06032	0001 7247 001	. Anchor Assy, Triple Rod: Consists of	4	4
43	06032	0001 7247 003	.. Anchor, Welded Assy: An alum welded assy consisting primarily of three tubes for containing the drive stakes.	4	4
44	06032	2077 8837	.. Bolt, Hex Hd: 1 - 8 x 6 1/2" Galv	1	4

ITEM	MFR'S CODE	MFR'S P/N	DESCRIPTION	QUANTITY ASSY / SYSTEM	
45	06032	2300 0521	.. Washer, Split Lock: 1" Galv	1	4
46		2100 0137	.. Nut, Hex: 1 - 8 Galv	1	4
47		0001 7240 001	. Stake, Anchor: Consists of	12	12
48		0001 7239 001	.. Rod, Stake: A 1 1/2" dia alum rod x 60" long.	1	12
49		0001 7299 001	.. Bail, Stake: A SST strap 1 1/8" wide x 8 1/2" long bent in "U" shape.	1	12
50		2078 2814	.. Bolt, Hex Hd: 3/8 - 16 x 2" SST	1	12
51		2100 0223	.. Nut, Hex: 3/8 - 16 SST	1	12
52		1000 0318 001	Balun Transformer Assy: An oil filled balun having a type "N" connector. Note: Field maintenance should <u>not</u> be performed on this balun. Any movement of the internal wires may disrupt the VSWR characteristics.	1	1
53		1000 0316 001	Tower Kit: Consists of	1	1
54		0001 7110 001	. Tapered Base Assy, 19": A 10' long insulated tower section, tapered on one end and having red color code markings on the other end.	2	2
55		0001 7127 001	. Tower Section Assy, 19" Red: A 10' long alum welded tower section, 19" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having red color code markings on the cripple end and yellow markings on the opposite end.	2	2
56		0001 7157 001	. Tower Section Assy, 19" Yellow: A 10' long alum welded tower section 19" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having yellow color code markings on the cripple end and blue markings on the opposite end.	2	2
57		0001 7158 001	. Tower Section Assy, 19" Blue: A 10' long alum welded tower section 19" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having blue color code markings on the cripple end and gray markings on the opposite end.	2	2
58		0001 7159 001	. Tower Section Assy, 15 1/2" Red: A 10' long alum welded tower section 15 1/2" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having red color code markings on the cripple end and yellow markings on the opposite end.	2	2
59	06032	0001 7160 001	. Tower Section Assy, 15 1/2" Yellow: A 10' long alum welded tower section 15 1/2" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having yellow color code markings on the cripple end and blue markings on the opposite end.	2	2

ITEM	MFR'S CODE	MFR'S P/N	DESCRIPTION	QUANTITY ASSY / SYSTEM	
60	06032	0001 7162 001	. Tower Section Assy, 15 1/2" Blue: A 10' long welded alum tower section 15 1/2" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having blue color code markings on the cripple end and gray markings on the opposite end.	2	2
61	06032	0001 7172 001	. Tower Section Assy, 12" Yellow: A 10' long alum welded tower section 12" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having yellow color code markings on the cripple end and blue markings on the opposite end.	2	2
62	06032	0001 7164 001	. Tower Section Assy, 12" Red: A 10' long alum welded tower section 12" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having red color code markings at the cripple end and yellow markings on the opposite end.	2	2
63	06032	0001 7173 001	. Tower Section Assy, 12" Blue: A 10' long alum welded tower section 12" between tower leg centers, insulated at the center with fiberglass reinforced plastic insulators and having blue color code markings on the cripple end and plugs welded into the legs on the opposite end. A SST U-bolt, APC P/N 0001 7237 001, is attached to the upper end of each leg. This is the top section of tower.	2	2
64	06032	0001 7144 001	. Tower Section, Transition - 12" to 15 1/2": A 12" long transition section having three cripples color coded gray at the cripple end and red at the opposite end, for transition between the 12" tower and the 15 1/2" tower.	2	2
65	06032	0001 7143 001	. Tower Section, Transition - 15 1/2" to 19": A 12" long transition section having three cripples color coded gray at the cripple end and red markings at the opposite end, for transition between the 15 1/2" tower and the 19" tower.	2	2
66	06032	0001 7137 001	. Guy Bracket Assy: An assy of an 18 5/8" long channel with bent tabs on each end and having a "J" bolt at each end for connecting to a 12" tower section.	2	2
67	06032	0001 7209 001	. Pivot Base, Two-Tower: Consists of	1	1
68	06032	0001 7208 001	.. Base Plate Assy: A welded assy of an alum base plate 38" x 36" having two bent edges and two triangular channels containing two pivot holes welded in the upright position.	1	1
69	06032	0001 7204 001	.. Base Pivot Assy: The pivoting part of the tower base to which the towers and gin pole attach.	1	1
70	06032	0001 7278 001	.. Locking Pin, Two-Tower: A 3/8" dia alum rod x 9 3/4" long having two cotter pin holes.	1	1

