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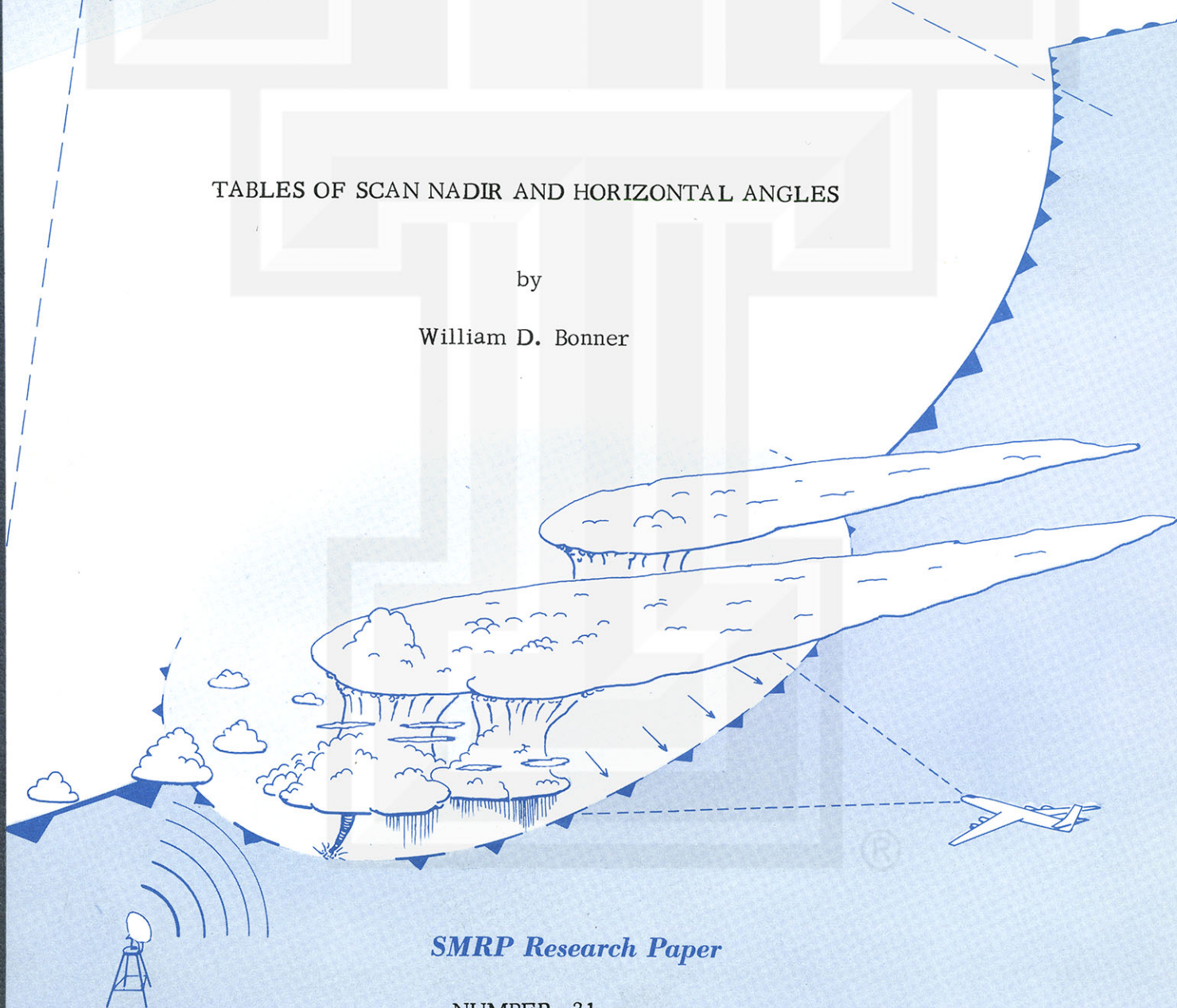
SATELLITE & MESOMETEOROLOGY RESEARCH PROJECT

*Department of the Geophysical Sciences
The University of Chicago*

TABLES OF SCAN NADIR AND HORIZONTAL ANGLES

by

William D. Bonner



SMRP Research Paper

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TABLE OF CONTENTS

	Page
1. INTRODUCTION	1
2. MATHEMATICS	2
3. USING THE TABLES	3
4. TABLES	
Table I: $\beta = 45 \text{ deg}$	7
Table II: $\beta = 70 \text{ deg}$	21
Table III: $\beta = 90 \text{ deg}$	37



ABSTRACT

Tables are presented which may be used in place of the tilt and radiometer grids in the Fujita technique for the analysis of satellite radiation data. Scan geometry is briefly described and an example is given showing the use of the tables in plotting a scan line on an OEC projection.

1. Introduction

Fujita¹ has developed a graphical technique for plotting the scan lines from satellite-born scanning radiometers. This technique, applied to analog traces from TIROS master telemetry tapes, permits a synoptic analysis of the radiation data with a resolution limited only by the resolution of the sensor and telemetric system of the satellite.

The purely graphical technique, while valuable for mesoscale research, is both tedious and time-consuming and, for this reason, Fujita, Arnold, and Bonner at SMRP have worked to develop faster ways of locating the scan lines without significantly reducing their accuracy. These include:

A. The use of tables to replace the tilt and radiometer grids in the graphical technique.

B. The development of a set of pre-plotted scan lines which can be traced directly onto an OEC chart.

C. The writing of a program for machine calculation of scan-spot latitude and longitude from subpoint and attitude information.

Techniques B and C above will be discussed in later reports;² this report presents machine-calculated tables which may replace the tilt and radiometer grids in the plotting of TIROS and NIMBUS scan lines. Three sets of tables are given: for β angles of 45, 70, and 90 deg corresponding respectively to the design inclinations of the radiometer axes in previous TIROS, in a proposed TIROS, and in NIMBUS satellites.

¹ Fujita, T., 1963: Outline of a theory and examples for precise analysis of satellite radiation data. Mesomet. Res. Paper #15, Chicago Univ. Fujita, T., 1964: A technique for precise analysis of satellite data: Vol. II, Radiation analysis, section 6. Fixed-position scanning. SMRP Res. Paper #29, Chicago Univ.

² Scan-line grids will be described in SMRP Res. Paper #32, the computer program in SMRP Res. Paper #42 - both to be published during 1964.

2. Mathematics

For a comprehensive discussion of scan geometry and for clarification of the terms used below, see the second paper by Fujita listed in footnote 1.

If the orbital motion of a satellite is ignored during a single rotation of its radiometer axis, the geometry of the scan becomes relatively simple. As shown in Fig. 1, the radiometer axis sweeps out a cone in space with half-vertex angle β and with the axis of the cone inclined at an angle η_a from the vertical. The intersection of the cone with the earth is the terrestrial scan line. Any point TSC on the scan line may be located by its coordinates η_s and ψ_s , the scan nadir angle and scan horizontal angle respectively. Given the satellite position and attitude, these coordinates may be transformed either graphically or mathematically to latitude and longitude on the earth.

If β and η_a are known, η_s and ψ_s corresponding to a particular scan angle σ are obtained by solving the spherical triangle formed by the projections of TSP, TPM, and TSC onto an arbitrary sphere centered at the satellite (see Figs. 1 and 2). Referring to Fig. 2,

$$\cos \eta_s = \cos \beta \cos \eta_a - \sin \beta \sin \eta_a \cos \sigma \quad (1)$$

and

$$\sin \psi_s = \sin \beta \sin \sigma / \sin \eta_s \quad (2)$$

where ψ_s and σ are measured from the primary plane. The angle σ by convention is 0 deg at aponadir and, for the floor sensor on TIROS satellites, is measured in a counterclockwise direction from the primary line.

If the angle $(\beta + \eta_a)$ exceeds the complement of the dip angle (δ_H) , the radiometer will be viewing space during at least a portion of the scan. It would be possible to interpolate σ and ψ_s at the horizon from the condition that $\eta_s = 90 - \delta_H$; however, accurate interpolation is difficult in this case and, instead, separate tables were computed giving σ and ψ_s at the horizon as a function of δ_H and η_a . The horizon tables were produced by solving equations (1) and (2) for σ and ψ_s with η_s replaced by $(90 - \delta_H)$.

The programs for producing the tables were written with β and with the range and increment of δ_H as input data rather than as constants in the program so that tables can be quickly and easily produced for a wide variety of satellite-radiometer systems.

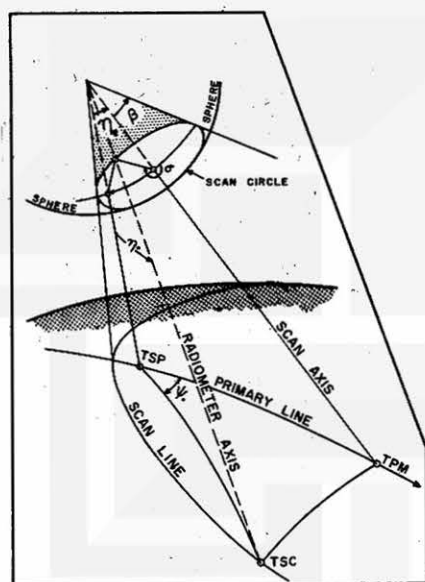


Fig. 1. Scan geometry showing the projection of TSP, TPM and an arbitrary scan point TSC onto the surface of a sphere centered at the satellite. Given the position of the satellite, the nadir angle η_s and horizontal angle ψ_s define the location of TSC.

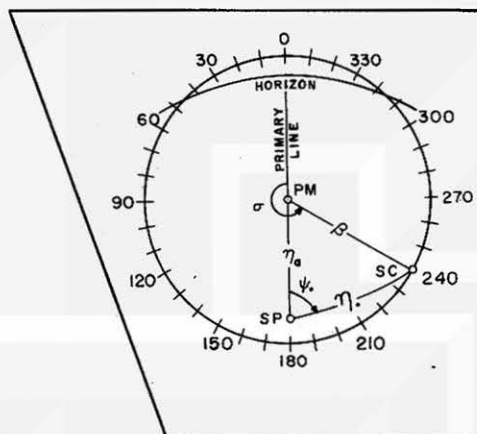


Fig. 2. View from the satellite of the spherical triangle formed by the projection of TSP, TPM, and TSC onto the sphere in Fig. 1. Note horizon intersections with the scan circle and the symmetry about the primary line. As drawn, the axis of the floor sensor of TIROS satellite would first intersect the earth at $\sigma = 45$ deg and would leave the earth at $\sigma = 315$ deg. Coordinates (η_s, ψ_s) of points in between are obtained by solving the spherical triangle (equations 1 and 2).

3. Using the Tables

The plotting of a scan line on an OEC chart is illustrated in Fig. 3. The example refers to TIROS with $\beta = 45$ deg, $\eta_s \equiv \eta_a = 38.5$ deg. The altitude of the satellite is assumed to be 730 km.

