# APPENDIX 6. USEFUL NAVAIDS INFORMATION

## Figure 1. VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING

| CHANNEL | VOR Freq. Mc/s | DME/TACAN Airborne Interrogating Freq. Mc/s | DME/TACAN Ground Transponder Freq. Mc/s | ICAO Seq. No. | ILS LOC Freq. Mc/s | ILS Glide Slope Freq. Mc/s |
|---|---|---|---|---|---|---|
| 1 | | 1025 | 962 | | | |
| 2 | | 1026 | 963 | | | |
| 3 | | 1027 | 964 | | | |
| 4 | | 1028 | 965 | | | |
| 5 | | 1029 | 966 | | | |
| 6 | | 1030 | 967 | | | |
| 7 | | 1031 | 968 | | | |
| 8 | | 1032 | 969 | | | |
| 9 | | 1033 | 970 | | | |
| 10 | | 1034 | 971 | | | |
| 11 | | 1035 | 972 | | | |
| 12 | | 1036 | 973 | | | |
| 13 | | 1037 | 974 | | | |
| 14 | | 1038 | 975 | | | |
| 15 | | 1039 | 976 | | | |
| 16 | | 1040 | 977 | | | |
| 17 | 108.0 | 1041 | 978 | | | |
| 18 | | 1042 | 979 | 11 | 108.1 | 334.7 |
| 19 | 108.2 | 1043 | 980 | | | |
| 20 | | 1044 | 981 | 12 | 108.3 | 334.1 |
| 21 | 108.4 | 1045 | 982 | | | |
| 22 | | 1046 | 983 | 13 | 108.5 | 329.9 |
| 23 | 108.6 | 1047 | 984 | | | |
| 24 | | 1048 | 985 | 14 | 108.7 | 330.5 |
| 25 | 108.8 | 1049 | 986 | | | |
| 26 | | 1050 | 987 | 15 | 108.9 | 329.3 |
| 27 | 109.0 | 1051 | 988 | | | |
| 28 | | 1052 | 989 | 7 | 109.1 | 331.4 |
| 29 | 109.2 | 1053 | 990 | | | |
| 30 | | 1054 | 991 | 6 | 109.3 | 332.0 |
| 31 | 109.4 | 1055 | 992 | | | |
| 32 | | 1056 | 993 | 3 | 109.5 | 332.6 |
| 33 | 109.6 | 1057 | 994 | | | |
| 34 | | 1058 | 995 | 5 | 109.7 | 333.2 |
| 35 | 109.8 | 1059 | 996 | | | |
| 36 | | 1060 | 997 | 2 | 109.9 | 333.8 |
| 37 | 110.0 | 1061 | 998 | | | |
| 38 | | 1062 | 999 | 4 | 110.1 | 334.4 |
| 39 | 110.2 | 1063 | 1000 | | | |
| 40 | | 1064 | 1001 | 1 | 110.3 | 335.0 |

Figure 1. VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING (CONT'D)

| CHANNEL | VOR | DME/TACAN | | | ILS | |
|---|---|---|---|---|---|---|
| | Freq. Mc/s | Airborne Interrogating Freq. Mc/s | Ground Transponder Freq. Mc/s | ICAO Seq. No. | LOC Freq. Mc/s | Glide Slope Freq. Mc/s |
| 41 | 110.4 | 1065 | 1002 | | | |
| 42 | | 1066 | 1003 | 10 | 110.5 | 329.6 |
| 43 | 110.6 | 1067 | 1004 | | | |
| 44 | | 1068 | 1005 | 9 | 110.7 | 330.2 |
| 45 | 110.8 | 1069 | 1006 | | | |
| 46 | | 1070 | 1007 | 8 | 110.9 | 330.8 |
| 47 | 111.0 | 1071 | 1008 | | | |
| 48 | | 1072 | 1009 | 16 | 111.1 | 331.7 |
| 49 | 111.2 | 1073 | 1010 | | | |
| 50 | | 1074 | 1011 | 17 | 111.3 | 332.3 |
| 51 | 111.4 | 1075 | 1012 | | | |
| 52 | | 1076 | 1013 | 18 | 111.5 | 332.9 |
| 53 | 111.6 | 1077 | 1014 | | | |
| 54 | | 1078 | 1015 | 19 | 111.7 | 333.5 |
| 55 | 111.8 | 1079 | 1016 | | | |
| 56 | | 1080 | 1017 | 20 | 111.9 | 331.1 |
| 57 | 112.0 | 1081 | 1018 | | | |
| 58 | 112.1 | 1082 | 1019 | | | |
| 59 | 112.3 | 1083 | 1020 | | | |
| 60 | | 1084 | 1021 | | | |
| 61 | | 1085 | 1022 | | | |
| 62 | | 1086 | 1023 | | | |
| 63 | | 1087 | 1024 | | | |
| 64 | | 1088 | 1151 | | | |
| 65 | | 1089 | 1152 | | | |
| 66 | | 1090 | 1153 | | | |
| 67 | | 1091 | 1154 | | | |
| 68 | | 1092 | 1155 | | | |
| 69 | | 1093 | 1156 | | | |
| 70 | 112.3 | 1094 | 1157 | | | |
| 71 | 112.4 | 1095 | 1158 | | | |
| 72 | 112.5 | 1096 | 1159 | | | |
| 73 | 112.6 | 1097 | 1160 | | | |
| 74 | 112.7 | 1098 | 1161 | | | |
| 75 | 112.8 | 1099 | 1162 | | | |
| 76 | 112.9 | 1100 | 1163 | | | |
| 77 | 113.0 | 1101 | 1164 | | | |
| 78 | 113.1 | 1102 | 1165 | | | |
| 79 | 113.2 | 1103 | 1166 | | | |
| 80 | 113.3 | 1104 | 1167 | | | |
| 81 | 113.4 | 1105 | 1168 | | | |
| 82 | 113.5 | 1106 | 1169 | | | |
| 83 | 113.6 | 1107 | 1170 | | | |

Figure 1. VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING (CONT'D)

| CHANNEL | VOR | DME/TACAN | | | ILS | |
|---|---|---|---|---|---|---|
| | Freq. Mc/s | Airborne Interrogating Freq. Mc/s | Ground Transponder Freq. Mc/s | ICAO Seq. No. | LOC Freq. Mc/s | Glide Slope Freq. Mc/s |
| 84 | 113.7 | 1108 | 1171 | | | |
| 85 | 113.8 | 1109 | 1172 | | | |
| 86 | 113.9 | 1110 | 1173 | | | |
| 87 | 114.0 | 1111 | 1174 | | | |
| 88 | 114.1 | 1112 | 1175 | | | |
| 89 | 114.2 | 1113 | 1176 | | | |
| 90 | 114.3 | 1114 | 1177 | | | |
| 91 | 114.4 | 1115 | 1178 | | | |
| 92 | 114.5 | 1116 | 1179 | | | |
| 93 | 114.6 | 1117 | 1180 | | | |
| 94 | 114.7 | 1118 | 1181 | | | |
| 95 | 114.8 | 1119 | 1182 | | | |
| 96 | 114.9 | 1120 | 1183 | | | |
| 97 | 115.0 | 1121 | 1184 | | | |
| 98 | 115.1 | 1122 | 1185 | | | |
| 99 | 115.2 | 1123 | 1186 | | | |
| 100 | 115.3 | 1124 | 1187 | | | |
| 101 | 115.4 | 1125 | 1188 | | | |
| 102 | 115.5 | 1126 | 1189 | | | |
| 103 | 115.6 | 1127 | 1190 | | | |
| 104 | 115.7 | 1128 | 1191 | | | |
| 105 | 115.8 | 1129 | 1192 | | | |
| 106 | 115.9 | 1130 | 1193 | | | |
| 107 | 116.0 | 1131 | 1194 | | | |
| 108 | 116.1 | 1132 | 1195 | | | |
| 109 | 116.2 | 1133 | 1196 | | | |
| 110 | 116.3 | 1134 | 1197 | | | |
| 111 | 116.4 | 1135 | 1198 | | | |
| 112 | 116.5 | 1136 | 1199 | | | |
| 113 | 116.6 | 1137 | 1200 | | | |
| 114 | 116.7 | 1138 | 1201 | | | |
| 115 | 116.8 | 1139 | 1202 | | | |
| 116 | 116.9 | 1140 | 1203 | | | |
| 117 | 117.0 | 1141 | 1204 | | | |
| 118 | 117.1 | 1142 | 1205 | | | |
| 119 | 117.2 | 1143 | 1206 | | | |
| 120 | 117.3 | 1144 | 1207 | | | |
| 121 | 117.4 | 1145 | 1208 | | | |
| 122 | 117.5 | 1146 | 1209 | | | |
| 123 | 117.6 | 1147 | 1210 | | | |
| 124 | 117.7 | 1148 | 1211 | | | |
| 125 | 117.8 | 1149 | 1212 | | | |
| 126 | 117.9 | 1150 | 1213 | | | |

