MICROWAVE ANTENNAS

KS-15676 HORN-REFLECTOR ANTENNA

DESCRIPTION

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1. GENERAL

1.01 This section contains descriptive equipment data, representative transmission characteristics, and other information pertaining to the KS-15676 L9 and L14 horn-reflector antennas and associated circular waveguide. Horn-reflector antennas not identified with this KS specification are not covered in this practice.

1.02 This section is reissued to update earlier data, including new equipment features and new transmission characteristics. Detailed transmission properties are described in engineering Section 940-340-154. Since this is a major revision, change arrows ordinarily used have been omitted.

1.03 The KS-15676 antenna is designed for operation within the 3700 MHz to 4200 MHz, the 5925 MHz to 6425 MHz, and the 10,700 MHz to 11,700 MHz common carrier bands.

1.04 This antenna can accommodate both horizontal and vertical polarizations and can be used as either a transmitting or a receiving antenna. With a suitable isolating network, one antenna may be used for both transmitting and receiving. This antenna provides high forward gain, and good side and rear signal suppression. It is, therefore, especially useful on long paths or in situations requiring good directivity and shielding.

1.05 The L14 antenna (commonly known as the "hardened" antenna) is designed to resist an overpressure of 2 psi which may result from the detonation of a nuclear weapon, and is intended for use at hardened stations.

1.06 The L9 antenna may be converted to an L14 antenna by installing the L15 modification kit. This may be accomplished without removing the antenna from service as described in Section 402-421-220.

2. INTRODUCTION

2.01 The KS-15676 L9 and L14 horn-reflector antennas consist of an electromagnetic horn which illuminates a sector of a large paraboloidal reflector whose focal point is at the apex or feed point of the horn. The paraboloidal reflector converts the spherical wave front emanating from the feed horn to a plane wave front at the antenna aperture.

2.02 The antenna is fed with 2.812-inch ID circular waveguide with TE°_{11} dominant mode transmission of both vertically and horizontally polarized signals. The use of alternate polarizations permits efficient use of the frequency spectrum.

2.03 The antenna has a projected trapezoidal aperture area of 64.57 square feet (6.00 square meters).

3. EQUIPMENT FEATURES

3.01 The basic antenna, furnished as a KS-15676 L9 or L14 antenna, includes the following subassemblies:

L2 Weather Cover

L5 Mounting Frame

L7 Sealing Kit

L11 Mounting Clamps (4)

The following list identifies additional associated subassemblies which are ordered and furnished as required. With the exception of the L18 kit, "Manufacture Discontinued" items are not listed.

L3 Feed Horn

L4 Mounting Base

L10 Repair Kit

L13 Tilt Adjusting Tool

L15 Hardening Modification Kit

L17 Azimuth Adjusting Tool

L18 Stud Bar Kit (Manufacture Discontinued)

L19 Weather Cover Edge Seal Kit

L20 Stud Bar and Edge Seal Kit

L21 Stud Bar and 14-Edge Blinders

L22 14-Edge Blinders

3.02 As shown by Fig. 1, the L9 antenna is constructed of aluminum alloy sheets. The sides are reinforced by extruded stiffeners, and the reflector by longitudinal spars and horizontal ribs. The L9 antenna is factory assembled and pressure tested. The L14 antenna, shown in Fig. 2, consists of an L9 antenna with an additional "skin" of 0.062-inch thick aluminum sheets added to the side, front, and rear panels to give the additional strength required to resist blast overpressures of 2 psi. The L14 antenna is factory assembled and pressure tested and is intended for use at hardened stations.

3.03 The antenna aperture is protected from the weather by an L2 weather cover consisting of a 4-ply, polyester-impregnated, glass fiber fabric laminate, 0.040-inch thick. Additional plies are added along the edges and to the corners to give the window sufficient strength to withstand wind loads of 100 pounds per square foot.

3.04 The small end of the horn-reflector assembly terminates in an 11.592-inch square aperture to which an L3 feed horn is attached. This feed horn is a precision aluminum alloy casting about 21 inches long. The internal contour tapers down in a gradual hyperbolic transformation from the 11.592-inch square aperture which matches the large horn to a 2.812-inch diameter that matches the circular waveguide.

3.05 The L4 circular mounting base may be installed without regard to the final aiming of the antenna. The antenna is placed on the mounting base, aligned roughly in the desired direction, and clamped down. Final aiming is accomplished by orientation according to the procedure described in Sections 402-421-206, 402-421-207, or 402-421-208.

3.06 The antenna will normally be mounted on a tower with the horn in a vertical position (the symmetry axis of the pyramidal horn is approximately perpendicular to the earth's surface). The L5 mounting frame assembly provides for a minimum adjustment of the antenna of ± 5 degrees in azimuth and ± 3 degrees in elevation. The mounting frame assembly is arranged for anchoring to the L4 circular mounting base with four L11 mounting clamps. The antenna is secured in its tilt (elevation) position with eight locking screws.

3.07 All antenna seams are sealed with the sealer strip assembly which consists of a conducting rubber compound in combination with a woven wire mesh. Though primarily a weather seal, the conducting rubber also provides an important secondary protection against microwave leakage. The sealer strip assembly is part of the L7 Sealing Kit.