The subpoint and primary line must be drawn on the OEC chart in order to properly orient the height grid underlay. Subpoint positions and satellite altitudes may be obtained from the Definitive AT Map produced by NASA. Spin axis points may be obtained from photo analysis³ or from tables or graphs giving celestial coordinates of

³ Fujita, T., 1963: A technique for precise analysis of satellite data: Volume I - photogrammetry. MSL Rep. #14, U.S. Wea. Bur.

the spin-axis point as a function of time.^{3,4} The primary line and the satellite nadir angle are determined by constructing the great circle connecting the spin axis point and the subpoint, as described by Fujita.³

In the example, a ZE height grid is centered at the subpoint on the OEC chart with its axis along the primary line. The dip angle is a function of height alone and may be obtained from the nomogram in Fig. 4. In this case, δ_H is approximately 26.25 deg and, therefore, using the table on page 11, the first horizon intersection of the radiometer axis occurs at $\sigma = 75.4$ deg with $\psi_s = 49.7$ deg, giving the first point of the scan line in Fig. 3. Since the geometry is symmetrical about the primary line, the radiometer axis will leave the earth at $360 - \sigma$ or 284.6 deg and with $\psi_s = 49.7$ deg measured in the opposite direction from the primary line, giving the second horizon in Fig. 3. Height grid coordinates for $\sigma = 180$ deg to $\sigma = 80$ deg are obtained from the tables on page 10. These points, together with their image points on the opposite side of the primary line, are plotted and connected together by a smooth curve to yield the scan line in Fig. 3.

If the satellite nadir angle is sufficiently large

$$\beta + \eta_s > 90 + \delta_H$$

the wall sensor on TIROS will view the earth either alone or in alternation with the floor sensor. The tables may be used for plotting the scan lines of the wall sensor provided that η_a is replaced by $180 - \eta_s$. In this case, the rotation of the radiometer axis is in a clockwise rather than a counterclockwise sense.

⁴ Goldshlak, L., 1962: TIROS III and IV attitude summaries. ARACON Geophysics Corp., Concord, Mass.

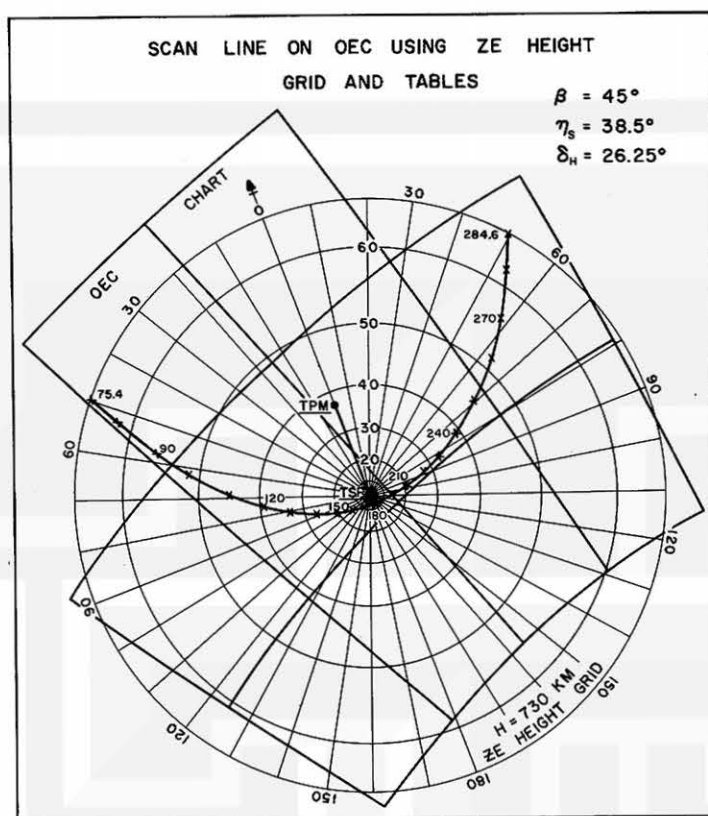


Fig. 3. Schematic illustration showing scan line plot on OEC using a ZE height grid and tables. Note the symmetry about the primary line and the proper orientation of the height grid on the OEC. The plotted positions of the scan spots on the height grid were taken from the tables on pages 10 and 11.

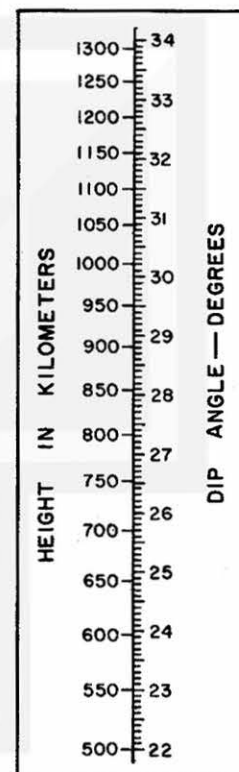
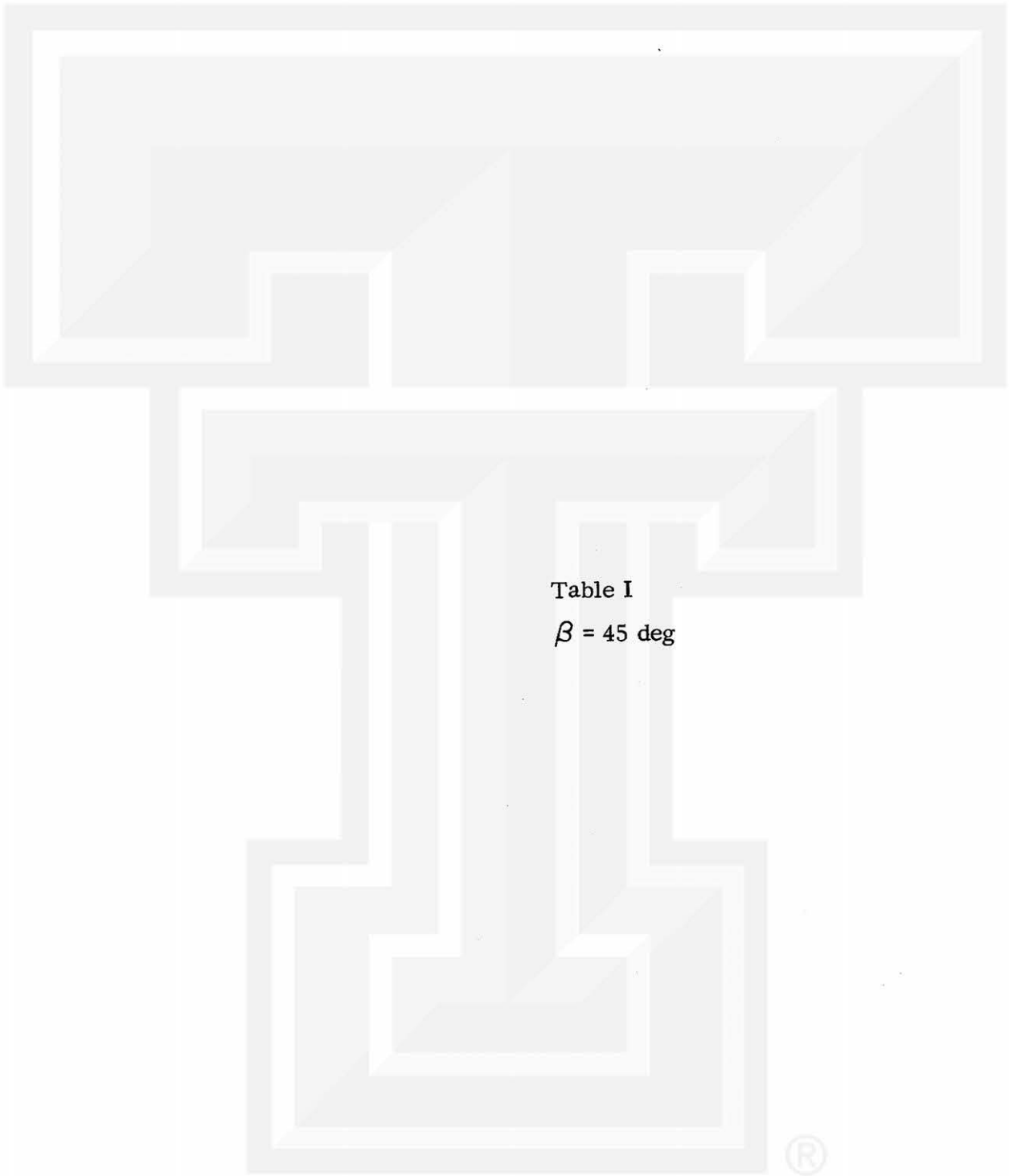


Fig. 4. Nomogram for conversion of altitude in km to dip angle in deg.

4. Tables of Scan Nadir and Horizontal Angles

Nadir and azimuth angles of 10-deg scan spots are listed on the left hand pages as a function of the nadir angle of the radiometer axis, η_a . The spin angle is 180 deg at aponadir and 0 deg at perinadir. Tables of spin angle and scan-horizontal angle at the horizon are given on facing pages for the same range of η_a at 0.25-deg increments of dip. See Fig. 4 for conversion of satellite height to dip angle.

Zeros fill in the horizon tables where there is no horizon intersection (closed or null modes). Tables of nadir and horizontal angles are cut off with the first value of η_a exceeding 70 deg and succeeding row entries are 0.



SPIN ANGLE (UPPER) AND SCAN HORIZONTAL ANGLE (LOWER) AT THE HORIZON FOR BETA=45.0DEG

	24.00	24.25	24.50	24.75	25.00	25.25	25.50	25.75	26.00	26.25	26.50	26.75	27.00	27.25	27.50	27.75	28.00
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.9	15.5	
18.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.8	15.3	18.8	21.7
18.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.7	15.1	18.6	21.5	24.0
19.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.6	15.0	18.4	21.2	23.8	26.0	28.2
19.5	0.	0.	0.	0.	0.	0.	0.	10.5	14.8	18.2	21.0	23.5	25.8	27.9	29.8	31.6	33.4
	0.	0.	0.	0.	0.	0.	0.	8.2	11.6	14.2	16.5	18.4	20.2	21.8	23.3	24.8	26.2