## Figure 2. BASIC ILS FORMULAS

### DDM

Definition: Difference in depth of modulation of 90 and 150 Hz Navigational tones.

$$DDM = 2m \frac{E_{ss}}{E_{cs}} \cos \phi$$

Where:

m = modulation depth $\begin{Bmatrix} 0.2 \text{ Loc.} \\ 0.4 \text{ G/P} \end{Bmatrix}$

$E_{ss}$ = sideband only (SBO) space voltage

$E_{cs}$ = carrier + sideband (CSB) space voltage

$\phi$ = phase angle between Ess and Ecs

NOTE:

Equation is valid only —

a) for $E_{ss} \leq E_{cs}$
b) for $1 < E_{ss}/E_{cs} < 2.5$, and $\phi = 0°$ DDM = 0.4 (Loc.)
c) for $1 < E_{ss}/E_{cs} < 1.25$, and $\phi = 0°$ DDM = 0.8 (G/P)

### VOLTAGE STANDING WAVE RATIO (VSWR)

Definition: The ratio of maximum (peak) voltage to minimum (valley) voltage at one point on a transmission line. (a measure of efficiency of transmission of energy from source to load).

$$VSWR = \frac{\sqrt{P_F} + \sqrt{P_R}}{\sqrt{P_F} - \sqrt{P_R}}$$

Where:

$P_F$ = forward power in watts

$P_R$ = reverse power in watts

(as measured with Thru-Line Wattmeter)

### DB - POWER RELATIONSHIPS

Definition: Gain (Loss) = 10 Log $\frac{P_1}{P_2}$ dB

or conversely $\frac{P_1}{P_2} = 10^{(dB \times 0.1)}$

Where:

$P_1$, $P_2$ measured in watts

Gain (Loss) measured in decibels (dB)

### DDM (μa) LOCALIZER

Definition: DDM as measured in μa at Localizer aircraft receiver.

$$DDM \text{ (μa Loc.)} = 150 \times \frac{DDM}{0.155}$$

### DDM (μa) G/P

Definition: DDM as measured in μa at Glide Path receiver.

$$DDM \text{ (μa G/P)} = 150 \times \frac{DDM}{0.175}$$

### DB - VOLTAGE/CURRENT RELATIONSHIPS

Definition: Gain (Loss) = 20 Log $\frac{E_1}{E_2}$ dB

or conversely $\frac{E_1}{E_2} = 10^{(dB \times 0.05)}$

Where:

$E_1$, $E_2$ measured in volts

Gain (Loss) measured in decibels (dB)

NOTE: $E_1$, $E_2$ could also be $I_1$, $I_2$ measured in amperes.

### DDM TO DB CONVERSION

Definition: $DDM_{(dB)} = 20 \text{ Log} \left[ \frac{m + \frac{DDM}{2}}{m - \frac{DDM}{2}} \right]$

Where:

m = Modulation depth $\begin{Bmatrix} .2 \text{ Loc.} \\ .4 \text{ G/P} \end{Bmatrix}$

DDM = Difference in depth of modulation

### DB TO DDM CONVERSION

Definition:

$$DDM = 2m \left[ \frac{10^{\frac{DDM_{(dB)}}{20}} - 1}{10^{\frac{DDM_{(dB)}}{20}} + 1} \right]$$

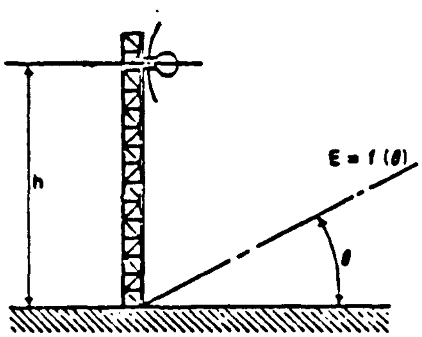
Where:

m = Modulation Depth $\begin{Bmatrix} .2 \text{ Loc.} \\ .4 \text{ G/P} \end{Bmatrix}$

## Figure 3. GLIDE SLOPE ANTENNA HEIGHT FORMULAS

### ANTENNA EQUATIONS (GLIDE PATH)

Definition:




$$E = 2E_o \sin(1.2\, hf \sin\theta)$$

Where:

- $E_o$ = relative voltage at antenna element
- $h$ = height above ground in meters
- $F$ = frequency in MHz

### PATH MONITOR HEIGHT (H)

Definition: The height of the path monitor antenna above the reflecting plane is given by:

$$H = D \tan\theta$$

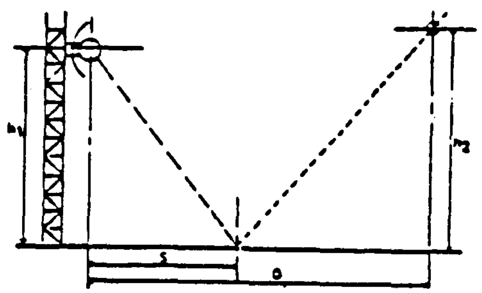
Where:

- $D$ = distance to path monitor tower from transmitting tower in meters
- $\theta$ = glide angle in degrees

### IMAGE REFLECTION POINTS OF ANTENNAE

Definition: Using image theory, the reflection point of transmitting antenna $h_1$ as seen by receiving antenna $h_2$ is given by:

$$S = \frac{h_1 D}{h_1 + h_2} \text{ meters}$$




## Glide Path

### GLIDE PATH TOWER DISTANCE FROM THRESHOLD (D)

Definition: To provide the required threshold crossing height (TCH), the glide path antenna must be positioned D meters back from the threshold where:

$$D = \frac{H \pm Y}{\tan(\theta \pm \alpha)} \text{ meters}$$

Where:

- $D$ = the horizontal distance between O and P
- $H$ = the nominal threshold crossing height
- $Y$ = the vertical height of the runway threshold above P';
- $\theta$ = the nominal ILS glide path angle;
- $\alpha$ = the longitudinal slope of the glide path reflection plane.