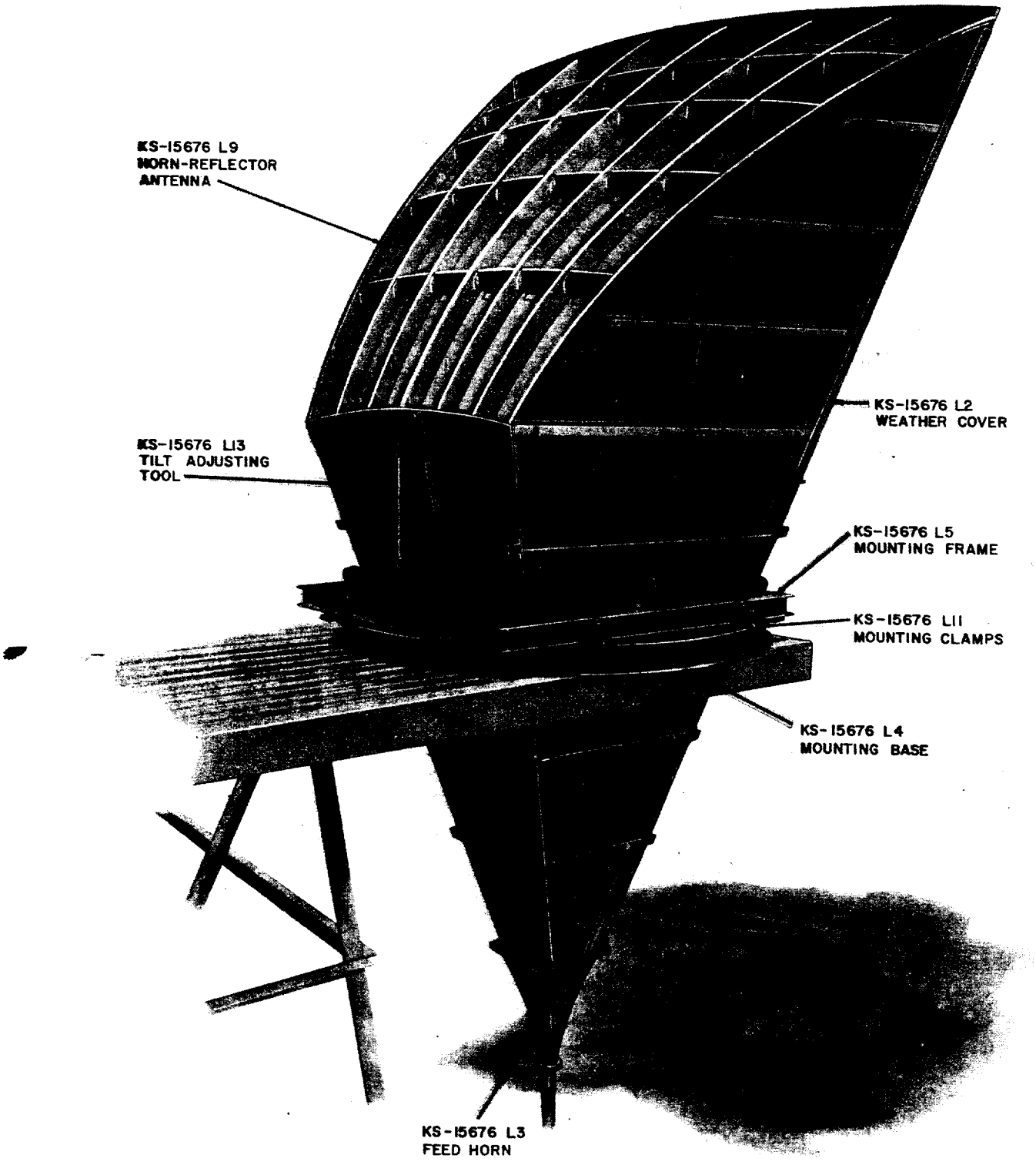

Fig. 1—KS-15676 L9 Horn-Reflector Antenna

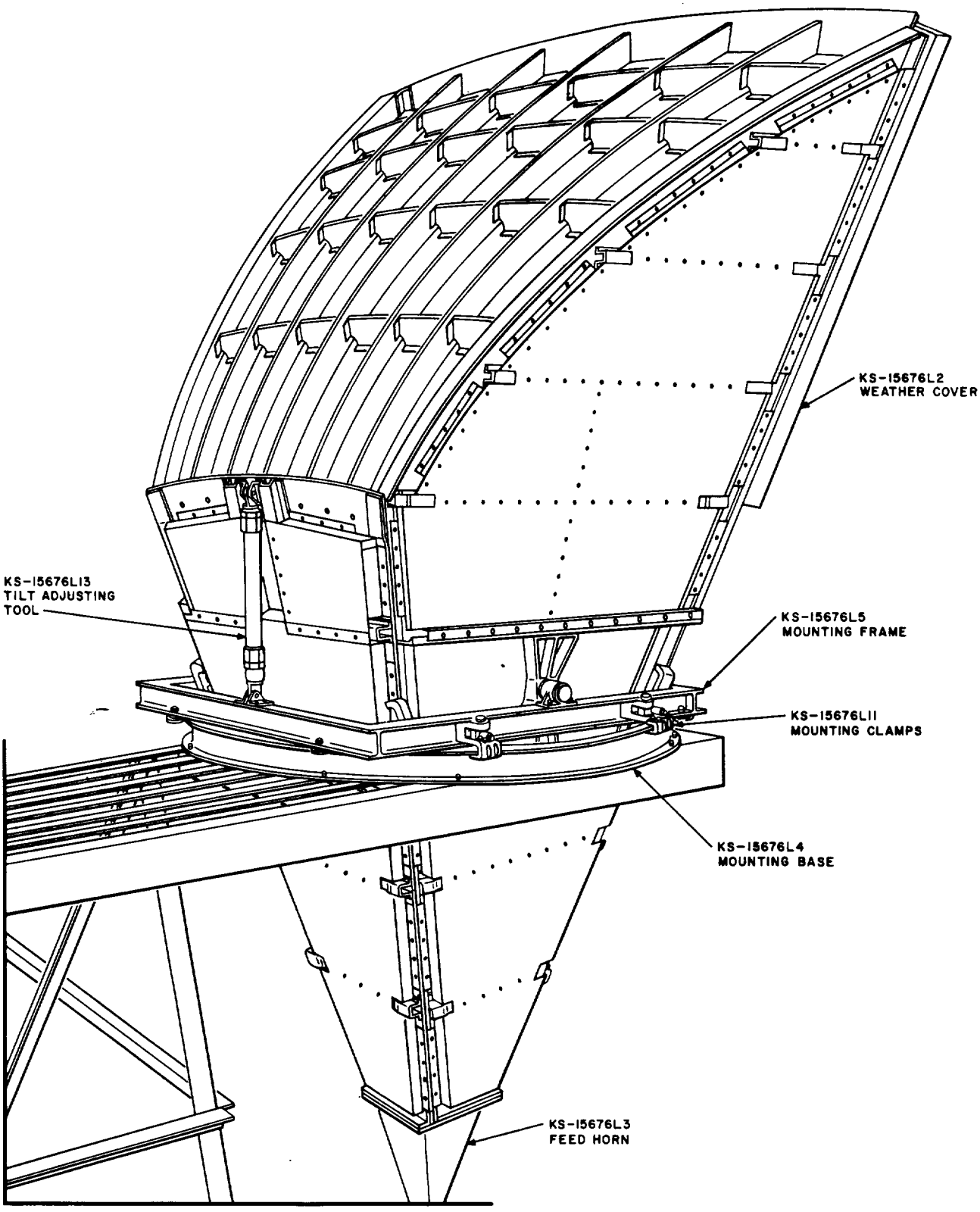

Fig. 2—KS-15676 L14 (Hardened) Horn-Reflector Antenna

3.08 The KS-15676 L10 repair kit is for use in making simple repairs of perforations such as bullet holes, etc, in the aluminum skin and the weather cover. The material furnished with each kit can be used to make a number of repairs, depending upon the size and nature of the damage. Instructions for the use of this kit can be found in Section 402-421-501.

3.09 The KS-15676 L11 mounting clamp, four of which are required for each KS-15676 L9 or L14 antenna, is designed for use with the L12 azimuth adjusting tool when making orientation adjustments as well as for final antenna lockdown.

3.10 The KS-15676 L13 tilt adjusting tool is designed for adjusting the tilt or elevation of the antenna during orientation.

3.11 The KS-15676 L15 modification kit consists of material and hardware necessary to harden (improve the blast resistance) the KS-15676 L9 horn-reflector antenna in the field.

3.12 The KS-15676 L17 azimuth adjusting tool is used with the L11 mounting clamp for making initial and final orientation adjustments. The L17 tool accomplishes azimuth adjustment by utilizing a ratchet assembly.