SPIN ANGLE (UPPER) AND SCAN HORIZONTAL ANGLE (LOWER) AT THE HORIZON FOR BETA=45.0DEG

	24.00	24.25	24.50	24.75	25.00	25.25	25.50	25.75	26.00	26.25	26.50	26.75	27.00	27.25	27.50	27.75	28.00
40.0	72.7 47.7	73.3 48.0	73.8 48.3	74.3 48.6	74.8 48.8	75.3 49.1	75.8 49.4	76.4 49.7	76.9 50.0	77.4 50.3	77.9 50.6	78.4 50.9	78.9 51.1	79.4 51.4	79.9 51.7	80.4 52.0	80.9 52.2
40.5	73.4 47.9	73.9 48.2	74.5 48.5	75.0 48.8	75.5 49.1	76.0 49.3	76.5 49.6	77.0 49.9	77.5 50.2	78.0 50.5	78.5 50.7	79.0 51.0	79.5 51.3	80.0 51.6	80.5 51.8	81.0 52.1	81.5 52.4
41.0	74.1 48.1	74.6 48.4	75.1 48.7	75.6 49.0	76.2 49.2	76.7 49.5	77.2 49.8	77.7 50.1	78.1 50.3	78.6 50.6	79.1 50.9	79.6 51.2	80.1 51.4	80.6 51.7	81.1 51.9	81.6 52.2	82.0 52.5
41.5	74.8 48.3	75.3 48.6	75.8 48.9	76.3 49.2	76.8 49.4	77.3 49.7	77.8 50.0	78.3 50.2	78.8 50.5	79.3 50.8	79.7 51.0	80.2 51.3	80.7 51.6	81.2 51.8	81.7 52.1	82.2 52.3	82.6 52.6
42.0	75.5 48.5	76.0 48.8	76.5 49.1	77.0 49.3	77.4 49.6	77.9 49.9	78.4 50.1	78.9 50.4	79.4 50.6	79.9 50.9	80.4 51.2	80.8 51.4	81.3 51.7	81.8 51.9	82.3 52.2	82.7 52.4	83.2 52.7
42.5	76.1 48.7	76.6 49.0	77.1 49.2	77.6 49.5	78.1 49.8	78.6 50.0	79.0 50.3	79.5 50.5	80.0 50.8	80.5 51.0	81.0 51.3	81.4 51.5	81.9 51.8	82.4 52.0	82.8 52.2	83.3 52.5	83.8 52.8
43.0	76.8 48.9	77.3 49.1	77.7 49.4	78.2 49.7	78.7 49.9	79.2 50.2	79.7 50.4	80.1 50.7	80.6 50.9	81.1 51.2	81.5 51.4	82.0 51.6	82.5 51.9	82.9 52.1	83.4 52.4	83.9 52.6	84.3 52.8
43.5	77.4 49.1	77.9 49.3	78.4 49.6	78.8 49.8	79.3 50.1	79.8 50.3	80.3 50.5	80.7 50.8	81.2 51.0	81.7 51.3	82.1 51.5	82.6 51.7	83.0 52.0	83.5 52.2	84.0 52.4	84.4 52.7	84.9 52.9
44.0	78.0 49.2	78.5 49.5	79.0 49.7	79.4 49.9	79.9 50.2	80.4 50.4	80.8 50.7	81.3 50.9	81.8 51.1	82.2 51.4	82.7 51.6	83.2 51.8	83.6 52.1	84.1 52.3	84.5 52.5	85.0 52.7	85.4 53.0
44.5	78.6 49.4	79.1 49.6	79.6 49.8	80.0 50.1	80.5 50.3	81.0 50.5	81.4 50.8	81.9 51.0	82.4 51.2	82.8 51.5	83.3 51.7	83.7 51.9	84.2 52.1	84.6 52.4	85.1 52.6	85.5 52.8	86.0 53.0
45.0	79.2 49.5	79.7 49.7	80.2 50.0	80.6 50.2	81.1 50.4	81.6 50.7	82.0 50.9	82.5 51.1	82.9 51.3	83.4 51.5	83.8 51.8	84.3 52.0	84.7 52.2	85.2 52.4	85.6 52.6	86.1 52.9	86.5 53.1
45.5	79.8 49.6	80.3 49.9	80.8 50.1	81.2 50.3	81.7 50.5	82.1 50.8	82.6 51.0	83.0 51.2	83.5 51.4	83.9 51.6	84.4 51.8	84.8 52.1	85.3 52.3	85.7 52.5	86.1 52.8	86.6 53.0	87.0 53.1
46.0	80.4 49.8	80.9 50.0	81.3 50.2	81.8 50.4	82.3 50.6	82.7 50.8	83.1 51.0	83.6 51.3	84.0 51.5	84.5 51.7	84.9 51.9	85.4 52.1	85.8 52.3	86.2 52.5	86.7 52.8	87.1 52.9	87.6 53.1
46.5	81.0 49.9	81.5 50.1	81.9 50.3	82.4 50.5	82.8 50.7	83.3 50.9	83.7 51.1	84.1 51.3	84.6 51.6	85.0 51.8	85.5 52.0	85.9 52.2	86.3 52.4	86.8 52.6	87.2 52.8	87.6 53.0	88.1 53.2
47.0	81.6 50.0	82.0 50.2	82.5 50.4	82.9 50.6	83.4 50.8	83.8 51.0	84.3 51.2	84.7 51.4	85.1 51.6	85.6 51.8	86.0 52.0	86.4 52.2	86.9 52.4	87.3 52.6	87.7 52.8	88.2 53.0	88.6 53.2
47.5	82.2 50.1	82.6 50.3	83.1 50.5	83.5 50.7	83.9 50.9	84.4 51.1	84.8 51.3	85.2 51.5	85.7 51.7	86.1 51.9	86.5 52.1	87.0 52.3	87.4 52.5	87.8 52.7	88.2 52.9	88.7 53.1	89.1 53.2
48.0	82.7 50.2	83.2 50.4	83.6 50.6	84.0 50.8	84.5 50.9	84.9 51.1	85.3 51.3	85.8 51.5	86.2 51.7	86.6 51.9	87.1 52.1	87.5 52.3	87.9 52.5	88.3 52.7	88.8 52.9	89.2 53.1	89.6 53.2
48.5	83.3 50.2	83.7 50.4	84.2 50.6	84.6 50.8	85.0 51.0	85.5 51.2	85.9 51.4	86.3 51.6	86.7 51.8	87.2 51.9	87.6 52.1	88.0 52.3	88.4 52.5	88.8 52.7	89.3 52.9	89.7 53.1	90.1 53.2
49.0	83.9 50.3	84.3 50.5	84.7 50.7	85.1 50.9	85.6 51.1	86.0 51.3	86.4 51.5	86.8 51.7	87.3 51.9	87.7 52.0	88.1 52.2	88.5 52.3	88.9 52.5	89.4 52.7	89.8 52.9	90.2 53.1	90.6 53.2
49.5	84.4 50.4	84.8 50.6	85.2 50.8	85.7 50.9	86.1 51.1	86.5 51.3	86.9 51.5	87.4 51.6	87.8 51.8	88.2 52.0	88.6 52.2	89.0 52.3	89.4 52.5	89.9 52.7	90.3 52.9	90.7 53.1	91.1 53.2
50.0	84.9 50.4	85.4 50.6	85.8 50.8	86.2 51.0	86.6 51.2	87.0 51.3	87.5 51.5	87.9 51.7	88.3 51.8	88.7 52.0	89.1 52.2	89.5 52.4	89.9 52.5	90.4 52.7	90.8 52.9	91.2 53.1	91.6 53.2
50.5	85.5 50.5	85.9 50.7	86.3 50.8	86.7 51.0	87.1 51.2	87.6 51.4	88.0 51.5	88.4 51.7	88.8 51.9	89.2 52.0	89.6 52.2	90.0 52.4	90.4 52.5	90.9 52.7	91.3 52.8	91.7 53.0	92.1 53.2
51.0	86.0 50.5	86.4 50.7	86.8 50.9	87.3 51.1	87.7 51.2	88.1 51.4	88.5 51.6	88.9 51.7	89.3 51.9	89.7 52.0	90.1 52.2	90.5 52.4	90.9 52.5	91.3 52.7	91.7 52.8	92.2 53.0	92.6 53.1
51.5	86.5 50.6	86.9 50.8	87.4 50.9	87.8 51.1	88.2 51.2	88.6 51.4	89.0 51.6	89.4 51.7	89.8 51.9	90.2 52.0	90.6 52.2	91.0 52.3	91.4 52.5	91.8 52.7	92.2 52.8	92.6 53.0	93.0 53.1
52.0	87.1 50.6	87.5 50.8	87.9 50.9	88.3 51.1	88.7 51.3	89.1 51.4	89.5 51.6	89.9 51.7	90.3 51.9	90.7 52.0	91.1 52.2	91.5 52.3	91.9 52.5	92.3 52.6	92.7 52.8	93.1 52.9	93.5 53.1
52.5	87.6 50.7	88.0 50.8	88.4 51.0	88.8 51.1	89.2 51.3	89.6 51.4	90.0 51.6	90.4 51.7	90.8 51.9	91.2 52.0	91.6 52.2	92.0 52.3	92.4 52.5	92.8 52.7	93.2 52.8	93.6 52.9	94.0 53.0
53.0	88.1 50.7	88.5 50.8	88.9 51.0	89.3 51.1	89.7 51.3	90.1 51.4	90.5 51.6	90.9 51.7	91.3 51.9	91.7 52.0	92.1 52.2	92.5 52.3	92.9 52.5	93.3 52.6	93.7 52.8	94.1 52.9	94.5 53.0
53.5	88.6 50.7	89.0 50.8	89.4 51.0	89.8 51.1	90.2 51.3	90.6 51.4	91.0 51.6	91.4 51.7	91.8 51.9	92.2 52.0	92.6 52.1	93.0 52.3	93.4 52.4	93.8 52.5	94.2 52.7	94.6 52.8	94.9 52.9
54.0	89.1 50.7	89.5 50.9	89.9 51.0	90.3 51.1	90.7 51.3	91.1 51.4	91.5 51.6	91.9 51.7	92.3 51.8	92.7 52.0	93.1 52.1	93.5 52.2	93.9 52.4	94.3 52.5	94.7 52.7	95.1 52.8	95.4 52.9
54.5	89.6 50.7	90.0 50.9	90.4 51.0	90.8 51.1	91.2 51.3	91.6 51.4	92.0 51.5	92.4 51.7	92.8 51.8	93.2 51.9	93.6 52.1	93.9 52.2	94.3 52.3	94.7 52.4	95.1 52.6	95.5 52.7	95.9 52.8
55.0	90.1 50.7	90.5 50.9	90.9 51.0	91.3 51.1	91.7 51.2	92.1 51.4	92.5 51.5	92.9 51.6	93.2 51.8	93.6 51.9	94.0 52.0	94.4 52.1	94.8 52.3	95.2 52.4	95.6 52.5	95.9 52.6	96.3 52.7
55.5	90.6 50.7	91.0 50.8	91.4 51.0	91.8 51.1	92.2 51.2	92.6 51.4	93.0 51.5	93.3 51.6	93.7 51.7	94.1 51.8	94.5 52.0	94.9 52.1	95.3 52.2	95.7 52.3	96.0 52.4	96.4 52.6	96.8 52.7
56.0	91.1 50.7	91.5 50.8	91.9 50.9	92.3 51.1	92.7 51.2	93.0 51.3	93.4 51.4	93.8 51.5	94.2 51.6	94.6 51.7	95.0 51.8	95.4 52.0	95.7 52.1	96.1 52.2	96.5 52.3	96.9 52.4	97.3 52.6
56.5	91.6 50.7	92.0 50.8	92.4 50.9	92.8 51.1	93.1 51.2	93.5 51.3	93.9 51.4	94.3 51.5	94.7 51.6	95.1 51.8	95.4 51.9	95.8 52.0	96.2 52.1	96.6 52.2	97.0 52.3	97.3 52.4	97.7 52.5
57.0	92.1 50.7	92.5 50.8	92.9 50.9	93.2 51.0	93.6 51.1	94.0 51.3	94.4 51.4	94.8 51.5	95.2 51.6	95.5 51.7	95.9 51.8	96.3 51.9	96.7 52.0	97.1 52.1	97.4 52.2	97.8 52.3	98.2 52.4
57.5	92.6 50.6	93.0 50.8	93.3 50.9	93.7 51.0	94.1 51.1	94.5 51.2	94.9 51.3	95.2 51.4	95.6 51.5	96.0 51.6	96.4 51.7	96.8 51.8	97.1 51.9	97.5 52.1	97.9 52.2	98.3 52.3	98.6 52.4
58.0	93.1 50.6	93.4 50.7	93.8 50.8	94.2 50.9	94.6 51.1	95.0 51.2	95.3 51.3	95.7 51.4	96.1 51.5	96.5 51.6	96.8 51.7	97.2 51.8	97.6 51.9	98.0 52.0	98.3 52.1	98.7 52.2	99.1 52.3
58.5	93.5 50.6	93.9 50.7	94.3 50.8	94.7 50.9	95.1 51.0	95.4 51.1	95.8 51.2	96.2 51.3	96.6 51.4	96.9 51.5	97.3 51.6	97.7 51.7	98.1 51.8	98.4 51.9	98.8 52.0	99.2 52.1	99.5 52.2
59.0	94.0 50.5	94.4 50.6	94.8 50.7	95.2 50.8	95.5 50.9	95.9 51.0	96.3 51.1	96.7 51.2	97.0 51.3	97.4 51.4	97.8 51.5	98.1 51.6	98.5 51.7	98.9 51.8	99.3 51.9	99.6 52.0	100.0 52.1
59.5	94.5 50.5	94.9 50.6	95.3 50.7	95.6 50.8	96.0 50.9	96.4 51.0	96.8 51.1	97.1 51.2	97.5 51.3	97.9 51.4	98.2 51.5	98.6 51.6	99.0 51.7	99.4 51.8	99.7 51.9	100.1 52.0	100.5 52.1