NOTE: [illegible]

Figure 4. ILS FACILITIES PLACEMENT CHART

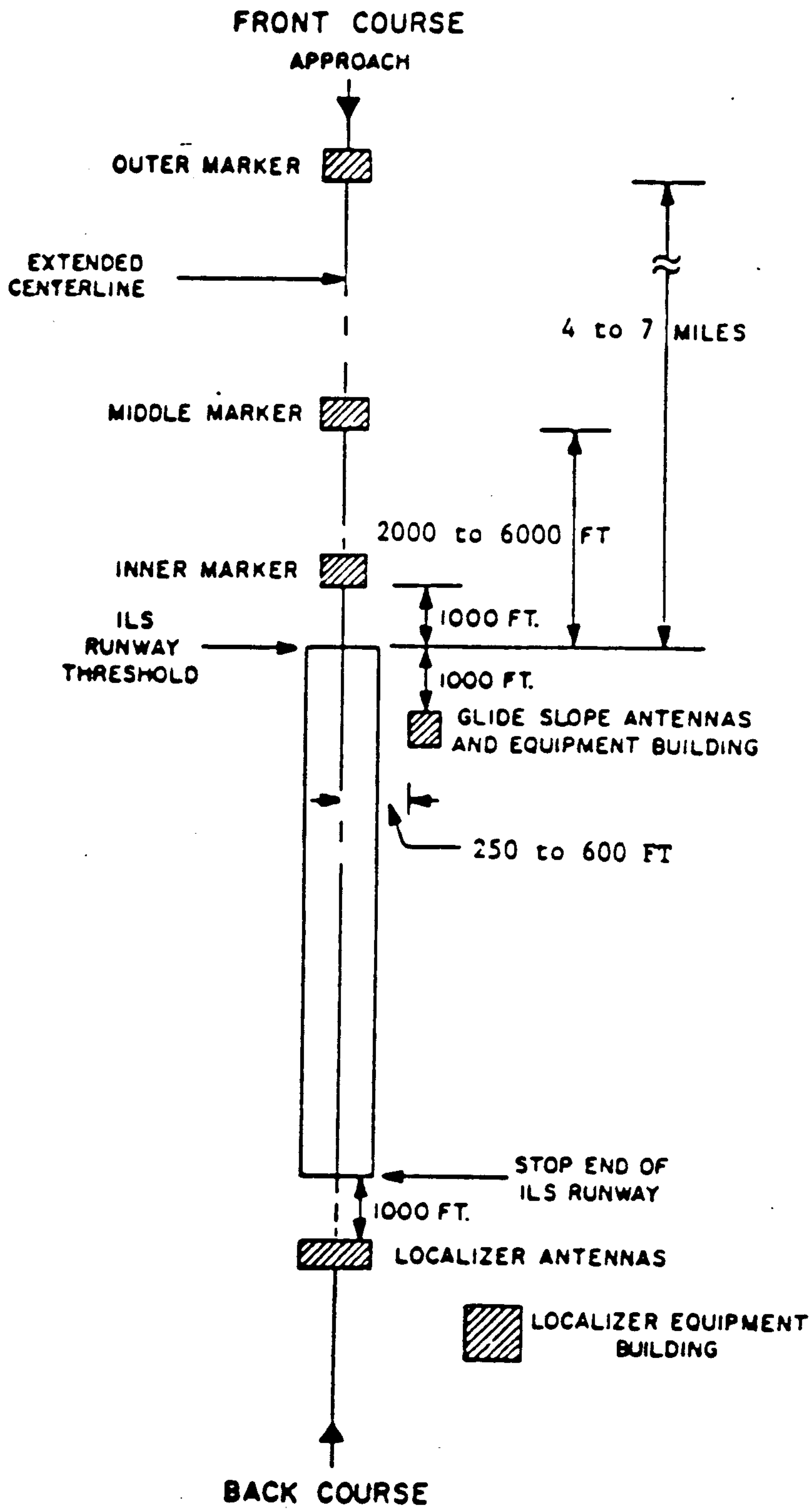


Figure 5. GLIDE SLOPE PATH STRUCTURE TOLERANCE CHART

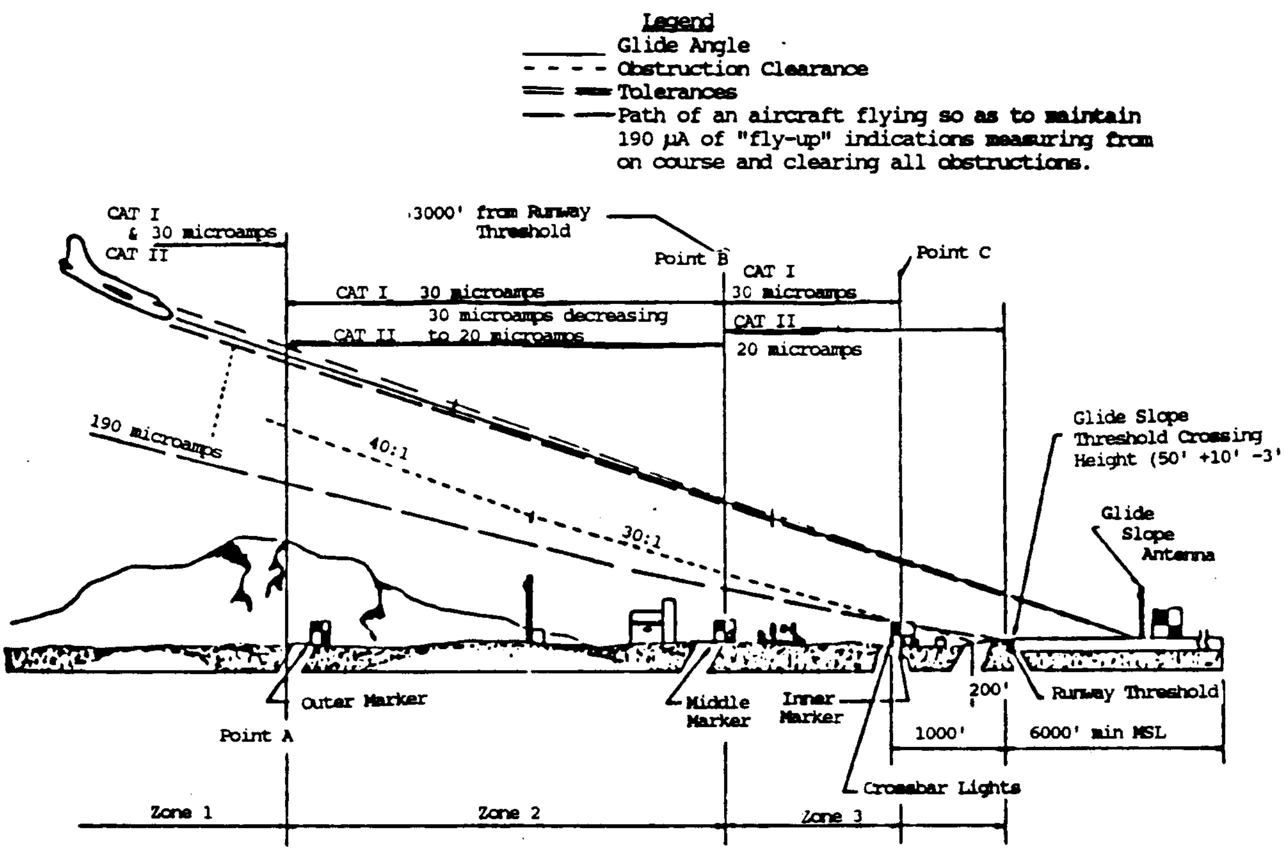
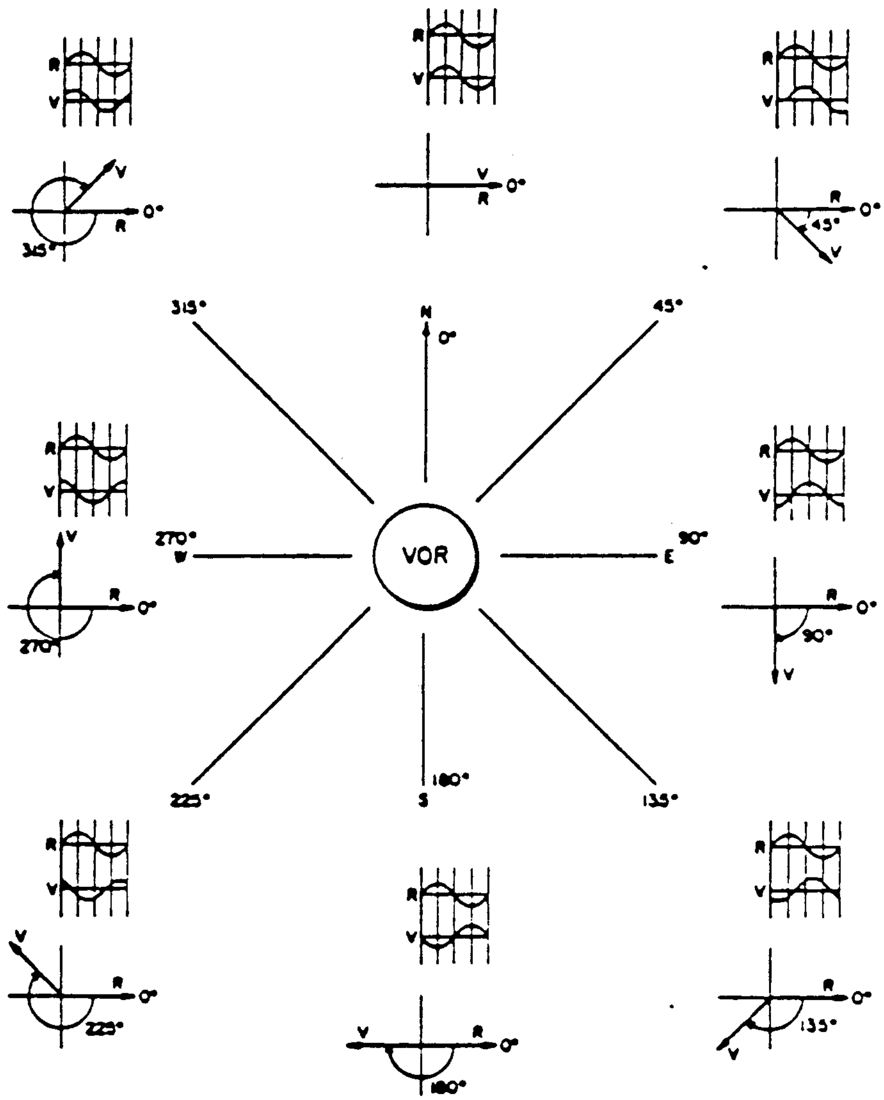