3.13 The KS-15676 L18 modification kit is used for the removal of captive nuts along the bottom edge of the window and the subsequent addition of a stud bar. This modification reduces the level of some sidelobes in the radiation pattern of the antenna. This kit is rated "Manufacture Discontinued."

3.14 The KS-15676 L19 modification consists of adding a weather cover edge seal to each side of the antenna. This seal eliminates RF energy that escapes through the edge of the weather cover.

3.15 The KS-15676 L20 modification consists of the L19 weather cover edge seal plus the replacement of the captive nuts and bolts used to fasten the bottom edge of the antenna weather cover with a stud bar. This modification reduces the level of some sidelobes in the radiation pattern of the antenna.

3.16 The KS-15676 L21 modification consists of the addition of 14-edge blinders to each side of the antenna along the window edge. It also includes the replacement of the captive nuts and bolts at the inside bottom edge of the weather cover with a stud bar. This modification further reduces the level of some sidelobes in the radiation pattern of the antenna. The KS-15676 L9 antenna with the L21 modification is shown in Fig. 3.

3.17 The KS-15676 L22 modification consists of the addition of 14-edge blinders to each side of the antenna along the window edge. These blinders also serve as a weather cover edge seal.

3.18 Modification kits KS-15676 L19 through L22 cannot be applied to an L9 antenna that has been field modified with the L15 hardening kit.