	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	C
60.0	15.0 0.	16.9 24.9	21.7 40.8	27.9 49.1	34.6 53.1	41.7 54.6	48.7 54.6	55.7 53.5	62.6 51.6	69.3 49.1	75.7 45.9	0.	0.	0.	0.	0.	0.	0.	C.
60.5	15.5 0.	17.4 24.3	22.1 40.0	28.2 48.4	35.0 52.5	41.9 54.1	49.0 54.2	56.0 53.2	62.9 51.4	69.6 49.0	76.0 45.9	0.	C.	0.	0.	0.	0.	0.	C.
61.0	16.0 0.	17.8 23.6	22.5 39.2	28.5 47.7	35.3 51.9	42.2 53.7	49.3 53.9	56.3 53.0	63.2 51.2	70.0 48.8	76.4 45.8	0.	0.	0.	0.	0.	0.	0.	C.
61.5	16.5 0.	18.3 23.0	22.9 38.5	28.9 47.0	35.6 51.4	42.5 53.2	49.6 53.5	56.6 52.7	63.6 51.1	70.3 48.7	0.	0.	0.	0.	0.	0.	0.	0.	C.
62.0	17.0 0.	18.8 22.4	23.3 37.7	29.2 46.4	35.9 50.8	42.8 52.8	49.9 53.2	56.9 52.4	63.9 50.9	70.6 48.6	C.	0.	0.	0.	0.	0.	0.	0.	C.
62.5	17.5 0.	19.2 21.9	23.7 37.0	29.6 45.7	36.2 50.3	43.1 52.4	50.2 52.9	57.2 52.2	64.2 50.7	70.9 48.4	0.	0.	0.	0.	0.	0.	0.	0.	C.
63.0	18.0 0.	19.7 21.4	24.1 36.4	29.9 45.1	36.5 49.8	43.4 52.0	50.5 52.5	57.6 51.9	64.5 50.5	71.3 48.3	C.	0.	0.	0.	0.	0.	0.	0.	C.
63.5	18.5 0.	20.2 20.5	24.5 35.7	30.3 44.5	36.8 49.3	43.8 51.6	50.8 52.2	57.9 51.7	64.8 50.3	71.6 48.2	0.	0.	0.	0.	0.	0.	0.	0.	C.
64.0	19.0 0.	20.6 20.4	24.9 35.1	30.6 43.9	37.2 48.8	44.1 51.2	51.1 51.9	58.2 51.4	65.1 50.1	71.9 48.1	0.	0.	C.	0.	0.	0.	0.	0.	C.
64.5	19.5 0.	21.1 19.9	25.3 34.5	31.0 43.3	37.5 48.3	44.4 50.8	51.4 51.6	58.5 51.2	65.5 49.9	72.3 47.9	0.	0.	0.	0.	0.	0.	0.	0.	C.
65.0	20.0 0.	21.6 19.5	25.7 33.9	31.4 42.8	37.8 47.8	44.7 50.4	51.7 51.3	58.8 51.0	65.8 49.8	72.6 47.8	C.	0.	0.	0.	0.	0.	0.	0.	C.
65.5	20.5 0.	22.0 19.1	26.1 33.5	31.7 42.2	38.2 47.3	45.0 50.0	52.1 50.9	59.1 50.7	66.1 49.6	72.9 47.7	C.	0.	C.	C.	0.	0.	0.	C.	C.
66.0	21.0 0.	22.5 18.7	26.5 32.8	32.1 41.7	36.5 46.9	43.3 49.6	50.4 50.6	57.4 50.5	64.4 49.4	73.3 47.6	C.	C.	C.	C.	C.	C.	C.	C.	C.
66.5	21.5 0.	23.0 18.2	27.0 32.0	32.5 41.2	36.9 46.4	43.7 49.2	50.7 50.4	57.8 50.3	64.8 49.3	73.6 47.5	C.	C.	C.	C.	C.	0.	C.	C.	C.
67.0	22.0 0.	23.5 18.6	27.4 31.7	32.9 40.7	37.2 46.0	44.0 48.5	51.0 50.1	58.1 50.1	65.1 49.1	74.0 47.4	C.	C.	C.	C.	C.	C.	C.	C.	C.
67.5	22.5 0.	23.9 17.6	27.8 31.2	33.2 40.2	37.6 45.5	44.2 48.5	51.3 49.8	58.4 49.8	65.4 49.0	74.3 47.3	C.	C.	C.	C.	C.	0.	C.	C.	C.
68.0	23.0 0.	24.4 17.3	28.2 30.7	33.6 39.7	37.9 45.1	44.7 48.1	51.7 49.5	58.7 49.6	65.7 48.8	74.6 47.2	C.	C.	C.	C.	0.	0.	0.	0.	C.
68.5	23.5 0.	24.9 17.0	28.7 30.3	34.0 39.2	40.3 44.7	47.0 47.8	54.0 49.2	61.0 49.4	68.1 48.6	75.0 47.1	0.	0.	0.	0.	0.	0.	0.	0.	C.
69.0	24.0 0.	25.4 16.6	29.1 29.8	34.4 38.7	40.6 44.3	47.3 47.4	54.3 48.9	61.4 49.2											

	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	
80.0	35.0 0.	36.0 12.0	39.0 22.6	43.5 30.9	49.0 37.0	55.2 41.3	61.9 44.0	68.8 45.4	75.9 45.9	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
80.5	35.5 0.	36.5 11.9	39.5 22.4	43.9 30.7	49.4 36.8	55.6 41.0	62.3 43.8	69.2 45.3	76.2 45.8	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
81.0	36.0 0.	37.0 11.8	39.9 22.1	44.3 30.4	49.8 36.5	56.0 40.8	62.6 43.6	69.5 45.2	76.6 45.7	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
81.5	36.5 0.	37.5 11.6	40.4 20.9	44.8 30.1	50.2 36.3	56.4 40.6	63.0 43.4	69.9 45.0	76.9 45.6	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
82.0	37.0 0.	38.0 11.5	40.9 21.7	45.2 29.9	50.6 36.0	56.7 40.4	63.4 43.2	70.3 44.9	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
82.5	37.5 0.	38.5 11.4	41.3 21.5	45.6 29.6	51.0 35.8	57.1 40.2	63.7 43.1	70.6 44.8	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
83.0	38.0 0.	39.0 11.3	41.8 21.3	46.1 29.4	51.4 35.6	57.5 40.0	64.1 42.9	71.0 44.7	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
83.5	38.5 0.	39.5 11.1	42.2 21.1	46.5 29.2	51.8 35.3	57.9 39.8	64.4 42.7	71.3 44.5	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
84.0	39.0 0.	40.0 11.0	42.7 20.9	46.9 28.9	52.2 35.1	58.3 39.6	64.8 42.6	71.7 44.4	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
84.5	39.5 0.	40.5 10.9	43.2 20.7	47.4 28.7	52.6 34.9	58.7 39.4	65.2 42.4	72.0 44.3	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
85.0	40.0 0.	40.9 10.8	43.7 20.5	47.8 28.5	53.0 34.7	59.0 39.2	65.6 42.3	72.4 44.2	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
85.5	40.5 0.	41.4 10.7	44.1 20.3	48.2 28.3	53.5 34.5	59.4 39.0	65.9 42.1	72.7 44.1	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
86.0	41.0 0.	41.9 10.6	44.6 20.2	48.7 28.1	53.9 34.2	59.8 38.8	66.3 42.0	73.1 44.0	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
86.5	41.5 0.	42.4 10.5	45.1 20.0	49.1 27.9	54.3 34.0	60.2 38.6	66.7 41.8	73.5 43.9	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
87.0	42.0 0.	42.9 10.4	45.5 19.8	49.6 27.7	54.7 33.8	60.6 38.4	67.0 41.7	73.8 43.8	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
87.5	42.5 0.	43.4 10.3	46.0 19.6	50.0 27.5	55.1 33.7	61.0 38.3	67.4 41.5	74.2 43.7	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
88.0	43.0 0.	43.9 10.2	46.5 19.5	50.5 27.3	55.5 33.5	61.4 38.1	67.8 41.4	74.6 43.6	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
88.5	43.5 0.	44.4 10.1	46.9 19.3	50.9 27.1	55.9 33.3	61.8 37.9	68.2 41.3	74.9 43.5	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
89.0	44.0 0.	44.9 10.0	47.4 19.2	51.3 26.9	56.4 33.1	62.2 37.8	68.5 41.1	75.3 43.4	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
89.5	44.5 0.	45.4 9.9	47.9 19.0	51.8 26.7	56.8 32.9	62.6 37.6	68.9 41.0	75.6 43.3	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
90.0	45.0 0.	45.9 9.9	48.4 18.9	52.2 26.6	57.2 32.7	63.0 37.5	69.3 40.9	76.0 43.2	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
90.5	45.5 0.	46.4 9.8	48.8 18.7	52.7 26.4	57.6 32.6	63.4 37.3	69.7 40.8	76.4 43.1	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
91.0	46.0 0.	46.8 9.7	49.3 18.6	53.1 26.2	58.0 32.4	63.8 37.1	70.1 40.7	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
91.5	46.5 0.	47.3 9.6	49.8 18.5	53.6 26.1	58.5 32.2	64.2 37.0	70.4 40.5	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
92.0	47.0 0.	47.8 9.5	50.3 18.3	54.0 25.9	58.9 32.1	64.6 36.9	70.8 40.4	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
92.5	47.5 0.	48.3 9.5	50.7 18.2	54.5 25.7	59.3 31.9	65.0 36.7	71.2 40.3	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
93.0	48.0 0.	48.8 9.4	51.2 18.1	54.9 25.6	59.7 31.8	65.4 36.6	71.6 40.2	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
93.5	48.5 0.	49.3 9.3	51.7 18.0	55.4 25.4	60.2 31.6	65.8 36.4	72.0 40.1	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
94.0	49.0 0.	49.8 9.2	52.2 17.8	55.8 25.3	60.6 31.4	66.2 36.3	72.3 40.0	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
94.5	49.5 0.	50.3 9.2	52.6 17.7	56.3 25.2	61.0 31.3	66.6 36.2	72.7 39.9	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
95.0	50.0 0.	50.8 9.1	53.1 17.6	56.7 25.0	61.4 31.2	67.0 36.1	73.1 39.8	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
95.5	50.5 0.	51.3 9.1	53.6 17.5	57.2 24.9	61.9 31.0	67.4 35.9	73.5 39.7	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
96.0	51.0 0.	51.8 9.0	54.1 17.4	57.6 24.7	62.3 30.9	67.8 35.8	73.9 39.6	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
96.5	51.5 0.	52.3 8.9	54.5 17.3	58.1 24.6	62.7 30.8	68.2 35.7	74.3 39.5	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
97.0	52.0 0.	52.8 8.9	55.0 17.2	58.6 24.5	63.2 30.6	68.6 35.6	74.6 39.4	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
97.5	52.5 0.	53.3 8.8	55.5 17.1	59.0 24.4	63.6 30.5	69.0 35.5	75.0 39.3	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
98.0	53.0 0.	53.8 8.8	56.0 17.0	59.5 24.2	64.0 30.4	69.4 35.4	75.4 39.3	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
98.5	53.5 0.	54.3 8.7	56.5 16.9	59.9 24.1	64.5 30.2	69.8 35.2	75.8 39.2	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
99.0	54.0 0.	54.7 8.6	56.9 16.8	60.4 24.0	64.9 30.1	70.2 35.1	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.
99.5	54.5 0.	55.2 8.6	57.4 16.7	60.8 23.9	65.3 30.0	70.6 35.0	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.	0. 0.