Figure 6. VOR REFERENCE AND VARIABLE PHASE RELATIONSHIPS



## Figure 7. STUBBING OF RF TRANSMISSION LINES

1. STUBBING OF RF TRANSMISSION LINES. The following is a practical method of stubbing involving very little computation.

a. Set up equipment as indicated in Figure 7-1. Measure and record the original VSWR (S). Locate voltage minimum.

b. Determine the location of the stub by applying the original VSWR to Figure 7-1. Cut a positioning piece, shown as "P" in Figure 7-2, slightly longer than the indicated optimum. If available, include a phasing adapter fitting (line stretcher) as part of the "P" section. The phasing adapter should be set and locked at four turns out from minimum position.

c. Fabricate a variable stub by mounting a variable 0-25 ufd. condenser in a metal box, with a fitting to connect it to a short piece of line (about 6 inches), which in turn connects to the stub "tee" fitting. This setup is shown in Figure 7-2.

d. Again apply RF power and tune the variable stub for minimum reflected power as measured by the wattmeter and thru-line detector. This will result in either a voltage maximum or minimum one quarter wavelength from the stub. This would normally be a minimum, as the "P" section fabricated slightly long. A short "P" section would result in a maximum one quarter wavelength from the stub. Read and record the VSWR and "V" maximum and minimum.

e. From the original VSWR (S) and present VSWR (S), determine from Figures 7-3 and 7-4 the kind and amount of correction to make to the "P" section. Figure 7-5 converts electrical degrees to inches for coaxial cables having a V.P. of 0.66.

f. Repeat steps "d" and "e" until the voltage distribution along the feedline is essentially flat. Attach a longer open stub section in place of the variable stub. Again, use a phasing adapter, if available, set at four turns from minimum. Trim the stub in small decrements while observing the VSWR. Care should be taken to decouple and protect the wattmeter element each time a cut is made. Trim until the reflected power is zero. Final minute adjustments can be made by adjusting the phasing adapters if required.

Figure 7-1. EQUIPMENT REQUIRED

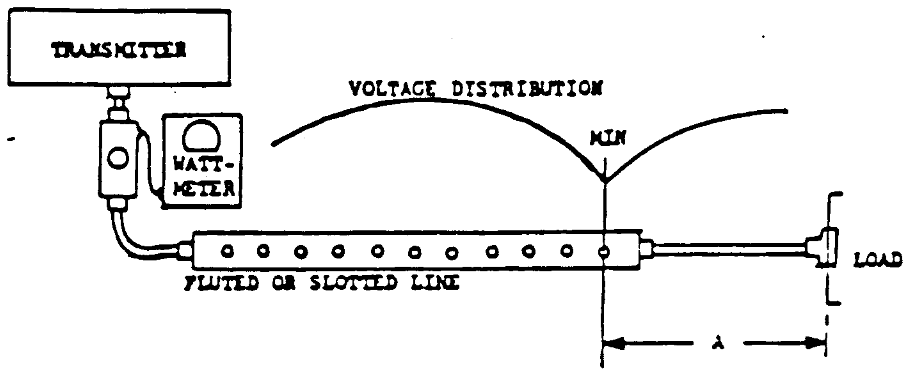
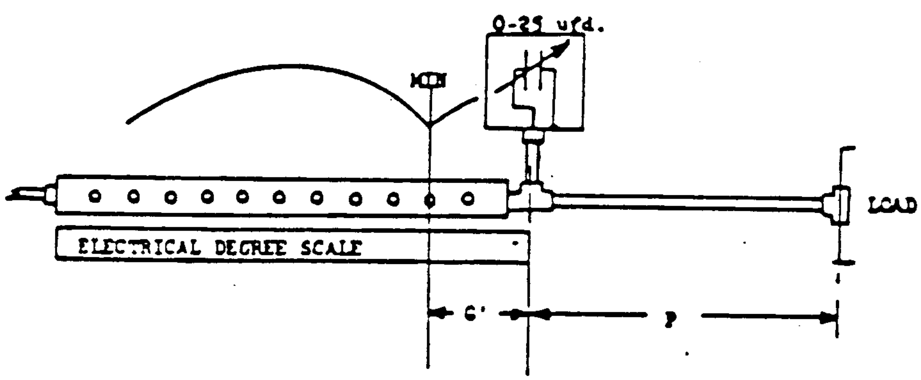



