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COBRA GLINT MODEL AH-1G

by

Richard H. Daumit
John B. Goodell
Richard F. Higby

Westinghouse Defense and Electronic Systems Center
Systems Development Division
Baltimore, MD 21203

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This report details the development of a computer simulation model of the Attack Helicopter to predict the visual detectivity of the aircraft by a ground observer due to sun reflections from its windows. In addition, the model was exercised to determine probabilities of detection versus angles of incident sunlight and also used to determine sunshade configuration for reducing reflections. The helicopter canopy was described by 1464 separate segments that were defined with respect to an earth-referenced coordinate

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system. This permitted the model to be used with various aircraft altitudes, attitudes and sun angle and zenith relationships.

The results showed that large glints occur at all angles of incidence and suggest that a combination of improved window design, improved anti-reflection window coatings, and a sunshade system may be required to reduce reflections to an acceptable level.

The model as developed to this point may also be used in evaluation of other canopy configurations by inputting the appropriate window information into the model.

FOREWORD

This effort was sponsored by the US Army Land Warfare Laboratory, Aberdeen Proving Ground, MD. It was initiated by, and performed under the technical supervision of, Mr. Harold C. Forst, Physicist, of the Advanced Development Division, Applied Physics Branch. The work was conducted to develop the capabilities required by LWL Task 06-P-72, entitled Glare Reduction, which involved various approaches to reduce the visible signature of the attack helicopter. The period of performance extended from August through December 1972 with the latter two months being under the technical supervision of Mr. Gerald E. Cook of the Applied Physics Branch due to reassignment of Mr. Forst.

TABLE OF CONTENTS

1. INTRODUCTION AND SUMMARY

Work Assignment #2 to Contract Number DAAD05-72-C-0284 is concerned with development of a Glint Model for the Cobra AH-1G to analyze glint off the windows. Sun glints off the rotor hub, fuselage and windows in level flight and while banking allow the visual observer to detect low flying aircraft at much longer ranges than is possible in nonglint conditions. Reflections and glints from the rotor blades, rotor hub and fuselage have been adequately taken care of by use of a non-reflecting light-dispersing paint. This task is then concerned with window areas.

The objectives of the task are to develop a simulation model of the Cobra AH-1G for use in predicting the visual detectivity of the aircraft by a ground observer due to sun glints from the windows; to exercise this model to determine probabilities of detection vs. angles of incidence of sunlight; and to use the model to determine the best sunshade configuration. These objectives were met by the model described in Section 3 which used the window configuration described in Section 2. The model included the parameters of sun angle, sun intensity, atmospheric transmission, sun-aircraft relationship, detection sensitivity of the human eye, background intensity and contrast between background and aircraft(to determine detection ranges for observer position relative to the aircraft). A 50% probability of detection criterion was used to determine the ranges. The required reflectivities for the windows were computed as a function of angle of incidence for reducing detection range to the nonglint detection range of the helicopter and for reducing detection range to 1500 meters.

The results showed that to reduce detection range to the nonglint detection range of the helicopter, the required reflectivity varied from less than

.1% to more than 30% over all angles of incidence. To reduce detection range to 1500 meters, the required reflectivity varied from less than .001% to more than .5% over all angles. The most stringent requirements were due to large glints off the relatively flat overhead window. If this window was removed from the model, the low end requirements were relaxed by an order of magnitude to less than 2% and less than .01% respectively. These data indicate that large glints occur at all angles of incidence and that a combination of improved window design, improved window coatings and a sunshade system may be required to reduce glints to an acceptable level.

It is recommended that additional work in this area be performed on shutter designs and then use the model developed under this task as a basic tool in evaluating the shutter redesigns. The model should be modified for future use to consider cluttered and uncluttered backgrounds with high and low background reflectance. This modification is a minor one. In addition, the criteria for use in evaluating shutter designs must be determined and agreed upon.

The model as developed to this point may also be used in evaluation of other helicopter windows by inputting the appropriate window information into the model.

2. THE HELICOPTER WINDOWS

The Cobra AH-1G has five windows, two on each side and an overhead. The location of the windows is described by five outline drawings (listed below) and their contour is described by Bell Helicopter drawing 209-B3 Revision A.

Window	Outline Drawing	Contour Drawing
Pilot's Door (Pilot's left side)	209-030-516	
Pilot's Window (Right side)	209-030-507	209-B3
Gunner's Door (Left side)	209-030-515	
Gunner's Window (Right side)	209-030-508	209-B3
Overhead Window	209-030-509	209-B3

The contour drawing describes the mold used in making the windows. Although it describes only the right hand side and overhead windows, the left side windows are the mirror image of the right hand side windows. The format of the drawing is a series of twenty-seven full scale curves taken at various flight stations from 53.5 to 169.5 along the longitudinal axis of the Cobra at intervals of at least .5" and no more than 6".

In order to describe the windows for use in the model, xyz information was generated for 726 points on the right side windows and for 12 points on the overhead window using the curves on the Bell drawing. Points were generated only for those portions of each curve which fell within the outline of the windows as determined by the five outline drawings noted above.

The center of the coordinate system for the x, y, z values was taken as the 0, 0, 0 point for Flight Station 0, Bulkhead Line 0 and Water Line 0.

This point is shown in figure 2-1 which was taken from figure 12-2 of the Cobra Manual[1]. This system assigns negative x values to Flight Station numbers, positive y values to left Bulkhead Line numbers and positive z values to Water Line numbers. The x y z points for the side windows were determined by plotting points at approximately 1" intervals along each of the twenty-seven curves of the contour drawing and noting their x, y, z values. Although this process could be done by a digitizing plotter with a printout in thousandths of an inch; it was done by hand for this task due to lead time requirements for the digitizer. x,y,z values were measured to the nearest hundredth of an inch, with an estimated accuracy of ±.01 inches. The errors in blueprint distortion were estimated to be 1/16" in 36" or less than .5%. The right hand window was assigned negative x values, negative y values and positive z values. Corresponding points on the left hand window had identical x and z values and identical y values with a positive rather than negative sign.

The overhead window was flat along y and curved in x and z with flats at the front and top. It was described by twelve points, with the first and second describing the front flat, the eleventh and twelth describing the top flat and the second through eleventh describing the curved portion.

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[1] Operator's Manual, Army Model AH-1G Helicopter, TM 55-1520-221-10, Headquarters, Department of the Army, 19 June 1971.

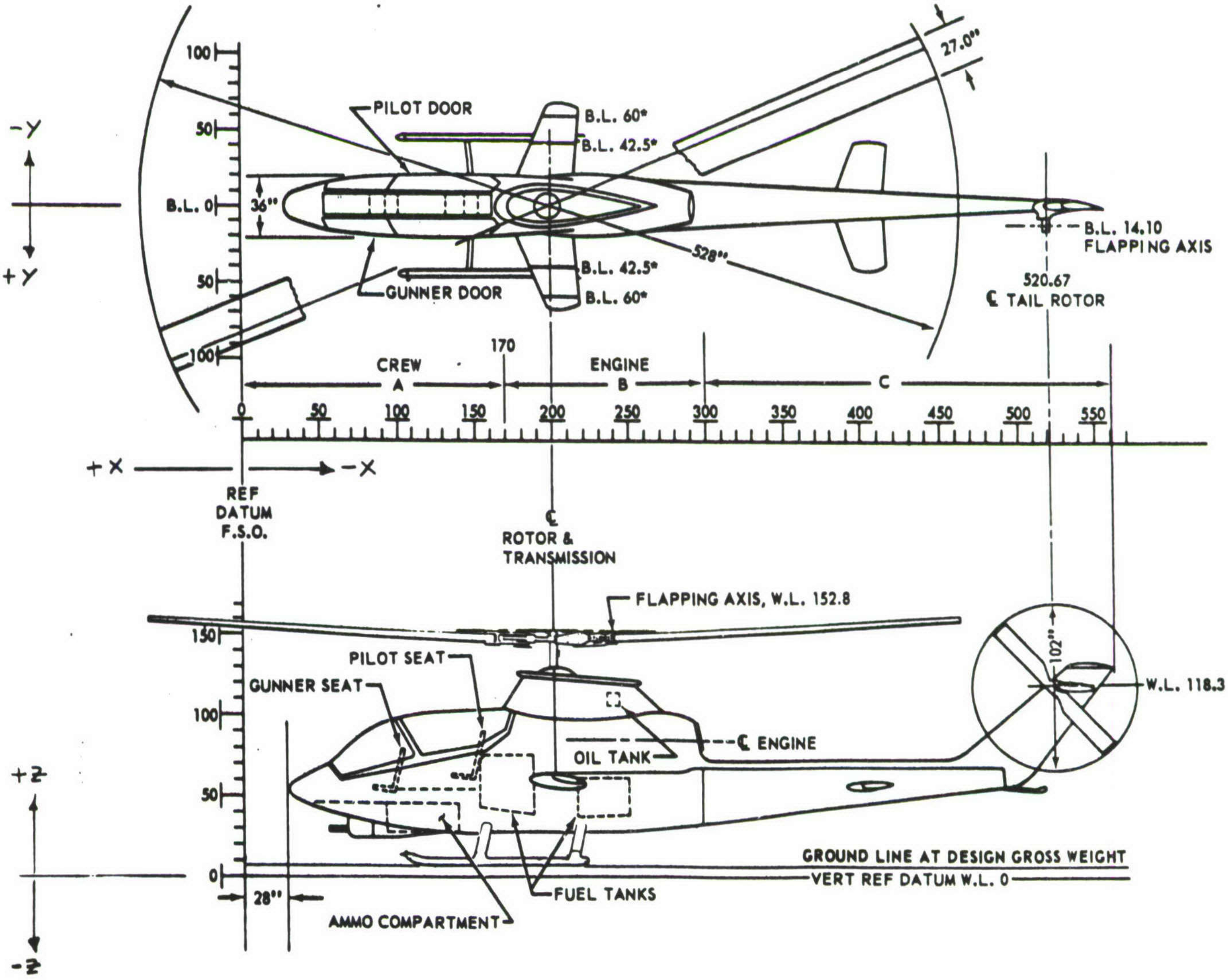


Figure 2-1. Helicopter Reference Points

3. THE COMPUTER MODEL

3.1 General

The computer model was programmed in Fortran IV and run on the Univac 1108 digital computer at the Westinghouse and Defense Center. The model output includes the following:

a) A listing of 726 side window surfaces and 12 center window surfaces with their x,y,z coordinates, x,y,z components of their normals and effective area.

b) A listing of the 1464 surfaces of both side windows and the center window by surface number with x,y,z coordinates for each surface.

c) An Area Contour Plot showing the projection of all normals in zenith and azimuth coordinates.

d) A listing of the azimuth and zenith coordinates of each normal.

e) A Brightness Plot showing the relative brightness of reflected rays in zenith and azimuth coordinates.

f) A Helicopter Detection Range contour plot showing the detection range of the helicopter along each reflected ray in zenith and azimuth coordinates.

g) A Window Detection Range contour plot showing the detection range of the glint along each reflected ray in zenith and azimuth coordinates.

h) A listing of the azimuth and zenith coordinates, the angle of incidence and the glint detection range for each reflected ray.

i) A listing of the required reflectivity for each angle of incidence.

j) A plot of required reflectivity vs. angle of incidence.

A flow chart of the model is shown in figure 3-1. Paragraph numbers are inserted in the flow chart to show where discussion on the various parts of the model can be found. In order to keep machine time and thus computer costs down, the model was divided into three segments. The first segment computed normals and effective areas. Its output is a) above. This output

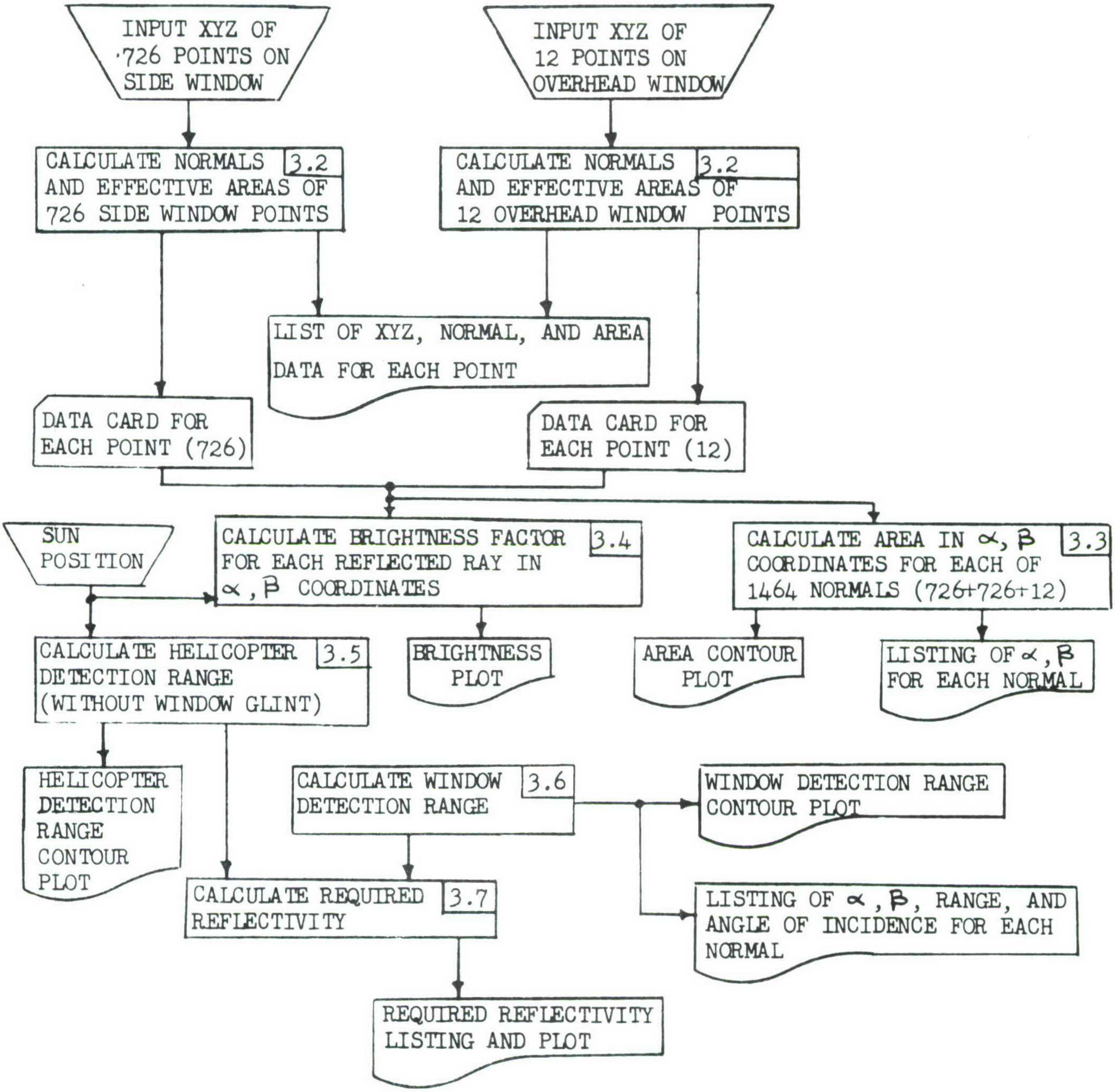


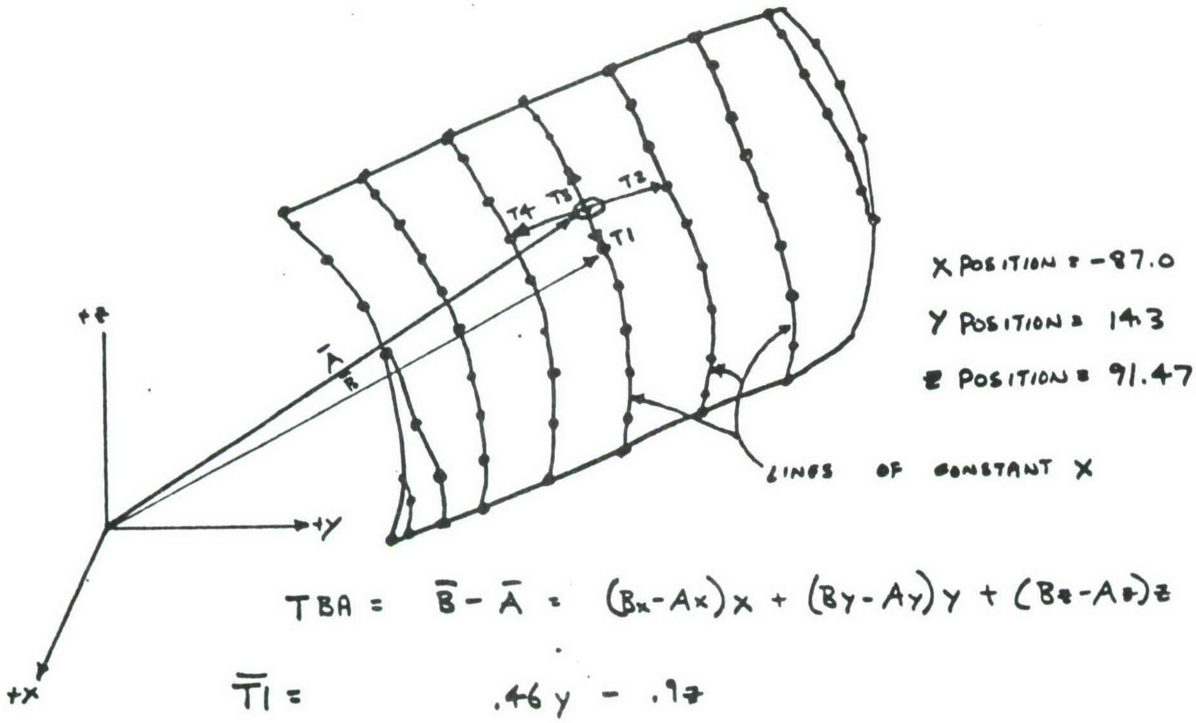
Figure 3-1. Flow Chart for Cobra Model

is fed into the second segment which computes an Area Contour Plot and an associated α, β (zenith, azimuth) plot. Its output is b), c) and d) above. This output is required only once for a given window configuration. The output of the first segment is also fed into the third segment which computes brightness factors, detection ranges and required reflectivities for various sun positions, visibility conditions and reflectivity requirement criteria. Its output is e) through g) above. A listing of the three segments is provided in Appendix A.

3.2 Normal Computation

The normal computation segment of the model was performed in two different programs, one for the right side window and one for the overhead window. Both programs computed tangents on the window and used these tangents to compute x,y,z components of the normals and effective areas. Since this data doesn't change for the same window, it was computed only once, and output on IBM cards which were then used as an integral part of the next program segments. The data generated for the right side window applied to the left side window when the signs of the y position and the y component of the normal were changed from - to +.

The 726 points on the side window were grouped in 27 sets of from 1 to 40 points which described contour curves of equal x values. Figure 3-2 shows a representation of several of these lines. Data for each of these points was read into the program. The data was then ordered in first x and then z. Then tangents along the x curve were computed by computing the vectors between adjacent points along the x curve. The tangents were described in x, y and z values. Each point, $P_{x,\ y,\ z}$, had tangents T1 and T3 computed where T1 was the vector from $P_{x,y,z}$ to $P_{x,y,z-1}$, the point with the next lowest z value on



$$TBA = \bar{B} - \bar{A} = (B_x - A_x)x + (B_y - A_y)y + (B_z - A_z)z$$

$$\overline{T1} = .46y - .9z$$

$$\overline{T2} = -6x + .9y + .29z$$

$$\overline{T3} = -.5y + .86z$$

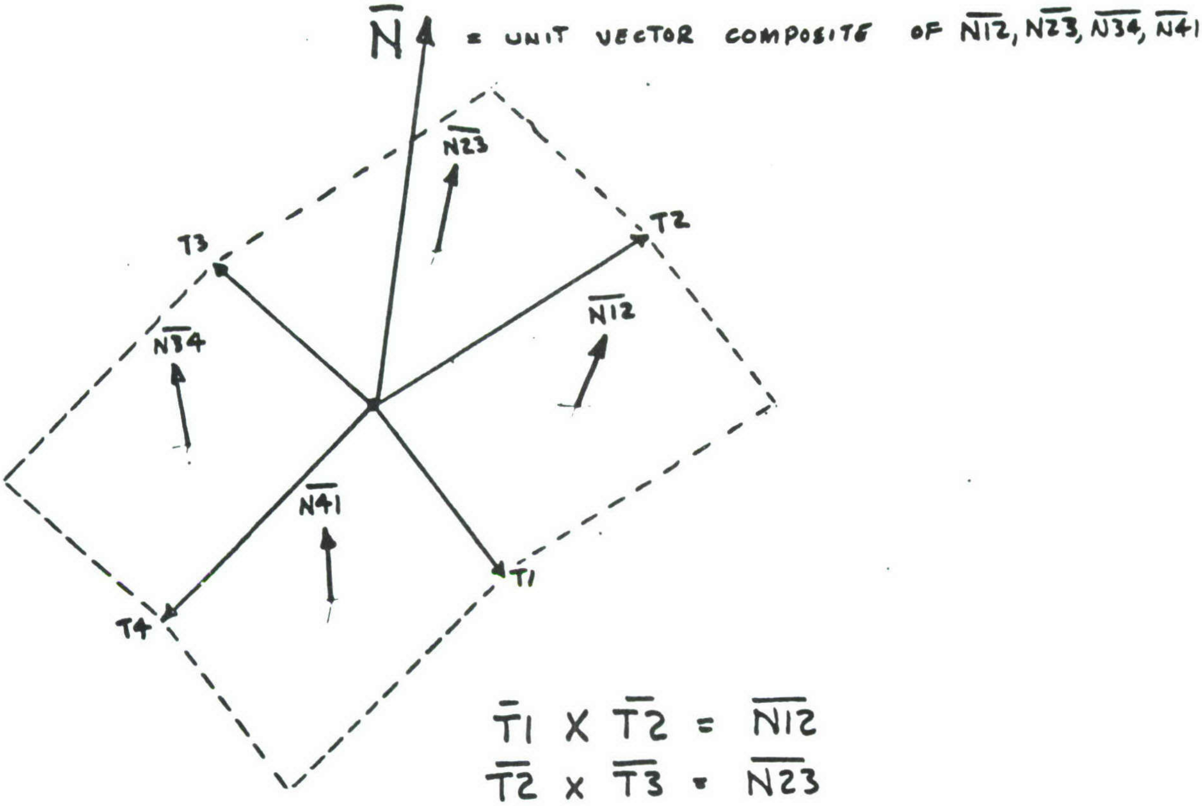
$$\overline{T4} = 6x - .95y - 1.21z$$

Figure 3-2. Tangents on Side Windows

that x curve, and T3 was the vector from $P_{x,y,z}$ to $P_{x,y,z+1}$, the point with the next highest z value on that x curve. At the end points, artificial vectors of length .001 were introduced to provide continuity. Tangents T2 and T4 across x curves were computed by finding the closest points on either side of the x curves and computing the vectors to them from $P_{x,y,z}$. On the extreme points, artificial vectors of length .001 were introduced to provide continuity. An example of the four tangent vectors for one point is given in figure 3-2.

To obtain the normals, cross products between T1 and T2, T2 and T3, T3 and T4 and T4 and T1 were computed. The result of each cross product computation was an x value, y value, z value and an area. The x value of the normal was obtained by dividing the sum of the four x values by the sum of the four area values. The y and z values were obtained in a similar manner. The result was a unit normal which was unaffected by the artificial tangents since they had a small length and thus a near zero area. A representation of the four subnormals, $\overline{N12}$, $\overline{N23}$, $\overline{N34}$ and $\overline{N41}$ and the resultant normal $\bar{N}$ is shown in figure 3-3.

The angle between each normal and its four subnormals was obtained by taking the dot product of the subnormal and the normal. The result was the cosine of the angle. This angle was then divided into $1/8^\circ$ and the result multiplied by the area obtained from the cross product computation to obtain the effective area for the subnormal. The four subnormal effective areas for each area were then added to provide a total effective area for each normal. This area was a function of the area of the sector defined by the normal, the radius of curvature of the sector and the $\pm 1/4^\circ$ angular subtense of the sun.



$$\overline{T1} \times \overline{T2} = \overline{N12}$$
$$\overline{T2} \times \overline{T3} = \overline{N23}$$
$$\overline{T3} \times \overline{T4} = \overline{N34}$$
$$\overline{T4} \times \overline{T1} = \overline{N41}$$

Figure 3-3. Normals on Side Window

A similar but simplified method was used for the twelve points on the overhead window. Two tangents, T1 and T3, were computed for each point using the adjacent points. A third tangent, T2 of x=0, y=16, z=0 was used to represent the window width. The normals and effective areas were then generated using two cross products, T1 x T2 and T2 x T3.

The output of the two programs was a listing of 738 points by their x,y,z position with x,y,z components of their unit vectors and their effective areas. This output is presented in Appendix B. An IBM data card was generated for each point for use in the next segments of the model.

3.3 Area Contour Plot

This segment of the model converts the data of 738 window sectors into 1464 window sectors covering both side windows (726 sectors each) and the overhead window (12 sectors).

The Area Contour Plot shows the projections of the normals in azimuth and zenith coordinates for a trimmed helicopter. The zenith angle of the normal is called α and the azimuth angle is called β on the plot. Figure 3-4 shows the α, β angular relationships. The zenith and azimuth angles are quantized in 3° increments and the sum of all areas within $\pm 1\frac{1}{2}^\circ$ of each quantized zenith and azimuth point are plotted on the Area Contour Plot. Numbers on the plot are two place integers representing $10 \log_{10}$ (Area x 1000). This representation was chosen to guarantee that all areas could be represented by a positive two place number.