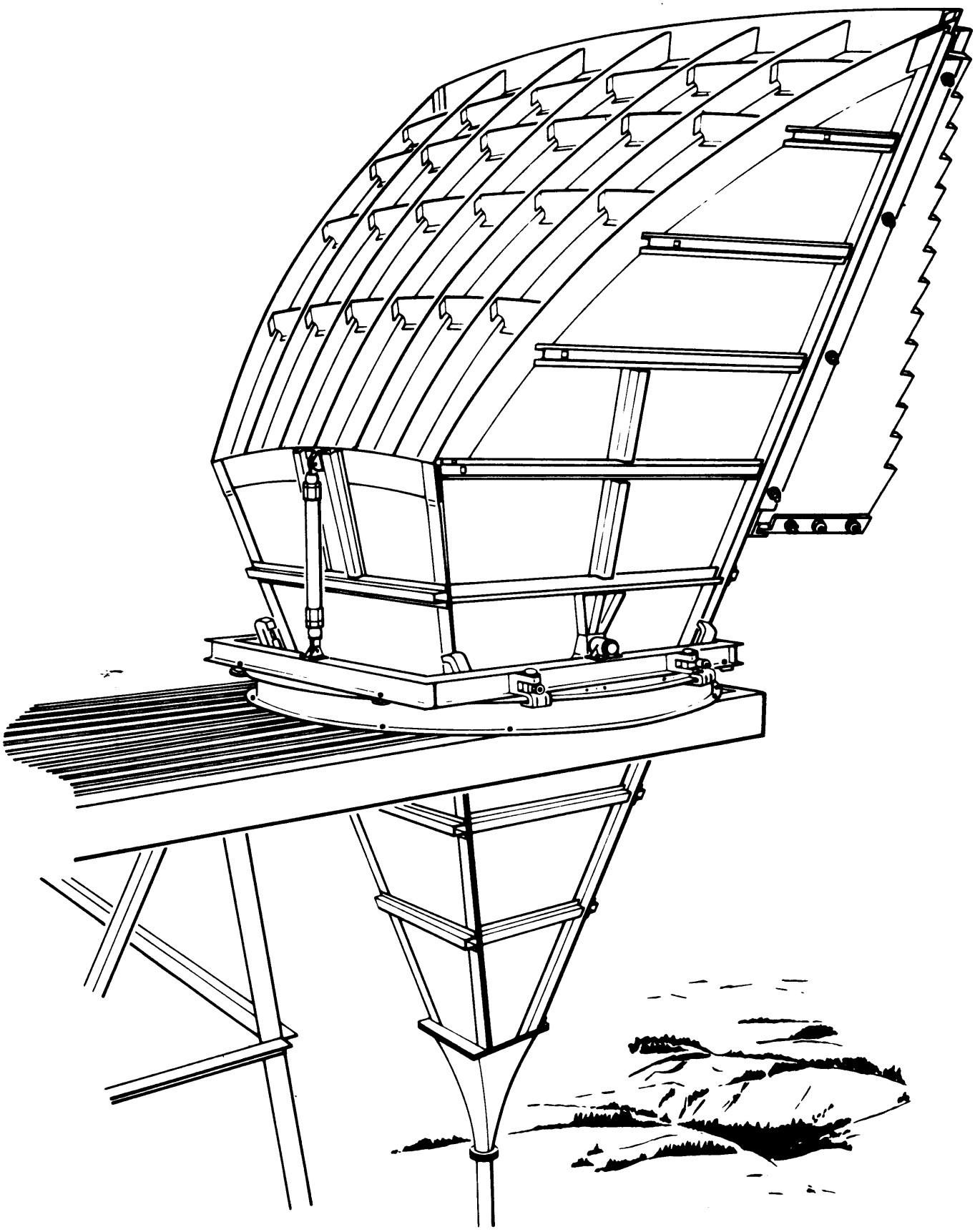

Fig. 3—KS-15676 L9 Horn-Reflector Antenna With L21 Modification (KS-15676 L9 BD)

3.19 The KS-15676 L9 or L14 antenna with the following modification kits is identified as follows:

Modification Kit	List No.
L19	L9 C or L14 C
L20, or L18 with L19	L9 BC or L14 BC
L21, or L22 with L18 or L20	L9 BD or L14 BD

4. TRANSMISSION CHARACTERISTICS

A. Gain

4.01 The mid-band gain of the antenna with respect to an isotropic radiator (point source) is as follows:

FREQ MHz	POLARIZATION	MIDBAND GAIN, DB
3950	Vertical	39.6
	Horizontal	39.4
6175	Vertical	43.2
	Horizontal	43.0
11,200	Vertical	48.0
	Horizontal	47.4

B. Half-Power Beam Widths

4.02 For the KS-15676 L9 BD or L14 BD antenna, the width of the main beam in the azimuthal plane between 3-dB points is as follows:

FREQ MHz	POLARIZATION	AZIMUTH HALF-POWER BEAM WIDTH (DEGREES)
3740	Vertical	2.37
	Horizontal	1.77
6325	Vertical	1.26
	Horizontal	0.99
10,960	Vertical	0.81
	Horizontal	0.66

C. Vertical Directivity

4.03 Limited vertical directivity information applicable to the KS-15676 L9 antenna is presented in Section 940-340-154.

D. Relative Response Patterns

4.04 Figures 4, 5, and 6 show typical smoothed patterns of the KS-15676 L9 BD or L14 BD antenna in the horizontal plane for horizontal polarization at 3740 MHz, 6325 MHz, and 10,960 MHz, respectively. These patterns show the relative response for either transmitting or receiving at any angle around the antenna in the horizontal plane.