Figure 7-2. VARIABLE STUB



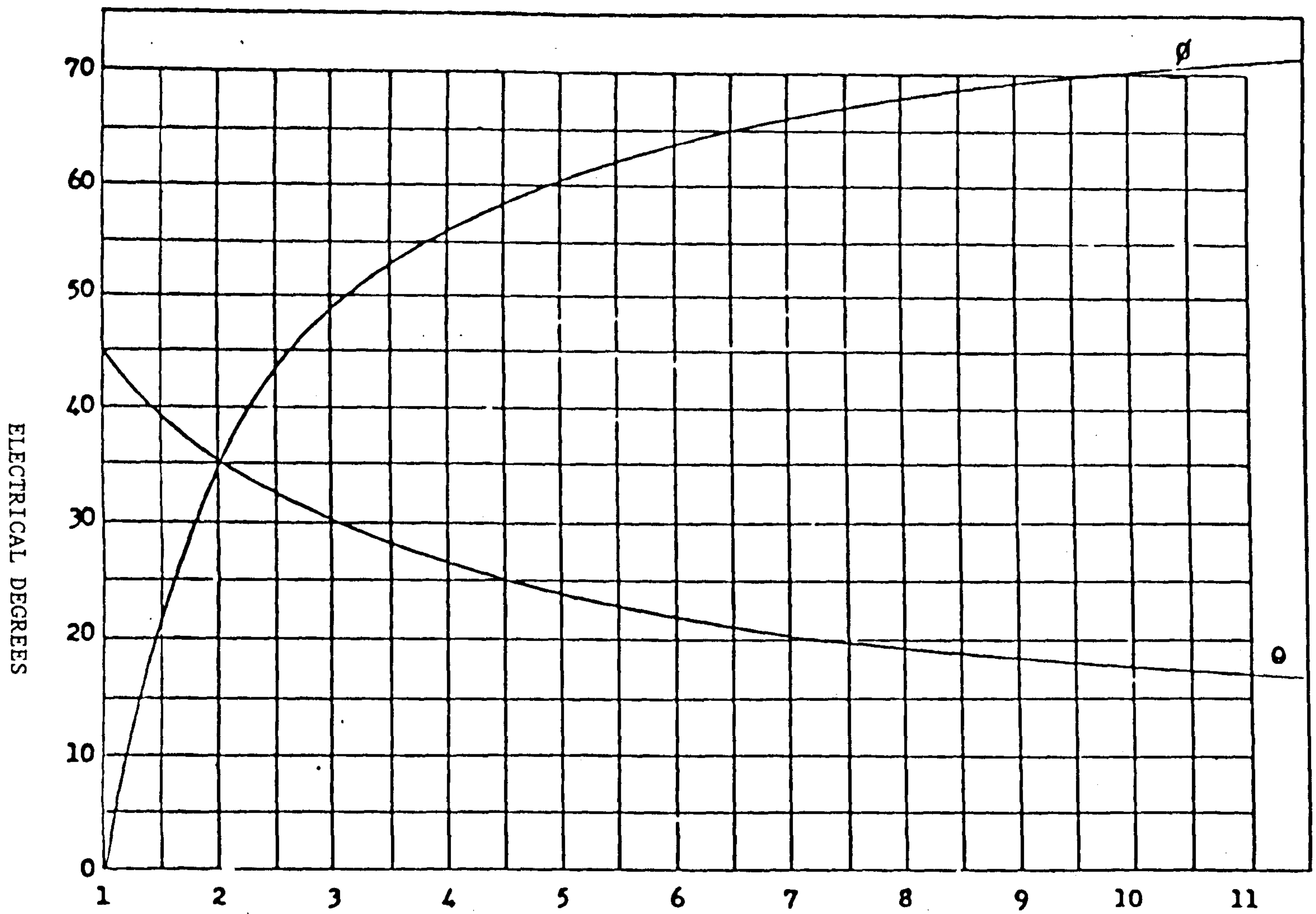



Figure 7-3. $S_o$ - ORIGINAL SWR

CHART SHOWING THE ELECTRICAL LENGTH OF STUB REQUIRED AND THE REQUIRED ELECTRICAL POSITION WITH RESPECT TO A VOLTAGE MINIMUM. ø IS THE LENGTH OF THE STUB IN ELECTRICAL DEGREES AND θ IS THE DISTANCE FROM VOLTAGE MINIMUM TO STUB IN ELECTRICAL DEGREES TOWARD THE TRANSMITTER.

Figure 7-4. PRESENT SWR

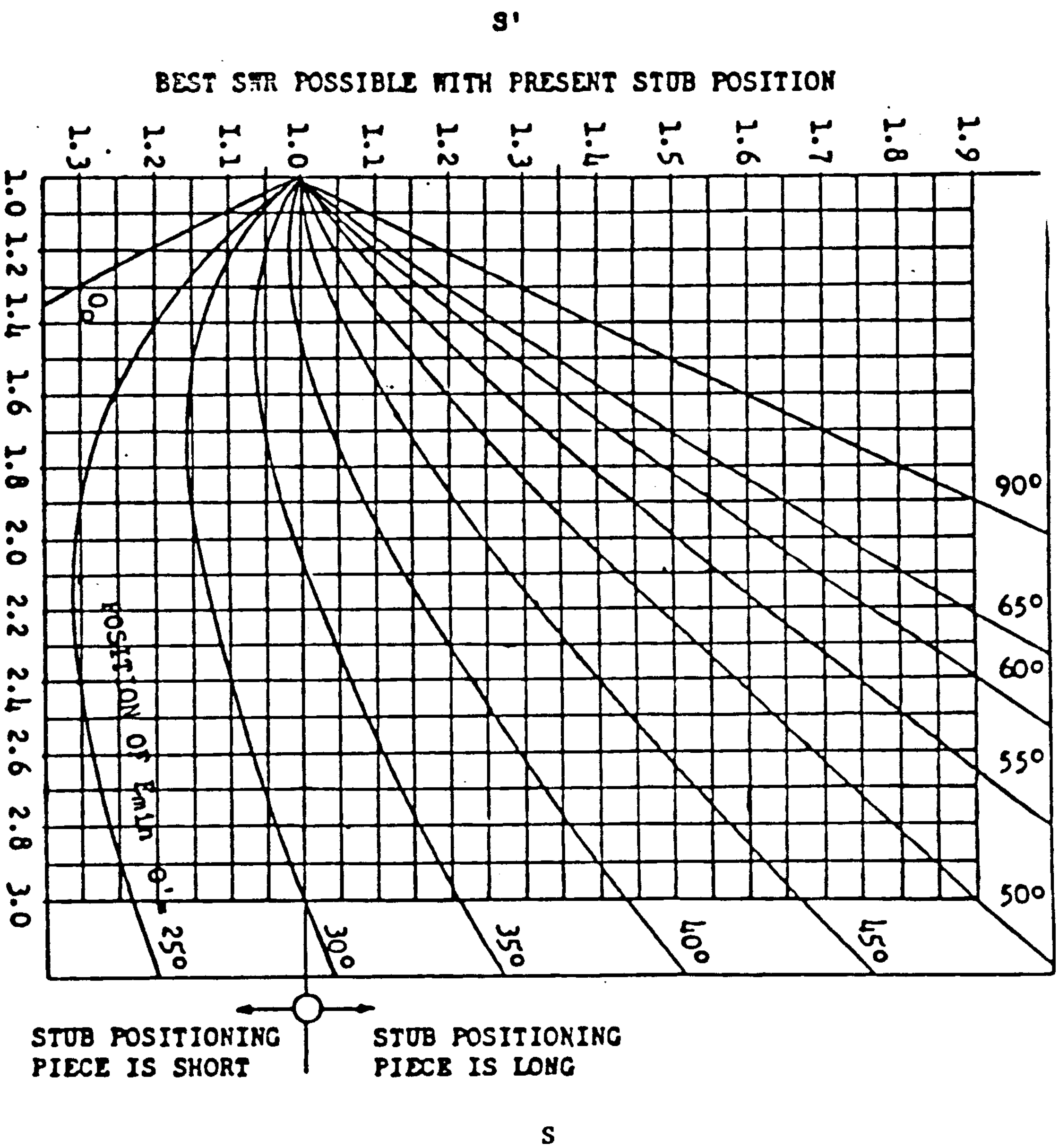



CHART SHOWING BEST SWR POSSIBLE USING PRESENT STUB POSITION. S IS THE EXISTING SWR. O' IS THE DISTANCE IN ELECTRICAL DEGREES FROM THE CENTER OF THE "T" (WHERE THE STUB IS ATTACHED) TO THE FIRST VOLTAGE MINIMUM TOWARD THE TRANSMITTER.