The output of this segment of the model is a listing by surface number of the x,y,z, coordinates of each of the 1464 normals, a listing by surface number of the α, β coordinates of each normal, and the Area Contour Plot. By assigning surface numbers and listing the α, β of each normal, it is

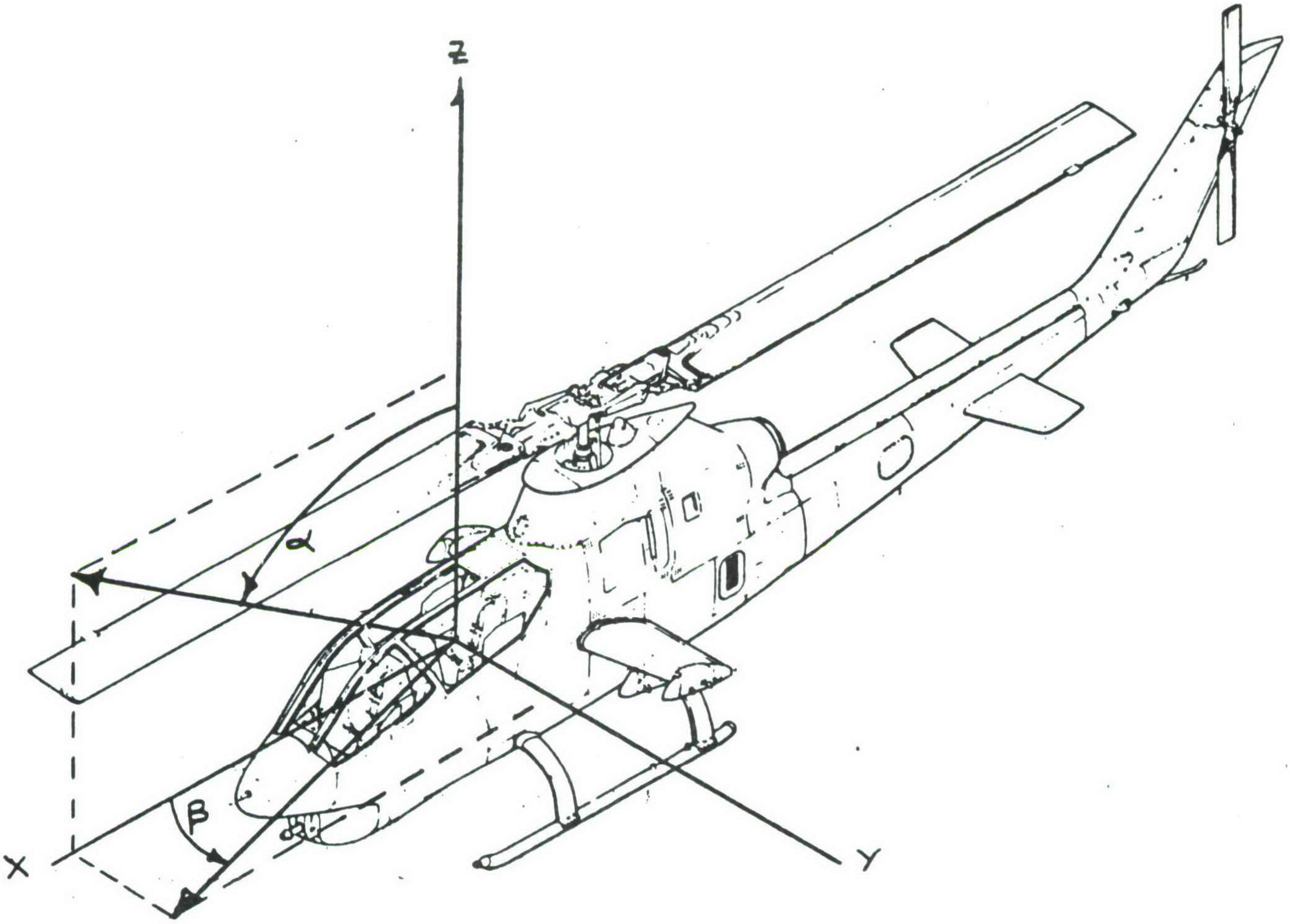


Figure 3-4. Alpha, Beta Coordinate System

possible to find the point or points on the windows which a given α, β or area corresponds to.

The surface x,y,z listing, the α, β listing and the Area Contour Plot are presented in Appendix B.

The data from this segment of the model is generated only once because it does not change for a given window configuration. This information is then used in the third segment of the model.

3.4 Brightness Plot

This segment of the program computes the reflected sun rays off the helicopter window and computes a brightness factor which is used later to compute detection range. A Brightness Plot showing relative brightness as a function of the azimuth and zenith position of the reflected rays is generated.

Each sun position relative to the helicopter's trim position is considered as one case. For each case a new brightness plot is generated showing all of the reflected rays. The x,y,z components of the reflected ray are computed by equations (1), (2) and (3).

(1) $RX = SX - 2 \times SDN \times XN$

(2) $RY = SY - 2 \times SDN \times YN$

(3) $RZ = SZ - 2 \times SDN \times ZN$

where :

SX = sun rays x component = -cos (sun azimuth) x sin (sun zenith)

SY = sun rays y component = -sin (sun azimuth) x sin (sun zenith)

SZ = sun rays z component = -cos (sun zenith)

XN = x component of normal

YN = y component of normal

ZN = Z component of normal

SDN = dot product of normal and sun ray = cosine of angle of incidence between sun ray and surface normal

When SDN is negative, the angle of incidence is greater than 90° and the normal under consideration is in the shadow of the window. For these normals there is no reflected ray and no brightness factor.

The sun ray vector is defined as a unit vector and the normal vector is a unit vector, thus the reflected ray vector is a unit vector. This vector is used to calculate the α , β position of the reflected ray in a manner similar to that of the α , β position of the normal vector in section 3.3, with the α , β position quantized in 3° sectors.

The brightness factor is computed by equation (4).

(4) BF = area x SDN x RO

where:

area = the area associated with the normal as computed in the normal computation

RO = coefficient of reflectivity of the window material (acrylic plastic) and the angle of incidence. This coefficient is computed in a continuous fraction subroutine which uses data supplied by LWL.

The highest brightness factor for each quantized α , β is printed on the Brightness Plot. Numbers on the plot are two place integers representing $10 \log_{10}$ (Brightness Factor x 10^7). This representation was chosen to guarantee that all brightness factors could be represented by a positive two place number.

A typical Brightness Plot (sun zenith = 45°) is presented in Appendix B.

3.5 Helicopter Detection Range

Helicopter detection range is the 50% probability of detecting the helicopter with the photopic eye and is calculated along each reflected ray. It is used in the determination of required reflectivity.

Two contrast equations are used in the calculations of detection range. The first equation (5) describes the contrast of the helicopter against an east horizon sky. The second equation (6) describes the contrast required in order to see the helicopter.

$$(5)\quad CT_1 = \frac{BH \times ROE - BH}{BH} \times 100 \times e^{(-3.9075 \times RT/RVIS)}$$

where:

BH = horizon brightness = .0009 w/cm^2/steradian

ROE = reflectivity of helicopter paint = .15

RT = detection range (50% probability) of helicopter in nautical miles

RVIS = visibility range in nautical miles

$e^{-(3.9075)}$ = two percent minimum contrast requirement

$$(6)\quad CT_2 = 1.57 + 36.5\ RT^2/A$$

where:

A = area in square feet

The area of the helicopter is calculated as the visible area of the helicopter along a reflected ray as calculated by equation (7).

$$(7)\quad AP = RX \times 35 + RY \times 450 + RZ \times 157.5$$

where:

35 = frontal area in square feet

450 = side area in square feet

157.5 = top area in square feet

Equations (5) and (6) are transcendental when solving for R. Thus, equation (8) and its derivative, equation (9) were used to solve for R. The equations approach a solution as F approaches 0. The pair of equations were iterated with initial R = 0 and $-F/F'$ being used as the correction factor. For each following iteration, R was incremented by $-F/F'$ until F/F' was less than .1 miles.

(8) $F = -CT_1 + 1.57 + 36 \times RT^2/AP$

(9) $F' = 3{,}9075\ CT_1/RVIS + 2 \times 36.5 \times RT/AP$

The Helicopter Detection Range Contour is obtained by using an α, β plot similar to that for the Brightness Plot except that the maximum Helicopter Range in nautical miles is plotted for each quantized α, β position. A typical Helicopter Detection Range Contour Plot (sun zenith = 45°, sun azimuth = 45°) is presented in Appendix B.

3.6 Window Detection Range

The window detection range is the range at which there is a 50% probability of detecting the window glint with the photopic eye.

As with helicopter detection range, two contrast equations, (10) and (11) respectively, describe the contrast of the sun glint against an eastern horizon sky and the contrast required to detect the glint, and difference equation (12) and its derivative, equation (13), are used to solve equations (10) and (11).

(10) $CG_1 = \dfrac{BS \times EYE \times RO - BH}{BH} \times 100 \times e^{(-3.9075\ RG/RVIS)}$

where:

BS = sun brightness = 2000 w/cm^2/steradian

EYE = photopic response of eye to the sun = .15

RG = detection range (50% probability) of window glint in nautical miles

(11) $CG_2 = 1.57 + 36.5 \times RG^2/ABF$

where: $ABF = BF/(RO \times 144.)$ = effective area of window sector in square feet

(12) $F = -CG_1 + 1.57 + 36.5\ RG^2/ABF$

(13) $F' = 3.9075\ CG_1/RVIS + 2 \times 36.5\ RG^2/ABF$

The Window Detection Range Contour is obtained by using an α , β plot similar to that for the Brightness Plot except that the maximum Window Detection Range in nautical miles is plotted for each quantized α , β position. A typical Window Detection Range Contour Plot (sun azimuth = 45°, sun zenith = 45°) is presented in Appendix B.

The relationship between brightness factor and window detection range can be shown by letting CG_1 of equation (10) equal CG_2 of equation (11). After some algebraic manipulation, we obtain equation (14).

(14) $$BF = \frac{36.5 \times RG^2 \times BH}{(BS \times EYE - BH) \times 100\ e^{(-3.9075\ RG/RVIS)}}$$

Figure 3-5 shows the relationship for visibility ranges of 5, 10 and 20 nautical miles.

3.7 Required Reflectivity

Required reflectivity is defined as that reflectivity which the windows would need in order that the detection range (50% probability) of the glint would not exceed a specified range, possibly the detection range of the helicopter itself, or a constant range such as 1500 meters. It is generated as a function of the angle of incidence of the sun's rays on the window surfaces.

The required reflectivity is computed by equating CG_1 of equation (10)

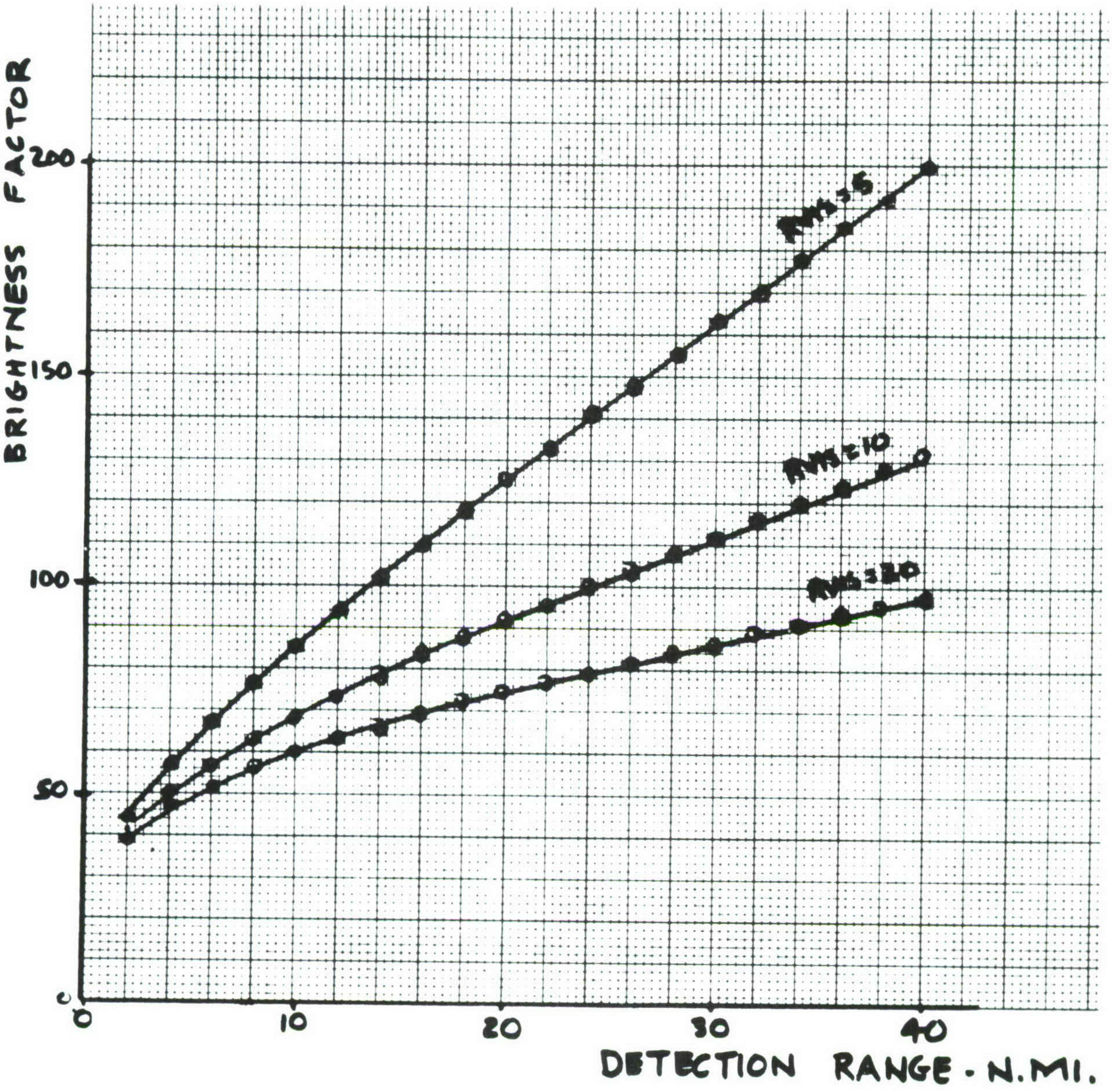


Figure 3-5. Brightness Factor vs. Detection Range

and CG_2 of equation (11) and solving for RO with RT, the desired range, substituted for RG. When helicopter detection range is the desired criteria, its value as computed earlier is used. When a constant range is specified, that range is used for RT. The resulting equation for required reflectivity (ROG) is given as equation (14).

$$(14) \quad ROG = \frac{1.57 + 36.5 \times RT^2}{ABF} \times \frac{BH}{BS \times EYE \times 100 \times e^{(-3.9075\ RT/RVIS)}}$$

The above calculation is made for each reflected ray. The angle of incidence of each ray is computed as arccosine (SDN) and rounded to the nearest degree. Then a lowest value of ROG is found for each angle of incidence from 0° to 90°. Where there are no reflected rays for an angle of incidence, ROG is assumed to be an arbitrary number, 10, which is higher than the actual maximum reflectivity of which any passive surface can have.

A listing and a plot of required reflectivity as a function of angle of incidence is generated for each case. The plot includes a count of the number of rays at each incident angle. At the end of a run of multiple cases, a summary listing and plot is printed out. An example of the listing and plot of required reflectivities is presented in Appendix B.

4. EXERCISING THE MODEL

The first two segments of the model were used one time to compute the window normals and the effective area associated with each normal and to generate an Area Contour Plot. These results are presented in Appendix B.

In the third segment of the program, several sets of runs were made for various visibility ranges and required reflectivity criteria. Each set of runs included 17 sun position cases as shown in Table 4-1. These sun positions relative to the helicopter covered the range of possible sun position-helicopter relationships. For example, a helicopter banking at 45° against a horizon sun might have a zenith = 135°, azimuth = 90° sun position relationship. Six sets of data were run as tabulated in Table 4-2. Different runs at 20 and 5 nautical miles were made to show the effect of visibility range on required reflectivity. Different runs using Helicopter Detection Range and a constant 1500 meters showed the effect of choosing the different criteria for judging window design. The runs without the overhead windows were run because the largest glints were found to occur on the overhead windows and these large glints overpowered the effect of glints off the curved

Table 4-1. Sun Positions Relative to Helicopter

	Azimuth				
Zenith	0	45	90	135	180
0	X				
45	X	X	X	X	X
90	X	X	X	X	X
135	X	X	X	X	X
180	X				

Table 4-2. **Parameter Variation in Runs Made**

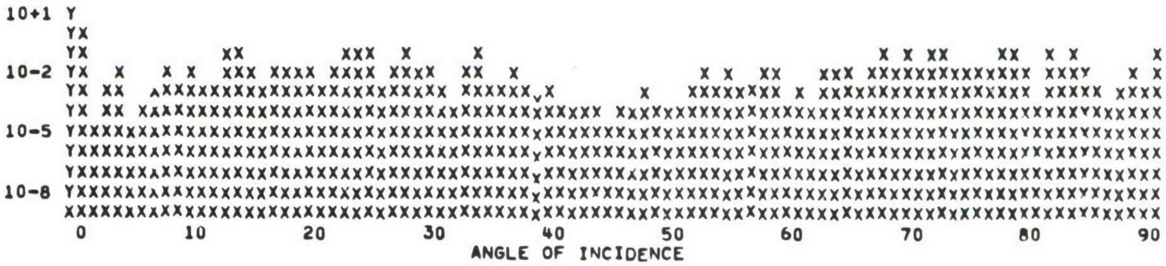
Run #	Reflectivity Requirement Criteria: Reduce Glint Range to:	Visibility Range N. Miles	Overhead Windows	Sun Position	Summary of Reflectivity Requirements
1	Helicopter Detection Range	5	Included	Per Table 4-1	Figure 4-1
2	Helicopter Detection Range	20	Included	Per Table 4-1	Figure 4-2
3	Helicopter Detection Range	5	Excluded	Per Table 4-1	Figure 4-3
4	1500 meters	5	Included	Per Table 4-1	Figure 4-4
5	1500 meters	20	Included	Per Table 4-1	Figure 4-5
6	1500 meters	5	Excluded	Per Table 4-1	Figure 4-6

side windows.

The output for each case in the 6 runs included the brightness plot, a listing of normal numbers, α , β , angle of incidence and glint detection range, and a listing and plot of the required reflectivity vs. angle of incidence. The summary reflectivity listings and plots for cases 1 through 6 are shown in figures 4-1 through 4-6. The reflectivity listings and plots for the seventeen cases in run #1 are included in Appendix C.

```
                        REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0           1          2          3          4          5          6          7          8          9
   0     *********   .000076    .001598    .031047    .000098    .000507    .002612    .057016    .002886    .088270
  10      .005551    .003631    .109365    .147049    .054292    .004900    .033839    .011043    .036657    .099216
  20      .006522    .040333    .213959    .247855    .314083    .007321    .029442    .313381    .026464    .084756
  30      .005657    .000171    .021894    .189603    .004293    .004217    .011198    .003476    .008480    .003198
  40      .000626    .000122    .000244    .000767    .000036    .000286    .000120    .002533    .000262    .000123
  50      .000633    .003240    .034166    .003520    .062352    .009595    .004308    .052130    .029269    .000294
  60      .005469    .000351    .030231    .044161    .054260    .005413    .028087    .117311    .039441    .110781
  70      .016656    .142733    .158858    .027732    .021630    .014414    .055543    .384746    .162881    .012413
  80      .000856    .202772    .011540    .223609    .012672    .002878    .000612    .003623    .055433    .002967
  90      .071355
```

SUMMARY OF
REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
FOR ALL SUN POSITIONS



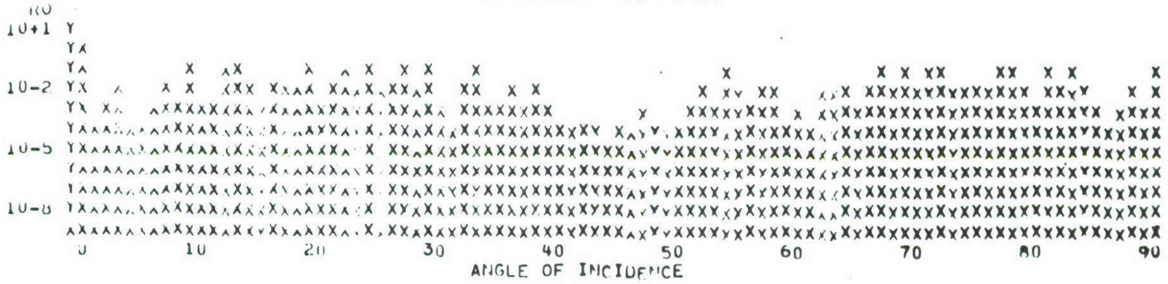
RVIS = 5 n. mi.

RT = Helicopter Detection Range

Figure 4-1. Case #1 Reflectivity Requirements

```
                         REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE         0         1         2         3         4         5         6         7         8         9
  0       ********   .000104   .002206   .053244   .000139   .000723   .003734   .097520   .004124   .150899
 10       .007876    .005173   .198241   .251100   .080283   .006922   .050631   .015712   .060490   .163654
 20       .009035    .067640   .324477   .339573   .501592   .010435   .045475   .430538   .042993   .124861
 30       .008083    .000271   .032279   .325846   .006111   .005171   .018213   .004918   .013801   .004493
 40       .000874    .000169   .000394   .000977   .000045   .000403   .000170   .003609   .000419   .000164
 50       .000842    .004275   .056708   .004567   .104539   .013603   .005309   .086356   .047903   .000471
 60       .006603    .000593   .048165   .069759   .085978   .007151   .047627   .194789   .066328   .189140
 70       .022446    .244643   .248736   .048324   .026248   .010754   .092915   .602964   .260581   .015278
 80       .001353    .326693   .014032   .309556   .015282   .003438   .000727   .005871   .075260   .004032
 90       .042491
```

SUMMARY OF
REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
FOR ALL SUN POSITIONS



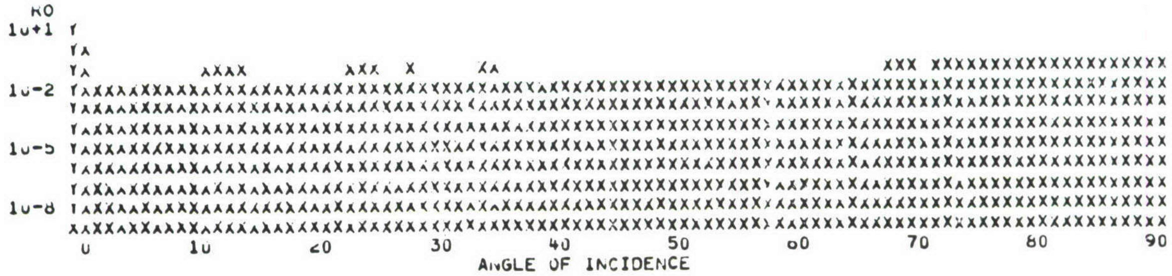
RVIS = 20 n. miles

RT = Helicopter Detection Range

Figure 4-2. Case #2 Reflectivity Requirements

```
                              REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0          1          2          3          4          5          6          7          8          9
   0     ********   .019297    .017359    .031047    .025236    .035949    .031275    .057016    .070168    .088270
  10     .104196    .114317    .109366    .147049    .054297    .042046    .033539    .031225    .036657    .099216
  20     .029076    .040333    .213959    .247891    .314085    .022846    .029442    .313381    .026464    .084756
  30     .025304    .021100    .021694    .109603    .123630    .036108    .024597    .028021    .023104    .024357
  40     .043655    .037743    .030162    .020765    .023118    .025932    .023043    .020674    .036708    .029796
  50     .057326    .032453    .043268    .072250    .062352    .078226    .060344    .052130    .029269    .032241
  60     .029738    .032729    .030233    .044161    .054265    .075137    .096976    .117321    .146261    .110781
  70     .097857    .142733    .158658    .111342    .140114    .128950    .131300    .384746    .162881    .213600
  80     .345074    .202772    .231393    .223609    .123129    .154087    .129183    .125708    .128318    .184402
  90     .671355
```

SUMMARY OF
REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
FOR ALL SUN POSITIONS



RVIS = 5 n. mi.

RT = Helicopter Detection Range

No Overhead Window

Figure 4-3. Case #3 Reflectivity Requirements

```
                      REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE          0         1         2         3         4         5         6         7         8         9
    0     ********   .000001   .000009   .000076   .000001   .000003   .000014   .000141   .000015   .000218
   10      .000029   .000019   .000261   .000365   .000175   .000026   .000094   .000058   .000099   .000268
   20      .000037   .000104   .000721   .000791   .000852   .000038   .000130   .001007   .000107   .000308
   30      .000030   .000001   .000106   .000482   .000023   .000036   .000031   .000019   .000024   .000017
   40      .000004   .000001   .000001   .000013   .000001   .000001   .000001   .000013   .000001   .000001
   50      .000004   .000021   .000091   .000025   .000154   .000050   .000033   .000139   .000081   .000001
   60      .000050   .000001   .000089   .000134   .000172   .000081   .000071   .000311   .000151   .000275
   70      .000102   .000351   .000666   .000101   .000208   .000101   .000145   .001190   .000476   .000099
   80      .000003   .000582   .000104   .001266   .000130   .000032   .000007   .000010   .000333   .000018
   90      .008913
```

```
                                            SUMMARY OF
                    REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
                                       FOR ALL SUN POSITIONS
 RO
10+1 Y
     YX
     YX
10-2 YX
     YX                          X                                                 X     X      X
     YX      X X  XXX    X XXXX XXXX  XX                   X  X     XX  XXXXXXXXXXXX  XXXX   X X
10-5 YX  X  XXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXX   X   X    XXXXXXXX X XXXXXXXXXXXXXXXXXX XXXXX  XXX
     YX XX XXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXX  X   X  XXXXXXXXX X XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-8 YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      0        10        20        30        40        50        60        70        80        90
                                       ANGLE OF INCIDENCE
```

RVIS = 5 n. mi.

RT = 1500 meters

Figure 4-4. Case #4 Reflectivity Requirements

```
                    REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE         0        1        2        3        4        5        6        7        8        9
    0    ******** .000000  .000006  .000047  .000000  .000002  .000008  .000088  .000009  .000136
   10     .000018 .000012  .000162  .000227  .000109  .000016  .000058  .000036  .000061  .000167
   20     .000023 .000065  .000448  .000492  .000530  .000024  .000081  .000627  .000066  .000191
   30     .000016 .000000  .000036  .000300  .000014  .000022  .000020  .000012  .000015  .000011
   40     .000002 .000000  .000000  .000008  .000000  .000001  .000000  .000008  .000001  .000001
   50     .000003 .000013  .000057  .000015  .000096  .000031  .000021  .000087  .000050  .000001
   60     .000031 .000001  .000036  .000083  .000107  .000051  .000044  .000194  .000094  .000171
   70     .000064 .000218  .000414  .000063  .000129  .000063  .000090  .000740  .000296  .000061
   80     .000002 .000362  .000065  .000787  .000081  .000020  .000005  .000006  .000207  .000011
   90     .005544
```

```
                                            SUMMARY OF
                    REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
                                      FOR ALL SUN POSITIONS
  RO
10+1 Y
     YX
     YX
10-2 YX
     YX                                                                                         X
     YX        X  XXX    X  XXX  X X   X                              X  X X XX X  XX  X X    X X
10-5 YX  X   X XXXXXXXXXXXXXXXXXXXXXX XXXXXXXX           XXXXXXXX X XXXXXXXXXXXXXXXXXX XXXXX  XXX
     YX XX XXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXX  X   X  XXXXXXXXX X XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     YX XX XXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXX  X X XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-8 YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      0        10        20        30        40        50        60        70        80        90
                                      ANGLE OF INCIDENCE
```

RVIS = 20 n. mi

RT = 1500 meters

Figure 4-5. Case #5 Reflectivity Requirements

```
                    REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE         0        1        2        3        4        5        6        7        8        9
    0     ********  .000047  .000042  .000076  .000062  .000088  .000077  .000141  .000173  .000218
   10      .000253  .000282  .000261  .000365  .000175  .000219  .000094  .000120  .000099  .000268
   20      .000124  .000104  .000721  .000791  .000852  .000107  .000130  .001007  .000107  .000308
   30      .000104  .000110  .000106  .000482  .000306  .000148  .000120  .000146  .000119  .000099
   40      .000117  .000102  .000082  .000058  .000059  .000065  .000061  .000062  .000114  .000093
   50      .000135  .000121  .000158  .000287  .000154  .000205  .000161  .000139  .000081  .000090
   60      .000084  .000095  .000069  .000134  .000172  .000271  .000236  .000311  .000574  .000275
   70      .000348  .000351  .000666  .000319  .000337  .000369  .000372  .001190  .000476  .000620
   80      .001592  .000582  .000663  .001266  .000776  .001045  .001046  .001010  .001319  .001926
   90      .008913


                                            SUMMARY OF
                    REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
                                       FOR ALL SUN POSITIONS
  RO
10+1 Y
     YX
     YX
10-2 YX
     YX                          X                                                 X  X  X XXXXXX
     YX      XXXXXXXXX X XXXXXXXXXXXXXXXXXXXX XX      X XXXXXXXX     XXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-5 YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-8 YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      0        10        20        30        40        50        60        70        80        90
                                       ANGLE OF INCIDENCE
```

RVIS = 5 n. mi.