4.05 Smoothed radiation patterns are prepared by the commonly accepted practice of drawing a smooth line through the peaks in the detailed pattern, thereby forming an envelope of peaks. The smoothed patterns also present the highest composite level of the left and right sides of the actual radiation pattern.

E. Cross Polarization Discrimination

4.06 Cross polarization discrimination (XPD) of an antenna is a measure of the ability of that antenna to discriminate between two received signals polarized 90 degrees with respect to each other. The cross polarization discrimination of the horn-reflector antenna is maximum when signals arrive on the axis of the main lobe. The on-axis cross polarization discrimination of the antenna alone in the 4-, 6-, and 11-GHz common carrier bands is at least 45 dB.

F. Coupling Losses

4.07 The coupling loss between similar antennas in operating position at the same level on a tower is defined as the ratio (in dB) of the power input to one antenna to the resulting power output by the other antenna for specified polarization conditions. Typical coupling losses for horn-reflector antennas in side-to-side and back-to-back configurations are given in Section 940-340-154.

G. Return Loss

4.08 Measurements made on the horn-reflector antenna indicate that in each of the three common carrier frequency bands, the return loss is higher than 40 dB.

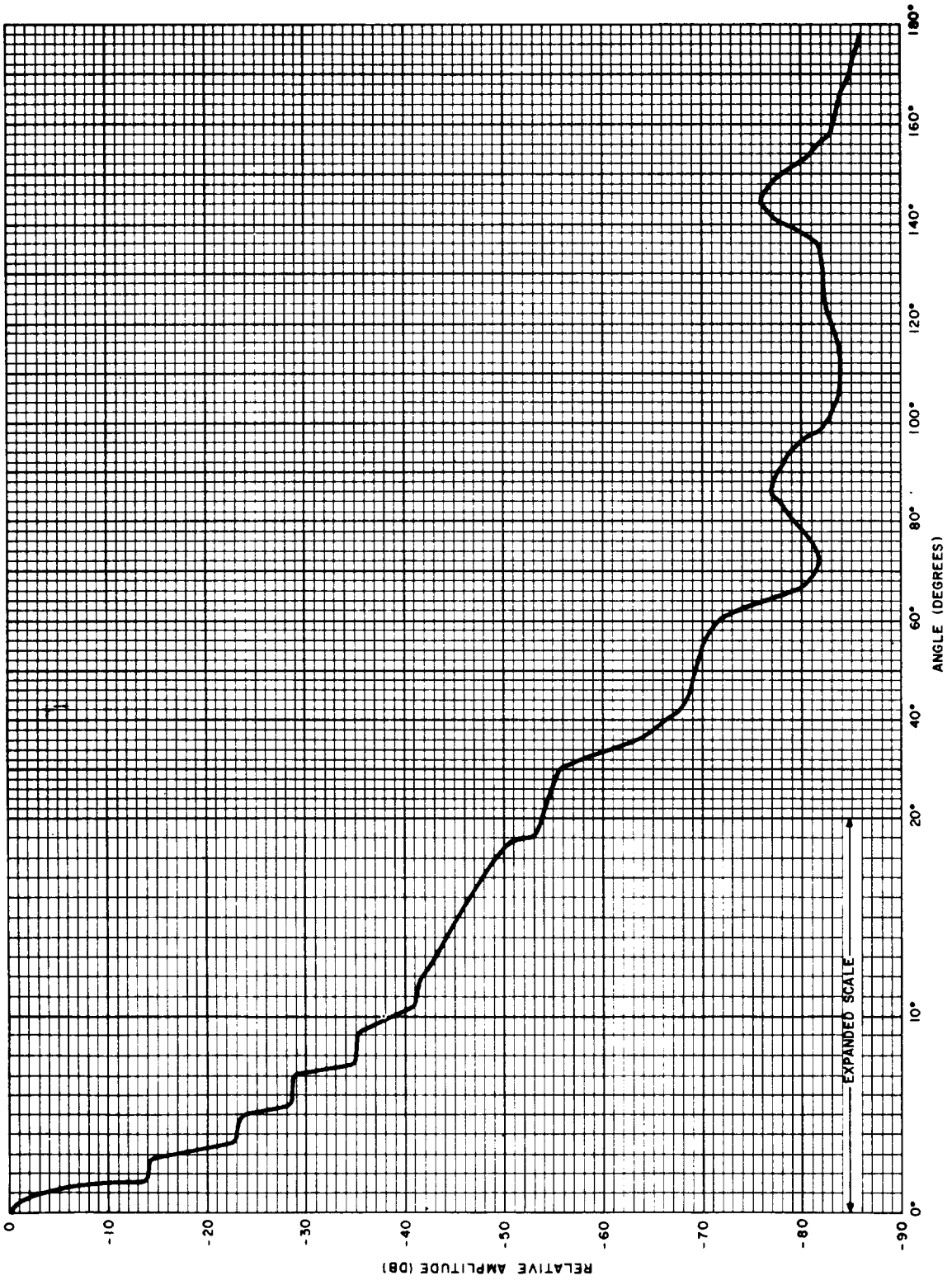

Fig. 4—Horizontal Directivity—Horizontal Polarization—3740 MHz, KS-15676 L9 BD or L14 BD Antenna