Table II
 $\beta = 70 \text{ deg}$



	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	0
0.	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
	180.0	170.0	160.0	150.0	140.0	130.0	120.0	110.0	100.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	20.0	10.0	0.
0.5	69.5	69.5	69.5	69.6	69.6	69.7	69.8	69.8	69.9	70.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	170.0	159.9	149.9	139.9	129.9	119.8	109.8	99.8	89.8	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.0	69.0	69.0	69.1	69.1	69.2	69.4	69.5	69.7	69.8	70.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.9	159.9	149.8	139.8	129.7	119.7	109.7	99.6	89.6	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	68.5	68.5	68.6	68.7	68.9	69.0	69.3	69.5	69.7	70.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.9	159.8	149.7	139.6	129.6	118.5	109.5	99.5	89.5	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	68.0	68.0	68.1	68.3	68.5	68.7	69.0	69.3	69.7	70.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.9	159.7	149.6	139.5	129.4	119.4	109.3	99.3	89.3	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.5	67.5	67.5	67.7	67.8	68.1	68.4	68.8	69.2	69.6	70.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.8	159.7	149.5	139.4	129.3	119.2	109.1	99.1	89.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	67.0	67.0	67.2	67.4	67.7	68.1	68.5	69.0	69.5	70.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.8	159.6	149.4	139.2	129.1	119.0	108.9	98.9	88.9	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.5	66.5	66.6	66.7	67.0	67.3	67.8	68.3	68.8	69.4	70.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.8	159.5	149.3	139.1	129.0	118.8	108.8	98.7	88.7	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	66.0	66.1	66.2	66.5	67.0	67.5	68.0	68.7	69.4	70.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.7	159.4	149.2	139.0	128.8	118.7	108.6	98.5	88.5	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.5	65.5	65.6	65.8	66.1	66.6	67.1	67.8	68.5	69.3	70.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.7	159.4	149.1	138.8	128.6	118.5	108.4	98.4	88.4	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	65.0	65.1	65.3	65.7	66.2	66.8	67.6	68.4	69.2	70.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.6	159.3	149.0	138.7	128.5	118.3	108.2	98.2	88.2	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.5	64.5	64.6	64.8	65.3	65.8	66.5	67.3	68.2	69.1	70.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
	180.0	169.6	159.2	148.8	138.5	128.3	118.1	108.0	98.0	88.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
6.0	64.0	64.1	64.4	64.8	65.5	66.2	67.1	68.1	69.1	70.1	0								

SPIN ANGLE (UPPER) AND SCAN HORIZONTAL ANGLE (LOWER) AT THE HORIZON FOR BETA=70.0DEG

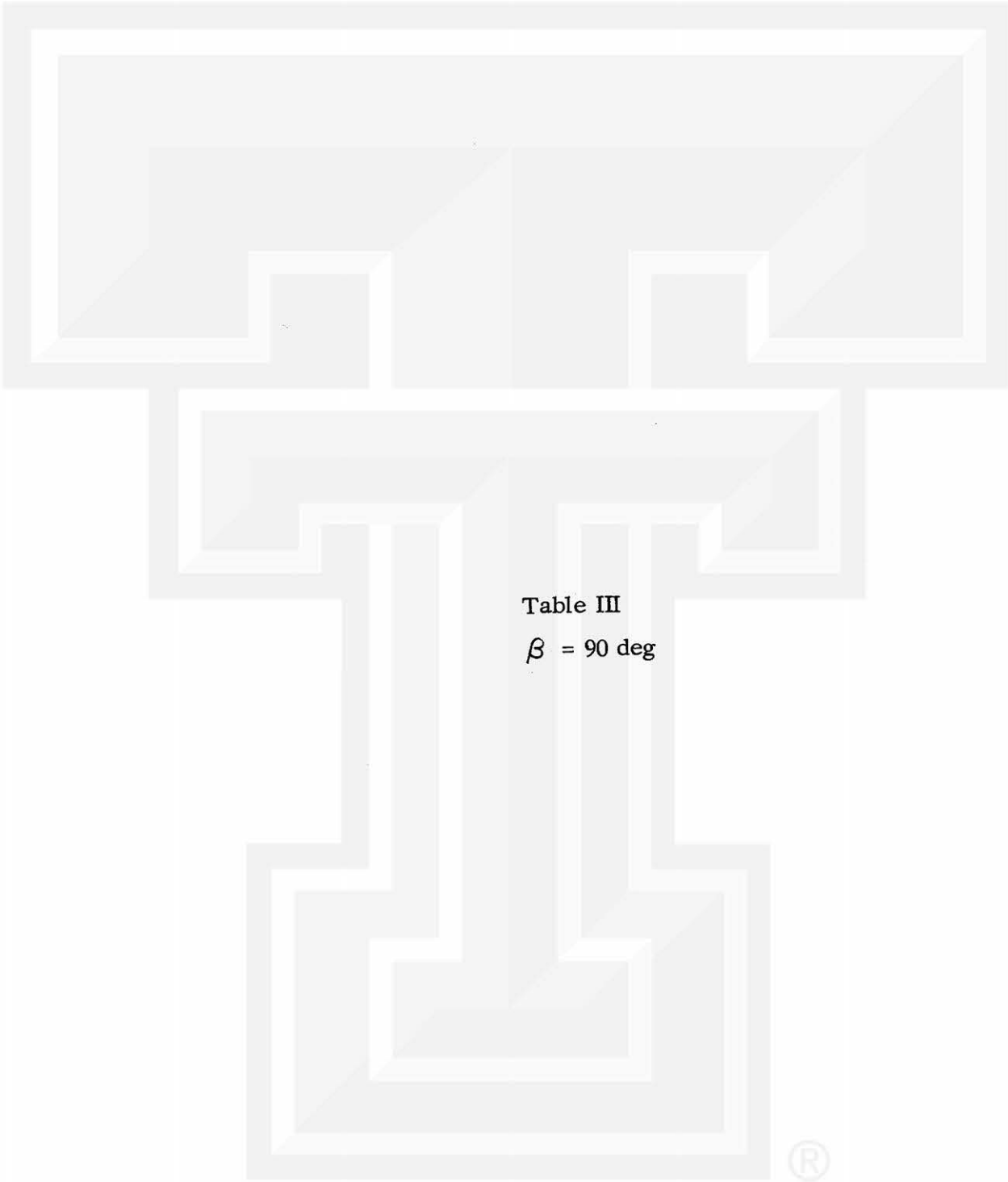
	24.00	24.25	24.50	24.75	25.00	25.25	25.50	25.75	26.00	26.25	26.50	26.75	27.00	27.25	27.50	27.75	28.00
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	180.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.5	153.1	161.1	180.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	143.7	148.7	154.6	162.1	180.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.5	137.4	141.3	145.5	150.3	155.8	163.0	180.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6.0	132.7	135.9	139.4	143.1	147.1	151.6	156.9	163.7	180.0	0.	0.	0.	0.	0.	0.	0.	0.
6.5	129.0	131.8	134.7	137.8	141.1	144.6	148.5	152.8	157.9	164.4	180.0	0.	0.	0.	0.	0.	0.
7.0	126.0	128.5	131.1	133.7	136.6	139.5	142.7	146.0	149.7	153.9	158.7	165.0	180.0	0.	0.	0.	0.
7.5	123.5	125.7	128.1	130.4	132.9	135.5	138.2	141.0	144.0	147.3	150.8	154.8	159.5	165.6	180.0	0.	0.
8.0	121.4	123.4	125.5	127.7	129.9	132.2	134.6	137.1	139.7	142.4	145.3	148.4	151.8	155.7	160.2	166.1	180.0
8.5	119.5	121.4	123.4	125.4	127.4	129.5	131.6	133.8	136.1	138.5	141.0	143.6	146.4	149.4	152.8	156.5	160.8
9.0	117.7	119.7	121.5	123.4	125.2	127.1	129.1	131.1	133.2	135.3	137.5	139.8	142.2	144.8	147.5	150.4	153.6
9.5	116.6	118.2	119.9	121.6	123.4	125.1	126.9	128.8	130.7	132.6	134.6	136.6	138.8	141.0	143.3	145.8	148.4
10.0	115.4	116.9	118.5	120.1	121.7	123.4	125.0	126.7	128.5	130.3	132.1	134.0	135.9	137.9	140.0	142.1	144.4
10.5	114.3	115.8	117.2	118.7	120.3	121.8	123.4	125.0	126.6	128.2	129.9	131.6	133.4	135.2	137.1	139.0	141.1
11.0	113.3	114.7	116.1	117.5	119.0	120.4	121.9	123.4	124.9	126.5	128.0	129.6	131.3	132.9	134.7	136.4	138.2
11.5	112.5	113.8	115.1	116.5	117.8	119.2	120.6	122.0	123.4	124.9	126.4	127.8	129.4	130.9	132.5	134.1	135.8
12.0	111.7	112.9	114.2	115.5	116.8	118.1	119.4	120.8	122.1	123.5	124.9	126.3	127.7	129.1	130.6	132.1	133.7
12.5	111.0	112.2	113.4	114.6	115.9	117.1	118.4	119.6	120.9	122.2	123.5	124.8	126.2	127.6	128.9	130.4	131.8
13.0	110.3	111.5	112.7	113.8	115.0	116.2	117.4	118.6	119.8	121.1	122.3	123.6	124.8	126.1	127.4	128.8	130.1
13.5	109.8	110.9	112.0	113.1	114.2	115.4	116.5	117.7	118.8	120.0	121.2	122.4	123.6	124.8	126.1	127.3	128.6
14.0	109.2	110.3	111.4	112.4	113.5	114.6	115.7	116.8	117.9	119.1	120.2	121.3	122.5	123.7	124.8	126.0	127.3
14.5	108.7	109.8	110.8	111.8	112.9	113.9	115.0	116.0	117.1	118.2	119.3	120.4	121.5	122.6	123.7	124.9	126.0
15.0	108.3	109.3	110.3	111.3	112.3	113.3	114.3	115.3	116.4	117.4	118.4	119.5	120.6	121.6	122.7	123.8	124.9
15.5	107.9	108.9	109.8	110.8	111.7	112.7	113.7	114.7	115.7	116.7	117.7	118.7	119.7	120.7	121.8	122.8	123.9
16.0	107.5	108.4	109.4	110.3	111.2	112.2	113.1	114.1	115.0	116.0	117.0	117.9	118.9	119.9	120.9	121.9	122.9
16.5	107.2	108.1	109.0	109.9	110.8	111.7	112.6	113.5	114.4	115.4	116.3	117.2	118.2	119.1	120.1	121.1	122.0
17.0	106.9	107.7	108.6	109.5	110.4	111.2	112.1	113.0	113.9	114.8	115.7	116.6	117.5	118.4	119.4	120.3	121.2
17.5	106.6	107.4	108.3	109.1	110.0	110.8	111.7	112.5	113.4	114.3	115.1	116.0	116.9	117.8	118.7	119.6	120.5
18.0	106.3	107.1	107.9	108.8	109.6	110.4	111.2	112.1	112.9	113.8	114.6	115.5	116.3	117.2	118.0	118.9	119.8
18.5	106.0	106.8	107.6	108.4	109.2	110.0	110.9	111.7	112.5	113.3	114.1	114.9	115.8	116.6	117.4	118.3	119.1
19.0	105.8	106.6	107.4	108.1	108.9	109.7	110.5	111.3	112.1	112.9	113.7	114.5	115.3	116.1	116.9	117.7	118.5
19.5	105.6	106.4	107.1	107.9	108.6	109.4	110.2	110.9	111.7	112.5	113.2	114.0	114.8	115.6	116.4	117.2	118.0