RT = 1500 meters

No Overhead Windows

Figure 4-6. Case #6 Reflectivity Requirements

5. CONCLUSIONS

From the data obtained in exercising the model, we can obtain several conclusions about the nature of the window glint. These conclusions point the way to future work required in designing the window.

5.1 Effect of Visibility Range on Required Reflectivity

Figures 4-1 and 4-2 show the results of runs #1 and #2 with visibilities of 5 and 20 n. miles respectively and reflectivity requirements based on reducing detection range to that of the non-glint helicopter. This criteria produces more stringent reflectivity requirements for lower visibility ranges because the non-glint detection range is affected more by the reduced visibility than the glint detection range.

However, if the reflectivity requirement is based on reducing detection range to a fixed value, as done in runs #4 and #5 (figures 4-4 and 4-5), the more stringent reflectivity requirements occur at higher visibility ranges.

5.2 Effect of Detection Criteria on Required Reflectivity

A comparison of the results of runs #1 and #4 (figures 4-1 and 4-4) and of the results of runs #2 and #5 (figures 4-2 and 4-5), shows a marked difference in requirements based on the selection of either reducing detection range to the non-glint detection range of the helicopter or reducing detection range to a fixed range (1500 meters in runs #4 and #5) as the detection criteria. This result points out the importance of selecting the criteria to be used in evaluating window modifications or redesign early in any future work effort to guarantee the proper evaluation of proposed solutions.

5.3 Effect of Flat vs. Curved Windows

Early evaluation of the results of exercising the model showed the largest glints came from the large flat sections of the overhead and that as sun position relative to the helicopter changed, these glints caused very stringent reflectivity requirements over all angles of incidence. When the overhead and thus the flats were removed from the models, as in cases #3 and #6 (see results in figures 4-3 and 4-6), the more stringent reflectivity requirements were reduced by an order of magnitude.

This implies that any window redesign should attempt to eliminate flats and should probably attempt to achieve a minimum value for radius of curvature.

5.4 Use of Sunshades

The goal of using sunshades would be to block off certain sections of the windows which caused the largest glints or to limit the angles of incidence over certain portions of the window to ease the reflectivity requirements. It appears that sunshades would be sucessful in achieving this goal, but that they alone would not solve the complete problem of reducing sun glints because of the large glints remaining over low angles of incidence. A more detailed investigation of the effects of sunshades on both reduction of glint and reduction of pilot visibility should be made before a final recommendation is made.