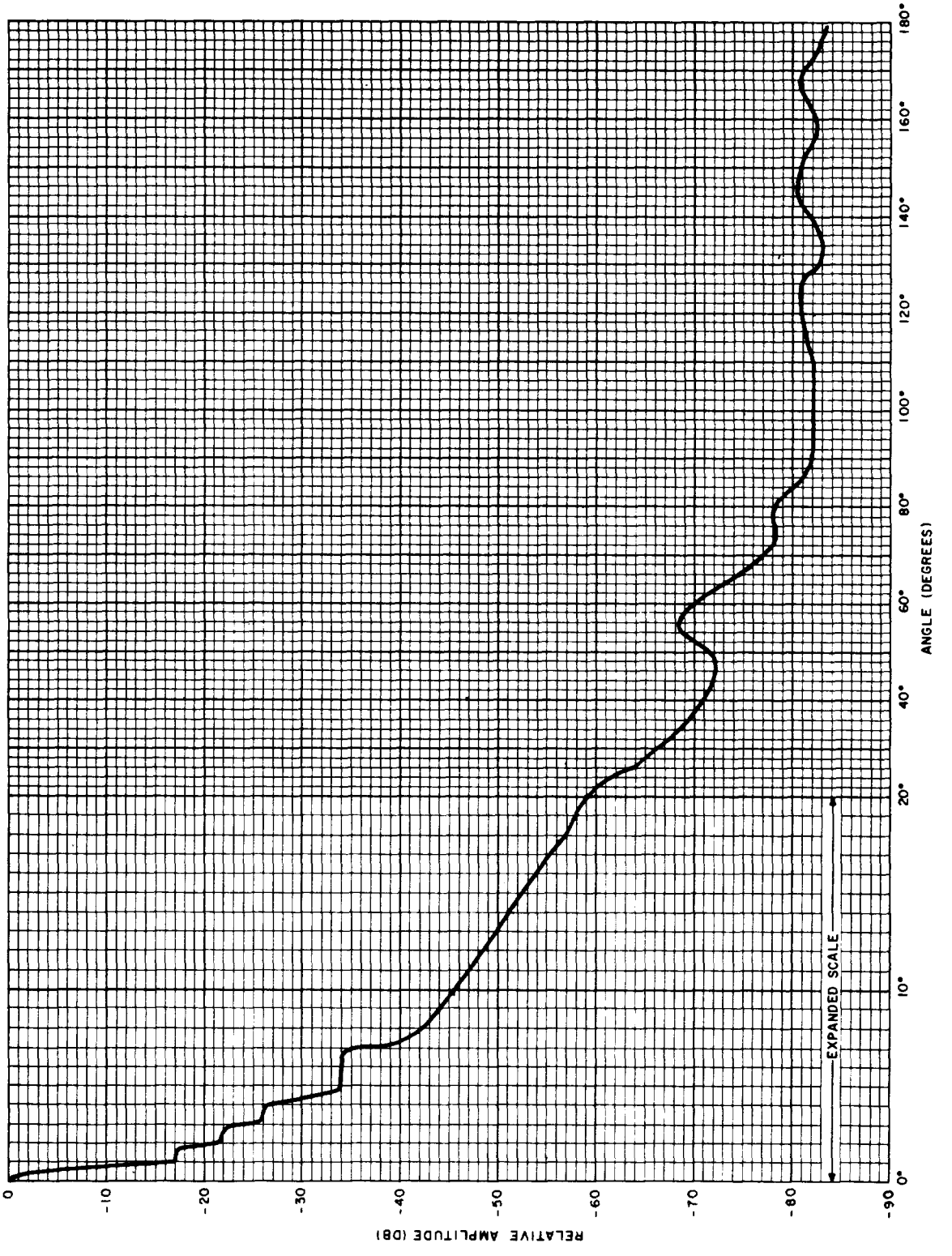

Fig. 5—Horizontal Directivity—Horizontal Polarization—6325 MHz, KS-15676 L9 BD or L14 BD Antenna