Figure 7-5. BEST SWR POSSIBLE WITH PRESENT STUB POSITION

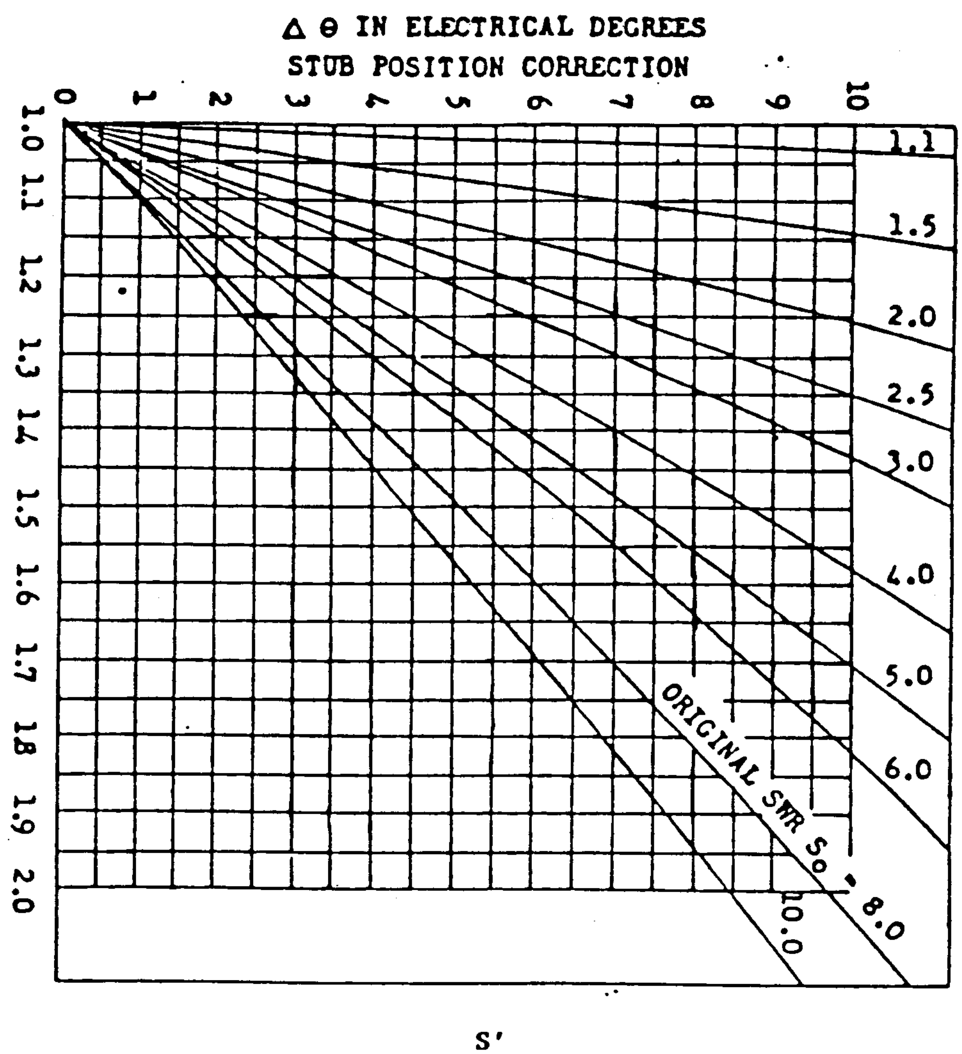



CHART SHOWING CORRECTION TO BE MADE ON STUB POSITIONING PIECE. S' IS DETERMINED FROM FIGURE 7-4. $S_o$ IS THE ORIGINAL SWR ON THE LINE.

## Figure 8. VOR ERROR CURVE ANALYSIS AND CORRECTION

1. GENERAL. After a VOR has been completely tuned and adjusted as per instructions outlined in maintenance handbooks, a preliminary ground check should be made on both sets of equipment and the error curves plotted on a standard form or graph paper. An analysis of the error curves will show: (1) octantal error, (2) quadrantal error, (3) duantal error, (4) random error, or a combination of all four types of error.

a. Octantal error is caused by the spacing between the loops and can be minimized only by careful adjustment of the antenna end plates. It cannot be completely eliminated.

b. Quadrantal error is usually caused by misphasing between the two SB pairs of antennas, or by unequal SB outputs as a result of bad goniometer or high attenuation in one SB feedline, fitting, or relay. It usually shows a maximum excursion at the 0, 90, 180, and 270 degree points.

c. Duantal error is usually caused by misphasing between the two loops of a pair, or unequal power outputs of an SB pair. It can also be caused by a bad modulation eliminator.

d. Random error also exists after minimizing octantal, quadrantal, and duantal errors. Imperfections in the physical construction of the antenna, counterpoise unevenness, and inaccuracies in detector bracket placement will contribute to random error and limit the final error reduction. A well installed VOR should have less than 0.5 degrees of random error.

2. INSTRUCTION. The following instructions apply to reduction of duantal error caused by misphasing between the two loops of an SB pair, where the error shows maximum excursions at the 45, 135, 222, and 315 degree points.

a. After plotting the error curves of both transmitters, select the equipment with the greater error spread.

b. Draw a line between the 45 and 225 degree points, also the 135 and 315 degree points.

c. If these lines slope, refer to Figure 8-1, VOR L4 Antenna Feedline Adjustment Chart, and determine which adjustments will effect the desired lobe movement to reduce error spread.

d. Disconnect the SB input feedline from the bridge that requires adjustment and connect the oscilloscope RF pickup lead to the bridge input tee.

e. Disconnect the other SB input feedline and connect a 52 ohm dummy load to the bridge input tee.

Figure 8. VOR ERROR CURVE ANALYSIS AND CORRECTION (CONT'D)

f. Disconnect the goniometer input feedline and connect this line to a 52 ohm dummy load.

g. Turn on transmitter plate power and tune oscilloscope for maximum deflection.

h. While observing the scope, make the necessary adjustments to the L4 line phasing adapter on one antenna only, as indicated by the chart. DO NOT EXCEED two turns on phasing adapter for each adjustment.

i. At this point, the bridge will go out of balance. Rebalance the bridge by making slight adjustment on the antenna end plate. If the L4 has been shortened, it will be necessary to increase the end plate adjustment.

j. Reconnect the antenna system for normal operation. Rephase the antennas and conduct another ground check. Plot the error curve and compare it with the previous curve. If the results show improvement, repeat the above steps in small increments until the desired correction is obtained.