APPENDIX A

LISTING OF
DIGITAL COMPUTER PROGRAM
FOR
COBRA WINDOW MODEL

Segment 1 - Normals and Effective Areas

Segment 2 - Area Contours

Segment 3 - Brightness Factors, Detection Ranges and Required Reflectivities

```
MI FOR COBWIN
COMPILATION BY UNIVAC 1107 FORTRAN-IV DATLD      JUNE 22,1965 FA008
THIS COMPILATION WAS DONE ON 05 DEC 72 AT 14:21:24

   MAIN PROGRAM            ENTRY POINT 000000

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001    *CODE    001327
         0000    *DATA    054531
         0002    *BLANK   000000



   EXTERNAL REFERENCES (BLOCK, NAME)

         0003    COS
         0004    SIN
         0005    SQRT
         0006    ATAN2
         0007    NRDU$
         0010    NI01$
         0011    NI02$
         0012    NWDU$
         0013    NSTOP$



   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0000     054453 102F          0000     054470 103F           0000     054472 105F
   0001     000070 143G          0001     000074 147G           0000     054451 2F
   0001     000232 224G          0001     000174 23L            0001     000362 202G
   0001     000136 3L            0001     000523 330G           0001     000531 347G
   0001     000475 42L           0001     000506 45L            0001     000602 46L
   0000 R   054354 ANGLE         0000 R   054450 ANOR           0000 R   054413 AN12
   0000 R   054427 AN41          0000 R   054436 AR12           0000 R   054441 AR23
   0006 R   000000 ATAN2         0000 R   054435 A12            0000 R   054440 A23
   0003 R   000000 COS           0000 R   054373 DEL            0000 R   054402 DELTEM
   0000 R   054401 DELZ          0000 R   054434 D12            0000 R   054437 D23
   0000 I   054355 I             0000 I   054345 ICRD           0000 I   054370 II
   0000 I   054375 IIX           0000 I   054405 INUM           0000 I   054344 IOUT
```

```
0000 I 054371 IXI         0000 I 054406 IXMIN       0000 I 054376 IXPL
0000 I 054356 M           0000 I 054365 MM          0000 I 054407 MXY
0000 I 054374 NOIXP       0000 I 054362 NUMX        0000 I 054305 NUMXY
0005 R 000000 SQRT        0000 R 054351 SX          0000 R 054352 SY
0000 R 004216 X           0000 R 054364 XA          0000 R 010420 XL
0000 R 017655 XT1         0000 R 026763 XT2         0000 R 036071 XT3
0000 R 054410 X12         0000 R 054414 X23         0000 R 054420 X34
0000 R 012757 YL          0000 R 054432 YNORM       0000 R 022157 YT1
0000 R 047501 YT4         0000 R 001332 YY          0000 R 054411 Y12
0000 R 054425 Y41         0000 R 007072 Z           0000 R 015316 ZL
0000 R 054346 ZPOS        0000 R 024461 ZT1         0000 R 033567 ZT2
0000 R 002664 ZZ          0000 R 054412 Z12         0000 R 054416 Z23
```

```
C       COBRA WINDOW
        DIMENSION XX(730),YY(730),ZZ(730),X(726),Y(726),Z(726)
        DIMENSION XL(29,43),YL(29,43), ZL(29,43)
        DIMENSION XT1(29,42),YT1(29,42),ZT1(29,42)
        DIMENSION XT2(29,42),YT2(29,42),ZT2(29,42)
        DIMENSION XT3(29,42),YT3(29,42),ZT3(29,42)
        DIMENSION XT4(29,42),YT4(29,42),ZT4(29,42)
        DIMENSION NUMXY(30)
        IIN=5
        IOUT=6
        ICRD=7
        ZPOS=12.*200.
        SZEN=.017453*45.
        SAZ=.017453*135.
        SX=-COS(SAZ)*SIN(SZEN)
        SY=-SIN(SAZ)*SIN(SZEN)
        SZ=-COS(SZEN)
        ANGLE=.125*.017453
        READ(IIN,2)(XX(I),YY(I),ZZ(I),I=1,726)
      2 FORMAT(9F8.3)
        DO 1 I=1,726
        XX(I)=-XX(I)
      1 CONTINUE
        DO 10 M=2,727
        X0=900.
        DO 3 I=1,726
        IF(XX(I)-X0)4,5,3
```

```
    4 X(M)=XX(I)
      Z(M)=ZZ(I)
      Y(M)=YY(I)
      XO=XX(I)
      ZO=ZZ(I)
      K=I
      GO TO 3
    5 IF(ZZ(I)-ZO)6,3,3
    6 X(M)=XX(I)
      Z(M)=ZZ(I)
      Y(M)=YY(I)
      ZO=ZZ(I)
      K=I
    3 CONTINUE
      XX(K)=1000.
   10 CONTINUE
      NUMX=28
      M=2
      DO 30 IX=2,NUMX
   20 XA=X(M)
      MM=M
      N=1
      L=1
   23 M=M+1
      IF(X(M)-XA)21,22,21
   22 N=N+1
      GO TO 23
   21 XL(IX,1)=X(L)
      YL(IX,1)=Y(L)
      ZL(IX,1)=Z(L)-.001
      N=N+1
      DO 24 I=2,N
      XL(IX,I)=X(L)
      YL(IX,I)=Y(L)
      ZL(IX,I)=Z(L)
      II=I-1
      XT1(IX,I)=XL(IX,II)-XL(IX,I)
      YT1(IX,I)=YL(IX,II)-YL(IX,I)
      ZT1(IX,I)=ZL(IX,II)-ZL(IX,I)
      XT3(IX,II)=-XT1(IX,I)
      YT3(IX,II)=-YT1(IX,I)
      ZT3(IX,II)=-ZT1(IX,I)
      L=L+1
```

```
 24 CONTINUE
    NUMXY(IX)=N
    XT3(IX,N)=0.
    YT3(IX,N)=-.001
    ZT3(IX,N)=0.
 30 CONTINUE
    NUMXY(1)=2
    NUMXY(NUMX+1)=2
    XL(1,2)=-169.501
    XL(29,2)=-53.499
    YL(1,2)=YL(2,2)
    YL(29,2)=YL(28,2)
    ZL(1,2)=ZL(2,2)
    ZL(29,2)=ZL(28,2)
    DO 40 IX=2,NUMX
    IXI=NUMXY(IX)
    DO 41 I=2,IXI
    III=IX-1
    DEL=1.5*(XL(IX,2)-XL(III,2))
    NOIXP=0
    IIX=NUMXY(IX-1)
    DO 42 IXPL=2,IIX
    DELX=XL(III,IXPL)-XL(IX,I)
    DELY=YL(III,IXPL)-YL(IX,I)
    DELZ=ZL(III,IXPL)-ZL(IX,I)
    DELTEM=SQRT(DELX*DELX+DELY*DELY+DELZ*DELZ)
    IF(DEL -  DELTEM)42,42,43
 43 DEL=DELTEM
    XT2(IX,I)=DELX
    YT2(IX,I)=DELY
    ZT2(IX,I)=DELZ
    NOIXP=IXPL
 42 CONTINUE
    IF(NOIXP)44,44,45
 44 ZT2(IX,I)=0.
    YT2(IX,I)=0.
    XT2(IX,I)=.001
 45 NOIXM=0
    IPLUS=IX+1
    DEL=1.5*(XL(IPLUS,2)-XL(IX,2))
    INUM=NUMXY(IX+1)
    DO 40 IXMIN=2,INUM
    DELX=XL(IPLUS,IXMIN)-XL(IX,I)
```

```
      DELY=YL(IPLUS,IXMIN)-YL(IX,I)
      DELZ=ZL(IPLUS,IXMIN)-ZL(IX,I)
      DELTEM=SQRT(DELX*DELX+DELY*DELY+DELZ*DELZ)
      IF(DEL-DELTEM)46,46,47
   47 DEL=DELTEM
      XT4(IX,I)=DELX
      YT4(IX,I)=DELY
      ZT4(IX,I)=DELZ
      NOIXM=IXMIN
   46 CONTINUE
      IF(NOIXM)48,48,41
   48 XT4(IX,I)=-.001
      YT4(IX,I)=0.
      ZT4(IX,I)=0.
   41 CONTINUE
   40 CONTINUE
      WRITE(IOUT,102)
  102 FORMAT(5X,1HX,9X,1HY,9X,1HZ,5X,8HX NORMAL,2X,8HY NORMAL,
     22X,8HZ NORMAL,6X,4HAREA)
      L=2
      DO 50 IX=2,NUMX
      NXY=NUMXY(IX)
      DO 60 I=2,NXY
      X12=YT1(IX,I)*ZT2(IX,I)-YT2(IX,I)*ZT1(IX,I)
      Y12=XT1(IX,I)*ZT2(IX,I)-XT2(IX,I)*ZT1(IX,I)
      Y12=-Y12
      Z12=XT1(IX,I)*YT2(IX,I)-XT2(IX,I)*YT1(IX,I)
      AN12=SQRT(X12*X12+Y12*Y12+Z12*Z12)
      X23=YT2(IX,I)*ZT3(IX,I)-YT3(IX,I)*ZT2(IX,I)
      Y23=XT2(IX,I)*ZT3(IX,I)-XT3(IX,I)*ZT2(IX,I)
      Y23=-Y23
      Z23=XT3(IX,I)*YT3(IX,I)-XT3(IX,I)*YT2(IX,I)
      AN23=SQRT(X23*X23+Y23*Y23+Z23*Z23)
      X34=YT3(IX,I)*ZT4(IX,I)-YT4(IX,I)*ZT3(IX,I)
      Y34=XT3(IX,I)*ZT4(IX,I)-XT4(IX,I)*ZT3(IX,I)
      Y34=-Y34
      Z34=XT3(IX,I)*YT4(IX,I)-XT4(IX,I)*YT3(IX,I)
      AN34=SQRT(X34*X34+Y34*Y34+Z34*Z34)
      X41=YT4(IX,I)*ZT1(IX,I)-YT1(IX,I)*ZT4(IX,I)
      Y41=XT4(IX,I)*ZT1(IX,I)-XT1(IX,I)*ZT4(IX,I)
      Y41=-Y41
      Z41=XT4(IX,I)*YT1(IX,I)-XT1(IX,I)*YT4(IX,I)
      AN41=SQRT(X41*X41+Y41*Y41+Z41*Z41)
```

```
      AN=(AN12+AN23+AN34+AN41)/4.
      XNORM=(X12+X23+X34+X41)/(4.*AN)
      YNORM=(Y12+Y23+Y34+Y41)/(4.*AN)
      ZNORM=(Z12+Z23+Z34+Z41)/(4.*AN)
      D12=(X12*XNORM+Y12*YNORM+Z12*ZNORM)/(AN12)
      A12=ATAN2(SQRT(1.00-D12*D12),D12)
      AR12=AN12*ANGLE/A12
      D23=(X23*XNORM+Y23*YNORM+Z23*ZNORM)/(AN23)
      A23=ATAN2(SQRT(1.00-D23*D23),D23)
      AR23=AN23*ANGLE/A23
      D34=(X34*XNORM+Y34*YNORM+Z34*ZNORM)/(AN34)
      A34=ATAN2(SQRT(1.00-D34*D34),D34)
      AR34=AN34*ANGLE/A34
      D41=(X41*XNORM+Y41*YNORM+Z41*ZNORM)/(AN41)
      A41=ATAN2(SQRT(1.00-D41*D41),D41)
      AR41=AN41*ANGLE/A41
      ANOR=AR12+AR23+AR34+AR41
      WRITE(IOUT,103)X(L),Y(L),Z(L),XNORM,YNORM,ZNORM,ANOR
  103 FORMAT(2X,7F10.5)
      WRITE(ICRD,105)X(L),Y(L),Z(L),XNORM,YNORM,ZNORM,ANOR
  105 FORMAT(5X,1H1,3(F8.3,1H,),3(F7.5,1H,),F10.5,1H,)
      L=L+1
   60 CONTINUE
   50 CONTINUE
      STOP
      END

END OF LISTING.      0 *DIAGNOSTIC* MESSAGE(S).
```

```
@I FOR COBNOR
COMPILATION BY UNIVAC 1107 FORTRAN-IV DATED      JUNE 22,1965 F4008
THIS COMPILATION WAS DONE ON 06 DEC 72 AT 10:26:37


   MAIN PROGRAM           ENTRY POINT 000000

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001    *CODE    000447
         0000    *DATA    000373
         0002    *BLANK   000000



   EXTERNAL REFERENCES (BLOCK, NAME)

         0003    SQRT
         0004    ATAN2
         0005    NRDU$
         0006    N101$
         0007    N102$
         0010    NWDU$
         0011    NSTOP$



   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0000     000323 102F          0000    000325 112F          0000    000336 113F
    0001     000036 125G          0001    000056 141G          0001    000073 153G
    0001     000356 400L          0001    000360 420L          0001    000363 421L
    0000 R 000322 ANOR            0000 R 000304 AN12           0000 R 000310 AN23
    0004 R 000000 ATAN2           0000 R 000315 A12            0000 R 000320 A23
    0000 I 000265 I               0000 I 000261 ICRD           0000 I 000257 II
    0000 R 000255 SAZ             0003 R 000000 SQRT           0000 R 000264 SZEN
    0000 R 000275 XT1             0000 R 000267 XT2            0000 R 000276 XT3
    0000 R 000305 X23             0000 R 000144 YN             0000 R 000312 YNORM
    0000 R 000272 YT3             0000 R 000031 YY             0000 R 000302 Y12
    0000 R 000313 ZNORM           0000 R 000263 ZPOS           0000 R 000277 ZT1
    0000 R 000002 Z2              0000 R 000303 Z12            0000 R 000307 Z23
```

```
C     COBRA WINDOW-CENTER
      DIMENSION XX(25),YY(25),ZZ(25),XN(25),YN(25),ZN(25),AN(25)
      IIN=5
      IOUT=6
      ICRD=7
      ANGLE=.125*.017453
      ZPOS=12.*200.
      SZEN=.017453*45.
      SZEN=0.
      SAZ=.017453*135.
      READ(IIN,102)(XX(I),YY(I),ZZ(I),I=2,13)
  102 FORMAT(9F8.3)
      DO 101 I=2,13
      XX(I)=-XX(I)
  101 CONTINUE
      XX(1)=-55.5
      XX(14)=-142.05
      YY(1)=YY(2)
      YY(14)=YY(13)
      ZZ(1)=70.
      ZZ(14)=103.9135
      DO 103 I=1,14
  103 CONTINUE
      WRITE(IOUT,112)
  112 FORMAT(11X,1HX,9X,1HY,9X,1HZ,8X,2HXN,8X,2HYN,8X,2HZN,9X,1HA)
      XT2=0.
      YT1=0.
      YT2=10.
      YT3=0.
      ZT2=0.
      DO 1 IX=2,13
      XT1=XX(IX-1)-XX(IX)
      XT3=XX(IX+1)-XX(IX)
      ZT1=ZZ(IX-1)-ZZ(IX)
      ZT3=ZZ(IX+1)-ZZ(IX)
      X12=YT1*ZT2-YT2*ZT1
      Y12=XT1*ZT2-XT2*ZT1
      Y12=-Y12
      Z12=XT1*YT2-XT2*YT1
      AN12=SQRT(X12*X12+Y12*Y12+Z12*Z12)
  131 X23=YT2*ZT3-YT3*ZT2
```

```
          Y23=XT2*ZT3-XT3*ZT2
          Y23=-Y23
          Z23=XT2*YT3-XT3*YT2
          AN23=SQRT(X23*X23+Y23*Y23+Z23*Z23)
          AN(IX)=(AN12+AN23)/2.
          XN(IX)=(X12+X23)/(2.*AN(IX))
          YN(IX)=(Y12+Y23)/(2.*AN(IX))
          ZN(IX)=(Z12+Z23)/(2.*AN(IX))
          XNORM=XN(IX)
          YNORM=YN(IX)
          ZNORM=ZN(IX)
          IF(IX.EQ.2) GO TO 421
          IF(IX.EQ.13)GO TO 421
          D12=(X12*XNORM+Y12*YNORM+Z12*ZNORM)/AN12
          IF(D12)300,300,310
      310 A12=ATAN2(SQRT(1-D12*D12),D12)
          AR12=AN12*ANGLE/A12
          GO TO 320
      300 AR12=AN12
      320 D23=(X23*XNORM+Y23*YNORM+Z23*ZNORM)/AN23
          IF(D23)400,400,410
      410 A23=ATAN2(SQRT(1-D23*D23),D23)
          AR23=AN23*ANGLE/A23
          GO TO 420
      400 AR23=AN23
      420 CONTINUE
          ANOR=AR12+AR23
      421 IF(IX.EQ.2) ANOR=AN12+AN23
          IF(IX.EQ.13)ANOR=AN12+AN23
          WRITE(IOUT,113)XX(IX),YY(IX),ZZ(IX),XNORM,YNORM,ZNORM,ANOR
      113 FORMAT(2X,7F10.5)
          WRITE(ICRD,115)XX(IX),YY(IX),ZZ(IX),XNORM,YNORM,ZNORM,ANOR
      115 FORMAT(5X,1H1,3(F10.5,1H,),3(F6.5,1H,),F10.5,1H,)
        1 CONTINUE
          STOP
          END

END OF LISTING.       0 *DIAGNOSTIC* MESSAGE(S).
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```
@I FOR COBWIN
COMPILATION BY UNIVAC 1108 FORTRAN-IV DATED      JUNE 22,1965 F4008
THIS COMPILATION WAS DONE ON 04 DEC 72 AT 21:24:26


     MAIN PROGRAM            ENTRY POINT 000000

     STORAGE USED (BLOCK, NAME, LENGTH)

          0001    *CODE    000552
          0000    *DATA    011046
          0002    *BLANK   000000
          0003    BLK1     012056
          0004    BLK2     016230



     EXTERNAL REFERENCES (BLOCK, NAME)

          0005    ATAN2
          0006    SQRT
          0007    PLOTT
          0010    NRDU$
          0011    NIO1$
          0012    NIO2$
          0013    NWDU$
          0014    NSTOP$



     STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

      0000    010723 1F          0000    010710 105F         0000    010755 11F
      0001    000074 147G        0001    000146 171G         0001    000340 2L
      0000    010732 241F        0000    010745 243F         0000    010736 250F
      0000    010716 3F          0001    000457 305G         0000    010752 341F
      0000    011001 39F         0000    010737 4F           0001    000327 46L
      0000    010762 9F          0000 R  010706 ALPHA        0003 R  010514 AN
      0000 R  010707 BETA        0000 R  010662 BH           0000 R  010660 BS
      0004 I  002070 IBETA       0000 I  010656 IIN          0000 I  010657 IOUT
      0000 I  010702 JJ          0000 I  010674 JJD          0000 I  010703 JJJ
      0000 I  010705 N           0000 I  010676 NN           0000 I  010654 NNOR
      0000 I  010677 NUM         0000 R  010664 RA           0000 R  010653 RADIAN
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0000 R 010667 RD          0000 R 010670 RE          0000 R 010671 RF
0000 R 010661 ROL         0000 R 010520 ROGL        0004   005560 RT
0003 R 010450 SZE         0003 R 000000 X           0003 R 004246 XN
0003 R 005610 YN          0000 R 002670 YR          0003 R 002704 Z
```

```
C     COBRA WINDOW
      DIMENSION XR(1464),YR(1464),ZR(1464)
      DIMENSION SZE(20),SAZI(20),ROGL(91)
      COMMON/BLK1/X(738),Y(738),Z(738),XN(738),YN(738),ZN(738),AN(738)
      COMMON/BLK2/IALPH(1464),IBETA(1464),RT(1464),RG(1464),B(1464)
      RADIAN=57.29578
      NNOR=738
      NNORT=1464
      ROGL(1)=0.
      IIN=5
      IOUT=6
      SS=2000.
      ROL=.15
      SM=.0009
      EYL=.15
      READ(IIN,105)RA,RB,RC,RD,RE,RF,RGG
  105 FORMAT(F6.3,6E12.7)
      READ(IIN,49)JD
   49 FORMAT(I3)
      READ(IIN,48)(SZE(JJD),SAZI(JJD),JJD=1,JD)
   48 FORMAT(2F8.2)
      DO 230 NOR=1,NNORT
      NN=NOR
      IF(NOR.GT.738)NN=NOR-738
      XR(NOR)=X(NN)
      YR(NOR)=Y(NN)
      ZR(NOR)=Z(NN)
      IF(NOR.GT.738)YR(NOR)=-YR(NOR)
  230 CONTINUE
      NUM=INT(NNORT/4)
      WRITE(IOUT,3)
    3 FORMAT(54X,21HSURFACE X,Y,Z LISTING)
      J=0
      DO 240 L=1,NUM
      J=J+1
```

```
      IF(J.EQ.1)WRITE(IOUT,1)
    1 FORMAT(2X,4(31H NUM      X       Y       Z    ))
      JJ=L*4-3
      JJJ=JJ+3
      WRITE(IOUT,241)(LL,XR(LL),YR(LL),ZR(LL),LL=JJ,JJJ)
  241 FORMAT(2X,4(I4,F9.3,2F8.3,2X))
      IF(J.EQ.40)WRITE(IOUT,250)
      IF(J.EQ.40)J=0
  250 FORMAT(1H1)
  240 CONTINUE
      WRITE(IOUT,250)
      DO 2 N=1,NNOR
      AN(N)=AN(N)*1000.
      ALPHA=ATAN2(SQRT(1-ZN(N)*ZN(N)),ZN(N))
      ALPHA=ALPHA*RADIAN
      IALPH(N)=3*INT(ALPHA/3.+.5)
      BETA=ATAN2(YN(N),XN(N))
      BETA=BETA*RADIAN
      IF(BETA)47,46,46
   47 IBETA(N)=3*INT(BETA/3-.5)
      GO TO 2
   46 IBETA(N)=3*INT(BETA/3.+.5)
    2 CONTINUE
      DO 242 N=1,NNORT
      NN=N
      IF(N.GT.738)NN=N-738
      IALPH(N)=IALPH(NN)
      IBETA(N)=IBETA(NN)
      IF(N.GT.738)IBETA(N)=-IBETA(N)
      B(N)=AN(NN)
  242 CONTINUE
      NUM=INT(NNORT/6)
      WRITE(IOUT,4)
    4 FORMAT(52X,25HNORMAL ALPHA,BETA LISTING)
      J=0
      DO 350 L=1,NUM
      J=J+1
      IF(J.EQ.1)WRITE(IOUT,243)
  243 FORMAT(6(19H  NUM ALPHA  BETA  ))
      JJ=L*6-5
      JJJ=JJ+5
      WRITE(IOUT,341)(LL,IALPH(LL),IBETA(LL),LL=JJ,JJJ)
  341 FORMAT(6(I5,2I6,2X))
```

```
      IF(J.EQ.40)WRITE(IOUT,250)
      IF(J.EQ.40)J=0
  350 CONTINUE
      WRITE(IOUT,250)
      WRITE(IOUT,11)
   11 FORMAT(55X,17HAREA CONTOUR PLOT)
      WRITE(IOUT,9)
    9 FORMAT(39X,50HSCALE FACTOR: VALUE=10X LOG BASE 10 OF 1000X AREA )
      WRITE(IOUT,12)
   12 FORMAT(5H BETA)
      J=1
      CALL PLOTT(NNORT,J)
      WRITE(IOUT,38)
   38 FORMAT(5X,41(3HXXX))
      WRITE(IOUT,39)
   39 FORMAT(7X,1H0,8X,2H15,8X,2H30,8X,2H45,8X,2H60,8X,2H75,8X,2H90,
     27X,3H105,7X,3H120,7X,3H135,7X,3H150,7X,3H165,7X,3H180)
      WRITE(IOUT,37)
   37 FORMAT(65X,5HALPHA)
      STOP
      END

END OF LISTING.       0 *DIAGNOSTIC* MESSAGE(S).
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MI FOR NORMAL
COMPILATION BY UNIVAC 1108 FORTRAN-IV DATED      JUNE 22,1965 F4008
THIS COMPILATION WAS DONE ON 04 DEC 72 AT 21:24:28


     BLOCK DATA

     STORAGE USED (BLOCK, NAME, LENGTH)

           0003   BLK1    012056


     STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

      0003 R 010514 AN          0000 I 000000 N           0003 R 000000 X
      0003 R 005610 YN          0003 R 002704 Z           0003 R 007152 ZN



   1.          BLOCK DATA
   2.          COMMON/BLK1/X(738),Y(738),Z(738),XN(738),YN(738),ZN(738),AN(738)
   3.          DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=1,18)/
   4.         1-169.500,  14.350,  98.300,-.03122, .92731, .37267,     .25151,
   5.         1-169.500,  14.040,  99.070,-.01722, .91356, .40315,     .14960,
   6.         1-169.500,  13.600, 100.000,-.01154, .90216, .42780,     .08933,
   7.         1-167.330,  16.430,  90.080,-.06907, .98876, .12973,     .42359,
   8.         1-167.330,  16.300,  91.070,-.07164, .98642, .14449,     .67862,
   9.         1-167.330,  16.140,  92.060,-.06732, .98186, .17446,     .66528,
  10.         1-167.330,  15.950,  93.040,-.06792, .97713, .19943,     .76526,
  11.         1-167.330,  15.740,  94.020,-.06170, .97232, .22326,     .68875,
  12.         1-167.330,  15.500,  95.000,-.05352, .96559, .25256,     .67155,
  13.         1-167.330,  15.230,  95.970,-.04041, .95879, .27967,     .72331,
  14.         1-167.330,  14.940,  96.920,-.03823, .95584, .26886,     .24134,
  15.         1-167.330,  14.600,  97.860,-.02630, .94080, .31246,     .21456,
  16.         1-167.330,  14.200,  98.800,-.01370, .92415, .35439,     .19572,
  17.         1-167.330,  13.770,  99.700, .00097, .90361, .39736,     .17042,
  18.         1-167.330,  13.280, 100.570, .00510, .87661, .45325,     .14879,
  19.         1-167.330,  12.900, 101.170, .00323, .87015, .45960,     .10491,
  20.         1-167.330,  12.580, 101.720, .01873, .86289, .50316,     .23592,
  21.         1-162.00000,  17.04000,  85.61000,-.10684, .99425, .00000,2.27102/
  22.          DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=19,36)/
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     1-162.000,   17.040,   86.620,-.09867, .99502, .00479,    2.54481,
     1-162.000,   17.020,   87.620,-.08650, .99570, .02417,    1.50846,
     1-162.000,   16.960,   88.640,-.07538, .99509, .05340,    1.00382,
     1-162.000,   16.860,   89.640,-.06973, .99364, .07613,     .77616,
     1-162.000,   16.750,   90.640,-.06475, .99143, .09532,     .57549,
     1-162.000,   16.560,   91.640,-.06074, .98729, .12630,     .47128,
     1-162.000,   16.400,   92.650,-.05560, .98398, .14476,     .40025,
     1-162.000,   16.170,   93.620,-.04925, .97640, .18060,     .32252,
     1-162.000,   15.900,   94.600,-.04089, .97046, .20528,     .29047,
     1-162.000,   15.610,   95.560,-.03472, .96532, .22357,     .26375,
     1-162.000,   15.300,   96.500,-.03061, .95723, .24788,     .23368,
     1-162.000,   14.940,   97.430,-.02311, .94471, .28271,     .20837,
     1-162.000,   14.540,   98.350,-.01485, .92880, .32023,     .18528,
     1-162.000,   14.070,   99.250,-.00799, .90251, .37469,     .16180,
     1-162.000,   13.540,  100.100, .00034, .88090, .41250,     .14631,
     1-162.000,   13.000,  100.940, .01016, .86876, .43207,     .14030,
     1-162.000,   12.410,  101.760, .02406, .83593, .48117,     .12891,
     1-162.00000,  11.75000, 102.52000, .02131, .79374, .53567,.11704/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=37,54)/
     1-162.000,   11.050,  103.240, .01205, .75030, .58646,     .10856,
     1-162.000,   10.300,  103.880,-.00821, .69370, .64113,     .09859,
     1-162.000,    9.520,  104.460,-.03712, .62681, .69943,     .08918,
     1-162.000,    8.780,  104.900,-.07254, .55806, .73371,     .07367,
     1-162.000,    8.000,  105.310,-.07087, .45988, .87545,     .10990,
     1-157.000,   17.400,   81.490,-.12088, .99100,-.03850,     .35414,
     1-157.000,   17.480,   82.490,-.11165, .99153,-.05412,     .82110,
     1-157.000,   17.540,   83.490,-.10039, .99386,-.03465,     .97902,
     1-157.000,   17.560,   84.490,-.09005, .99569,-.00509,    1.44547,
     1-157.000,   17.540,   85.500,-.08576, .99583, .02195,    1.42026,
     1-157.000,   17.490,   86.500,-.07943, .99573, .03961,    1.26952,
     1-157.000,   17.430,   87.490,-.07107, .99550, .05243,     .94292,
     1-157.000,   17.340,   88.470,-.06451, .99403, .07485,     .70092,
     1-157.000,   17.220,   89.460,-.05694, .99164, .09856,     .54041,
     1-157.000,   17.060,   90.460,-.04908, .98862, .12234,     .45751,
     1-157.000,   16.880,   91.460,-.04309, .98500, .14347,     .38476,
     1-157.000,   16.660,   92.430,-.03468, .97975, .17003,     .32530,
     1-157.00000,  16.42000,  93.40000,-.02926, .97356, .19463,.28177/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=55,72)/
     1-157.000,   16.120,   94.360,-.02341, .96449, .22759,     .24703,
     1-157.000,   15.810,   95.310,-.01707, .95926, .24370,     .22890,
     1-157.000,   15.460,   96.250,-.00926, .94997, .27062,     .20773,
     1-157.000,   15.090,   97.170,-.00435, .93916, .29716,     .18719,
     1-157.000,   14.660,   98.080, .00136, .92201, .33667,     .16866,
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     1-157.000,  14.200,   98.960, .00750, .90577, .36851,     .15282,
     1-157.000,  13.690,   99.820, .00911, .88360, .40886,     .13947,
     1-157.000,  13.140,  100.640, .01558, .85433, .45461,     .12524,
     1-157.000,  12.520,  101.420, .02177, .82333, .49781,     .11613,
     1-157.000,  11.680,  102.180, .02801, .79453, .53762,     .10893,
     1-157.000,  11.220,  102.840, .03494, .75026, .58236,     .09650,
     1-157.000,  10.470,  103.500, .04207, .69789, .63858,     .09685,
     1-157.000,   9.660,  104.090, .05265, .62137, .71050,     .09173,
     1-157.000,   8.880,  104.540, .06040, .54584, .75777,     .08104,
     1-157.000,   8.000,  104.960, .06391, .42962, .90065,    1.60435,
     1-152.270,  17.670,   77.520,-.08827, .99391,-.03523,     .23796,
     1-152.270,  17.750,   78.520,-.08707, .99388,-.05052,     .58721,