ITEM	MFR'S CODE	MFR'S P/N	DESCRIPTION	QUANTITY ASSY / SYSTEM	
71	06032	2077 8213	.. Bolt, Hex Hd: 3/4 - 10 x 2 1/2" Galv	2	2
72	06032	2100 0175	.. Jam Nut: 3/4 - 10 Galv	2	2
73	06032	2077 8863	.. Bolt, Hex Hd: 1 - 8 x 10" Galv	1	1
74	06032	2310 0153	.. Washer, Flat: 3/4 - 10 Galv	2	2
75	06032	2310 0618	.. Washer, Flat: 1" Galv	2	2
76	06032	2300 0163	.. Washer, Split Lock: 1" Galv	1	1
77	06032	2450 0371	.. Eye Bolt W/Nut: 3/8 - 16 x 2 1/2" Shank Galv	1	1
78	06032	2077 6806	.. Bolt, Hex Hd: 3/8 - 16 x 1" Galv	8	8
79	06032	2310 0597	.. Washer, Flat: 3/8" Galv	8	8
80	06032	2100 0137	.. Nut, Hex: 1 - 8 Galv	1	1
81	06032	2300 0153	.. Washer, Split Lock: 3/8" Galv	8	8
82	06032	2210 1806	.. Cotter Pin: 1/8 x 1" SST	2	2
83	06032	0001 7115 001	. Pin Assy: A spring loaded locking pin having 3 1/2" of 1/16" dia aircraft cable attached. This pin assy is attached with a drive screw to each leg of the tower section.	6	132
84	06032	0001 7109 001	. Joint Insulator: A fiberglass reinforced plastic insulator 5 1/2" long machined on both ends to slip into the tower legs.	3	60
85	06032	1000 0319 001	Curtain Assy: The one curtain assy as used on the LPH-15 is completely assembled for shipment having nicopressed type connections. Removal of the fiberglass insulators or wire sections may be accomplished by removing the nicopress sleeve and replacing with another nicopress sleeve, rope clip or preformed guy grip dead end if sufficient room is available. The following is a partial list of such replaceable items.	1	1
86	06032	0001 7230 101	. Element Assy #1: A nicopressed assy of dropper wire, insulator and element wire, the element wire having a length of 4'-9 5/16".	2	2
87	06032	0001 7230 102	. Element Assy #2: Same as Item 86 except element wire is 5'-6 15/16".	2	2
88	06032	0001 7230 103	. Element Assy #3: Same as Item 86 except element wire is 6'-6 5/15".	2	2
89	06032	0001 7230 104	. Element Assy #4: Same as Item 86 except element wire is 7'-7 3/4".	2	2
90	06032	0001 7230 105	. Element Assy #5: Same as Item 86 except element wire is 8'-11 1/2".	2	2

ITEM	MFR'S CODE	MFR'S P/N	DESCRIPTION	QUANTITY	
				ASSY	SYSTEM
91	06032	0001 7230 106	. Element Assy #6: Same as Item 86 except element wire is 10' - 6".	2	2
92	06032	0001 7230 107	. Element Assy #7: Same as Item 86 except element wire is 12'-3 13/16".	2	2
93	06032	0001 7230 108	. Element Assy #8: Same as Item 86 except element wire is 14'-5 7/16".	2	2
94	06032	0001 7230 109	. Element Assy #9: Same as Item 86 except element wire is 16'-11 5/8".	2	2
95	06032	0001 7230 110	. Element Assy #10: Same as Item 86 except element wire is 19'-11 1/16".	2	2
96	06032	0001 7230 111	. Element Assy #11: Same as Item 86 except element wire is 23'-4 13/16".	2	2
97	06032	0001 7230 112	. Element Assy #12: Same as Item 86 except element wire is 27'-5 15/16".	2	2
98	06032	0001 7230 113	. Element Assy #13: Same as Item 86 except element wire is 32'-3 3/4".	2	2
99	06032	0001 7230 114	. Element Assy #14: Same as Item 86 except element wire is 37'-11 3/4".	2	2
100	06032	0001 7230 115	. Element Assy #15: Same as Item 86 except element wire is 44'-7 11/16".	2	2
101	06032	0001 7230 116	. Element Assy #16: Same as Item 86 except element wire is 52'-5 13/16".	2	2
102	06032	0001 7230 117	. Element Assy #17: Same as Item 86 except element wire is 61'-8 1/2".	2	2
102a	06032	0001 7494 001	. Spacer, Xmsn: A 3/8" thk fiberglass reinforced plastic strip 1" wide x 6" long having two 1/4" holes.	8	8
103	06032	0001 7257 001	. Center Insulator: A fiberglass reinforced plastic molded insulator 7" OD x 4" ID x 3/4" thk.	17	17
104		Blank			
105	06032	0001 7183 001	. Equalizer Plate, Insulated: A triangular shaped 3/8" thk fiberglass reinforced plastic 5 5/8 x 6 1/2" having three holes. An insert is attached in one hole.	2	2
106		Blank			
107	06032	0001 7184 001	. Bracket, Transmission Support: A 1/4" thk alum strap 1 1/4" wide x 4 1/8" long having three holes.	1	1