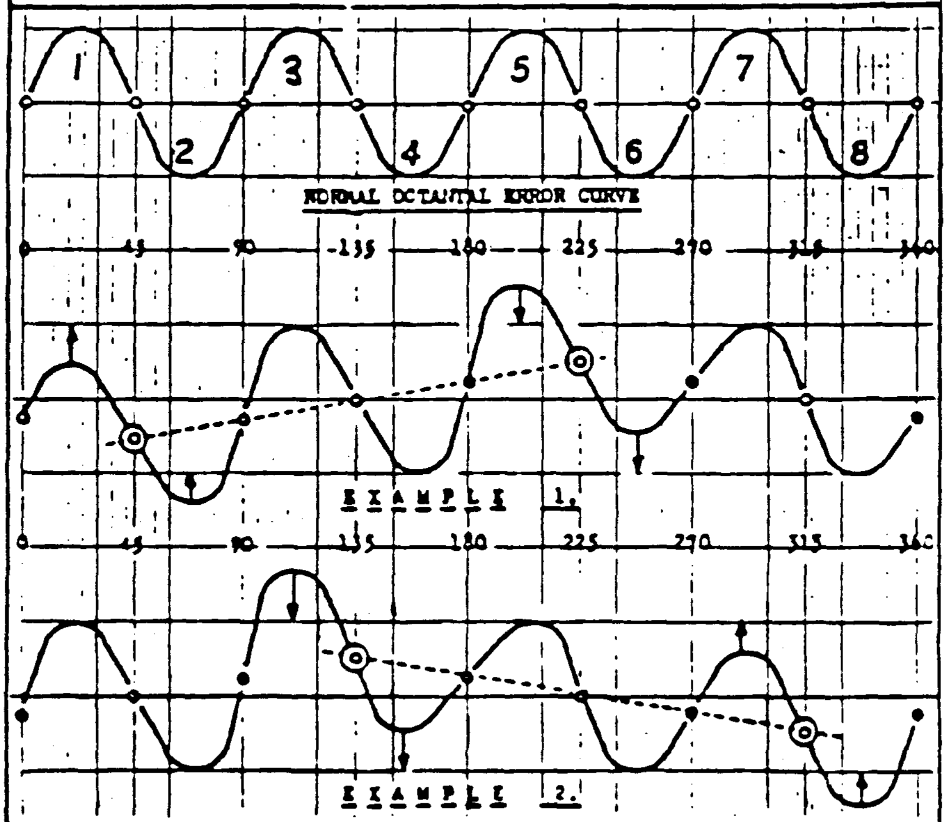
k. After a satisfactory error curve is obtained, recheck the VSWR on both sideband and carrier feedlines and make the necessary adjustments to the stubs or position sections to bring the VSWR within tolerance.

l. Make a final ground check to determine that the error curve remained the same as previous curve.

# Figure 8-1. VOR L4 ANTENNA FEEDLINE ADJUSTMENT CHART

| CORRECTION ON L4 LINE | DIRECTION OF LOBE OR NULL MOVEMENT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | | 135 | | 225 | | 315 | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| SHORTEN N W AND/OR LENGTHEN S E | ↑ | ↑ | • | • | ↓ | ↓ | • | • |
| SHORTEN N E AND/OR LENGTHEN S W | • | • | ↑ | ↑ | • | • | ↓ | ↓ |
| SHORTEN S E AND/OR LENGTHEN N W | ↓ | ↓ | • | • | ↑ | ↑ | • | • |
| SHORTEN S W AND/OR LENGTHEN N E | • | • | ↓ | ↓ | • | • | ↑ | ↑ |

↑ = Lobe moves plus ↓ =Lobe moves minus • =Lobe moves very little




EXAMPLE 1. Indicates that it is necessary to Shorten the N W and/or Lengthen the S E L4 lines.

EXAMPLE 2. Indicates that it is necessary to Shorten the S W and/or Lengthen the N E L4 lines.

Figure 8-2. VOR ERROR CURVE ANALYSIS AND CORRECTION

Example 3 below shows a condition that would indicate it is necessary to shorten both the S E and S W L4 sections. However, an attempt should first be made to correct this type of error by adjusting the length of the SB feedline between the modulation eliminator and the goniometer. The following steps can be taken to determine the correct feedline length.

a. Add at least 4 inches of extra length to the goniometer feedline by use of L fittings or straight-through connectors.

b. Rephase the antennas and conduct another ground check.

c. Compare the error curve with the preliminary ground check error curve.

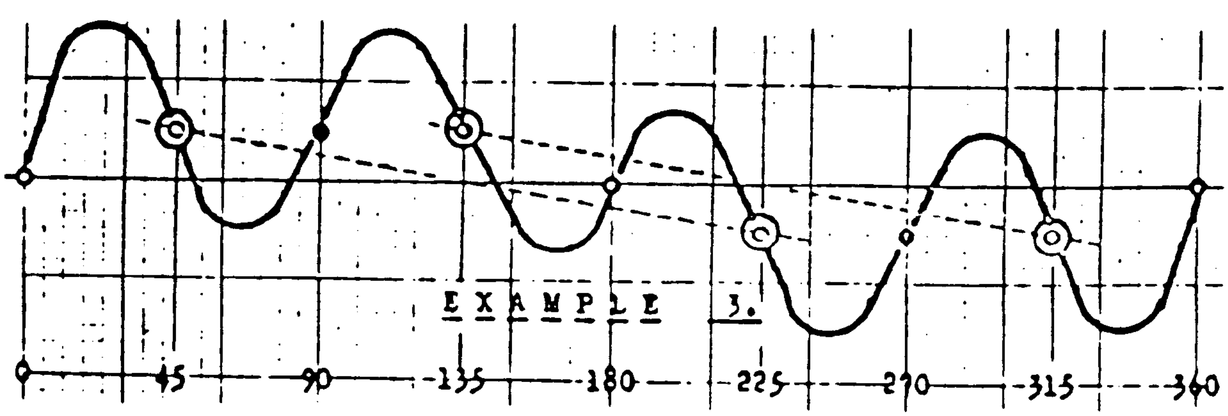
d. If no appreciable change is noted, add another 4 inches of line, rephase and repeat ground check. If no further change is noted, refer to the L4 adjustment chart for corrections.

e. If the error spread shows improvement, continue adding lengths of line or fittings until a satisfactory curve is obtained. Do not forget to rephase after each addition of line. If the phaser goes off scale, add necessary length to carrier feedline above thru-line wattmeter section, to return phaser to center position.

f. After a satisfactory error curve is obtained, measure back exactly 1/2 wavelength from the end of the added fittings or sections and cut the line, installing a new plug. It will be necessary to do the same on the carrier and feedline to get the phaser back to center.

g. If the error spread increases, it will be necessary to remove the added length and shorten this line in 2-inch increments, rephasing each time. Continue shortening until a satisfactory curve is obtained. Remove the necessary length from the carrier antenna feedline to bring the phaser back to center.

h. After a satisfactory curve is obtained on one piece of equipment, remove the same amount of line from the other goniometer feedline.



## Figure 9. WILCOX 585 VOR AND SLOT ANTENNA TUNEUP

The sequence of tuning adjustments must be performed as listed because of interactions of adjustments.

1. ANTENNA PHYSICAL ADJUSTMENT. Physically adjust the four antenna slot capacitors, with a gauge to 5/16-inch spacing. Set all adjustable shorting stubs in the base of the antenna to 2 7/8 inches. Physically set the inductors and plungers (top and bottom) to the values indicated on the antenna chart for the assigned frequency. Securely tighten all hardware, after each change during the adjustments.

2. BALANCE THE ANTENNA BRIDGES. Connect the transmitter to the antenna carrier input. Connect the #1 sideband antenna input to the oscilloscope RF head and Dummy the #2 sideband antenna input. Adjust the antenna slot capacitors (31) for minimum RF indication. Adjust differentially; increase one by the amount the other is decreased (1/8 turn increments). Perform the same adjustments to the #2 sideband antenna pair. Tune for minimum.

3. REDUCE VSWR ON THE SIDEBAND FEEDLINES. If the sideband stub capacitors are in the antenna base, relocate them down into the equipment room by adding 360° to the lines. Adjust the lower antenna bridges and tune the stub capacitors to have no reflected power first on sideband #1, then #2. Sidebands #1 and #2 capacitors should have the same or nearly the same dial reading (equal feed impedance).

4. REDUCE VSWR ON THE CARRIER FEEDLINE. Adjust the top or bottom plunger for minimum reflected power. Final adjustments are extremely small (as little as the thickness of a piece of paper).