     1-152.27000,  17.80000,  79.53000,-.08936, .99479,-.03811,.88286/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=73,90)/
     1-152.270,  17.860,   80.520,-.08949, .99471,-.03886,     .83140,
     1-152.270,  17.900,   81.520,-.08909, .99542,-.02420,    1.08343,
     1-152.270,  17.920,   82.530,-.08015, .99655,-.01424,    1.62808,
     1-152.270,  17.940,   83.540,-.07273, .99713,-.00549,    1.33112,
     1-152.270,  17.920,   84.550,-.06566, .99750, .01873,    1.48568,
     1-152.270,  17.880,   85.550,-.06282, .99717, .03321,    1.13895,
     1-152.270,  17.820,   86.550,-.06033, .99612, .05197,     .75761,
     1-152.270,  17.720,   87.550,-.05207, .99455, .07582,     .57655,
     1-152.270,  17.600,   88.560,-.04658, .99219, .09645,     .45067,
     1-152.270,  17.430,   89.560,-.03975, .98838, .12471,     .36580,
     1-152.270,  17.250,   90.540,-.03564, .98564, .13959,     .31975,
     1-152.270,  17.030,   91.520,-.02994, .98038, .16550,     .27505,
     1-152.270,  16.780,   92.500,-.02556, .97537, .18686,     .24554,
     1-152.270,  16.310,   93.450,-.02001, .96944, .20792,     .21595,
     1-152.270,  16.200,   94.400,-.01612, .96134, .23436,     .19428,
     1-152.270,  15.860,   95.340,-.01772, .95300, .25779,     .17702,
     1-152.270,  15.480,   96.280,-.00971, .94411, .28226,     .16419,
     1-152.27000,  15.09000,  97.19000,-.00234, .93585, .30089,.15092/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=91,108)/
     1-152.270,  14.650,   98.100, .00372, .91718, .34136,     .13607,
     1-152.270,  14.140,   98.980, .00819, .89431, .36516,     .12211,
     1-152.270,  13.610,   99.830, .01451, .87810, .41134,     .11341,
     1-152.270,  13.020,  100.670, .01988, .85252, .45195,     .10645,
     1-152.270,  12.390,  101.470, .02249, .81794, .50041,     .09673,
     1-152.270,  11.700,  102.200, .02915, .77439, .55146,     .08780,
     1-152.270,  10.960,  102.900, .03578, .72305, .61712,     .08246,
     1-152.270,  10.300,  103.410, .04726, .66779, .65051,     .06578,
     1-152.270,   9.460,  103.960, .05917, .59215, .73420,     .07412,
     1-152.270,   8.810,  104.320, .06903, .50899, .77833,     .05624,
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109.        1-152.270,    8.000, 104.620, .06609, .34636, .93569,    1.29560,
110.        1-148.500,   17.700,  76.800,-.04355, .99186,-.09039,     .17533,
111.        1-148.500,   17.860,  77.800,-.04204, .99105,-.11091,     .49218,
112.        1-148.500,   17.970,  78.790,-.04654, .99444,-.08346,     .68863,
113.        1-148.500,   18.070,  79.790,-.05205, .99560,-.06648,     .72351,
114.        1-148.500,   18.130,  80.800,-.05301, .99740,-.04109,    1.10968,
115.        1-148.500,   18.170,  81.800,-.05397, .99805,-.01980,    1.12040,
116.        1-148.50000,   18.17000,   82.81000,-.05253, .99853, .00283,2.10544/
117.         DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=109,126)/
118.        1-148.500,   18.160,  83.810,-.04674, .99838, .01922,    1.27816,
119.        1-148.500,   18.110,  84.810,-.04586, .99795, .03917,    1.38651,
120.        1-148.500,   18.060,  85.810,-.04280, .99752, .04769,    1.02917,
121.        1-148.500,   17.980,  86.810,-.03804, .99487, .07950,     .60800,
122.        1-148.500,   17.840,  87.810,-.03542, .99136, .11179,     .52241,
123.        1-148.500,   17.690,  88.810,-.03109, .98894, .12773,     .44838,
124.        1-148.500,   17.500,  89.810,-.03025, .98491, .15123,     .39124,
125.        1-148.500,   17.300,  90.790,-.02710, .98157, .16754,     .34399,
126.        1-148.500,   17.070,  91.750,-.02294, .97568, .19321,     .29627,
127.        1-148.500,   16.810,  92.700,-.02061, .96938, .21650,     .26610,
128.        1-148.500,   16.510,  93.680,-.01531, .96063, .24680,     .24011,
129.        1-148.500,   16.180,  94.600,-.01462, .95667, .25770,     .22035,
130.        1-148.500,   15.880,  95.540,-.01086, .94944, .27536,     .19914,
131.        1-148.500,   15.460,  96.460,-.00558, .92475, .33900,     .17616,
132.        1-148.500,   15.020,  97.370,-.00064, .91249, .36467,     .16415,
133.        1-148.500,   14.530,  98.260, .00701, .89569, .39734,     .15247,
134.        1-148.500,   14.020,  99.130, .01027, .87730, .43007,     .14012,
135.        1-148.50000,   13.47000,   99.94000, .01704, .85010, .47111,.12631/
136.         DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=127,144)/
137.        1-148.500,   12.860, 100.750, .02514, .82129, .51267,     .12120,
138.        1-148.500,   12.200, 101.520, .02927, .78530, .55893,     .11269,
139.        1-148.500,   11.510, 102.230, .03647, .73973, .60824,     .10389,
140.        1-148.500,   10.730, 102.900, .04537, .67057, .68231,     .09923,
141.        1-148.500,   10.010, 103.400, .05167, .59363, .73913,     .08273,
142.        1-148.500,    9.220, 103.840, .05444, .52043, .79742,     .08179,
143.        1-148.500,    8.590, 104.150, .07901, .45076, .83769,     .06603,
144.        1-148.500,    8.000, 104.360, .08544, .33429, .94009,     .86312,
145.        1-143.500,   17.600,  75.800,-.04276, .99433,-.06811,     .21855,
146.        1-143.500,   17.940,  76.800,-.04671, .99170,-.10342,     .55161,
147.        1-143.500,   18.080,  77.800,-.04406, .99272,-.09623,     .57869,
148.        1-143.500,   18.190,  78.800,-.04326, .99508,-.07606,     .72905,
149.        1-143.500,   18.280,  79.800,-.04139, .99569,-.05950,     .89249,
150.        1-143.500,   18.340,  80.800,-.04155, .99805,-.03952,    1.33812,
151.        1-143.500,   18.380,  81.810,-.03967, .99882,-.01988,    1.52826,
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     1-143.500,   18.380,   82.810,-.03876, .99919, .00489,    3.54437,
     1-143.500,   18.360,   83.810,-.03673, .99891, .02222,    1.84879,
     1-143.50000,   18.31000,   84.81000,-.03685, .99808, .04227,1.26507/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=145,162)/
     1-143.500,   18.240,   85.800,-.03282, .99668, .06267,     .82232,
     1-143.500,   18.130,   86.780,-.02878, .99442, .08722,     .63477,
     1-143.500,   18.000,   87.780,-.02850, .99226, .10390,     .53848,
     1-143.500,   17.840,   88.770,-.02524, .98929, .12399,     .45448,
     1-143.500,   17.660,   89.760,-.02495, .98598, .14229,     .39460,
     1-143.500,   17.450,   90.730,-.02176, .97993, .17040,     .32476,
     1-143.500,   17.190,   91.700,-.01860, .97336, .19782,     .28720,
     1-143.500,   16.920,   92.660,-.01542, .96769, .21734,     .25747,
     1-143.500,   16.600,   93.600,-.01176, .96008, .24225,     .23217,
     1-143.500,   16.290,   94.530,-.00755, .95572, .25356,     .21792,
     1-143.500,   15.910,   95.470, .00150, .93892, .29964,     .19195,
     1-143.500,   15.500,   96.350, .00329, .92736, .32406,     .17166,
     1-143.500,   15.060,   97.260, .00570, .91501, .35153,     .16429,
     1-143.500,   14.570,   98.120, .00872, .89364, .39147,     .14581,
     1-143.500,   14.050,   98.960, .01573, .87438, .42354,     .13548,
     1-143.500,   13.470,   99.780, .02031, .84484, .46919,     .12549,
     1-143.500,   12.840, 100.560, .02709, .82012, .50244,     .11735,
     1-143.50000,   12.20000, 101.32000, .03380, .78860, .54253,.11002/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=163,180)/
     1-143.500,   11.470, 102.010, .04314, .72728, .61001,     .10142,
     1-143.500,   10.700, 102.640, .05150, .67139, .66384,     .09538,
     1-143.500,    9.890, 103.190, .06041, .58502, .73462,     .09098,
     1-143.500,    8.980, 103.640, .06984, .47620, .80721,     .09319,
     1-143.500,    8.000, 104.010, .06481, .35230, .93358,    2.01327,
     1-138.700,   17.800,   74.880,-.04498, .98898,-.10398,     .16892,
     1-138.700,   17.990,   75.860,-.04388, .98559,-.14322,     .46026,
     1-138.700,   18.170,   76.860,-.04390, .98868,-.12512,     .51224,
     1-138.700,   18.300,   77.840,-.04312, .99336,-.09292,     .67975,
     1-138.700,   18.400,   78.830,-.04129, .99576,-.07177,     .89420,
     1-138.700,   18.480,   79.830,-.04022, .99713,-.05584,    1.13955,
     1-138.700,   18.540,   80.840,-.03628, .99839,-.03520,    1.30624,
     1-138.700,   18.560,   81.840,-.03429, .99929,-.00732,    2.43718,
     1-138.700,   18.550,   82.830,-.03321, .99930, .01327,    3.09284,
     1-138.700,   18.520,   83.820,-.03121, .99895, .02840,    2.06363,
     1-138.700,   18.470,   84.840,-.02723, .99792, .04884,    1.13707,
     1-138.700,   18.380,   85.840,-.02615, .99570, .07724,     .82611,
     1-138.69999,   18.26000,   86.84000,-.02530, .99337, .09833,.66760/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=181,198)/
     1-138.700,   18.120,   87.820,-.02218, .99032, .11950,     .53551,
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     1-138.700,  17.940,  88.810,-.02015, .98682, .14112,     .47283,
     1-138.700,  17.750,  89.800,-.01533, .98363, .15721,     .41802,
     1-138.700,  17.520,  90.780,-.01372, .97704, .18692,     .35494,
     1-138.700,  17.260,  91.740,-.01056, .97044, .21152,     .31205,
     1-138.700,  16.960,  92.720,-.00766, .96283, .23780,     .28601,
     1-138.700,  16.630,  93.680,-.00601, .95223, .26877,     .25041,
     1-138.700,  16.250,  94.620,-.00179, .94135, .29787,     .22803,
     1-138.700,  15.860,  95.550, .00475, .93301, .31785,     .21229,
     1-138.700,  15.430,  96.450, .00700, .91926, .34823,     .19293,
     1-138.700,  14.980,  97.330, .01185, .90500, .37589,     .17791,
     1-138.700,  14.470,  98.200, .01384, .88009, .42141,     .16295,
     1-138.700,  13.910,  99.030, .01973, .85456, .46152,     .14931,
     1-138.700,  13.310,  99.840, .02329, .82682, .50181,     .13961,
     1-138.700,  12.660, 100.600, .02907, .79120, .54615,     .12935,
     1-138.700,  11.950, 101.340, .03804, .74665, .59869,     .12345,
     1-138.700,  11.190, 102.000, .04565, .68852, .65557,     .11406,
     1-138.69999,  10.38000, 102.60000, .05517, .61574, .72331,.10866/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=199,216)/
     1-138.700,   9.600, 103.050, .06410, .51929, .79105,     .09576,
     1-138.700,   8.820, 103.390, .07165, .43144, .83901,     .09139,
     1-138.700,   8.000, 103.680, .06633, .33247, .94070,    1.67109,
     1-133.000,  17.840,  73.810,-.05307, .98340,-.12465,     .14753,
     1-133.000,  18.080,  74.780,-.04777, .97993,-.16699,     .40282,
     1-133.000,  18.260,  75.760,-.04508, .98829,-.12566,     .53727,
     1-133.000,  18.400,  76.760,-.04126, .99211,-.10303,     .68511,
     1-133.000,  18.530,  77.750,-.03889, .99392,-.08843,     .74363,
     1-133.000,  18.620,  78.740,-.03751, .99645,-.06528,    1.05738,
     1-133.000,  18.700,  79.750,-.03338, .99781,-.04458,    1.04079,
     1-133.000,  18.720,  80.760,-.03029, .99939,-.01504,    4.60218,
     1-133.000,  18.740,  81.760,-.02913, .99946,-.00743,    2.78829,
     1-133.000,  18.730,  82.760,-.02603, .99942, .01525,    2.44909,
     1-133.000,  18.690,  83.760,-.02273, .99829, .04300,    1.22904,
     1-133.000,  18.600,  84.760,-.02042, .99696, .06531,    1.06939,
     1-133.000,  18.520,  85.760,-.01848, .99639, .07051,     .92546,
     1-133.000,  18.400,  86.760,-.01592, .99299, .10082,     .67041,
     1-132.99999,  18.24000,  87.75000,-.01372, .98932, .12607,.55348/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=217,234)/
     1-133.000,  18.060,  88.740,-.01132, .98511, .14824,     .46440,
     1-133.000,  17.830,  89.730,-.00848, .98021, .17225,     .41412,
     1-133.000,  17.600,  90.720,-.00489, .97578, .18951,     .36692,
     1-133.000,  17.310,  91.680,-.00217, .96660, .22345,     .31589,
     1-133.000,  17.010,  92.640,-.00024, .96170, .23884,     .29543,
     1-133.000,  16.670,  93.590, .00193, .95302, .26453,     .26907,
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    1-133.000,  16.310,  94.530, .00445, .93988, .29753,    .23621,
    1-133.000,  15.870,  95.440, .00996, .92159, .33966,    .21153,
    1-133.000,  15.420,  96.350, .01221, .91383, .35677,    .20231,
    1-133.000,  14.950,  97.210, .01715, .89919, .38289,    .18363,
    1-133.000,  14.430,  98.060, .02133, .87630, .42386,    .17204,
    1-133.000,  13.850,  98.900, .02538, .84775, .46702,    .15652,
    1-133.000,  13.230,  99.710, .03155, .81466, .52192,    .14388,
    1-133.000,  12.690, 100.300, .03695, .78429, .54128,    .11235,
    1-133.000,  11.980, 101.020, .04372, .73983, .60104,    .12849,
    1-133.000,  11.210, 101.660, .05278, .67299, .66500,    .11922,
    1-133.000,  10.380, 102.230, .06004, .60276, .73129,    .11339,
    1-132.99999,    9.68000, 102.64000, .06855, .53118, .76844,.09417/
     DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=235,252)/
    1-133.000,   8.760, 103.040, .07355, .41237, .85731,    .11688,
    1-133.000,   8.000, 103.270, .06697, .28881, .95497,   1.69831,
    1-127.000,  17.880,  72.640,-.05273, .98408,-.12038,    .15408,
    1-127.000,  18.120,  73.620,-.04837, .97978,-.16746,    .41350,
    1-127.000,  18.310,  74.600,-.04262, .98633,-.13769,    .50739,
    1-127.000,  18.480,  75.590,-.03875, .98962,-.11935,    .58168,
    1-127.000,  18.620,  76.590,-.03558, .99302,-.09682,    .71251,
    1-127.000,  18.730,  77.590,-.03161, .99548,-.07715,    .89584,
    1-127.000,  18.820,  78.590,-.02821, .99738,-.05458,   1.01711,
    1-127.000,  18.860,  79.600,-.02338, .99922,-.02721,   2.41705,
    1-127.000,  18.890,  80.610,-.02300, .99949,-.01723,   2.70650,
    1-127.000,  18.900,  81.630,-.01962, .99956, .00497,   1.85469,
    1-127.000,  18.860,  82.620,-.01622, .99899, .03532,   1.80169,
    1-127.000,  18.800,  83.610,-.01334, .99837, .04790,   1.42811,
    1-127.000,  18.730,  84.600,-.01271, .99718, .06232,   1.02433,
    1-127.000,  18.620,  85.610,-.00841, .99458, .08907,    .77795,
    1-127.000,  18.480,  86.610,-.00593, .99191, .10966,    .64123,
    1-127.00000,  18.32000,  87.60000,-.00412, .98857, .12981,.53325/
     DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=253,270)/
    1-127.000,  18.120,  88.590,-.00068, .98419, .15332,    .46281,
    1-127.000,  17.900,  89.590,-.00035, .97939, .17489,    .40524,
    1-127.000,  17.640,  90.550, .00442, .97210, .20358,    .34396,
    1-127.000,  17.360,  91.500, .00518, .96716, .22027,    .31728,
    1-127.000,  17.050,  92.460, .00745, .96024, .24259,    .29306,
    1-127.000,  16.710,  93.400, .01078, .94973, .27172,    .25968,
    1-127.000,  16.320,  94.330, .01657, .93488, .30907,    .23135,
    1-127.000,  15.890,  95.230, .01656, .92268, .33575,    .21190,
    1-127.000,  15.440,  96.130, .02007, .91155, .35848,    .20063,
    1-127.000,  14.940,  97.010, .02298, .89213, .39479,    .18442,
    1-127.000,  14.400,  97.870, .02845, .86985, .43234,    .17009,
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     1-127.000,  13.810,  98.690, .03228, .83829, .48016,     .15397,
     1-127.000,  13.180,  99.450, .03899, .80598, .52120,     .14042,
     1-127.000,  12.500, 100.190, .04281, .76943, .56623,     .13380,
     1-127.000,  11.770, 100.870, .05038, .71191, .62637,     .12400,
     1-127.000,  10.960, 101.480, .05703, .64377, .68855,     .11841,
     1-127.000,  10.120, 102.020, .06122, .57151, .75873,     .11295,
     1-127.00000,   9.49000, 102.35000, .07049, .48826, .80395,.08125/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=271,288)/
     1-127.000,   8.640, 102.600, .08135, .40103, .84138,     .08224,
     1-127.000,   8.000, 102.860, .06597, .29486, .95320,    2.06973,
     1-121.000,  17.910,  71.520,-.05036, .98269,-.12650,     .14540,
     1-121.000,  18.160,  72.490,-.04405, .97819,-.17468,     .39252,
     1-121.000,  18.360,  73.480,-.03838, .98515,-.14502,     .48637,
     1-121.000,  18.540,  74.460,-.03479, .98859,-.12610,     .53755,
     1-121.000,  18.680,  75.440,-.02900, .99305,-.09780,     .68527,
     1-121.000,  18.790,  76.440,-.02506, .99566,-.07716,     .89141,
     1-121.000,  18.880,  77.440,-.02111, .99730,-.05984,    1.08347,
     1-121.000,  18.940,  78.440,-.01618, .99885,-.03746,    1.54143,
     1-121.000,  18.970,  79.440,-.01399, .99962,-.01989,    2.98152,
     1-121.000,  18.990,  80.450,-.01096, .99981,-.00742,    2.69908,
     1-121.000,  18.980,  81.460,-.00677, .99974, .01492,    2.49201,
     1-121.000,  18.940,  82.460,-.00427, .99895, .03746,    1.55833,
     1-121.000,  18.870,  83.460,-.00203, .99774, .05737,    1.15946,
     1-121.000,  18.780,  84.460, .00189, .99613, .07509,     .89004,
     1-121.000,  18.660,  85.450, .00442, .99385, .09537,     .72009,
     1-121.00000,  18.52000,  86.44000, .00607, .99131, .11322,.60527/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=289,306)/
     1-121.000,  18.350,  87.420, .00855, .98696, .13848,     .49515,
     1-121.000,  18.140,  88.400, .01020, .98266, .16043,     .43838,
     1-121.000,  17.920,  89.380, .01410, .97837, .17811,     .38992,
     1-121.000,  17.650,  90.350, .01492, .97055, .20869,     .33924,
     1-121.000,  17.360,  91.310, .01614, .96555, .22513,     .31425,
     1-121.000,  17.040,  92.280, .02009, .95705, .25199,     .28397,
     1-121.000,  16.690,  93.190, .02366, .94419, .28533,     .24196,
     1-121.000,  16.290,  94.100, .02575, .93250, .31338,     .22596,
     1-121.000,  15.860,  95.020, .02680, .92159, .33741,     .21463,
     1-121.000,  15.380,  95.930, .03095, .90593, .36946,     .19926,
     1-121.000,  14.880,  96.810, .03312, .88847, .40058,     .18185,
     1-121.000,  14.320,  97.660, .03762, .86087, .44599,     .16575,
     1-121.000,  13.720,  98.470, .04118, .83082, .48903,     .15152,
     1-121.000,  13.060,  99.240, .04498, .79354, .53696,     .14079,
     1-121.000,  12.350,  99.970, .04921, .74919, .59311,     .13041,
     1-121.000,  11.680, 100.560, .05857, .69936, .63234,     .11127,
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324.        1-121.000,  10.850, 101.170, .06179, .63198, .69851,      .11962,
325.        1-121.00000,    9.99000, 101.70000, .06669, .54864, .77669,.11475/
326.         DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=307,324)/
327.        1-121.000,   9.360, 102.000, .07595, .45108, .82998,      .08014,
328.        1-121.000,   8.780, 102.200, .08182, .38368, .84585,      .07234,
329.        1-121.000,   8.000, 102.440, .06838, .29321, .95353,     1.81874,
330.        1-115.000,  17.900,  70.320,-.04397, .98329,-.12529,      .14811,
331.        1-115.000,  18.150,  71.300,-.03793, .97915,-.17147,      .39850,
332.        1-115.000,  18.340,  72.290,-.03037, .98637,-.14020,      .50365,
333.        1-115.000,  18.520,  73.270,-.02469, .98840,-.12914,      .53521,
334.        1-115.000,  18.680,  74.280,-.01961, .99202,-.10664,      .63148,
335.        1-115.000,  18.790,  75.270,-.01450, .99558,-.08005,      .85910,
336.        1-115.000,  18.890,  76.270,-.00995, .99681,-.06728,      .96269,
337.        1-115.000,  18.960,  77.270,-.00576, .99852,-.04493,     1.30336,
338.        1-115.000,  19.000,  78.270,-.00087, .99950,-.02486,     1.97750,
339.        1-115.000,19.020,79.280,.00222,.99984,-.00990,2.55072,
340.        1-115.000,  19.020,  80.290, .00626, .99981, .00750,     2.26124,
341.        1-115.000,  18.990,  81.280, .01048, .99921, .03013,     1.65029,
342.        1-115.000,  18.930,  82.280, .01362, .99818, .04966,     1.28398,
343.        1-115.000,  18.850,  83.290, .01604, .99676, .06695,      .97852,
344.        1-115.00000,  18.74000,  84.29000, .02008, .99461, .08747,.77873/
345.         DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=325,342)/
346.        1-115.000,  18.610,  85.280, .02229, .99261, .10277,      .66609,
347.        1-115.000,  18.460,  86.270, .02445, .99003, .11940,      .57707,
348.        1-115.000,  18.280,  87.270, .02769, .98601, .14193,      .49228,
349.        1-115.000,  18.070,  88.250, .02923, .98035, .16842,      .41086,
350.        1-115.000,  17.820,  89.220, .03326, .97487, .19095,      .36811,
351.        1-115.000,  17.560,  90.190, .03271, .97139, .20384,      .34472,
352.        1-115.000,  17.270,  91.150, .03631, .96246, .23302,      .29993,
353.        1-115.000,  16.930,  92.090, .03928, .95133, .26596,      .26530,
354.        1-115.000,  16.570,  93.010, .04011, .94302, .28701,      .24396,
355.        1-115.000,  16.170,  93.930, .04275, .93163, .31392,      .22711,
356.        1-115.000,  15.730,  94.850, .04575, .91659, .34758,      .20849,
357.        1-115.000,  15.260,  95.710, .04686, .90118, .37549,      .18754,
358.        1-115.000,  14.750,  96.590, .05101, .88356, .40820,      .17930,
359.        1-115.000,  14.190,  97.420, .05322, .85609, .45168,      .16127,
360.        1-115.000,  13.590,  98.220, .05692, .82697, .49249,      .14958,
361.        1-115.000,  12.920,  98.990, .05951, .78629, .55332,      .13762,
362.        1-115.000,  12.360,  99.570, .06528, .74826, .57959,      .10799,
363.        1-115.00000,  11.59000, 100.21000, .06930, .68518, .64926,.12069/
364.         DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=343,360)/
365.        1-115.000,  10.780, 100.810, .07414, .62770, .70056,      .11779,
366.        1-115.000,   9.900, 101.330, .08299, .53025, .77521,      .11692,
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      1-115.000,    8.970, 101.730, .08814, .40394, .85309,    .12084,
      1-115.000,    8.000, 102.000, .07529, .26725, .96062,   2.16446,
      1-109.000,   17.880,  69.160,-.03064, .98770,-.10854,    .17302,
      1-109.000,   18.100,  70.160,-.02871, .98314,-.15641,    .45317,
      1-109.000,   18.290,  71.140,-.02076, .98689,-.13847,    .50160,
      1-109.000,   18.460,  72.120,-.01427, .99016,-.11942,    .56701,
      1-109.000,   18.600,  73.130,-.01010, .99297,-.10229,    .69324,
      1-109.000,   18.730,  74.110,-.00138, .99462,-.08791,    .72657,
      1-109.000,   18.820,  75.110, .00297, .99745,-.06045,   1.04298,
      1-109.000,   18.880,  76.090, .00772, .99870,-.04287,   1.49389,
      1-109.000,   18.930,  77.090, .01338, .99923,-.02748,   1.51654,
      1-109.000,   18.940,  78.090, .01737, .99980,-.00497,   4.12069,
      1-109.000,   18.940,  79.100, .02191, .99968, .00495,   3.22820,