	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	0
20.0	50.0 180.0	50.4 167.8	51.4 155.7	53.1 144.0	55.4 132.8	58.1 122.0	61.2 111.7	64.4 101.8	67.8 92.0	71.3 82.9	0.	0.	0.	0.	0.	0.	0.	0.	0.
20.5	49.5 180.0	49.9 167.7	51.0 155.6	52.7 143.8	55.1 132.6	57.9 121.8	61.0 111.5	64.3 101.6	67.8 92.0	71.3 82.7	0.	0.	0.	0.	0.	0.	0.	0.	0.
21.0	49.0 180.0	49.4 167.6	50.5 155.4	52.3 143.6	54.7 132.3	57.6 121.5	60.8 111.2	64.2 101.4	67.8 91.8	71.4 82.6	0.	0.	0.	0.	0.	0.	0.	0.	0.
21.5	48.5 180.0	48.9 167.5	50.1 155.2	51.9 143.4	54.4 132.0	57.3 121.2	60.6 111.0	64.2 101.1	67.8 91.6	71.4 82.4	0.	0.	0.	0.	0.	0.	0.	0.	0.
22.0	48.0 180.0	48.4 167.4	49.6 155.0	51.5 143.1	54.1 131.8	57.1 121.0	60.5 110.7	64.1 100.9	67.8 91.4	71.5 82.2	0.	0.	0.	0.	0.	0.	0.	0.	0.
22.5	47.5 180.0	47.9 167.3	49.2 154.9	51.1 142.9	53.7 131.5	56.8 120.7	60.3 110.4	64.0 100.6	67.8 91.2	71.6 82.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
23.0	47.0 180.0	47.4 167.2	48.7 154.7	50.7 142.6	53.4 131.2	56.6 120.4	60.1 110.2	63.9 100.4	67.8 91.0	71.6 81.9	0.	0.	0.	0.	0.	0.	0.	0.	0.
23.5	46.5 180.0	46.9 167.1	48.3 154.5	50.3 142.4	53.1 130.9	56.3 120.1	59.9 109.9	63.8 100.2	67.7 90.8	71.7 81.7	0.	0.	0.	0.	0.	0.	0.	0.	0.
24.0	46.0 180.0	46.5 167.0	47.8 154.3	50.0 142.1	52.8 130.6	56.1 119.8	59.8 109.6	63.7 99.9	67.7 90.6	71.8 81.6	0.	0.	0.	0.	0.	0.	0.	0.	0.
24.5	45.5 180.0	46.0 166.9	47.4 154.1	49.6 141.9	52.4 130.4	55.8 119.5	59.6 109.3	63.6 99.7	67.7 90.4	71.9 81.4	0.	0.	0.	0.	0.	0.	0.	0.	0.
25.0	45.0 180.0	45.5 166.8	46.9 153.9	49.2 141.6	52.1 130.1	55.6 119.2	59.4 109.1	63.5 99.4	67.7 90.2	71.9 81.3	0.	0.	0.	0.	0.	0.	0.	0.	0.
25.5	44.5 180.0	45.0 166.7	46.5 153.7	48.8 141.3	51.8 129.8	55.3 118.9	59.3 108.8	63.4 99.2	67.7 90.0	72.0 81.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
26.0	44.0 180.0	44.5 166.5	46.0 153.5	48.4 141.1	51.5 129.5	55.1 118.6	59.1 108.5	63.4 98.9	67.7 89.8	72.1 80.9	0.	0.	0.	0.	0.	0.	0.	0.	0.
26.5	43.5 180.0	44.0 166.4	45.6 153.3	48.0 140.8	51.2 129.1	54.9 118.3	59.0 108.2	63.3 98.7	67.7 89.6	72.2 80.8	0.	0.	0.	0.	0.	0.	0.	0.	0.
27.0	43.0 180.0	43.5 166.3	45.1 153.0	47.6 140.5	50.8 128.8	54.6 118.0	58.8 107.9	63.2 98.4	67.7 89.4	72.3 80.6	0.	0.	0.	0.	0.	0.	0.	0.	0.
27.5	42.5 180.0	43.1 166.2	44.7 152.8	47.2 140.2	50.5 128.5	54.4 117.7	58.6 107.6	63.1 98.2	67.7 89.2	72.3 80.5	0.	0.	0.	0.	0.	0.	0.	0.	0.
28.0	42.0 180.0	42.6 166.0	44.2 152.6	46.8 139.9	50.2 128.2	54.2 117.4	58.5 107.4	63.1 97.9	67.8 89.0	72.4 80.3	0.	0.	0.	0.	0.	0.	0.	0.	0.
28.5	41.5 180.0	42.1 165.9	43.8 152.3	46.5 139.6	49.9 127.9	53.9 117.1	58.3 107.1	63.0 97.7	67.8 88.8	72.5 80.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
29.0	41.0 180.0	41.6 165.8	43.3 152.1	46.1 139.3	49.6 127.5	53.7 116.7	58.2 106.8	62.9 97.4	67.8 88.6	72.6 80.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
29.5	40.5 180.0	41.1 165.6	42.9 151.8	45.7 139.0	49.3 127.2	53.5 116.4	58.1 106.5	62.9 97.2	67.8 88.4	72.7 79.8	0.	0.	0.	0.	0.	0.	0.	0.	0.
30.0	40.0 180.0	40.6 165.5	42.5 151.6	45.3 138.6	49.0 126.8	53.3 116.1	57.9 106.2	62.8 96.9	67.8 88.2	72.8 79.7	0.	0.	0.	0.	0.	0.	0.	0.	0.
30.5	39.5 180.0	40.1 165.3	42.0 151.3	44.9 138.3	48.7 126.5	53.0 115.7	57.8 105.9	62.8 96.7	67.8 88.0	72.9 79.5	0.	0.	0.	0.	0.	0.	0.	0.	0.
31.0	39.0 180.0	39.7 165.2	41.6 151.0	44.6 138.0	48.4 126.1	52.8 115.4	57.6 105.6	62.7 96.4	67.8 87.8	73.0 79.4	0.	0.	0.	0.	0.	0.	0.	0.	0.
31.5	38.5 180.0	39.2 165.0	41.1 150.8	44.1 137.6	48.1 125.8	52.6 115.0	57.5 105.3	62.6 96.2	67.9 87.6	73.0 79.2	0.	0.	0.	0.	0.	0.	0.	0.	0.
32.0	38.0 180.0	38.7 164.9	40.7 150.5	43.8 137.3	47.8 125.4	52.4 114.7	57.4 104.9	62.6 95.9	67.9 87.3	73.1 79.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
32.5	37.5 180.0	38.2 164.7	40.3 150.2	43.5 136.9	47.5 125.0	52.2 114.3	57.3 104.6	62.5 95.6	67.9 87.1	73.2 78.9	0.	0.	0.	0.	0.	0.	0.	0.	0.
33.0	37.0 180.0	37.7 164.5	39.8 149.9	43.1 136.6	47.2 124.6	52.0 114.0	57.1 104.3	62.5 95.4	67.9 86.9	73.3 78.8	0.	0.	0.	0.	0.	0.	0.	0.	0.
33.5	36.5 180.0	37.3 164.4	39.4 149.6	42.7 136.2	47.0 124.3	51.8 113.6	57.0 104.0	62.4 95.1	68.0 86.7	73.4 78.6	0.	0.	0.	0.	0.	0.	0.	0.	0.
34.0	36.0 180.0	36.8 164.2	39.0 149.3	42.4 135.8	46.7 123.9	51.6 113.3	56.9 103.7	62.4 94.9	68.0 86.5	73.5 78.5	0.	0.	0.	0.	0.	0.	0.	0.	0.
34.5	35.5 180.0	36.3 164.0	38.6 149.0	42.0 135.4	46.4 123.5	51.4 112.9	56.8 103.4	62.4 94.6	68.0 86.3	73.6 78.4	0.	0.	0.	0.	0.	0.	0.	0.	0.
35.0	35.0 180.0	35.8 163.8	38.1 148.6	41.7 135.0	46.1 123.1	51.2 112.5	56.7 103.1	62.3 94.3	68.1 86.1	73.7 78.2	0.	0.	0.	0.	0.	0.	0.	0.	0.
35.5	34.5 180.0	35.3 163.6	37.7 148.3	41.3 134.6	45.9 122.7	51.0 112.2	56.5 102.7	62.3 94.1	68.1 85.9	73.8 78.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
36.0	34.0 180.0	34.9 163.4	37.3 148.0	41.0 134.2	45.6 122.3	50.8 111.8	56.4 102.4	62.3 93.8	68.1 85.7	73.9 77.9	0.	0.	0.	0.	0.	0.	0.	0.	0.
36.5	33.5 180.0	34.4 163.2	36.9 147.6	40.6 133.8	45.3 121.8	50.6 111.4	56.3 102.1	62.2 93.6	68.2 85.5	74.0 77.8	0.	0.	0.	0.	0.	0.	0.	0.	0.
37.0	33.0 180.0	33.9 163.0	36.4 147.2	40.3 133.4	45.1 121.4	50.5 111.0	56.2 101.8	62.2 93.3	68.2 85.3	74.1 77.6	0.	0.	0.	0.	0.	0.	0.	0.	0.
37.5	32.5 180.0	33.4 162.8	36.0 146.9	39.9 133.0	44.8 121.0	50.3 110.6	56.1 101.4	62.2 93.0	68.2 85.1	74.3 77.5	0.	0.	0.	0.	0.	0.	0.	0.	0.
38.0	32.0 180.0	32.9 162.5	35.6 146.5	39.6 132.5	44.5 120.6	50.1 110.2	56.0 101.1	62.1 92.8	68.3 84.9	74.4 77.4	0.	0.	0.	0.	0.	0.	0.	0.	0.
38.5	31.5 180.0	32.5 162.3	35.2 146.1	39.3 132.1	44.3 120.1	49.9 109.8	55.9 100.8	62.1 92.5	68.3 84.7	74.5 77.2	0.	0.	0.	0.	0.	0.	0.	0.	0.
39.0	31.0 180.0	32.0 162.1	34.8 145.7	38.9 131.6	44.0 119.7	49.8 109.4	55.8 100.4	62.1 92.2	68.4 84.5	74.6 77.1	0.	0.	0.	0.	0.	0.	0.	0.	0.
39.5	30.5 180.0	31.5 161.8	34.4 145.3	38.6 131.1	43.8 119.2	49.6 109.0	55.8 100.1	62.1 92.0	68.4 84.3	74.7 77.0	0.	0.	0.	0.	0.	0.	0.	0.	0.