ITEM	MFR'S CODE	MFR'S P/N	DESCRIPTION	QUANTITY ASSY / SYSTEM	
108	06032	0001 7182 001	. Clevis Bolt: A 5/16 - 18 turnbuckle jaw having a 1" shank.	1	1
109	06032	0001 7249 001	. Sling, Transmission Line: A 3/8" dia mylar rope sling having a thimble and 5/16" shackle nicopressed on each end. The distance between shackles is 70'-11/16".	2	2
110	06032	2350 6102	. Turnbuckle, J & E: 5/16 - 18 x 4 1/2" Galv	1	1
111		Blank			
112		Blank			
113		Blank			
114	06032	2100 0325	. Nut, Hex: 7/16 - 14 Silicone Bronze	4	4
115	06032	2100 0121	. Nut, Hex: 5/16 - 18 Galv	1	1
116	06032	2300 0152	. Washer, Split Lock: 5/16" Galv	1	1
117	06032	0001 7261 001	. Feed Assy: Consists of	1	1
118	06032	0001 7260 001	.. Cable Assy: An RG-17 coaxial cable 89" long having terminals on each end.	2	2
119	06032	0001 7259 001	.. Spacer: A 1/4" teflon strip 1" wide x 4 1/8" long having two holes.	4	4
120	06032	2078 2403	.. Bolt, Hex Hd: 1/4 - 20 x 5/8" SST	8	8
121	06032	2300 0909	.. Washer, Split Lock: 1/4" SST	8	R
122	06032	2100 1532	.. Cap Nut: 1/4 - 20 SST	8	8
123	06032	0001 5632 001	.. Clamp: A soft alum strip 3/4" wide x 4" long bent to form a clamp around the coaxial cable.	8	8
124	06032	0001 7314 001	. Tool Kit: Consists of	1	1
125	06032	0001 6835 001	.. Bar, Anchor: A 1 1/4" dia alum bar 6' long	1	1
126	06032	2450 2184	.. Wrench, Combination - Open End: 1/2" & 9/16"	1	1
127	06032	2450 2188	.. Wrench, Combination - Open End: 19/32" x 11/16"	1	1
128	06032	2450 2181	.. Wrench, Combination - Open End: 5/8" x 3/4"	1	1
129	06032	2450 2183	.. Wrench, Combination - Open End: 1 1/16" & 1 1/8"	1	1
130	06032	0001 7315 001	. Erection Spare Hardware Kit: Consists of	1	1
131	06032	2100 0133	.. Nut, Hex: 3/4 - 10 Galv	1	R
132	06032	2077 6806	.. Bolt, Hex Hd: 3/8 - 16 x 1" Galv	1	R
133	06032	2210 1806	.. Cotter Pin: 1/8 x 1" SST	5	R
134	06032	0001 7115 001	.. Pin Assy: See Item 83	1	R
135	06032	2072 3721	.. Drive Screw: #4 x 3/16" SST	2	400

Mfr's Code

Manufacturer

06550	Beebe Brothers Incorporated Seattle, Washington 98134
76257	McKissick Products Corporation Tulsa, Oklahoma 74101
87541	Standley Hardware Company Incorporated Philadelphia, Pennsylvania 19103
73569	A. B. Chance Company Centralia, Missouri 65240
06032	Antenna Products Company Mineral Wells, Texas 76067