      1-109.000,   18.920,  80.110, .02582, .99922, .02237,   2.04045,
      1-109.000,   18.870,  81.110, .02894, .99833, .04222,   1.51829,
      1-109.00000,  18.80000,  82.12000, .03115, .99726, .05734,1.16702/
       DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=361,378)/
      1-109.000,   18.710,  83.110, .03528, .99519, .07752,    .84065,
      1-109.000,   18.580,  84.110, .03833, .99258, .09976,    .70059,
      1-109.000,   18.440,  85.100, .04102, .99105, .10956,    .63236,
      1-109.000,   18.280,  86.100, .04414, .98760, .12966,    .53263,
      1-109.000,   18.080,  87.080, .04624, .98281, .15465,    .45383,
      1-109.000,   17.860,  88.070, .05019, .97811, .17466,    .40301,
      1-109.000,   17.600,  89.040, .05114, .97312, .19462,    .36347,
      1-109.000,   17.340,  90.020, .05424, .96831, .21072,    .33259,
      1-109.000,   17.020,  90.970, .05755, .95704, .24682,    .28736,
      1-109.000,   16.680,  91.920, .05948, .95132, .26313,    .27102,
      1-109.000,   16.320,  92.850, .06182, .93962, .29204,    .24090,
      1-109.000,   15.890,  93.770, .06452, .92254, .33201,    .21806,
      1-109.000,   15.440,  94.670, .06859, .91295, .35133,    .20472,
      1-109.000,   14.970,  95.550, .06946, .89754, .38093,    .18776,
      1-109.000,   14.450,  96.390, .07405, .87461, .41909,    .17086,
      1-109.000,   13.880,  97.230, .07769, .84964, .45849,    .16161,
      1-109.000,   13.250,  98.030, .08131, .81319, .50956,    .14781,
      1-109.00000,  12.58000,  98.77000, .08671, .77306, .55802,.13459/
       DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=379,396)/
      1-109.000,   11.870,  99.450, .09290, .71693, .63051,    .12173,
      1-109.000,   11.320,  99.890, .09690, .67214, .65347,    .08559,
      1-109.000,   10.670, 100.350, .10144, .61894, .70843,    .09140,
      1-109.000,   10.070, 100.720, .10732, .55593, .75214,    .08060,
      1-109.000,    9.430, 101.030, .11374, .47171, .80191,    .08215,
      1-109.000,    8.670, 101.320, .11926, .37269, .86830,    .09721,
      1-109.000,    8.000, 101.500, .10015, .25790, .96068,    .59255,
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1-103.000,  17.600,  68.020,-.01659, .99215,-.08360,     .18192,
1-103.000,  17.980,  68.990,-.01447, .98695,-.13641,     .43042,
1-103.000,  18.180,  69.980,-.01028, .98693,-.13663,     .43130,
1-103.000,  18.340,  70.960,-.00257, .99175,-.10801,     .52444,
1-103.000,  18.460,  71.950, .00405, .99417,-.09128,     .64209,
1-103.000,  18.600,  72.960, .00940, .99465,-.08319,     .58517,
1-103.000,  18.660,  73.950, .01519, .99840,-.04607,    1.24749,
1-103.000,  18.730,  74.950, .02066, .99826,-.04605,    1.19321,
1-103.000,  18.780,  75.960, .02356, .99906,-.02711,    1.42014,
1-103.000,  18.790,  76.960, .02907, .99953,-.00497,    4.20375,
1-103.00000,  18.79000,  77.97000, .03273, .99933, .00675,2.44574/
 DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=397,414)/
1-103.000,  18.760,  78.980, .03732, .99888, .02371,    2.17418,
1-103.000,  18.720,  80.000, .04188, .99828, .03358,    1.54858,
1-103.000,  18.660,  80.980, .04462, .99729, .04878,    1.11633,
1-103.000,  18.580,  81.970, .04752, .99558, .06731,     .81748,
1-103.000,  18.460,  82.970, .05203, .99285, .09116,     .64819,
1-103.000,  18.320,  83.970, .05369, .99083, .10539,     .56597,
1-103.000,  18.160,  84.970, .05722, .98835, .12010,     .49926,
1-103.000,  17.980,  85.960, .06088, .98563, .13463,     .44417,
1-103.000,  17.790,  86.920, .06326, .98131, .15359,     .37399,
1-103.000,  17.540,  87.900, .06740, .97443, .18304,     .33075,
1-103.000,  17.280,  88.880, .06908, .97107, .19512,     .31005,
1-103.000,  16.990,  89.850, .07377, .96397, .21863,     .27722,
1-103.000,  16.670,  90.800, .07466, .95536, .24447,     .24619,
1-103.000,  16.310,  91.740, .07974, .94550, .27080,     .22387,
1-103.000,  15.930,  92.660, .08410, .93597, .29272,     .20556,
1-103.000,  15.500,  93.580, .08615, .92006, .32899,     .18692,
1-103.000,  15.030,  94.460, .09070, .90584, .35622,     .17028,
1-103.00000,  14.55000,  95.33000, .09801, .89261, .37884,.16028/
 DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=415,432)/
1-103.000,  14.000,  96.180, .10020, .86465, .42597,     .14658,
1-103.000,  13.400,  97.000, .10587, .83723, .46673,     .13539,
1-103.000,  12.770,  97.770, .12597, .79990, .51147,     .12275,
1-103.000,  12.060,  98.490, .12058, .74499, .57816,     .11337,
1-103.000,  11.300,  99.130, .13035, .68244, .63902,     .10402,
1-103.000,  10.500,  99.690, .13662, .61710, .69984,     .09653,
1-103.000,   9.790, 100.120, .14527, .54226, .76594,     .08189,
1-103.000,   9.270, 100.360, .16053, .45103, .80329,     .05662,
1-103.000,   8.690, 100.560, .17126, .36705, .84106,     .06160,
1-103.000,   8.000, 100.750, .13810, .26269, .95462,     .54222,
1 -98.000,  17.680,  67.060,-.00621, .99201,-.08919,     .17473,
1 -98.000,  17.860,  68.060,-.00345, .98879,-.12919,     .45541,
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     1 -98.000,  18.020,  69.050, .00199, .98985,-.12251,     .47687,
     1 -98.000,  18.200,  70.080, .01104, .99077,-.11470,     .47770,
     1 -98.000,  18.310,  71.080, .01697, .99558,-.07965,     .72088,
     1 -98.000,  18.410,  72.080, .02201, .99641,-.07010,     .79386,
     1 -98.000,  18.490,  73.070, .02868, .99735,-.05764,     .98679,
     1 -98.00000,  18.56000,  74.07000, .03049, .99816,-.04242,1.03829/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=433,450)/
     1 -98.000,  18.590,  75.070, .03632, .99897,-.02248,    2.16333,
     1 -98.000,  18.620,  76.070, .04206, .99883,-.01249,    1.52730,
     1 -98.000,  18.610,  77.070, .04475, .99882, .01249,    2.24111,
     1 -98.000,  18.580,  78.070, .05055, .99814, .02745,    1.63405,
     1 -98.000,  18.530,  79.070, .05338, .99732, .04218,    1.24529,
     1 -98.000,  18.460,  80.080, .05819, .99628, .05452,    1.04107,
     1 -98.000,  18.380,  81.080, .06180, .99520, .06501,     .86239,
     1 -98.000,  18.280,  82.070, .06595, .99279, .08524,     .64465,
     1 -98.000,  18.140,  83.060, .06941, .98994, .10642,     .54572,
     1 -98.000,  17.990,  84.070, .07148, .98792, .11855,     .49237,
     1 -98.000,  17.810,  85.060, .07506, .98410, .13917,     .42028,
     1 -98.000,  17.610,  86.050, .07848, .98044, .15598,     .37643,
     1 -98.000,  17.380,  87.040, .08329, .97447, .18083,     .32642,
     1 -98.000,  17.120,  87.990, .08666, .96858, .20179,     .28728,
     1 -98.000,  16.840,  88.960, .09076, .96386, .21724,     .27276,
     1 -98.000,  16.530,  89.920, .09439, .95675, .23919,     .24832,
     1 -98.000,  16.200,  90.860, .09976, .94610, .26672,     .21915,
     1 -98.00000,  15.80000,  91.80000, .10264, .93203, .30241,.20070/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=451,468)/
     1 -98.000,  15.380,  92.740, .10921, .92181, .32490,     .18804,
     1 -98.000,  14.930,  93.630, .11361, .90444, .35822,     .16685,
     1 -98.000,  14.420,  94.520, .11906, .88272, .39824,     .15503,
     1 -98.000,  13.870,  95.370, .12861, .85983, .44138,     .13872,
     1 -98.000,  13.430,  96.020, .13801, .84545, .45222,     .10621,
     1 -98.000,  12.930,  96.660, .14871, .76260, .56462,     .08774,
     1 -98.000,  12.390,  97.060, .14959, .75519, .52681,     .07542,
     1 -98.000,  11.740,  97.900, .15727, .77424, .54796,     .11896,
     1 -98.000,  11.030,  98.480, .17110, .66413, .65780,     .09215,
     1 -98.000,  10.370,  98.950, .18346, .59644, .71282,     .07906,
     1 -98.000,   9.730,  99.300, .19893, .51574, .76171,     .06933,
     1 -98.000,   9.090,  99.600, .20953, .43314, .81767,     .06847,
     1 -98.000,   8.520,  99.790, .22040, .32374, .86678,     .06055,
     1 -98.000,   8.000,  99.910, .18492, .22068, .95721,     .31621,
     1 -93.000,  17.520,  66.080, .00653, .99188,-.09376,     .19638,
     1 -93.000,  17.690,  67.060, .01040, .98944,-.12646,     .53451,
     1 -93.000,  17.840,  68.050, .01523, .99191,-.11011,     .61483,
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1 -93.00000,  17.97000,  69.05000, .02198, .99393,-.09395,.71595/
 DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=469,486)/
1 -93.000,  18.080,  70.060, .03106, .99519,-.08147,     .85209,
1 -93.000,  18.180,  71.060, .03492, .99623,-.06849,     .92868,
1 -93.000,  18.250,  72.070, .04153, .99722,-.05394,    1.23151,
1 -93.000,  18.320,  73.060, .04544, .99745,-.04602,    1.19432,
1 -93.000,  18.360,  74.060, .05136, .99821,-.02257,    1.68323,
1 -93.000,  18.370,  75.070, .05536, .99837,-.00226,    2.56224,
1 -93.000,  18.360,  76.070, .06099, .99802, .01049,    3.16284,
1 -93.000,  18.340,  77.060, .06491, .99725, .02642,    1.49081,
1 -93.000,  18.280,  78.060, .06964, .99615, .04619,    1.40224,
1 -93.000,  18.220,  79.060, .07339, .99530, .05375,    1.13237,
1 -93.000,  18.130,  80.080, .07634, .99375, .07111,     .95738,
1 -93.000,  18.030,  81.080, .08110, .99199, .08393,     .79069,
1 -93.000,  17.900,  82.100, .08567, .98884, .10636,     .64722,
1 -93.000,  17.740,  83.100, .08913, .98602, .12376,     .56299,
1 -93.000,  17.580,  84.070, .09431, .98342, .13502,     .49453,
1 -93.000,  17.380,  85.060, .09721, .97880, .15819,     .44191,
1 -93.000,  17.160,  86.050, .10275, .97403, .17710,     .39400,
1 -93.00000,  16.91000,  87.02000, .10758, .96678, .20341,.34133/
 DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=487,504)/
1 -93.000,  16.620,  87.990, .11234, .95976, .22676,     .31193,
1 -93.000,  16.320,  88.940, .11825, .95439, .24111,     .28933,
1 -93.000,  15.990,  89.890, .12542, .94347, .26950,     .26060,
1 -93.000,  15.600,  90.840, .13214, .93027, .30255,     .23984,
1 -93.000,  15.200,  91.760, .13816, .91833, .32748,     .21611,
1 -93.000,  14.750,  92.650, .14781, .90061, .36088,     .19771,
1 -93.000,  14.260,  93.550, .15782, .88071, .39662,     .18432,
1 -93.000,  13.730,  94.380, .16883, .85186, .43977,     .16279,
1 -93.000,  13.140,  95.200, .17981, .81851, .49346,     .14928,
1 -93.000,  12.630,  95.820, .18821, .79132, .51316,     .11951,
1 -93.000,  11.960,  96.550, .18949, .74545, .58079,     .12838,
1 -93.000,  11.360,  97.100, .22028, .68964, .62336,     .10243,
1 -93.000,  10.720,  97.600, .23669, .62747, .67480,     .09780,
1 -93.000,  10.040,  98.040, .25449, .54650, .73281,     .09480,
1 -93.000,   9.320,  98.400, .26780, .44751, .79739,     .09283,
1 -93.000,   8.680,  98.640, .28832, .34716, .83559,     .08177,
1 -93.000,   8.000,  98.820, .24454, .24774, .93664,     .33090,
1 -87.00000,  17.26000,  64.93000, .02181, .99407,-.07523,.24443/
 DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=505,522)/
1 -87.000,  17.410,  65.920, .02448, .99186,-.10770,     .63703,
1 -87.000,  17.540,  66.910, .03245, .99307,-.09731,     .70518,
1 -87.000,  17.670,  67.910, .03804, .99401,-.08698,     .74274,
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     1 -87.000,   17.760,   68.910, .04535, .99611,-.06442,    1.01785,
     1 -87.000,   17.840,   69.920, .05051, .99646,-.05730,    1.13369,
     1 -87.000,   17.910,   70.910, .05699, .99693,-.04258,    1.16660,
     1 -87.000,   17.940,   71.910, .06154, .99762,-.02494,    2.09112,
     1 -87.000,   17.980,   72.910, .06760, .99723,-.02244,    1.75419,
     1 -87.000,   17.990,   73.910, .07396, .99715,-.00248,    2.51721,
     1 -87.000,   17.980,   74.920, .07852, .99669, .01240,    2.22156,
     1 -87.000,   17.950,   75.920, .08303, .99592, .02739,    1.71013,
     1 -87.000,   17.900,   76.920, .08919, .99449, .04475,    1.23563,
     1 -87.000,   17.820,   77.920, .09278, .99299, .06206,    1.02868,
     1 -87.000,   17.730,   78.920, .09776, .99186, .06943,     .93999,
     1 -87.000,   17.630,   79.920, .10403, .98981, .08207,     .77026,
     1 -87.000,   17.500,   80.910, .10829, .98699, .10167,     .65644,
     1 -87.000,   17.350,   81.910, .11460, .98378, .11805,     .57163,
     1 -87.00000,   17.17000,   82.91000, .11917, .97962, .13924,.49373/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=523,540)/
     1 -87.000,   16.970,   83.880, .12632, .97601, .15266,     .44605,
     1 -87.000,   16.760,   84.860, .13289, .97143, .16851,     .40157,
     1 -87.000,   16.500,   85.840, .14124, .96315, .19757,     .35405,
     1 -87.000,   16.220,   86.810, .14883, .95603, .21796,     .31961,
     1 -87.000,   15.900,   87.770, .15638, .94658, .24412,     .28834,
     1 -87.000,   15.560,   88.710, .16631, .93657, .26652,     .26197,
     1 -87.000,   15.170,   89.650, .17854, .92319, .29532,     .24236,
     1 -87.000,   14.760,   90.570, .19154, .90946, .31981,     .22109,
     1 -87.000,   14.300,   91.470, .19816, .88837, .36090,     .20003,
     1 -87.000,   13.790,   92.330, .21175, .86267, .40089,     .18070,
     1 -87.000,   13.230,   93.170, .23620, .83119, .44109,     .16714,
     1 -87.000,   12.620,   93.960, .25343, .79467, .48449,     .15345,
     1 -87.000,   11.950,   94.720, .27269, .74600, .54537,     .14072,
     1 -87.000,   11.360,   95.280, .28560, .69218, .59096,     .10827,
     1 -87.000,   10.730,   95.780, .31450, .62781, .63409,     .10454,
     1 -87.000,    9.970,   96.280, .33783, .54389, .70639,     .11079,
     1 -87.000,    9.360,   96.600, .36547, .45611, .73651,     .08604,
     1 -87.00000,    8.61000,   96.89000, .37581, .33718, .80847,.09858/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=541,558)/
     1 -87.000,    8.000,   97.040, .32880, .22491, .91537,     .21622,
     1 -81.000,   16.940,   63.780, .04050, .99542,-.06205,     .32136,
     1 -81.000,   17.060,   64.780, .04357, .99351,-.09106,     .80460,
     1 -81.000,   17.180,   65.770, .04993, .99421,-.08074,     .82422,
     1 -81.000,   17.260,   66.770, .05769, .99562,-.06312,    1.10924,
     1 -81.000,   17.350,   67.770, .06535, .99544,-.05774,    1.05579,
     1 -81.000,   17.400,   68.770, .07249, .99633,-.03786,    1.63190,
     1 -81.000,   17.450,   69.770, .07832, .99610,-.03251,    1.64502,
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     1 -81.000,  17.480,  70.780, .08523, .99600,-.01992,   2.18858,
     1 -81.000,  17.500,  71.790, .09205, .99549,-.00986,   1.87414,
     1 -81.000,  17.500,  72.800, .09918, .99478, .00772,   1.74132,
     1 -81.000,  17.470,  73.800, .10611, .99375, .02524,   1.67129,
     1 -81.000,  17.430,  74.800, .11287, .99256, .03516,   1.37911,
     1 -81.000,  17.370,  75.810, .12067, .99053, .05263,   1.05148,
     1 -81.000,  17.280,  76.810, .12906, .98807, .07015,    .89356,
     1 -81.000,  17.180,  77.810, .13649, .98600, .07966,    .78038,
     1 -81.000,  17.060,  78.820, .14590, .98202, .09977,    .63083,
     1 -81.00000,  16.90000,  79.81000, .15542, .97825, .11641,.57829/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=559,576)/
     1 -81.000,  16.750,  80.820, .16619, .97486, .12381,    .51537,
     1 -81.000,  16.550,  81.810, .17657, .96793, .15192,    .44741,
     1 -81.000,  16.340,  82.790, .18844, .96205, .16689,    .39919,
     1 -81.000,  16.090,  83.770, .20271, .95265, .19270,    .35154,
     1 -81.000,  15.820,  84.720, .21683, .94300, .21434,    .31610,
     1 -81.000,  15.500,  85.690, .23015, .93150, .24103,    .29453,
     1 -81.000,  15.160,  86.640, .24855, .91894, .26139,    .26804,
     1 -81.000,  14.780,  87.560, .26749, .90179, .29012,    .24363,
     1 -81.000,  14.360,  88.500, .29117, .87873, .32330,    .21977,
     1 -81.000,  13.880,  89.400, .30125, .85412, .36669,    .20423,
     1 -81.000,  13.350,  90.260, .32742, .82417, .40064,    .18943,
     1 -81.000,  12.780,  91.100, .35345, .77544, .46732,    .16146,
     1 -81.000,  12.300,  91.620, .38114, .74185, .47282,    .12120,
     1 -81.000,  11.740,  92.310, .40877, .71780, .49775,    .14161,
     1 -81.000,  11.150,  92.870, .43065, .64225, .56445,    .12346,
     1 -81.000,  10.510,  93.360, .47032, .56301, .60315,    .12527,
     1 -81.000,   9.660,  93.880, .49261, .47286, .66595,    .14454,
     1 -81.00000,   8.83000,  94.27000, .52691, .35064, .71348,.13393/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=577,594)/
     1 -81.000,   8.000,  94.500, .47584, .23322, .84215,    .19210,
     1 -74.500,  16.480,  62.500, .06041, .99608,-.04071,    .34383,
     1 -74.500,  16.580,  63.500, .06315, .99477,-.06602,    .78466,
     1 -74.500,  16.660,  64.500, .07143, .99507,-.05609,    .89302,
     1 -74.500,  16.740,  65.500, .07984, .99488,-.04818,    .89272,
     1 -74.500,  16.780,  66.490, .08645, .99553,-.02820,   1.35693,
     1 -74.500,  16.820,  67.490, .09649, .99473,-.02182,   1.28143,
     1 -74.500,  16.830,  68.500, .10384, .99435,-.00701,   1.65163,
     1 -74.500,  16.840,  69.490, .11287, .99330,-.00295,   1.39345,
     1 -74.500,  16.830,  70.490, .12385, .99163, .01510,   1.05875,
     1 -74.500,  16.780,  71.490, .13547, .98960, .03284,    .96967,
     1 -74.500,  16.740,  72.490, .14622, .98780, .03390,    .84068,
     1 -74.500,  16.670,  73.490, .15614, .98503, .05261,    .68999,
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     1 -74.500,  16.580,  74.490, .16862, .98135, .06859,     .56854,
     1 -74.500,  16.460,  75.480, .18355, .97604, .08940,     .46822,
     1 -74.500,  16.310,  76.470, .19668, .97072, .10763,     .41125,
     1 -74.500,  16.140,  77.460, .21292, .96431, .12326,     .36399,
     1 -74.50000,  15.94000,  78.44000, .22727, .95752, .14095,.33318/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=595,612)/
     1 -74.500,  15.720,  79.430, .24732, .94783, .15863,     .29073,
     1 -74.500,  15.460,  80.390, .26969, .93584, .17975,     .26261,
     1 -74.500,  15.180,  81.380, .27861, .92874, .19774,     .25493,
     1 -74.500,  14.860,  82.320, .30435, .90880, .23107,     .21700,
     1 -74.500,  14.480,  83.250, .32928, .88612, .27164,     .18771,
     1 -74.500,  14.150,  84.000, .35938, .86739, .28112,     .14994,
     1 -74.500,  13.800,  84.710, .37741, .85040, .29474,     .15181,
     1 -74.500,  13.300,  85.600, .40895, .81631, .33821,     .16704,
     1 -74.500,  12.760,  86.450, .44351, .77541, .37560,     .15317,
     1 -74.500,  12.150,  87.230, .47968, .72203, .41915,     .14198,
     1 -74.500,  11.470,  87.980, .51181, .66309, .47360,     .13232,
     1 -74.500,  10.880,  88.520, .55845, .59281, .49744,     .10601,
     1 -74.500,  10.230,  89.000, .58346, .52137, .54265,     .10372,
     1 -74.500,   9.580,  89.400, .61764, .44488, .56513,     .09963,
     1 -74.500,   8.840,  89.750, .64553, .33580, .60647,     .10660,
     1 -74.500,   8.000,  90.000, .58828, .22883, .76926,     .18895,
     1 -70.000,  16.090,  61.630, .08420, .99516,-.03591,     .42222,
     1 -70.00000,  16.16000,  62.65000, .08913, .99409,-.05258,.97074/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=613,630)/
     1 -70.000,  16.230,  63.650, .09920, .99355,-.04262,     .87224,
     1 -70.000,  16.260,  64.650, .10929, .99349,-.02275,    1.31893,
     1 -70.000,  16.290,  65.650, .12052, .99229,-.01750,    1.27709,
     1 -70.000,  16.300,  66.650, .13132, .99097, .00026,    1.08832,
     1 -70.000,  16.280,  67.650, .14314, .98920, .01779,    1.13601,
     1 -70.000,  16.250,  68.640, .15606, .98680, .02779,     .90488,
     1 -70.000,  16.200,  69.650, .17058, .98322, .04763,     .70191,
     1 -70.000,  16.110,  70.650, .18574, .97864, .07201,     .62063,
     1 -70.000,  16.000,  71.660, .20116, .97421, .08435,     .54873,
     1 -70.000,  15.880,  72.650, .22173, .96825, .09520,     .48001,
     1 -70.000,  15.740,  73.630, .24161, .96030, .11501,     .40050,
     1 -70.000,  15.560,  74.610, .26295, .94908, .14504,     .33985,
     1 -70.000,  15.330,  75.600, .27249, .94140, .17114,     .32778,
     1 -70.000,  15.090,  76.570, .29849, .92891, .18704,     .29113,
     1 -70.000,  14.800,  77.550, .32586, .91153, .21935,     .25078,
     1 -70.000,  14.560,  78.300, .35796, .89057, .23464,     .19312,
     1 -70.000,  14.170,  79.240, .39125, .86146, .27907,     .21096,
     1 -70.00000,  13.76000,  80.17000, .42369, .83722, .29834,.19972/
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      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=631,648)/
     1 -70.000,  13.300,  81.070, .46009, .80028, .33361,      .18475,
     1 -70.000,  12.780,  81.930, .48159, .76209, .37913,      .17197,
     1 -70.000,  12.180,  82.750, .53356, .69999, .41972,      .16769,
     1 -70.000,  11.520,  83.510, .56465, .64085, .47114,      .15249,
     1 -70.000,  11.000,  84.020, .60675, .57791, .48729,      .11284,
     1 -70.000,  10.450,  84.470, .63369, .51519, .51336,      .10937,
     1 -70.000,   9.810,  84.910, .67360, .43407, .52872,      .12408,
     1 -70.000,   8.920,  85.380, .68947, .33380, .58064,      .14605,
     1 -70.000,   8.000,  85.700, .66044, .24647, .70900,     1.15109,
     1 -65.000,  15.570,  60.680, .10770, .99353,-.02127,      .46917,
     1 -65.000,  15.620,  61.680, .11486, .99242,-.02921,      .83421,
     1 -65.000,  15.640,  62.670, .12617, .99156,-.00997,      .96634,
     1 -65.000,  15.640,  63.670, .13988, .98977, .00424,      .99648,
     1 -65.000,  15.620,  64.670, .15256, .98765, .01607,      .87266,
     1 -65.000,  15.590,  65.690, .16578, .98492, .02911,      .70796,
     1 -65.000,  15.520,  66.700, .17988, .98135, .05092,      .62734,
     1 -65.000,  15.440,  67.700, .19569, .97689, .06452,      .49757,
     1 -65.00000,  15.32000,  68.69000, .21112, .97110, .08918,.42355/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=649,666)/
     1 -65.000,  15.180,  69.660, .22126, .96690, .10447,      .39992,
     1 -65.000,  15.010,  70.660, .23913, .95904, .12530,      .34536,
     1 -65.000,  14.800,  71.650, .25944, .94766, .15492,      .28506,
     1 -65.000,  14.550,  72.600, .28587, .93320, .18173,      .24286,
     1 -65.000,  14.270,  73.550, .31258, .91821, .20374,      .22129,
     1 -65.000,  13.950,  74.480, .34174, .89607, .23627,      .19308,
     1 -65.000,  13.540,  75.430, .37418, .86529, .28197,      .17374,
     1 -65.000,  13.090,  76.330, .42546, .82608, .31028,      .15434,
     1 -65.000,  12.580,  77.210, .44978, .79190, .35130,      .14496,