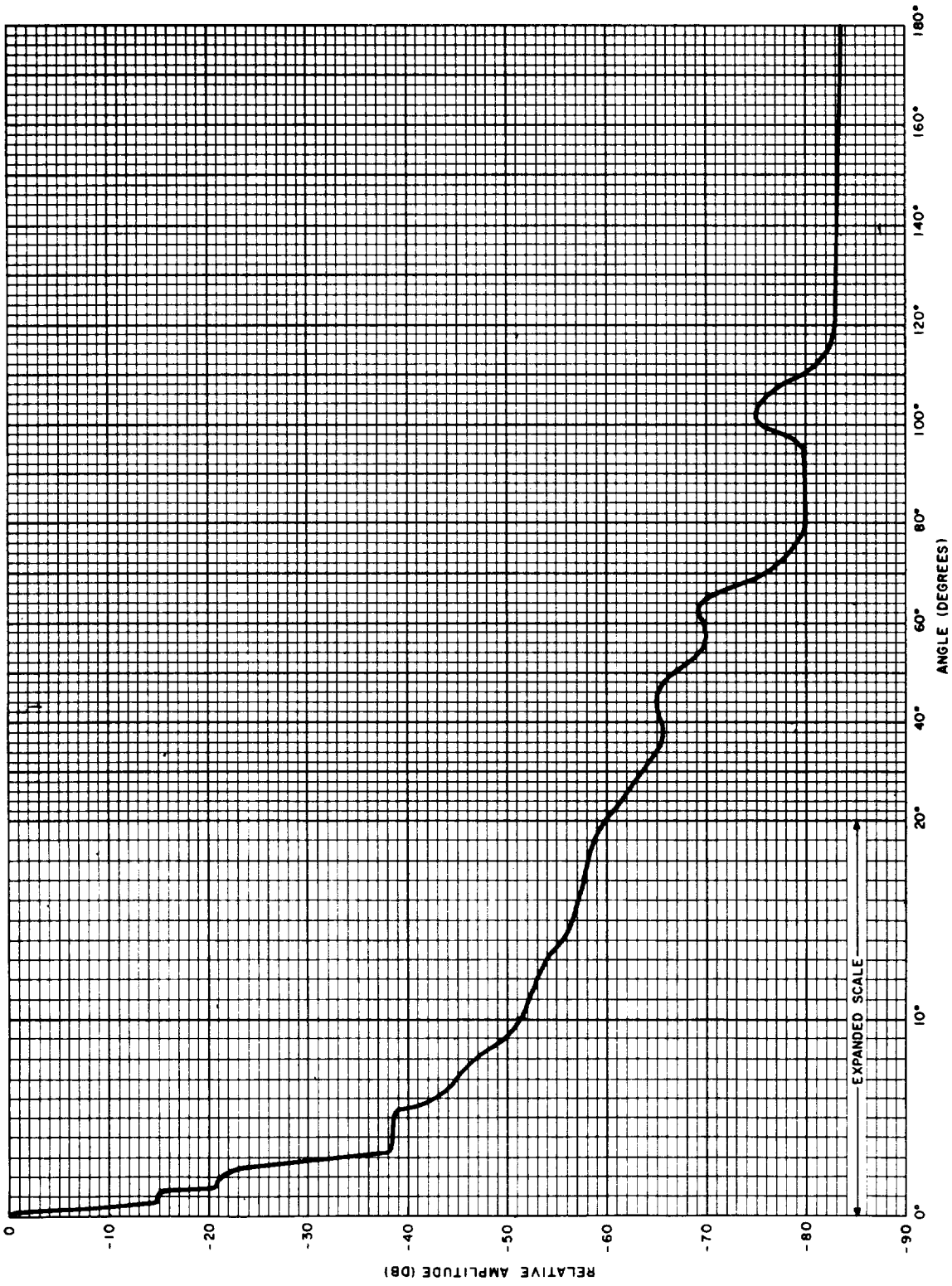

Fig. 6—Horizontal Directivity—Horizontal Polarization—10,960 MHz, KS-15676 L9 BD or L14 BD Antenna

5. CIRCULAR WAVEGUIDE

5.01 Precision bent ED-59409-72 rigid circular waveguide (WC281) may be used between the KS-15676 L3 feed horn and the rigid circular waveguide run. Flexible circular waveguide KS-20104 may also be used.

5.02 Flexible circular waveguide is available in two lengths, L1 and L2. The L1 length (8 feet long) is used to permit the full range of antenna elevation adjustment ($\pm$3 degrees). The L2 length (4 feet) may be used in special circumstances where minimum antenna heights are required and where nominal ($\pm$1.5 degrees) elevation adjustment will suffice.

5.03 The ED-59409-72 rigid circular waveguide is 8 feet long and has a fixed flange at one end and a close tolerance rotatable flange at the other end.

5.04 In order to compensate for thermodifferential expansion of the aluminum horn and the 8 feet of copper waveguide versus the steel tower, a pair of bimetallic expansion compensating rods (AT-8566) are installed which extend from the antenna support members to the hanger plate. The rods, as shown in Fig. 7, support a floating hanger plate and expand or contract at the same rate as the horn, copper waveguide, and tower steel between the antenna mount and the hanger plate.

5.05 The precision bent waveguide is recommended for new installations and as a replacement for flexible waveguide. Detailed information regarding flexible and bent rigid waveguide is available in Section 804-331-158.

5.06 The ED-59409-70 circular waveguide is available in lengths ranging from 1 foot to 12 feet 6-1/4 inches. The most commonly used length, 12 feet 6-1/4 inches, has been provided for installation on guyed and self-supporting towers. Shorter lengths are used to connect to system combining networks as required.