SCAN NADIR ANGLE (UPPER) AND SCAN HORIZONTAL ANGLE (LOWER) FOR BETA=70.0DEG

	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	0
80.0	10.0 0.	13.9 42.8	21.7 60.3	30.6 67.4	39.8 70.7	49.1 72.1	58.5 72.6	67.9 71.6	77.3 71.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80.5	10.5 0.	14.3 41.5	22.0 59.2	30.8 66.6	40.0 70.1	49.3 71.7	58.7 72.3	68.1 72.2	77.4 71.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
81.0	11.0 0.	14.6 40.2	22.2 58.1	31.0 65.9	40.1 69.6	49.5 71.3	58.8 72.0	68.2 71.4	77.6 71.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
81.5	11.5 0.	15.0 39.0	22.5 57.1	31.2 65.1	40.3 69.0	49.6 70.9	59.0 71.7	68.4 71.8	77.8 71.2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
82.0	12.0 0.	15.4 37.9	22.8 56.1	31.4 64.4	40.5 68.5	49.8 70.5	59.1 71.4	68.5 71.6	77.9 71.1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
82.5	12.5 0.	15.8 36.8	23.1 55.1	31.6 63.6	40.7 67.9	49.9 70.1	59.3 71.2	68.7 71.4	78.1 71.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
83.0	13.0 0.	16.2 35.7	23.3 54.2	31.9 62.9	40.9 67.4	50.1 69.7	59.5 70.9	68.9 71.2	78.3 70.9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
83.5	13.5 0.	16.6 34.8	23.6 53.3	32.1 62.2	41.1 66.8	50.3 69.3	59.6 70.6	69.0 71.0	78.4 70.9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
84.0	14.0 0.	17.0 33.8	23.9 52.4	32.3 61.5	41.3 66.3	50.5 69.0	59.8 70.3	69.2 70.9	78.6 70.8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
84.5	14.5 0.	17.5 33.0	24.3 51.5	32.6 60.8	41.5 65.8	50.7 68.6	60.0 70.0	69.3 70.7	78.7 70.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
85.0	15.0 0.	17.9 32.1	24.6 50.6	32.8 60.1	41.7 65.3	50.8 68.2	60.1 69.8	69.5 70.5	78.9 70.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
85.5	15.5 0.	18.3 31.3	24.9 49.8	33.1 59.5	41.9 64.8	51.0 67.8	60.3 69.5	69.7 70.3	79.1 70.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
86.0	16.0 0.	18.7 30.5	25.2 49.0	33.3 58.8	42.1 64.3	51.2 67.4	60.5 69.2	69.9 70.2	79.2 70.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
86.5	16.5 0.	19.2 29.8	25.5 48.2	33.6 58.2	42.3 63.8	51.4 67.1	60.7 69.0	70.0 70.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
87.0	17.0 0.	19.6 29.1	25.9 47.5	33.8 57.5	42.5 63.3	51.6 66.7	60.8 68.7	70.2 69.8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
87.5	17.5 0.	20.0 28.4	26.2 46.7	34.1 56.9	42.8 62.8	51.8 66.3	61.0 68.5	70.4 69.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
88.0	18.0 0.	20.5 27.8	26.6 45.9	34.4 56.3	43.0 62.3	52.0 66.0	61.2 68.2	70.5 69.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
88.5	18.5 0.	20.9 27.2	26.9 45.2	34.7 55.7	43.2 61.9	52.2 65.6	61.4 68.0	70.7 69.3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
89.0	19.0 0.	21.4 26.6	27.3 44.5	35.0 55.1	43.5 61.4	52.4 65.3	61.6 67.7	70.9 69.1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
89.5	19.5 0.	21.8 26.0	27.6 43.9	35.2 54.5	43.7 60.9	52.6 64.9	61.8												

	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	0
100.0	30.0 0.	31.6 18.2	35.9 33.3	42.1 44.5	49.5 52.6	57.6 58.5	66.2 62.8	75.1 66.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100.5	30.5 0.	32.0 17.9	36.3 32.9	42.5 44.1	49.8 52.3	57.9 58.2	66.4 62.6	75.3 65.9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
101.0	31.0 0.	32.5 17.7	36.7 32.5	42.8 43.7	50.1 51.9	58.2 57.9	66.7 62.4	75.5 65.8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
101.5	31.5 0.	33.0 17.4	37.1 32.2	43.2 43.4	50.4 51.6	58.4 57.7	66.9 62.2	75.7 65.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
102.0	32.0 0.	33.5 17.2	37.6 31.8	43.5 43.0	50.7 51.3	58.7 57.4	67.1 62.0	75.9 65.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
102.5	32.5 0.	34.0 17.0	38.0 31.5	43.9 42.7	51.0 51.0	59.0 57.2	67.4 61.8	76.1 65.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
103.0	33.0 0.	34.4 16.8	38.4 31.1	44.3 42.3	51.4 50.7	59.2 56.9	67.6 61.7	76.3 65.3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
103.5	33.5 0.	34.9 16.6	38.9 30.8	44.6 42.0	51.7 50.3	59.5 56.7	67.9 61.5	76.5 65.2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
104.0	34.0 0.	35.4 16.4	39.3 30.5	45.0 41.6	52.0 50.0	59.8 56.4	68.1 61.3	76.8 65.1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
104.5	34.5 0.	35.9 16.2	39.7 30.2	45.4 41.3	52.3 49.7	60.1 56.2	68.3 61.1	77.0 65.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
105.0	35.0 0.	36.4 16.0	40.1 29.9	45.8 41.0	52.6 49.5	60.3 55.9	68.6 61.0	77.2 64.9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
105.5	35.5 0.	36.8 15.8	40.6 29.6	46.1 40.7	53.0 49.2	60.6 55.7	68.8 60.8	77.4 64.8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
106.0	36.0 0.	37.3 15.6	41.0 29.3	46.5 40.3	53.3 48.9	60.9 55.5	69.1 60.6	77.6 64.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
106.5	36.5 0.	37.8 15.4	41.5 29.0	46.9 40.0	53.6 48.6	61.2 55.2	69.3 60.4	77.8 64.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
107.0	37.0 0.	38.3 15.3	41.9 28.8	47.3 39.7	54.0 48.3	61.5 55.0	69.6 60.3	78.0 64.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
107.5	37.5 0.	38.8 15.1	42.3 28.5	47.7 39.5	54.3 48.1	61.8 54.8	69.8 60.1	78.2 64.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
108.0	38.0 0.	39.2 14.9	42.8 28.2	48.1 39.2	54.6 47.8	62.0 54.6	70.1 60.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
108.5	38.5 0.	39.7 14.8	43.2 28.0	48.5 38.9	55.0 47.5	62.3 54.4	70.3 59.8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
109.0	39.0 0.	40.2 14.6	43.7 27.7	48.8 38.6	55.3 47.3	62.6 54.2	70.6 59.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
109.5	39.5 0.	40.7 14.5	44.1 27.5	49.2 38.3	55.6 47.0	62.9 53.9	70.8 59.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
110.0	40.0 0.	41.2 14.3																	