5. MEASURE AND CORRECT GONIOMETER ERRORS.

a. Dummy #2 sideband antenna feed and measure the detected phase, with the monitor and test generator, at 135° and 315° azimuths. These should be 180° apart within 0.1°. Dummy #1 sideband antenna feedline, radiate #2 sideband, and measure the detected phase at 45° and 225°. These should be 180° apart within 0.1° and 90° displaced from the #1 detected phases with 0.1°.

b. Disconnect the audio from the modulators (pull audio boards) and with the carrier applied and an RF detector (RF head of the scope or RF meter or detected DC level from the thru-line body), set one pot and one capacitor physically midrange and null the RF output by alternately adjusting the other capacitor and pots for minimum RF out. Repeat these adjustments because they interact. Perform the same adjustment for the other balance modulator.

c. Adjust the audio signals for correct waveform and amplitude.

d. Monitoring the 45° - 225°, 135° - 315° azimuths, set the correct audio phases. (180° apart and 90° displaced).

Figure 9. WILCOX 585 VOR AND SLOT ANTENNA TUNEUP (CONT'D)

6. RF PHASE THE CARRIER AND SIDEBAND FEEDLINES. Cut the carrier and sideband feedlines so that the RF phasers are midrange, phasing is optimum, and sensing is correct.

7. MINIMIZE OCTANTAL ERROR. Perform a 16-point ground check. If any octantal error is present, it can be eliminated by adjusting all antenna stubs an EQUAL distance. Low end of the band, try 3/8 inch longer (screw stubs out). High end of the band shorten (screw stubs in). Perform additional 16-point ground checks and refine the adjustments. These stub adjustments will cause the sideband VSWR to increase and the lines must be "flattened" again. Be aware that unequal movement of the stubs will cause the nulls to move.

8. REDUCE GROUND CHECK ERROR SPREAD.

a. The nulls can be moved by differentially adjusting antenna slot capacitors. Small changes (1/8 turn) make considerable course changes. The nulls can be moved by adjusting individual antenna stubs. Perform an 8-point ground check after each adjustment. Four turns of the stub is suggested for each adjustment resulting in individual null movements of approximately 0.2 to 0.4 degrees. The nulls can be adjusted to be in a straight line (rectangular graph), all equal.

b. If quadrantal error is present and sideband power imbalance is unacceptable, attenuation of one sideband power may be accomplished by adding wavelength increments to the sideband that has excessive amplitude. Add to the antenna side of the RF thru-line RF body. Adding only one wavelength changes cardinal points approximately 0.5°. Proper adjustment of the goniometer and antenna will make the use of line loss unnecessary.

9. COMPLETE THE SYSTEM TUNEUP.

a. First set the reference radial (rotate courses), modulation percentages, and monitor parameters. During error spread reduction procedures, it may be desirable to determine what errors are caused by the counterpoise, detector bracket misplacement, and environmental effects or radiated signal errors. Mechanically rotate the antenna 90° (use the monitor and test generator to set 0° signal to the 90° detector bracket). Perform an all-points ground check. Careful analysis of the errors that moved 90° and those that did not move will supply valuable information. This procedure is difficult and is not recommended except in those cases where the source of errors cannot be determined.

Figure 9. WILCOX 585 VOR AND SLOT ANTENNA TUNEUP (CONT'D)

b. Many details have not been included in the instructions because they should be obvious to a trained technician.

(1) Antenna measurements will be made when no one is in the antenna shelter.

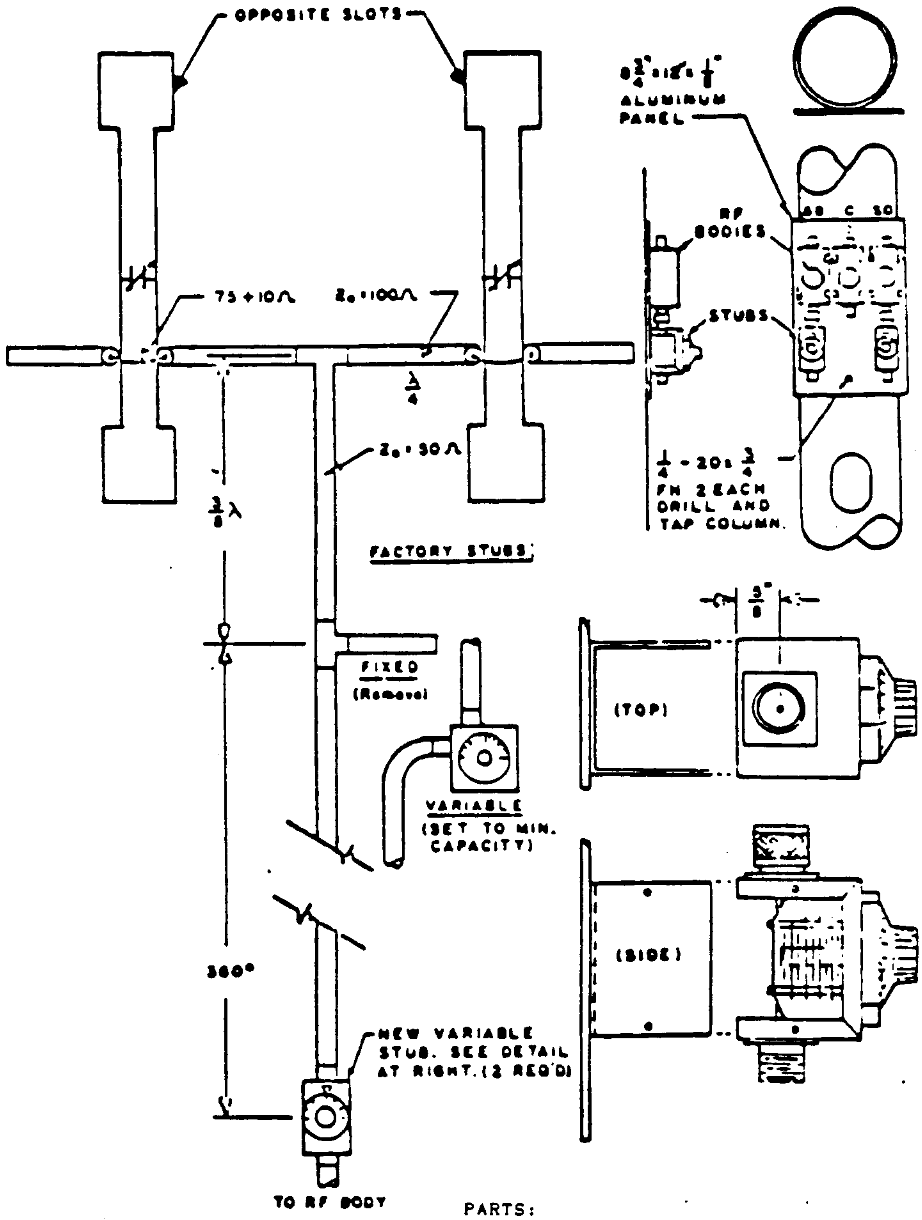
(2) The oscilloscope RF head is resonated to channel frequency.

(3) Vehicles are far from the antenna.

(4) The shelter door is closed because an open door causes course phase shift.

(5) The field detector cable is dressed down and radially from the VOR antenna and the technician stands centered behind the detector.

Figure 9. WILCOX 585 VOR AND SLOT ANTENNA TUNEUP (CONT'D)




PARTS:
- 2 each Aluminum box 2-3/4 x 2-1/8 x 1-5/8" Bud CU3000A.
- 2 each Male and Female Type N chassis jack.
- 2 each Hammerlund HF-30-X 5.2 - 30pf capacitor
- 2 each Vernier dial, 2" Burstein Appleton 170274