6. FIGURES AND REFERENCES

FIGURE	TITLE
1	KS-15676 L9 Horn-Reflector Antenna
2	KS-15676 L14 (Hardened) Horn-Reflector Antenna
3	KS-15676 L9 Horn-Reflector Antenna with L21 Modification (KS-15676 L9 BD)
4	Horizontal Directivity—Horizontal Polarization—3740 MHz, KS-15676 L9 BD or L14 BD Antenna
5	Horizontal Directivity—Horizontal Polarization—6325 MHz, KS-15676 L9 BD or L14 BD Antenna
6	Horizontal Directivity—Horizontal Polarization—10,960 MHz, KS-15676 L9 BD or L14 BD Antenna
7	KS-15676 L9, L14 Horn-Reflector Antenna With Bimetallic Expansion Rods Installed (AT-8566)

SECTION	TITLE
402-421-206	KS-15676 Horn-Reflector and Waveguide System, Orientation Using ED-59410-70 Transducer
402-421-207	KS-15676 Horn-Reflector and Waveguide System, Orientation Using 11A Directional Coupler
402-421-208	KS-15676 Horn-Reflector and Waveguide System, Orientation Using 21A Coupler
402-421-220	KS-15676 Horn-Reflector and Waveguide System, KS-15676 L15 Modification Kits
402-421-501	KS-15676 Horn-Reflector and Waveguide System, Horn-Reflector Assembly
804-331-158	Microwave Radio, Outdoor Waveguide for Microwave Communications Systems
940-340-154	Antennas and Reflectors, KS-15676 Horn Reflector

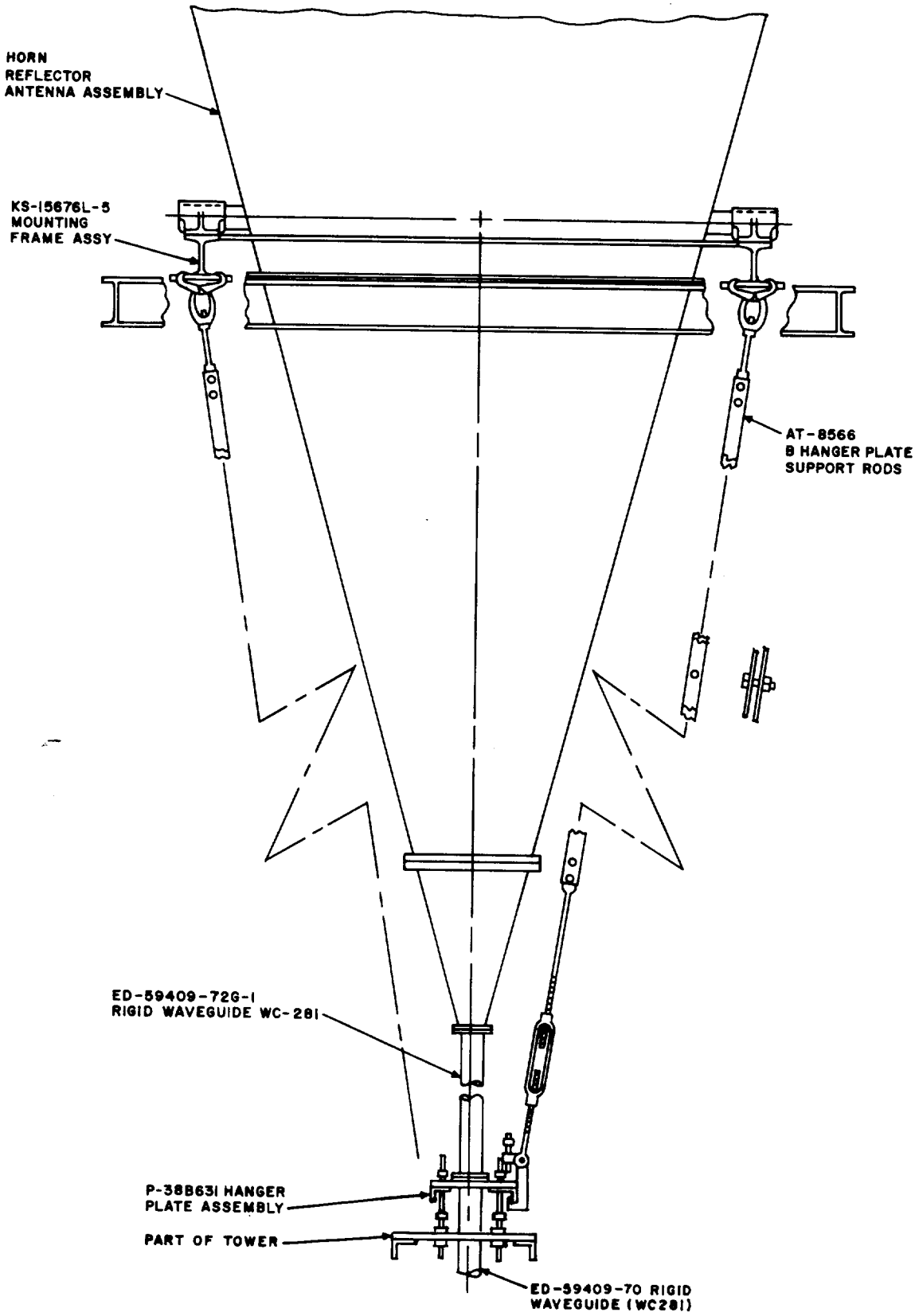

Fig. 7—KS-15676 L9, L14 Horn-Reflector Antenna With Bimetallic Expansion Rods Installed (AT-8566)