SPIN ANGLE (UPPER) AND SCAN HORIZONTAL ANGLE (LOWER) AT THE HORIZON FOR BETA=90.0DEG

	28.00	28.25	28.50	28.75	29.00	29.25	29.50	29.75	30.00	30.25	30.50	30.75	31.00	31.25	31.50	31.75	32.00
20.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28.0	180.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28.5	169.7	172.7	180.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29.0	165.5	167.5	169.8	172.8	180.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29.5	162.4	164.0	165.7	167.6	169.9	172.9	180.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30.0	159.9	161.2	162.6	164.1	165.8	167.8	170.0	172.9	180.0	0.	0.	0.	0.	0.	0.	0.	0.
30.5	157.7	158.8	160.1	161.4	162.8	164.3	166.0	167.9	170.1	173.0	180.0	0.	0.	0.	0.	0.	0.
31.0	155.7	156.8	157.9	159.0	160.3	161.6	163.0	164.5	166.1	168.0	170.2	173.1	180.0	0.	0.	0.	0.
31.5	154.0	154.9	156.0	157.0	158.1	159.3	160.5	161.8	163.1	164.6	166.3	168.1	170.3	173.2	180.0	0.	0.
32.0	152.4	153.3	154.2	155.2	156.2	157.2	158.3	159.5	160.7	161.9	163.3	164.8	166.4	168.2	170.4	173.2	180.0
32.5	150.9	151.8	152.6	153.5	154.5	155.4	156.4	157.4	158.5	159.7	160.8	162.1	163.4	164.9	166.5	168.3	170.5
33.0	149.5	150.3	151.2	152.0	152.9	153.8	154.7	155.7	156.6	157.7	158.7	159.8	161.0	162.3	163.6	165.1	166.6
33.5	148.3	149.0	149.8	150.6	151.4	152.3	153.1	154.0	154.9	155.9	156.9	157.9	158.9	160.0	161.2	162.4	163.8
34.0	147.1	147.8	148.6	149.3	150.1	150.9	151.7	152.5	153.4	154.3	155.2	156.1	157.1	158.1	159.1	160.2	161.4
34.5	146.0	146.7	147.4	148.1	148.9	149.6	150.4	151.2	152.0	152.8	153.6	154.5	155.4	156.3	157.3	158.3	159.3
35.0	144.9	145.6	146.3	147.0	147.7	148.4	149.2	149.9	150.7	151.4	152.2	153.1	153.9	154.7	155.6	156.6	157.5
35.5	143.9	144.6	145.3	145.9	146.6	147.3	148.0	148.7	149.4	150.2	150.9	151.7	152.5	153.3	154.1	155.0	155.9
36.0	143.0	143.6	144.3	144.9	145.6	146.2	146.9	147.6	148.3	149.0	149.7	150.4	151.2	152.0	152.7	153.5	154.4
36.5	142.1	142.7	143.3	144.0	144.6	145.2	145.9	146.5	147.2	147.9	148.6	149.3	150.0	150.7	151.5	152.2	153.0
37.0	141.3	141.9	142.5	143.1	143.7	144.3	144.9	145.5	146.2	146.8	147.5	148.2	148.8	149.5	150.3	151.0	151.7
37.5	140.5	141.0	141.6	142.2	142.8	143.4	144.0	144.6	145.2	145.8	146.5	147.1	147.8	148.4	149.1	149.8	150.5
38.0	139.7	140.2	140.8	141.4	141.9	142.5	143.1	143.7	144.3	144.9	145.5	146.1	146.8	147.4	148.1	148.7	149.4
38.5	139.0	139.5	140.0	140.6	141.2	141.7	142.3	142.9	143.4	144.0	144.6	145.2	145.8	146.4	147.1	147.7	148.3
39.0	138.2	138.8	139.3	139.8	140.4	140.9	141.5	142.0	142.6	143.2	143.8	144.3	144.9	145.5	146.1	146.7	147.4
39.5	137.6	138.1	138.6	139.1	139.7	140.2	140.7	141.3	141.8	142.4	142.9	143.5	144.1	144.6	145.2	145.8	146.4
	130.2	130.7	131.2	131.7	132.3	132.8	133.3	133.9	134.5	135.0	135.6	136.2	136.8	137.4	138.0	138.6	139.3

SPIN ANGLE (UPPER) AND SCAN HORIZONTAL ANGLE (LOWER) AT THE HORIZON FOR BETA=90.0DEG

	28.00	28.25	28.50	28.75	29.00	29.25	29.50	29.75	30.00	30.25	30.50	30.75	31.00	31.25	31.50	31.75	32.00
60.0	122.8 107.9	123.1 108.1	123.4 108.3	123.7 108.6	124.0 108.7	124.3 108.9	124.7 109.1	125.0 109.3	125.3 109.5	125.6 109.7	125.9 109.9	126.2 110.1	126.5 110.3	126.8 110.5	127.1 110.7	127.4 110.9	127.7 111.1
60.5	122.6 107.5	122.9 107.7	123.2 108.1	123.5 108.3	123.9 108.5	124.2 108.7	124.5 108.9	124.8 109.1	125.1 109.3	125.4 109.5	125.7 109.7	126.0 109.9	126.3 110.1	126.6 110.3	126.9 110.5	127.2 110.7	127.5 110.9
61.0	122.5 107.1	122.8 107.3	123.1 107.5	123.4 107.7	123.7 108.1	124.0 108.3	124.3 108.5	124.6 108.7	124.9 108.9	125.2 109.1	125.5 109.3	125.8 109.5	126.1 109.7	126.4 109.9	126.7 110.1	127.0 110.3	127.3 110.5
61.5	122.3 106.8	122.6 107.1	122.9 107.3	123.2 107.5	123.5 107.7	123.8 107.9	124.1 108.1	124.4 108.3	124.7 108.5	125.0 108.7	125.3 108.9	125.6 109.1	125.9 109.3	126.2 109.5	126.5 109.7	126.8 109.9	127.1 110.1
62.0	122.1 106.4	122.4 106.6	122.7 106.8	123.0 107.0	123.3 107.3	123.6 107.5	123.9 107.7	124.2 107.9	124.5 108.1	124.8 108.3	125.1 108.5	125.4 108.7	125.7 108.9	126.0 109.1	126.3 109.3	126.6 109.5	126.9 109.7
62.5	122.0 106.1	122.2 106.2	122.5 106.4	122.8 106.6	123.1 106.9	123.4 107.1	123.7 107.3	124.0 107.5	124.3 107.7	124.6 107.9	124.9 108.0	125.2 108.2	125.5 108.4	125.8 108.6	126.1 108.8	126.4 109.0	126.7 109.2
63.0	121.8 105.7	122.1 105.9	122.4 106.1	122.7 106.2	123.0 106.4	123.3 106.6	123.6 106.8	123.9 106.9	124.2 107.1	124.5 107.3	124.8 107.5	125.1 107.6	125.4 107.8	125.7 108.0	126.0 108.2	126.3 108.4	126.6 108.6
63.5	121.6 105.4	121.9 105.5	122.2 105.7	122.5 105.9	122.8 106.0	123.1 106.2	123.4 106.4	123.7 106.6	124.0 106.7	124.3 106.9	124.6 107.1	124.9 107.3	125.1 107.4	125.4 107.6	125.7 107.8	126.0 108.0	126.3 108.2
64.0	121.5 105.0	121.8 105.2	122.1 105.4	122.4 105.5	122.7 105.7	123.0 105.9	123.3 106.0	123.6 106.2	123.9 106.4	124.2 106.5	124.5 106.7	124.8 106.9	125.0 107.1	125.3 107.2	125.6 107.4	125.9 107.6	126.1 107.7
64.5	121.3 104.7	121.6 104.8	121.9 105.0	122.2 105.2	122.5 105.3	122.8 105.5	123.1 105.7	123.4 105.8	123.7 106.0	124.0 106.2	124.3 106.3	124.6 106.5	124.8 106.7	125.1 106.8	125.4 107.0	125.7 107.2	126.0 107.3
65.0	121.2 104.4	121.5 104.5	121.8 104.7	122.1 104.8	122.3 105.0	122.6 105.1	122.9 105.3	123.2 105.5	123.5 105.8	123.8 105.9	124.1 106.1	124.3 106.3	124.6 106.4	124.9 106.6	125.2 106.8	125.5 106.9	125.8 107.1
65.5	121.1 104.0	121.3 104.2	121.6 104.4	121.9 104.5	122.2 104.6	122.5 104.8	122.8 104.9	123.0 105.1	123.3 105.3	123.6 105.4	123.9 105.6	124.2 105.7	124.5 105.9	124.8 106.1	125.0 106.2	125.3 106.4	125.6 106.5
66.0	120.9 103.7	121.2 103.8	121.5 104.0	121.8 104.1	122.1 104.3	122.3 104.4	122.6 104.6	122.9 104.7	123.2 104.9	123.5 105.0	123.7 105.2	124.0 105.4	124.3 105.5	124.6 105.7	124.9 105.9	125.2 106.0	125.5

SCAN NADIR ANGLE (UPPER) AND SCAN HORIZONTAL ANGLE* (LOWER) FOR BETA=90.0DEG

	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	0
120.0	30.0 0.0	31.5 19.4	35.5 36.1	41.4 49.1	48.4 59.2	56.2 67.2	64.3 73.9	72.8 79.7	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
120.5	30.5 0.0	31.9 19.2	35.9 35.6	41.7 48.7	48.7 58.8	56.4 66.9	64.5 73.7	72.9 79.5	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
121.0	31.0 0.0	32.4 18.9	36.3 35.2	42.1 48.3	49.0 58.5	56.6 66.6	64.6 73.4	73.0 79.4	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
121.5	31.5 0.0	32.9 18.6	36.8 34.9	42.4 47.9	49.2 58.1	56.8 66.3	64.8 73.2	73.0 79.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
122.0	32.0 0.0	33.4 18.4	37.2 36.5	42.7 47.5	49.5 57.7	57.0 66.0	64.9 73.0	73.1 79.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.1 0.0	0.0 0.0
122.5	32.5 0.0	33.8 18.2	37.6 34.1	43.1 47.1	49.8 57.4	57.2 65.7	65.1 72.8	73.2 78.9	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
123.0	33.0 0.0	34.3 17.9	38.0 33.8	43.4 46.7	50.0 57.4	57.4 65.4	65.2 72.5	73.3 78.8	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
123.5	33.5 0.0	34.8 17.7	38.4 33.4	43.8 46.3	50.3 56.7	57.6 65.1	65.4 72.3	73.4 78.6	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
124.0	34.0 0.0	35.3 17.5	38.8 33.1	44.1 45.9	50.6 56.3	57.8 64.9	65.5 72.1	73.5 78.5	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
124.5	34.5 0.0	35.7 17.3	39.2 32.7	44.5 45.5	50.9 56.0	58.0 64.6	65.7 71.9	73.6 78.4	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
125.0	35.0 0.0	36.2 17.1	39.7 32.4	44.8 45.2	51.1 55.6	58.2 64.3	65.8 71.7	73.7 78.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
125.5	35.5 0.0	36.7 16.9	40.1 32.1	45.2 44.8	51.4 55.3	58.4 64.0	66.0 71.5	73.8 78.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
126.0	36.0 0.0	37.2 16.7	40.5 31.8	45.5 44.5	51.7 55.0	58.7 63.7	66.1 71.3	73.9 77.9	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
126.5	36.5 0.0	37.7 16.5	40.9 31.5	45.9 44.1	52.0 54.7	58.9 63.5	66.3 71.0	74.0 77.8	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
127.0	37.0 0.0	38.1 16.3	41.4 31.2	46.2 43.8	52.3 54														

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(Continued from front cover)

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