     1 -65.000,  12.000,  78.040, .50812, .72746, .40217,      .13282,
     1 -65.000,  11.470,  78.670, .55698, .66638, .42759,      .10612,
     1 -65.000,  10.910,  79.240, .56455, .62112, .47052,      .09573,
     1 -65.000,  10.290,  79.760, .60823, .53907, .50939,      .09455,
     1 -65.000,   9.620,  80.200, .64499, .45716, .53663,      .09299,
     1 -65.000,   8.910,  80.590, .69772, .35653, .53723,      .09778,
     1 -65.000,   8.000,  80.930, .65080, .26551, .71096,      .92923,
     1 -61.250,  15.120,  60.000, .12089, .99214,-.00000,      .25402,
     1 -61.25000,  15.11000,  61.00000, .14780, .98831, .00869,.52609/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=667,684)/
     1 -61.250,  15.090,  61.990, .15546, .98731, .01736,      .70014,
     1 -61.250,  15.050,  62.990, .16282, .98581, .03081,      .73083,
     1 -61.250,  14.990,  63.990, .17431, .98298, .04606,      .56561,
     1 -61.250,  14.900,  64.990, .18853, .97914, .06211,      .45846,
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     1 -61.250,   14.800,   66.000, .20591, .97457, .07212,       .39589,
     1 -61.250,   14.670,   67.000, .22108, .96825, .09467,       .30017,
     1 -61.250,   14.490,   68.020, .24051, .95969, .12056,       .25015,
     1 -61.250,   14.300,   69.000, .26124, .95062, .13720,       .20792,
     1 -61.250,   14.060,   69.960, .28501, .93636, .16825,       .17049,
     1 -61.250,   13.780,   70.920, .33411, .91094, .19897,       .14830,
     1 -61.250,   13.420,   71.860, .36888, .88016, .25344,       .12004,
     1 -61.250,   13.090,   72.600, .39191, .85775, .27352,       .08766,
     1 -61.250,   12.720,   73.330, .41871, .82680, .31374,       .08096,
     1 -61.250,   12.290,   74.000, .46845, .77104, .36124,       .07110,
     1 -61.250,   11.800,   74.640, .51737, .71973, .38914,       .06902,
     1 -61.250,   11.290,   75.260, .55816, .67037, .40776,       .06921,
     1 -61.250,   10.590,   75.910, .60833, .57538, .46576,       .07559,
     1 -61.25000,    9.78000,  76.50000, .65146, .48078, .50582,.07677/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=685,702)/
     1 -61.250,    8.910,   76.990, .69843, .37954, .52240,       .07654,
     1 -61.250,    8.000,   77.380, .65617, .29707, .69345,       .91966,
     1 -59.000,   14.640,   62.850, .18379, .98208,-.00003,       .10803,
     1 -59.000,   14.570,   63.750, .22164, .97165, .06327,       .24512,
     1 -59.000,   14.460,   64.720, .21944, .97013, .08706,       .25421,
     1 -59.000,   14.320,   65.710, .22987, .96509, .10723,       .22397,
     1 -59.000,   14.150,   66.700, .25559, .95464, .13027,       .18441,
     1 -59.000,   13.940,   67.680, .28459, .93996, .16021,       .14872,
     1 -59.000,   13.680,   68.650, .32575, .91760, .19398,       .12412,
     1 -59.000,   13.370,   69.600, .36816, .88792, .23434,       .10264,
     1 -59.000,   12.980,   70.520, .41914, .84603, .28192,       .08973,
     1 -59.000,   12.520,   71.420, .44757, .80616, .33470,       .07933,
     1 -59.000,   11.980,   72.240, .50271, .73785, .39008,       .06961,
     1 -59.000,   11.330,   73.020, .57522, .64531, .43914,       .06751,
     1 -59.000,   10.600,   73.700, .62017, .55645, .48510,       .06364,
     1 -59.000,    9.780,   74.300, .65916, .46640, .52127,       .06336,
     1 -59.000,    8.910,   74.800, .70186, .37603, .53063,       .06208,
     1 -59.00000,    8.00000,  75.22000, .65809, .31531, .68352,.67377/
      DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=703,720)/
     1 -57.000,   13.880,   65.450, .23613, .97073,-.00009,       .02869,
     1 -57.000,   13.830,   65.730, .23493, .96759, .03861,       .05504,
     1 -57.000,   13.590,   66.700, .35589, .90542, .18296,       .09570,
     1 -57.000,   13.290,   67.660, .35883, .89285, .23026,       .09708,
     1 -57.000,   12.910,   68.600, .37852, .86647, .28255,       .08951,
     1 -57.000,   12.470,   69.500, .42944, .81913, .33144,       .07772,
     1 -57.000,   11.950,   70.330, .49107, .74666, .39200,       .06747,
     1 -57.000,   11.310,   71.100, .55237, .65839, .45179,       .06402,
     1 -57.000,   10.600,   71.780, .62622, .55528, .48154,       .06153,
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          1 -57.000,    9.800,   72.360, .66526, .46324, .51799,      .06086,
          1 -57.000,    8.940,   72.880, .69480, .38098, .53904,      .06047,
          1 -57.000,    8.000,   73.320, .65291, .32090, .68592,      .76876,
          1 -55.000,   12.200,   68.050, .48229, .87493,-.00031,      .04803,
          1 -55.000,   11.900,   68.470, .45663, .82179, .20523,      .01685,
          1 -55.000,   11.270,   69.250, .55443, .67717, .40599,      .03992,
          1 -55.000,   10.570,   69.910, .62202, .57685, .44103,      .03679,
          1 -55.000,    9.780,   70.510, .66554, .48581, .47414,      .03650,
          1 -55.00000,    8.90000,   71.02000, .70182, .38932, .50483,.03683/
           DATA(X(N),Y(N),Z(N),XN(N),YN(N),ZN(N),AN(N),N=721,738)/
          1 -55.000,    8.000,   71.420, .65144, .30796, .69317,      .49396,
          1 -54.000,   10.180,   69.320, .77950, .62347,-.00091,      .01499,
          1 -54.000,    9.800,   69.580, .71243, .53616, .27469,      .00595,
          1 -54.000,    8.930,   70.060, .75063, .39676, .38313,      .00961,
          1 -54.000,    6.000,   70.480, .65341, .31138, .68973,      .21933,
          1 -53.50000,    8.00000,   70.00000, .48893, .51005, .00102,.01000,
          1 -73.00000,      .00000,   88.58000,.68977,.00000,.72403, 453.02071,
          1 -74.00000,      .00000,   89.53000,.68747,.00000,.72620,  21.37511,
          1 -74.50000,      .00000,   90.00000,.57845,.00000,.81472,   6.72945,
          1 -81.00000,      .00000,   94.50000,.48817,.00000,.86678,   3.50271,
          1 -87.00000,      .00000,   97.04000,.33819,.00000,.93941,   5.63053,
          1 -93.00000,      .00000,   98.82000,.25229,.00000,.96696,   7.68244,
          1 -98.00000,      .00000,   99.91000,.18945,.00000,.98160,  10.43519,
          1-103.00000,      .00000, 100.75000,.14303,.00000,.98950,  13.12666,
          1-109.00000,      .00000, 101.50000,.10358,.00000,.99441,  14.45457,
          1-115.00000,      .00000, 102.00000,.08085,.00000,.99672,  74.41462,
          1-118.00000,      .00000, 102.23000,.07479,.00000,.99720,  37.76113,
          1-119.00000,      .00000, 102.30000,.06983,.00000,.99756, 385.74158/
           END

END OF LISTING.      0 *DIAGNOSTIC* MESSAGE(S).
```

```
@I FOR PLOIT
COMPILATION BY UNIVAC 1108 FORTRAN-IV DATED       JUNE 22,1965 F4008
THIS COMPILATION WAS DONE ON 04 DEC 72 AT 21:24:33


   SUBROUTINE PLOIT       ENTRY POINT 000265

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001     *CODE     000302
         0000     *DATA     000306
         0002     *BLANK    000000
         0003     BLK1      012056
         0004     BLK2      016230



   EXTERNAL REFERENCES (BLOCK, NAME)

         0005     ALOG10
         0006     NWDU$
         0007     NI01$
         0010     NI02$



   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000013 123G         0001     000021 127G         0001     000034 134G
    0000     000262 19F          0001     000130 22L          0001     000226 230G
    0001     000236 30L          0001     000247 40L          0001     000110 65L
    0001     000171 92L          0001     000201 93L          0000 R 000254 A
    0004 R 013540 B              0000 I 000144 IA            0004 I 000000 IALPH
    0000 I 000247 IC             0000 I 000255 ICON          0000 I 000000 ICONV
    0000 I 000245 IOUT           0000 I 000252 IX            0000 I 000253 IXX
    0000 I 000243 IZERO          0000 I 000246 K             0000 I 000241 N
    0003     000000 X            0003     004246 XN          0003     001342 Y
    0003     007152 ZN



 1.          SUBROUTINE PLOIT(NNOR,J)
```

```
      DIMENSION ICONV(100)
      DIMENSION IA(61)
      COMMON/BLK1/X(738),Y(738),Z(738),XN(738),YN(738),ZN(738),AN(738)
      COMMON/BLK2/IALPH(1464),IBETA(1464),RT(1464),RG(1464),B(1464)
      DATA (ICONV(N),N=1,100)/2H01,2H02,2H03,2H04,2H05,2H06,2H07,2H08,
     12H09,2H10,2H11,2H12,2H13,2H14,2H15,2H16,2H17,2H18,2H19,2H20,
     22H21,2H22,2H23,2H24,2H25,2H26,2H27,2H28,2H29,2H30,
     32H31,2H32,2H33,2H34,2H35,2H36,2H37,2H38,2H39,2H40,
     42H41,2H42,2H43,2H44,2H45,2H46,2H47,2H48,2H49,2H50,
     52H51,2H52,2H53,2H54,2H55,2H56,2H57,2H58,2H59,2H60,
     62H61,2H62,2H63,2H64,2H65,2H66,2H67,2H68,2H69,2H70,
     72H71,2H72,2H73,2H74,2H75,2H76,2H77,2H78,2H79,2H80,
     82H81,2H82,2H83,2H84,2H85,2H86,2H87,2H88,2H89,2H90,
     92H91,2H92,2H93,2H94,2H95,2H96,2H97,2H98,2H99,2H00,
      DATA IBLNK/2H ./
      DATA IZERO/2H Z/
      DATA IHIGH/2H H/
      IOUT=6
      K=1
      IC=1
      DO 10 IY=3,360,3
      IYY=183-IY
      DO 15 IX=3,183,3
      IXX=IX/3
      A=0.
      DO 25 N=1,NNOR
      IF(IALPH(N).NE.(IX-3))GO TO 25
      IF(IBETA(N).NE.IYY)GO TO 25
      IF(J.EQ.1)A=A+B(N)
      IF(J.EQ.2)GO TO 70
      IF(J.EQ.3)GO TO 75
      IF(J.EQ.4)GO TO 65
       GO TO 25
   70 IF(A-B(N))71,25,25
   71 A=B(N)
      GO TO 25
   75 IF(A-RT(N))76,25,25
   76 A=RT(N)
      GO TO 25
   65 IF(A-RG(N))66,25,25
   66 A=RG(N)
   25 CONTINUE
      IF(A)21,21,22
```

```
 21 IA(IXX)=IBLNK
    GO TO 15
 22 IF(J.LE.2)ICON=INT(10.*ALOG10(A))
    IF(J.GE.3)ICON=INT(A+.5)
    IF(ICON)91,91,92
 91 IA(IXX)=IZERO
    GO TO 15
 92 IF(ICON-99)93,93,94
 94 IA(IXX)=IHIGH
    GO TO 15
 93 IA(IXX)=ICONV(ICON)
 15 CONTINUE
    IF(IC-K)30,35,30
 35 IO=180-(K-1)*3
    WRITE(IOUT,18)IO,(IA(IXX),IXX=1,61)
 18 FORMAT(1X,I4,1HY,61A2)
    IC=IC+5
    GO TO 40
 30 WRITE(IOUT,19)(IA(IXX),IXX=1,61)
 19 FORMAT(5X,1HY,61A2)
 40 K=K+1
 10 CONTINUE
    RETURN
    END

END OF LISTING.       0 *DIAGNOSTIC* MESSAGE(S).
```

```
WI FOR COBWIN
COMPILATION BY UNIVAC 1108 FORTRAN-IV DATED      JUNE 22,1965 F4006
THIS COMPILATION WAS DONE ON 17 NOV 72 AT 13:42:49


   MAIN PROGRAM           ENTRY POINT 000000

   STORAGE USED (BLOCK, NAME, LENGTH)

          0001    *CODE    002106
          0000    *DATA    015000
          0002    *BLANK   000000
          0003    BLK1     012056
          0004    BLK2     016230


   EXTERNAL REFERENCES (BLOCK, NAME)

          0005    COS
          0006    SIN
          0007    ATAN2
          0010    SQRT
          0011    CONFRA
          0012    EXP
          0013    PLOTT
          0014    ALOG10
          0015    NRDU$
          0016    NI01$
          0017    NI02$
          0020    NWDU$
          0021    NSTOP$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000655 100L       0001     000335 101L        0001     001747 1012G
    0001     002011 1034G      0001     002032 1045G       0000     014423 105F
    0000     014430 12F        0001     000031 130G        0001     000044 136G
    0001     000104 175G       0000     014525 201F        0000     014514 202F
    0001     000172 220G       0000     014567 243F        0000     014513 250F
    0000     014473 302F       0000     014634 311F        0000     014640 312F
```

```
0000      014432 38F       0000      014435 39F       0000      014504 401F
0000      014650 431F      0000      014653 432F      0000      014656 433F
0000      014646 436F      0000      014667 437F      0000      014707 438F
0001      001500 445L      0000      014644 449F      0001      001115 460G
0001      000573 471L      0001      000524 472L      0000      014426 48F
0000      014714 492F      0000      014551 500F      0000      014602 505F
0000      014720 508F      0000      014616 510F      0001      001164 511G
0001      001266 552G      0001      001277 560G      0001      001311 571G
0001      001415 623G      0001      001436 634G      0001      001457 645G
0001      001520 703G      0001      001541 711G      0001      001573 733G
0001      001672 774G      0014 R 000000 ALOG10    0000 R 014377 ALPHA
0000 R 014370 AREA      0007 R 000000 ATAN2     0004 R 013340 B
0000 R 014344 BH        0000 R 014342 BS        0000 R 014362 CG
0000 R 014404 E         0012 R 000000 EXP       0000 R 014345 EYE
0004 I 000000 IALPH     0004 I 002670 IBETA     0000 I 014333 IBL
0000 I 000302 IC10      0000 I 000014 IDATA     0000 I 014340 IIN
0000 I 014421 IROG      0000 I 011240 ISD       0000 I 014410 J
0000 I 014413 JJ        0000 I 014350 JJD       0000 I 014414 JJJ
0000 I 014422 JK        0000 I 014346 K         0000 I 014412 L
0000 I 014363 N         0000 I 014364 NN        0000 I 014337 NNORT
0000 R 014403 R         0000 R 014336 RADIAN    0004 R 010450 RG
0000 R 014407 ROG       0000 R 014200 ROGL      0004 R 005560 RT
0000 R 014372 RX        0000 R 014373 RY        0000 R 014374 RZ
0000 R 014375 SD        0000 R 014371 SDN       0006 R 000000 SIN
0000 R 014356 SY        0000 R 014357 SZ        0000 R 014130 SZE
0000 R 000000 XC        0003 R 004246 XN        0000 R 014365 XNORM
0000 R 000006 YC        0003 R 005610 YN        0000 R 014366 YNORM
0003 R 007152 ZN        0000 R 014367 ZNORM     0000 R 006350 ZR
```

```
C        COBRA WINDOW
         DIMENSION XC(6),YC(6)
         DIMENSION IDATA(91),IC(91),IC10(91),RTOT(91)
         DIMENSION XR(1464),YR(1464),ZR(1464)
         DIMENSION ISD(1464)
         DIMENSION SZE(20),SAZI(20),ROGL(91)
         COMMON/BLK1/X(738),Y(738),Z(738),XN(738),YN(738),ZN(738),AN(738)
         COMMON/BLK2/IALPH(1464),IBETA(1464),RT(1464),RG(1464),B(1464)
         DATA IBL/1H /
         DATA IBX/1HX/
         NXY=6
```

```
      RADIAN=57.29578
      NNORT=1464
      IIN=5
      IOUT=6
      BS=2000.
      ROE=.15
      BH=.0009
      EYE=.15
      READ(IIN,105)(XC(K),K=1,NXY)
      READ(IIN,105)(YC(K),K=1,NXY)
  105 FORMAT(6F6.3)
      READ(IIN,49)JD
   49 FORMAT(I3)
      READ(IIN,48)(SZE(JJD),SAZI(JJD),JJD=1,JD)
   48 FORMAT(2F8.2)
   12 FORMAT(5H BETA)
   38 FORMAT(5X,41(3HXXX))
   39 FORMAT(7X,1H0,8X,2H15,8X,2H30,8X,2H45,8X,2H60,8X,2H75,8X,2H90,
     27X,3H105,7X,3H120,7X,3H135,7X,3H150,7X,3H165,7X,3H180)
   37 FORMAT(65X,5HALPHA)
  301 FORMAT(47X,34HHELICOPTER DETECTION RANGE CONTOUR)
  302 FORMAT(43X,42HSCALE FACTOR:VALUE=RANGE IN NAUTICAL MILES)
  401 FORMAT(49X,30HWINDOW DETECTION RANGE CONTOUR)
      DO 600 IOA=1,91
      RTOT(IOA)=10.
  600 CONTINUE
      DO 80 M=1,JD
      SZEN=.017453*SZE(M)
      SAZ=.017453*SAZI(M)
      SX=-COS(SAZ)*SIN(SZEN)
      SY=-SIN(SAZ)*SIN(SZEN)
      SZ=-COS(SZEN)
      DO 260 IOA=1,91
      ROGL(IOA)=10.
      IC10(IOA)=0
      IC(IOA)=0
  260 CONTINUE
      RVIS=5.
      CT=ABS(ROE*BH-BH)*100./BH
      CG=(BS*EYE*100.)/BH
      DO 100 N=1,NNORT
      NN=N
      IF(N.GT.738)NN=N-738
```

```
      XNORM=XN(NN)
      YNORM=YN(NN)
      ZNORM=ZN(NN)
      IF(N.GT.738)YNORM=-YNORM
      AREA=AN(NN)
      SDN=SX*XNORM+SY*YNORM+SZ*ZNORM
      RX=SX-2.*SDN*XNORM
      RY=SY-2.*SDN*YNORM
      RZ=SZ-2.*SDN*ZNORM
      XR(N)=RX
      YR(N)=RY
      ZR(N)=RZ
      SDN=-SDN
      IF(SDN)101,101,102
  102 SD=ATAN2(SQRT(1-SDN*SDN),SDN)
      SD=SD*RADIAN
      ISD(N)=INT(SD+.5)
      CALL CONFRA(NXY,XC,YC,SD,RO)
      B(N)=AREA*SDN*RO
      B(N)=B(N)*1.0E+07
      GO TO 103
  101 B(N)=0.
      RT(N)=0.
      RG(N)=0.
      ISD(N)=0
      IALPH(N)=0
      IBETA(N)=0
      GO TO 100
  103 CONTINUE
      ALPHA=ATAN2(SQRT(1-ZR(N)*ZR(N)),ZR(N))
      ALPHA=ALPHA*RADIAN
      IALPH(N)=3*INT(ALPHA/3.+.5)
      BETA=ATAN2(YR(N),XR(N))
      BETA=BETA*RADIAN
      IF(BETA)44,43,43
   44 IBETA(N)=3*INT(BETA/3-.5)
      GO TO 42
   43 IBETA(N)=3*INT(BETA/3.+.5)
   42 CONTINUE
      BF=B(N)/(144.*1.0E+07)
      AP=ABS(RX*35.)+ABS(RY*450.)+ABS(RZ*157.5)
      R=0.
  462 E=EXP(-3.9075*R/RVIS)*CT
```

```
      F=-E+1.57+R*R*36.5/AP
      F1=3.9075*E/RVIS+2.*R*36.5/AP
      IF(F/F1+.1)460,461,461
  460 R=R-F/F1
      GO TO 462
  461 RT(N)=R
      R=0.
  472 E=EXP(-3.9075*R/RVIS)*CG*RO
      F=-E+1.57+R*R*36.5*RO/BF
      F1=3.9075*E/RVIS+2.*R*36.5*RO/BF
      IF(F/F1+.1)470,471,471
  470 R=R-F/F1
      GO TO 472
  471 RG(N)=R
      IOA=INT(SD+1.5)
      IC(IOA)=IC(IOA)+1
      ROG=((1.57+36.5*RT(N)*RT(N)*RO/BF)*BH/(100.*EXP(-3.9075*RT(N)/
     2RVIS)))/(BS*EYE)
      IF(ROG-ROGL(IOA))261,262,262
  261 ROGL(IOA)=ROG
      IF(ROG-RTOT(IOA))601,262,262
  601 RTOT(IOA)=ROG
  262 CONTINUE
  100 CONTINUE
      WRITE(IOUT,250)
  250 FORMAT(1H1)
      WRITE(IOUT,202)SZE(M),SAZI(M)
  202 FORMAT(44X,11HSUN ZENITH=,F6.0,4X,12HSUN AZIMUTH=,F6.0)
      WRITE(IOUT,201)
  201 FORMAT(56X,15HBRIGHTNESS PLOT)
      WRITE(IOUT,203)
  203 FORMAT(24X,38HSCALE FACTOR: VALUE=10X LOG BASE 10 OF,
     242H AREA X REFLECTIVITY X 10 TO THE 7TH POWER)
      WRITE(IOUT,12)
      J=2
      CALL PLOTT(NNORT,J)
      WRITE(IOUT,38)
      WRITE(IOUT,39)
      WRITE(IOUT,37)
      WRITE(IOUT,250)
      WRITE(IOUT,301)
      WRITE(IOUT,302)
      WRITE(IOUT,12)
```

```
      J=3
      CALL PLOTT(NNORT,J)
      WRITE(IOUT,38)
      WRITE(IOUT,39)
      WRITE(IOUT,37)
      WRITE(IOUT,250)
      WRITE(IOUT,401)
      WRITE(IOUT,302)
      WRITE(IOUT,12)
      J=4
      CALL PLOTT(NNORT,J)
      WRITE(IOUT,38)
      WRITE(IOUT,39)
      WRITE(IOUT,37)
      WRITE(IOUT,250)
      WRITE(IOUT,500)
  500 FORMAT(29X,40HREFLECTED RAY ALPHA, BETA, ANGLE OF INCI,
     230HDENCE, DETECTION RANGE LISTING)
      NUM=INT(NNORT/4)
      J=0
      DO 340 L=1,NUM
      J=J+1
      IF(J.EQ.1)WRITE(IOUT,243)
  243 FORMAT(1X,4(29H  NUM ALPHA  BETA ANGLE RANGE))
      JJ=L*4-3
      JJJ=JJ+3
      WRITE(IOUT,341)(LL,IALPH(LL),IBETA(LL),ISD(LL),RG(LL),LL=JJ,JJJ)
  341 FORMAT(1X,4(I4,3I6,F8.0,1X))
      IF(J.EQ.40)WRITE(IOUT,250)
      IF(J.EQ.40)J=0
  340 CONTINUE
      WRITE(IOUT,250)
      WRITE(IOUT,505)
  505 FORMAT(21X,40HREQUIRED REFLECTIVITY AS A FUNCTION OF A,
     217HNGLE OF INCIDENCE)
      WRITE(IOUT,510)
  510 FORMAT(1X,5HANGLE,8X,1H0,8X,1H1,8X,1H2,8X,1H3,8X,1H4,8X,1H5,8X,
     21H6,8X,1H7,8X,1H8,8X,1H9)
      DO 310 JJ=1,9
      JJJ=JJ*10-9
      JJJJ=JJJ+9
      JJJJJ=JJ*10-10
      WRITE(IOUT,311)JJJJJ,(ROGL(LL),LL=JJJ,JJJJ)
```

```
  311 FORMAT(2X,I4,5X,10(F8.6,1X))
  310 CONTINUE
      WRITE(IOUT,312)ROGL(91)
  312 FORMAT(4X,2H90,5X,F8.6)
      WRITE(IOUT,506)
  506 FORMAT(//)
      WRITE(IOUT,505)
      DO 450 J=1,91
      IC10(J)=IC(J)/10
      IC(J)=INT(IC(J)-10*IC10(J)+.1)
  450 CONTINUE
      WRITE(IOUT,449)(IC10(J),J=1,91)
      WRITE(IOUT,449)(IC(J),J=1,91)
  449 FORMAT(7X,9111)
      WRITE(IOUT,436)
  436 FORMAT(3X,2HRO)
      DO 440 JJ=1,10
      DO 430 J=1,91
      JA=11-JJ
      ROG=ROGL(J)*1.0E+09
      IROG=INT(100*ALOG10(ROG))
      IF(IROG.GE.JA*100)IDATA(J)=IBX
      IF(IROG.LT.JA*100)IDATA(J)=IBL
  430 CONTINUE
      IF(JJ.EQ.1)WRITE(IOUT,431)(IDATA(JJJ),JJJ=1,91)
      IF(JJ.EQ.1)GO TO 445
      IF(JJ.EQ.4)WRITE(IOUT,432)(IDATA(JJJ),JJJ=1,91)
      IF(JJ.EQ.4)GO TO 445
      IF(JJ.EQ.7)WRITE(IOUT,433)(IDATA(JJJ),JJJ=1,91)
      IF(JJ.EQ.7)GO TO 445
      IF(JJ.EQ.10)WRITE(IOUT,434)(IDATA(JJJ),JJJ=1,91)
      IF(JJ.EQ.10)GO TO 445
      WRITE(IOUT,435)(IDATA(JJJ),JJJ=1,91)
  431 FORMAT(1X,6H10+1 Y,91A1)
  432 FORMAT(1X,6H10-2 Y,91A1)
  433 FORMAT(1X,6H10-5 Y,91A1)
  434 FORMAT(1X,6H10-8 Y,91A1)
  435 FORMAT(1X,6H      Y,91A1)
  445 CONTINUE
  440 CONTINUE
      WRITE(IOUT,437)
  437 FORMAT(6X,92(1HX))
      WRITE(IOUT,439)
```

```
  439 FORMAT(7X,1H0,8X,2H10,8X,2H20,8X,2H30,8X,2H40,8X,2H50,8X,2H60,
     28X,2H70,8X,2H80,8X,2H90)
      WRITE(IOUT,438)
  438 FORMAT(40X,18HANGLE OF INCIDENCE)
      DO 491 JJ=1,13
      J=7*JJ-6
      JJJ=7*JJ
      WRITE(7,492)(ROGL(JK),JK=J,JJJ),M,JJ
  492 FORMAT(2X,7F9.6,3X,I2,2X,I2)
  491 CONTINUE
   80 CONTINUE
      WRITE(IOUT,250)
      WRITE(IOUT,505)
      WRITE(IOUT,510)
      DO 610 JJ=1,9
      JJJ=JJ*10-9
      JJJJ=JJJ+9
      JJJJJ=JJ*10-10
      WRITE(IOUT,311)JJJJJ,(RTOT(LL),LL=JJJ,JJJJ)
  610 CONTINUE
      WRITE(IOUT,312)RTOT(91)
      WRITE(IOUT,506)
      WRITE(IOUT,508)
  508 FORMAT(45X,10HSUMMARY OF)
      WRITE(IOUT,505)
      WRITE(IOUT,507)
  507 FORMAT(40X,21HFOR ALL SUN POSITIONS)
      WRITE(IOUT,436)
      DO 640 JJ=1,10
      DO 630 J=1,91
      JA=11-JJ
      ROG=RTOT(J)*1.0E+09
      IROG=INT(100*ALOG10(ROG))
      IF(IROG.GE.JA*100)IDATA(J)=IBX
      IF(IROG.LT.JA*100)IDATA(J)=IBL
  630 CONTINUE
      IF(JJ.EQ.1)WRITE(IOUT,431)(IDATA(JJJ),JJJ=1,91)
      IF(JJ.EQ.1)GO TO 645
      IF(JJ.EQ.4)WRITE(IOUT,432)(IDATA(JJJ),JJJ=1,91)
      IF(JJ.EQ.4)GO TO 645
      IF(JJ.EQ.7)WRITE(IOUT,433)(IDATA(JJJ),JJJ=1,91)
      IF(JJ.EQ.7)GO TO 645
      IF(JJ.EQ.10)WRITE(IOUT,434)(IDATA(JJJ),JJJ=1,91)
```

```
      IF(JJ.EQ.16)GO TO 645
      WRITE(IOUT,435)(IDATA(JJJ),JJJ=1,91)
  645 CONTINUE
  640 CONTINUE
      WRITE(IOUT,437)
      WRITE(IOUT,439)
      WRITE(IOUT,438)
      WRITE(7,490)(RTOT(J),J=1,91)
  490 FORMAT(2X,7F9.6)
      STOP
      END

END OF LISTING.      0 *DIAGNOSTIC* MESSAGE(S).
```

```
@I FOR CONFRA
COMPILATION BY UNIVAC 1108 FORTRAN-IV DATED      JUNE 22,1965 F4008
THIS COMPILATION WAS DONE ON 17 NOV 72 AT 13:42:59


   SUBROUTINE CONFRA     ENTRY POINT 000117

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001    *CODE    000161
         0000    *DATA    000016
         0002    *BLANK   000000



   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000004 105G          0001     000013 300L          0001     000025 310L
    0001     000075 600L          0001     000114 700L          0001     000104 800L
    0000 R 000004 C               0000 R 000003 C1              0000 I 000000 J



             SUBROUTINE CONFRA(NXY,X,Y,XIN,YOUT)
             DIMENSION X(10),Y(10)
             DO 35 J=1,NXY
             IF(XIN-X(J))300,35,35
          35 CONTINUE
         300 IF(J-3)370,310,310
         370 J=J+1
             IF(J-3)370,310,310
         310 YOUT=Y(J-2)
             IF(Y(J-1)-Y(J-2))710,700,710
         710 A=(X(J-1)-X(J-2))/(Y(J-1)-Y(J-2))
             IF(Y(J)-Y(J-2))720,700,720
         720 A1=(X(J)-X(J-2))/(Y(J)-Y(J-2))
             IF(A1-A)400,500,400
         500 C1=0.0
             GO TO 600
         400 CONTINUE
             C=(X(J)-X(J-1))/(A1-A)
             C1=(XIN-X(J-1))/C
```

```
      600 IF(A+C1)800,900,800
      900 YOUT=1.
          GO TO 700
      800 CONTINUE
          YOUT=Y(J-2)+(XIN-X(J-2))/(A+C1)
      700 RETURN
          END

END OF LISTING.      0 *DIAGNOSTIC* MESSAGE(S).
```

APPENDIX B

TYPICAL RESULTS
FROM
COBRA WINDOW MODEL

Segment 1 - Normals and Effective Areas

Segment 2 - Area Contours

Segment 3 - Brightness Factors, Detection Ranges and Required Reflectivities for Sun Azimuth = 45°, Sun Zenith = 45°, and Visibility = 5 Nautical Miles

```
     X            Y            Z        X NORMAL   Y NORMAL   Z NORMAL      AREA
-169.49999   14.35000    98.30000    -.03122     .92731     .37267      .25151
-169.49999   14.04000    99.07000    -.01722     .91356     .40315      .14960
-169.49999   13.60000   100.00000    -.01154     .90216     .42780      .08933
-167.33000   16.43000    90.08000    -.06907     .98876     .12973      .42359
-167.33000   16.30000    91.07000    -.07164     .98642     .14449      .67862
-167.33000   16.14000    92.06000    -.06732     .98186     .17446      .66528
-167.33000   15.95000    93.04000    -.06792     .97713     .19943      .76526
-167.33000   15.74000    94.02000    -.06170     .97232     .22326      .68875
-167.33000   15.50000    95.00000    -.05352     .96559     .25256      .67155
-167.33000   15.23000    95.97000    -.04041     .95879     .27967      .72331
-167.33000   14.94000    96.92000    -.03823     .95584     .26886      .24134
-167.33000   14.60000    97.86000    -.02630     .94080     .31240      .21450
-167.33000   14.20000    98.80000    -.01370     .92415     .35439      .19572
-167.33000   13.77000    99.70000     .00097     .90361     .39730      .17042
-167.33000   13.28000   100.57000     .00510     .87661     .45325      .14879
-167.33000   12.90000   101.17000     .00323     .87015     .45960      .10491
-167.33000   12.58000   101.72000     .01873     .86289     .50316      .23552
-162.00000   17.04000    85.61000    -.10684     .99425     .00000     2.27102
-162.00000   17.04000    86.62000    -.09867     .99502     .00479     2.54461
-162.00000   17.02000    87.62000    -.08650     .99570     .02417     1.50846
-162.00000   16.96000    88.64000    -.07538     .99509     .05340     1.00382
-162.00000   16.86000    89.64000    -.06973     .99364     .07613      .77616
-162.00000   16.75000    90.64000    -.06475     .99143     .09532      .57549
-162.00000   16.56000    91.64000    -.06074     .98729     .12630      .47128
-162.00000   16.40000    92.65000    -.05560     .98398     .14478      .40025
-162.00000   16.17000    93.62000    -.04925     .97640     .18060      .32252
-162.00000   15.90000    94.60000    -.04089     .97046     .20528      .29047
-162.00000   15.61000    95.56000    -.03472     .96532     .22357      .26375
-162.00000   15.30000    96.50000    -.03061     .95723     .24788      .23368
-162.00000   14.94000    97.43000    -.02311     .94471     .28271      .20837
-162.00000   14.54000    98.35000    -.01485     .92880     .32023      .18528
-162.00000   14.07000    99.25000    -.00799     .90251     .37469      .16180
-162.00000   13.54000   100.10000     .00034     .88090     .41250      .14631
-162.00000   13.00000   100.94000     .01018     .86876     .43207      .14030
-162.00000   12.41000   101.76000     .02406     .83593     .48117      .12891
-162.00000   11.75000   102.52000     .02131     .79374     .53567      .11704
-162.00000   11.05000   103.24000     .01205     .75030     .58646      .10856
-162.00000   10.30000   103.88000    -.00821     .69370     .64113      .09859
-162.00000    9.52000   104.46000    -.03712     .62681     .69943      .08918
-162.00000    8.76000   104.90000    -.07254     .55806     .73371      .07367
-162.00000    8.00000   105.31000    -.07087     .45988     .87545      .10990
-157.00000   17.40000    81.49000    -.12086     .99100    -.03850      .35414
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-157.00000   17.48000   82.49000   -.11165   .99153   -.05412    .82110
-157.00000   17.54000   83.49000   -.10039   .99386   -.03465    .97902
-157.00000   17.56000   84.49000   -.09005   .99569   -.00509   1.44547
-157.00000   17.54000   85.50000   -.08576   .99583    .02195   1.42026
-157.00000   17.49000   86.50000   -.07943   .99573    .03961   1.26952
-157.00000   17.43000   87.49000   -.07107   .99550    .05243    .94292
-157.00000   17.34000   88.47000   -.06451   .99403    .07485    .70092
-157.00000   17.22000   89.46000   -.05694   .99164    .09856    .54041
-157.00000   17.06000   90.46000   -.04906   .98862    .12234    .45751
-157.00000   16.88000   91.46000   -.04309   .98500    .14347    .38476
-157.00000   16.66000   92.43000   -.03468   .97975    .17003    .32530
-157.00000   16.42000   93.40000   -.02926   .97356    .19463    .28177
-157.00000   16.12000   94.36000   -.02341   .96449    .22759    .24703
-157.00000   15.81000   95.31000   -.01707   .95926    .24370    .22890
-157.00000   15.46000   96.25000   -.00926   .94997    .27062    .20773
-157.00000   15.09000   97.17000   -.00435   .93916    .29716    .18719
-157.00000   14.66000   98.08000    .00136   .92201    .33667    .16866
-157.00000   14.20000   98.96000    .00750   .90577    .36851    .15282
-157.00000   13.69000   99.82000    .00911   .88360    .40886    .13947
-157.00000   13.14000  100.64000    .01558   .85433    .45461    .12524
-157.00000   12.52000  101.42000    .02177   .82333    .49781    .11613
-157.00000   11.88000  102.18000    .02801   .79453    .53762    .10893
-157.00000   11.22000  102.84000    .03494   .75026    .58236    .09650
-157.00000   10.47000  103.50000    .04207   .69789    .63858    .09685
-157.00000    9.66000  104.09000    .05265   .62137    .71050    .09173
-157.00000    8.88000  104.54000    .06040   .54584    .75777    .08104
-157.00000    6.00000  104.96000    .06391   .42962    .90065   1.60435
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-152.27000   17.92000   84.55000   -.06566   .99750    .01873   1.48568
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-152.27000	14.65000	98.10000	.00372	.91718	.34136	.13607
-152.27000	14.14000	98.98000	.00819	.89431	.38516	.12211
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-148.50000	17.86000	77.80000	-.04204	.99105	-.11091	.49218
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-148.50000	17.69000	88.81000	-.03109	.98894	.12773	.44838
-148.50000	17.50000	89.81000	-.03025	.98491	.15123	.39124
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-148.50000	16.81000	92.70000	-.02061	.96938	.21650	.26610
-148.50000	16.51000	93.68000	-.01531	.96063	.24680	.24011
-148.50000	16.18000	94.60000	-.01462	.95667	.25770	.22035
-148.50000	15.86000	95.54000	-.01086	.94944	.27536	.19914
-148.50000	15.46000	96.46000	-.00558	.92475	.33900	.17616
-148.50000	15.02000	97.37000	-.00064	.91249	.36467	.16415
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-148.50000    8.59000  104.15000      .07901     .45076     .83769     .06603
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-143.50000   18.28000   79.80000     -.04139     .99669    -.05950     .89249
-143.50000   18.34000   80.80000     -.04155     .99805    -.03952    1.33812
-143.50000   18.38000   81.81000     -.03967     .99882    -.01988    1.52826
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-143.50000   15.50000   96.35000      .00329     .92736     .32406     .17166
-143.50000   15.06000   97.26000      .00570     .91501     .35153     .16429
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-143.50000   12.84000  100.56000      .02709     .82012     .50244     .11735
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-138.69999  18.55000   82.83000   -.03321   .99930    .01327   3.09284
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-138.69999  18.47000   84.84000   -.02723   .99792    .04884   1.13707
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-138.69999  17.52000   90.78000   -.01372   .97704    .18692    .35494
-138.69999  17.26000   91.74000   -.01056   .97044    .21152    .31265
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-138.69999  12.66000  100.60000    .02907   .79120    .54615    .12935
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-132.99999  18.53000   77.75000   -.03689   .99392   -.08843    .74363
-132.99999  18.62000   78.74000   -.03751   .99645   -.06528   1.05738
-132.99999  18.70000   79.75000   -.03338   .99781   -.04458   1.04079
-132.99999  18.72000   80.76000   -.03029   .99939   -.01504   4.60218
-132.99999  18.74000   81.76000   -.02913   .99946   -.00743   2.78829
-132.99999  18.73000   82.76000   -.02603   .99942    .01525   2.44909
-132.99999  18.69000   83.76000   -.02273   .99829    .04300   1.22964
-132.99999  18.60000   84.76000   -.02042   .99696    .06531   1.06939
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-132.99999  18.06000  88.74000   -.01132   .98511   .14824   .46440
-132.99999  17.83000  89.73000   -.00846   .98021   .17225   .41412
-132.99999  17.60000  90.72000   -.00489   .97578   .18951   .36692
-132.99999  17.31000  91.68000   -.00217   .96660   .22345   .31589
-132.99999  17.01000  92.64000   -.00024   .96170   .23884   .29543
-132.99999  16.67000  93.59000    .00193   .95302   .26453   .26907
-132.99999  16.31000  94.53000    .00445   .93988   .29753   .23621
-132.99999  15.87000  95.44000    .00996   .92159   .33966   .21153
-132.99999  15.42000  96.35000    .01221   .91383   .35677   .20231
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            X              Y            Z           XN           YN           ZN           A
    -73.00000         .00000     88.58000       .68977       .00000       .72403   453.02071
    -74.00000         .00000     89.53000       .68747       .00000       .72620    21.37511
    -74.50000         .00000     90.00000       .57845       .00000       .81472     6.72945
    -81.00000         .00000     94.50000       .48817       .00000       .86678     3.50271
    -87.00000         .00000     97.04000       .33819       .00000       .93941     5.63053
    -93.00000         .00000     98.82000       .25229       .00000       .96696     7.68244
    -98.00000         .00000     99.91000       .18945       .00000       .98160    10.43519
   -103.00000         .00000    100.75000       .14303       .00000       .98950    13.12666
   -109.00000         .00000    101.50000       .10358       .00000       .99441    14.45457
   -115.00000         .00000    102.00000       .08085       .00000       .99672    74.41462
   -118.00000         .00000    102.23000       .07479       .00000       .99720    37.76113
   -119.00000         .00000    102.30000       .06983       .00000       .99756   385.74158
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                                                        SURFACE X,Y,Z LISTING
NUM       X          Y        Z      NUM       X          Y        Z      NUM       X          Y        Z      NUM       X          Y        Z
  1 -169.500    14.350    98.300       2 -169.500    14.040    99.070       3 -169.500    13.600  100.000       4 -167.330    16.430    90.080
  5 -167.330    16.300    91.070       6 -167.330    16.140    92.060       7 -167.330    15.950    93.040       8 -167.330    15.740    94.020
  9 -167.330    15.500    95.000      10 -167.330    15.230    95.970      11 -167.330    14.940    96.920      12 -167.330    14.600    97.860
 13 -167.330    14.200    98.800      14 -167.330    13.770    99.700      15 -167.330    13.280  100.570      16 -167.330    12.900  101.170
 17 -167.330    12.580  101.720      18 -162.000    17.040    85.610      19 -162.000    17.040    86.620      20 -162.000    17.020    87.620
 21 -162.000    16.960    88.640      22 -162.000    16.860    89.640      23 -162.000    16.750    90.640      24 -162.000    16.580    91.640
 25 -162.000    16.400    92.650      26 -162.000    16.170    93.620      27 -162.000    15.900    94.600      28 -162.000    15.610    95.560
 29 -162.000    15.300    96.500      30 -162.000    14.940    97.430      31 -162.000    14.540    98.350      32 -162.000    14.070    99.250
 33 -162.000    13.540  100.100      34 -162.000    13.000  100.940      35 -162.000    12.410  101.760      36 -162.000    11.750  102.520
 37 -162.000    11.050  103.240      38 -162.000    10.300  103.880      39 -162.000     9.520  104.460      40 -162.000     8.780  104.900
 41 -162.000     8.000  105.310      42 -157.000    17.400    81.490      43 -157.000    17.480    82.490      44 -157.000    17.540    83.490
 45 -157.000    17.560    84.490      46 -157.000    17.540    85.500      47 -157.000    17.490    86.500      48 -157.000    17.430    87.490
 49 -157.000    17.340    88.470      50 -157.000    17.220    89.460      51 -157.000    17.060    90.460      52 -157.000    16.880    91.460
 53 -157.000    16.660    92.430      54 -157.000    16.420    93.400      55 -157.000    16.120    94.360      56 -157.000    15.810    95.310
 57 -157.000    15.460    96.250      58 -157.000    15.090    97.170      59 -157.000    14.660    98.080      60 -157.000    14.200    98.960
 61 -157.000    13.690    99.820      62 -157.000    13.140  100.640      63 -157.000    12.520  101.420      64 -157.000    11.880  102.180
 65 -157.000    11.220  102.840      66 -157.000    10.470  103.500      67 -157.000     9.660  104.090      68 -157.000     8.880  104.540
 69 -157.000     8.000  104.960      70 -152.270    17.670    77.520      71 -152.270    17.750    78.520      72 -152.270    17.800    79.530
 73 -152.270    17.860    80.520      74 -152.270    17.900    81.520      75 -152.270    17.920    82.530      76 -152.270    17.940    83.540
 77 -152.270    17.920    84.550      78 -152.270    17.880    85.550      79 -152.270    17.820    86.550      80 -152.270    17.720    87.550
 81 -152.270    17.600    88.560      82 -152.270    17.430    89.560      83 -152.270    17.250    90.540      84 -152.270    17.030    91.520
 85 -152.270    16.780    92.500      86 -152.270    16.510    93.450      87 -152.270    16.200    94.400      88 -152.270    15.860    95.340
 89 -152.270    15.480    96.280      90 -152.270    15.090    97.190      91 -152.270    14.650    98.100      92 -152.270    14.140    98.980
 93 -152.270    13.610    99.830      94 -152.270    13.020  100.670      95 -152.270    12.390  101.470      96 -152.270    11.700  102.200
 97 -152.270    10.960  102.900      98 -152.270    10.300  103.410      99 -152.270     9.460  103.960     100 -152.270     8.810  104.320
101 -152.270     8.000  104.620     102 -148.500    17.700    76.800     103 -148.500    17.860    77.800     104 -148.500    17.970    78.790
105 -148.500    18.070    79.790     106 -148.500    18.130    80.800     107 -148.500    18.170    81.800     108 -148.500    18.170    82.810
109 -148.500    18.160    83.810     110 -148.500    18.110    84.810     111 -148.500    18.060    85.810     112 -148.500    17.980    86.810
113 -148.500    17.840    87.810     114 -148.500    17.690    88.810     115 -148.500    17.500    89.810     116 -148.500    17.300    90.790
117 -148.500    17.070    91.750     118 -148.500    16.810    92.700     119 -148.500    16.510    93.680     120 -148.500    16.180    94.600
121 -148.500    15.880    95.540     122 -148.500    15.460    96.460     123 -148.500    15.020    97.370     124 -148.500    14.530    98.260
125 -148.500    14.020    99.130     126 -148.500    13.470    99.940     127 -148.500    12.860  100.750     128 -148.500    12.200  101.520
129 -148.500    11.510  102.230     130 -148.500    10.730  102.900     131 -148.500    10.010  103.400     132 -148.500     9.220  103.840
133 -148.500     8.590  104.150     134 -148.500     8.000  104.360     135 -143.500    17.800    75.800     136 -143.500    17.940    76.800
137 -143.500    18.080    77.800     138 -143.500    18.190    78.800     139 -143.500    18.280    79.800     140 -143.500    18.340    80.800
141 -143.500    18.380    81.810     142 -143.500    18.380    82.810     143 -143.500    18.360    83.810     144 -143.500    18.310    84.810
145 -143.500    18.240    85.800     146 -143.500    18.130    86.780     147 -143.500    18.000    87.790     148 -143.500    17.840    88.770
149 -143.500    17.660    89.760     150 -143.500    17.450    90.730     151 -143.500    17.190    91.700     152 -143.500    16.920    92.660
153 -143.500    16.600    93.600     154 -143.500    16.290    94.530     155 -143.500    15.910    95.470     156 -143.500    15.500    96.350
157 -143.500    15.060    97.260     158 -143.500    14.570    98.120     159 -143.500    14.050    98.960     160 -143.500    13.470    99.780
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NUM      X         Y       Z      NUM      X         Y       Z      NUM      X         Y       Z      NUM      X         Y       Z
161 -143.500  12.840 100.560   162 -143.500  12.200 101.320   163 -143.500  11.470 102.010   164 -143.500  10.700 102.640
165 -143.500   9.890 103.190   166 -143.500   8.980 103.640   167 -143.500   8.000 104.010   168 -138.700  17.800  74.880
169 -138.700  17.990  75.860   170 -138.700  18.170  76.860   171 -138.700  18.300  77.840   172 -138.700  18.400  78.830
173 -138.700  18.480  79.830   174 -138.700  18.540  80.840   175 -138.700  18.560  81.840   176 -138.700  18.550  82.830
177 -138.700  18.520  83.820   178 -138.700  18.470  84.840   179 -138.700  18.380  85.840   180 -138.700  18.260  86.840
181 -138.700  18.120  87.820   182 -138.700  17.940  88.810   183 -138.700  17.750  89.800   184 -138.700  17.520  90.780
185 -138.700  17.260  91.740   186 -138.700  16.960  92.720   187 -138.700  16.630  93.680   188 -138.700  16.250  94.620
189 -138.700  15.860  95.550   190 -138.700  15.430  96.450   191 -138.700  14.980  97.330   192 -138.700  14.470  98.200
193 -138.700  13.910  99.030   194 -138.700  13.310  99.840   195 -138.700  12.660 100.600   196 -138.700  11.950 101.340
197 -138.700  11.190 102.000   198 -138.700  10.380 102.600   199 -138.700   9.600 103.050   200 -138.700   8.820 103.390
201 -138.700   8.000 103.680   202 -133.000  17.840  73.810   203 -133.000  18.080  74.780   204 -133.000  18.260  75.760
205 -133.000  18.400  76.760   206 -133.000  18.530  77.750   207 -133.000  18.620  78.740   208 -133.000  18.700  79.750
209 -133.000  18.720  80.760   210 -133.000  18.740  81.760   211 -133.000  18.730  82.760   212 -133.000  18.690  83.760
213 -133.000  18.600  84.760   214 -133.000  18.520  85.760   215 -133.000  18.400  86.760   216 -133.000  18.240  87.750
217 -133.000  18.060  88.740   218 -133.000  17.830  89.730   219 -133.000  17.600  90.720   220 -133.000  17.310  91.680
221 -133.000  17.010  92.640   222 -133.000  16.670  93.590   223 -133.000  16.310  94.530   224 -133.000  15.870  95.440
225 -133.000  15.420  96.350   226 -133.000  14.950  97.210   227 -133.000  14.430  98.080   228 -133.000  13.850  98.900
229 -133.000  13.230  99.710   230 -133.000  12.690 100.300   231 -133.000  11.980 101.020   232 -133.000  11.210 101.660
233 -133.000  10.380 102.230   234 -133.000   9.680 102.640   235 -133.000   8.760 103.040   236 -133.000   8.000 103.270
237 -127.000  17.880  72.640   238 -127.000  18.120  73.620   239 -127.000  18.310  74.600   240 -127.000  18.480  75.590
241 -127.000  18.620  76.590   242 -127.000  18.730  77.590   243 -127.000  18.820  78.590   244 -127.000  18.860  79.600
245 -127.000  18.890  80.610   246 -127.000  18.900  81.630   247 -127.000  18.860  82.620   248 -127.000  18.800  83.610
249 -127.000  18.730  84.600   250 -127.000  18.620  85.610   251 -127.000  18.480  86.610   252 -127.000  18.320  87.600
253 -127.000  18.120  88.590   254 -127.000  17.900  89.590   255 -127.000  17.640  90.550   256 -127.000  17.360  91.500
257 -127.000  17.050  92.460   258 -127.000  16.710  93.400   259 -127.000  16.320  94.330   260 -127.000  15.890  95.230
261 -127.000  15.440  96.130   262 -127.000  14.940  97.010   263 -127.000  14.400  97.870   264 -127.000  13.810  98.690
265 -127.000  13.180  99.450   266 -127.000  12.500 100.190   267 -127.000  11.770 100.870   268 -127.000  10.960 101.480
269 -127.000  10.120 102.020   270 -127.000   9.490 102.350   271 -127.000   8.840 102.600   272 -127.000   8.000 102.860
273 -121.000  17.910  71.520   274 -121.000  18.160  72.490   275 -121.000  18.360  73.480   276 -121.000  18.540  74.460
277 -121.000  18.680  75.440   278 -121.000  18.790  76.440   279 -121.000  18.880  77.440   280 -121.000  18.940  78.440
281 -121.000  18.970  79.440   282 -121.000  18.990  80.450   283 -121.000  18.980  81.460   284 -121.000  18.940  82.460
285 -121.000  18.870  83.460   286 -121.000  18.780  84.460   287 -121.000  18.660  85.450   288 -121.000  18.520  86.440
289 -121.000  18.350  87.420   290 -121.000  18.140  88.400   291 -121.000  17.920  89.380   292 -121.000  17.650  90.350
293 -121.000  17.360  91.310   294 -121.000  17.040  92.280   295 -121.000  16.690  93.190   296 -121.000  16.290  94.100
297 -121.000  15.860  95.020   298 -121.000  15.380  95.930   299 -121.000  14.880  96.810   300 -121.000  14.320  97.660
301 -121.000  13.720  98.470   302 -121.000  13.060  99.240   303 -121.000  12.350  99.970   304 -121.000  11.680 100.560
305 -121.000  10.850 101.170   306 -121.000   9.990 101.700   307 -121.000   9.360 102.000   308 -121.000   8.780 102.200
309 -121.000   8.000 102.440   310 -115.000  17.900  70.320   311 -115.000  18.150  71.300   312 -115.000  18.340  72.290
313 -115.000  18.520  73.270   314 -115.000  18.680  74.280   315 -115.000  18.790  75.270   316 -115.000  18.890  76.270
317 -115.000  18.960  77.270   318 -115.000  19.000  78.270   319 -115.000  19.020  79.280   320 -115.000  19.020  80.290
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NUM	X	Y	Z	NUM	X	Y	Z	NUM	X	Y	Z	NUM	X	Y	Z
321	-115.000	18.990	81.280	322	-115.000	18.930	82.280	323	-115.000	18.850	83.290	324	-115.000	18.740	84.290
325	-115.000	18.610	85.230	326	-115.000	18.460	86.270	327	-115.000	18.280	87.270	328	-115.000	18.070	88.250
329	-115.000	17.820	89.220	330	-115.000	17.560	90.190	331	-115.000	17.270	91.150	332	-115.000	16.930	92.090
333	-115.000	16.570	93.010	334	-115.000	16.170	93.930	335	-115.000	15.730	94.850	336	-115.000	15.260	95.710
337	-115.000	14.750	96.590	338	-115.000	14.190	97.420	339	-115.000	13.590	98.220	340	-115.000	12.920	98.990
341	-115.000	12.360	99.570	342	-115.000	11.590	100.210	343	-115.000	10.780	100.810	344	-115.000	9.900	101.330
345	-115.000	8.970	101.730	346	-115.000	8.000	102.000	347	-109.000	17.880	69.160	348	-109.000	18.100	70.160
349	-109.000	18.290	71.140	350	-109.000	18.460	72.120	351	-109.000	18.600	73.130	352	-109.000	18.730	74.110
353	-109.000	18.820	75.110	354	-109.000	18.880	76.090	355	-109.000	18.930	77.090	356	-109.000	18.940	78.090
357	-109.000	18.940	79.100	358	-109.000	18.920	80.110	359	-109.000	18.870	81.110	360	-109.000	18.800	82.120
361	-109.000	18.710	83.110	362	-109.000	18.580	84.110	363	-109.000	18.440	85.100	364	-109.000	18.280	86.100
365	-109.000	18.080	87.060	366	-109.000	17.860	88.070	367	-109.000	17.600	89.040	368	-109.000	17.340	90.020
369	-109.000	17.020	90.970	370	-109.000	16.680	91.920	371	-109.000	16.320	92.850	372	-109.000	15.890	93.770
373	-109.000	15.440	94.670	374	-109.000	14.970	95.550	375	-109.000	14.450	96.390	376	-109.000	13.880	97.230
377	-109.000	13.250	98.030	378	-109.000	12.530	[illegible].770	379	-109.000	11.970	99.450	380	-109.000	11.320	99.890
381	-109.000	10.670	100.350	382	-109.000	10.070	100.720	383	-109.000	9.430	101.030	384	-109.000	8.670	101.320
385	-109.000	8.000	101.500	386	-103.000	17.800	68.020	387	-103.000	17.980	68.990	388	-103.000	18.180	69.980
389	-103.000	18.340	70.960	390	-103.000	18.460	71.950	391	-103.000	18.600	72.960	392	-103.000	18.660	73.950
393	-103.000	18.730	74.950	394	-103.000	18.780	75.960	395	-103.000	18.790	76.960	396	-103.000	18.790	77.970
397	-103.000	18.760	78.980	398	-103.000	18.720	80.000	399	-103.000	18.660	80.980	400	-103.000	18.580	81.970
401	-103.000	18.460	82.970	402	-103.000	18.320	83.970	403	-103.000	18.160	84.970	404	-103.000	17.980	85.960
405	-103.000	17.790	86.920	406	-103.000	17.540	87.900	407	-103.000	17.280	88.880	408	-103.000	16.990	89.850
409	-103.000	16.670	90.800	410	-103.000	16.310	91.740	411	-103.000	15.930	92.660	412	-103.000	15.500	93.580
413	-103.000	15.030	94.460	414	-103.000	14.550	95.330	415	-103.000	14.000	96.180	416	-103.000	13.400	97.000
417	-103.000	12.770	97.770	418	-103.000	12.060	98.490	419	-103.000	11.300	99.130	420	-103.000	10.500	99.690
421	-103.000	9.790	100.120	422	-103.000	9.270	100.360	423	-103.000	8.690	100.560	424	-103.000	8.000	100.750
425	-98.000	17.680	67.060	426	-98.000	17.860	68.060	427	-98.000	18.020	69.050	428	-98.000	18.200	70.080
429	-98.000	18.310	71.080	430	-98.000	18.410	72.080	431	-98.000	18.490	73.070	432	-98.000	18.560	74.070
433	-98.000	18.590	75.070	434	-98.000	18.620	76.070	435	-98.000	18.610	77.070	436	-98.000	18.580	78.070
437	-98.000	18.530	79.070	438	-98.000	18.460	80.080	439	-98.000	18.380	81.080	440	-98.000	18.280	82.070
441	-98.000	18.140	83.060	442	-98.000	17.990	84.070	443	-98.000	17.810	85.060	444	-98.000	17.610	86.050
445	-98.000	17.380	87.040	446	-98.000	17.120	87.990	447	-98.000	16.840	88.960	448	-98.000	16.530	89.920
449	-98.000	16.200	90.860	450	-98.000	15.800	91.800	451	-98.000	15.380	92.740	452	-98.000	14.930	93.630
453	-98.000	14.420	94.520	454	-98.000	13.870	95.370	455	-98.000	13.430	96.020	456	-98.000	12.930	96.660
457	-98.000	12.390	97.060	458	-98.000	11.740	97.900	459	-98.000	11.030	98.480	460	-98.000	10.370	98.950
461	-98.000	9.730	99.300	462	-98.000	9.090	99.600	463	-98.000	8.520	99.790	464	-98.000	8.000	99.910
465	-93.000	17.520	66.060	466	-93.000	17.690	67.060	467	-93.000	17.840	68.050	468	-93.000	17.970	69.050
469	-93.000	18.080	70.060	470	-93.000	18.180	71.060	471	-93.000	18.250	72.070	472	-93.000	18.320	73.060
473	-93.000	18.360	74.060	474	-93.000	18.370	75.070	475	-93.000	18.360	76.070	476	-93.000	18.340	77.060
477	-93.000	18.280	78.060	478	-93.000	18.220	79.060	479	-93.000	18.130	80.090	480	-93.000	18.030	81.080

NUM	X	Y	Z	NUM	X	Y	Z	NUM	X	Y	Z	NUM	X	Y	Z
481	-93.000	17.900	82.100	482	-93.000	17.740	83.100	483	-93.000	17.580	84.070	484	-93.000	17.380	85.060
485	-93.000	17.160	86.050	486	-93.000	16.910	87.020	487	-93.000	16.620	87.990	488	-93.000	16.320	88.940
489	-93.000	15.990	89.890	490	-93.000	15.600	90.840	491	-93.000	15.200	91.760	492	-93.000	14.750	92.650
493	-93.000	14.260	93.550	494	-93.000	13.730	94.380	495	-93.000	13.140	95.200	496	-93.000	12.630	95.820
497	-93.000	11.960	96.550	498	-93.000	11.360	97.100	499	-93.000	10.720	97.600	500	-93.000	10.040	98.040
501	-93.000	9.320	98.400	502	-93.000	8.680	98.640	503	-93.000	8.000	98.820	504	-87.000	17.260	64.930
505	-87.000	17.410	65.920	506	-87.000	17.540	66.910	507	-87.000	17.670	67.910	508	-87.000	17.760	68.910
509	-87.000	17.840	69.920	510	-87.000	17.910	70.910	511	-87.000	17.940	71.910	512	-87.000	17.980	72.910
513	-87.000	17.990	73.910	514	-87.000	17.980	74.920	515	-87.000	17.950	75.920	516	-87.000	17.900	76.920
517	-87.000	17.820	77.920	518	-87.000	17.730	78.920	519	-87.000	17.630	79.920	520	-87.000	17.500	80.910
521	-87.000	17.350	81.910	522	-87.000	17.170	82.910	523	-87.000	16.970	83.880	524	-87.000	16.760	84.860
525	-87.000	16.500	85.840	526	-87.000	16.220	86.810	527	-87.000	15.900	87.770	528	-87.000	15.560	88.710
529	-87.000	15.170	89.650	530	-87.000	14.760	90.570	531	-87.000	14.300	91.470	532	-87.000	13.790	92.330
533	-87.000	13.230	93.170	534	-87.000	12.620	93.960	535	-87.000	11.950	94.720	536	-87.000	11.360	95.280
537	-87.000	10.730	95.780	538	-87.000	9.970	96.280	539	-87.000	9.360	96.600	540	-87.000	8.610	96.890
541	-87.000	8.000	97.040	542	-81.000	16.940	63.780	543	-81.000	17.060	64.780	544	-81.000	17.180	65.770
545	-81.000	17.260	66.770	546	-81.000	17.350	67.770	547	-81.000	17.400	68.770	548	-81.000	17.450	69.770
549	-81.000	17.480	70.780	550	-81.000	17.500	71.790	551	-81.000	17.500	72.800	552	-81.000	17.470	73.800
553	-81.000	17.430	74.800	554	-81.000	17.370	75.810	555	-81.000	17.280	76.810	556	-81.000	17.180	77.810
557	-81.000	17.060	78.820	558	-81.000	16.900	79.810	559	-81.000	16.750	80.820	560	-81.000	16.550	81.810
561	-81.000	16.340	82.790	562	-81.000	16.090	83.770	563	-81.000	15.820	84.720	564	-81.000	15.500	85.690
565	-81.000	15.160	86.640	566	-81.000	14.780	87.580	567	-81.000	14.360	88.500	568	-81.000	13.880	89.400
569	-81.000	13.350	90.260	570	-81.000	12.780	91.100	571	-81.000	12.300	91.620	572	-81.000	11.740	92.310
573	-81.000	11.150	92.870	574	-81.000	10.510	93.360	575	-81.000	9.660	93.880	576	-81.000	8.830	94.270
577	-81.000	8.000	94.500	578	-74.500	16.480	62.500	579	-74.500	16.580	63.500	580	-74.500	16.660	64.500
581	-74.500	16.740	65.500	582	-74.500	16.780	66.490	583	-74.500	16.820	67.490	584	-74.500	16.830	68.500
585	-74.500	16.840	69.490	586	-74.500	16.830	70.490	587	-74.500	16.780	71.490	588	-74.500	16.740	72.490
589	-74.500	16.670	73.490	590	-74.500	16.580	74.490	591	-74.500	16.460	75.480	592	-74.500	16.310	76.470
593	-74.500	16.140	77.460	594	-74.500	15.940	78.440	595	-74.500	15.720	79.430	596	-74.500	15.460	80.390
597	-74.500	15.180	81.380	598	-74.500	14.860	82.320	599	-74.500	14.480	83.250	600	-74.500	14.150	84.000
601	-74.500	13.800	84.710	602	-74.500	13.300	85.600	603	-74.500	12.760	86.450	604	-74.500	12.150	87.230
605	-74.500	11.470	87.980	606	-74.500	10.880	88.520	607	-74.500	10.230	89.000	608	-74.500	9.580	89.400
609	-74.500	8.840	89.750	610	-74.500	8.000	90.000	611	-70.000	16.090	61.630	612	-70.000	16.160	62.650
613	-70.000	16.230	63.650	614	-70.000	16.260	64.650	615	-70.000	16.290	65.650	616	-70.000	16.300	66.650
617	-70.000	16.280	67.650	618	-70.000	16.250	68.640	619	-70.000	16.200	69.650	620	-70.000	16.110	70.650
621	-70.000	16.000	71.660	622	-70.000	15.880	72.650	623	-70.000	15.740	73.630	624	-70.000	15.560	74.610
625	-70.000	15.330	75.600	626	-70.000	15.090	76.570	627	-70.000	14.800	77.550	628	-70.000	14.560	78.300
629	-70.000	14.170	79.240	630	-70.000	13.760	80.170	631	-70.000	13.300	81.070	632	-70.000	12.780	81.930
633	-70.000	12.180	82.750	634	-70.000	11.520	83.510	635	-70.000	11.000	84.020	636	-70.000	10.450	84.470
637	-70.000	9.810	84.910	638	-70.000	8.920	85.380	639	-70.000	8.000	85.700	640	-65.000	15.570	60.680

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NUM      X        Y        Z     NUM      X        Y        Z     NUM      X        Y        Z     NUM      X        Y        Z
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645  -65.000   15.590   65.690   646  -65.000   15.520   66.700   647  -65.000   15.440   67.700   648  -65.000   15.320   68.690
649  -65.000   15.180   69.600   650  -65.000   15.010   70.660   651  -65.000   14.800   71.650   652  -65.000   14.550   72.600
653  -65.000   14.270   73.550   654  -65.000   13.950   74.480   655  -65.000   13.540   75.430   656  -65.000   13.090   76.330
657  -65.000   12.580   77.210   658  -65.000   12.000   78.040   659  -65.000   11.470   78.670   660  -65.000   10.910   79.240
661  -65.000   10.290   79.700   662  -65.000    9.620   80.200   663  -65.000    8.910   80.590   664  -65.000    8.000   80.930
665  -61.250   15.120   60.000   666  -61.250   15.110   61.000   667  -61.250   15.090   61.990   668  -61.250   15.050   62.990
669  -61.250   14.990   63.990   670  -61.250   14.900   64.990   671  -61.250   14.800   66.000   672  -61.250   14.670   67.000
673  -61.250   14.490   68.020   674  -61.250   14.300   69.000   675  -61.250   14.060   69.960   676  -61.250   13.780   70.920
677  -61.250   13.420   71.800   678  -61.250   13.090   72.600   679  -61.250   12.720   73.330   680  -61.250   12.290   74.000
681  -61.250   11.800   74.640   682  -61.250   11.290   75.260   683  -61.250   10.590   75.910   684  -61.250    9.780   76.500
685  -61.250    8.910   76.990   686  -61.250    8.000   77.380   687  -59.000   14.640   62.850   688  -59.000   14.570   63.750
689  -59.000   14.460   64.720   690  -59.000   14.320   65.710   691  -59.000   14.150   66.700   692  -59.000   13.940   67.680
693  -59.000   13.680   68.650   694  -59.000   13.370   69.600   695  -59.000   12.980   70.520   696  -59.000   12.520   71.420
697  -59.000   11.980   72.240   698  -59.000   11.330   73.020   699  -59.000   10.600   73.700   700  -59.000    9.780   74.300
701  -59.000    8.910   74.800   702  -59.000    8.000   75.220   703  -57.000   13.880   65.450   704  -57.000   13.830   65.730
705  -57.000   13.590   66.700   706  -57.000   13.290   67.660   707  -57.000   12.910   68.600   708  -57.000   12.470   69.500
709  -57.000   11.950   70.330   710  -57.000   11.310   71.100   711  -57.000   10.600   71.780   712  -57.000    9.800   72.380
713  -57.000    8.940   72.880   714  -57.000    8.000   73.320   715  -55.000   12.200   68.050   716  -55.000   11.900   68.470
717  -55.000   11.270   69.250   718  -55.000   10.570   69.910   719  -55.000    9.780   70.510   720  -55.000    8.900   71.020
721  -55.000    8.000   71.420   722  -54.000   10.180   69.320   723  -54.000    9.800   69.580   724  -54.000    8.930   70.060
725  -54.000    8.000   70.480   726  -53.500    8.000   70.000   727  -73.000     .000   88.580   728  -74.000     .000   89.530
729  -74.500     .000   90.000   730  -81.000     .000   94.500   731  -87.000     .000   97.040   732  -93.000     .000   98.820
733  -98.000     .000   99.910   734 -103.000     .000  100.750   735 -109.000     .000  101.500   736 -115.000     .000  102.000
737 -118.000     .000  102.230   738 -119.000     .000  102.300   739 -169.500  -14.350   98.300   740 -169.500  -14.040   99.070
741 -169.500  -13.600  100.000   742 -167.330  -16.430   90.080   743 -167.330  -16.300   91.070   744 -167.330  -16.140   92.060
745 -167.330  -15.950   93.040   746 -167.330  -15.740   94.020   747 -167.330  -15.500   95.000   748 -167.330  -15.230   95.970
749 -167.330  -14.940   96.920   750 -167.330  -14.600   97.860   751 -167.330  -14.200   98.800   752 -167.330  -13.770   99.700
753 -167.330  -13.280  100.570   754 -167.330  -12.900  101.170   755 -167.330  -12.580  101.720   756 -162.000  -17.040   85.610
757 -162.000  -17.040   86.620   758 -162.000  -17.020   87.620   759 -162.000  -16.960   88.640   760 -162.000  -16.860   89.640
761 -162.000  -16.750   90.640   762 -162.000  -16.580   91.640   763 -162.000  -16.400   92.650   764 -162.000  -16.170   93.620
765 -162.000  -15.900   94.600   766 -162.000  -15.610   95.560   767 -162.000  -15.300   96.500   768 -162.000  -14.940   97.430
769 -162.000  -14.540   98.350   770 -162.000  -14.070   99.250   771 -162.000  -13.540  100.100   772 -162.000  -13.000  100.940
773 -162.000  -12.410  101.700   774 -162.000  -11.750  102.520   775 -162.000  -11.050  103.240   776 -162.000  -10.300  103.880
777 -162.000   -9.520  104.400   778 -162.000   -8.780  104.900   779 -162.000   -8.000  105.310   780 -157.000  -17.400   81.490
781 -157.000  -17.480   82.490   782 -157.000  -17.540   83.490   783 -157.000  -17.560   84.490   784 -157.000  -17.540   85.500
785 -157.000  -17.490   86.500   786 -157.000  -17.430   87.490   787 -157.000  -17.340   88.470   788 -157.000  -17.220   89.460
789 -157.000  -17.060   90.400   790 -157.000  -16.880   91.460   791 -157.000  -16.660   92.430   792 -157.000  -16.420   93.400
793 -157.000  -16.120   94.360   794 -157.000  -15.810   95.310   795 -157.000  -15.460   96.250   796 -157.000  -15.090   97.170
797 -157.000  -14.660   98.080   798 -157.000  -14.200   98.960   799 -157.000  -13.690   99.820   800 -157.000  -13.140  100.640
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805 -157.000  -9.660 104.090   806 -157.000  -8.880 104.540   807 -157.000  -8.000 104.960   808 -152.270 -17.670  77.520
809 -152.270 -17.750  78.520   810 -152.270 -17.800  79.530   811 -152.270 -17.860  80.520   812 -152.270 -17.900  81.520
813 -152.270 -17.920  82.530   814 -152.270 -17.940  83.540   815 -152.270 -17.920  84.550   816 -152.270 -17.880  85.550
817 -152.270 -17.820  86.550   818 -152.270 -17.720  87.550   819 -152.270 -17.600  88.560   820 -152.270 -17.430  89.560
821 -152.270 -17.250  90.540   822 -152.270 -17.030  91.520   823 -152.270 -16.780  92.500   824 -152.270 -16.510  93.450
825 -152.270 -16.200  94.400   826 -152.270 -15.860  95.340   827 -152.270 -15.480  96.280   828 -152.270 -15.090  97.190
829 -152.270 -14.650  98.100   830 -152.270 -14.140  98.980   831 -152.270 -13.610  99.830   832 -152.270 -13.020 100.670
833 -152.270 -12.390 101.470   834 -152.270 -11.700 102.200   835 -152.270 -10.960 102.900   836 -152.270 -10.300 103.410
837 -152.270  -9.460 103.960   838 -152.270  -8.810 104.320   839 -152.270  -8.000 104.620   840 -148.500 -17.700  76.800
841 -148.500 -17.860  77.800   842 -148.500 -17.970  78.790   843 -148.500 -18.070  79.790   844 -148.500 -18.130  80.800
845 -148.500 -18.170  81.800   846 -148.500 -18.170  82.810   847 -148.500 -18.160  83.810   848 -148.500 -18.110  84.810
849 -148.500 -18.060  85.810   850 -148.500 -17.980  86.810   851 -148.500 -17.840  87.810   852 -148.500 -17.690  88.810
853 -148.500 -17.500  89.810   854 -148.500 -17.300  90.790   855 -148.500 -17.070  91.750   856 -148.500 -16.810  92.700
857 -148.500 -16.510  93.680   858 -148.500 -16.180  94.600   859 -148.500 -15.880  95.540   860 -148.500 -15.460  96.460
861 -148.500 -15.020  97.370   862 -148.500 -14.530  98.260   863 -148.500 -14.020  99.130   864 -148.500 -13.470  99.940
865 -148.500 -12.860 100.750   866 -148.500 -12.200 101.520   867 -148.500 -11.510 102.230   868 -148.500 -10.730 102.900
869 -148.500 -10.010 103.400   870 -148.500  -9.220 103.840   871 -148.500  -8.590 104.150   872 -148.500  -8.000 104.360
873 -143.500 -17.800  75.800   874 -143.500 -17.940  76.800   875 -143.500 -18.080  77.800   876 -143.500 -18.190  78.800
877 -143.500 -18.280  79.800   878 -143.500 -18.340  80.800   879 -143.500 -18.380  81.810   880 -143.500 -18.380  82.810
881 -143.500 -18.360  83.810   882 -143.500 -18.310  84.810   883 -143.500 -18.240  85.800   884 -143.500 -18.130  86.780
885 -143.500 -18.000  87.780   886 -143.500 -17.840  88.770   887 -143.500 -17.660  89.760   888 -143.500 -17.450  90.730
889 -143.500 -17.190  91.700   890 -143.500 -16.920  92.660   891 -143.500 -16.600  93.600   892 -143.500 -16.290  94.530
893 -143.500 -15.910  95.470   894 -143.500 -15.500  96.350   895 -143.500 -15.060  97.260   896 -143.500 -14.570  98.120
897 -143.500 -14.050  98.960   898 -143.500 -13.470  99.780   899 -143.500 -12.840 100.560   900 -143.500 -12.200 101.320
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905 -143.500  -8.000 104.010   906 -138.700 -17.800  74.880   907 -138.700 -17.990  75.860   908 -138.700 -18.170  76.860
909 -138.700 -18.300  77.840   910 -138.700 -18.400  78.830   911 -138.700 -18.480  79.830   912 -138.700 -18.540  80.840
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921 -138.700 -17.750  89.800   922 -138.700 -17.520  90.780   923 -138.700 -17.260  91.740   924 -138.700 -16.960  92.720
925 -138.700 -16.630  93.680   926 -138.700 -16.250  94.620   927 -138.700 -15.860  95.550   928 -138.700 -15.430  96.450
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933 -138.700 -12.660 100.600   934 -138.700 -11.950 101.340   935 -138.700 -11.190 102.000   936 -138.700 -10.380 102.600
937 -138.700  -9.600 103.050   938 -138.700  -8.820 103.390   939 -138.700  -8.000 103.680   940 -133.000 -17.840  73.810
941 -133.000 -18.080  74.780   942 -133.000 -18.260  75.760   943 -133.000 -18.400  76.760   944 -133.000 -18.530  77.750
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953 -133.000 -18.400  86.760   954 -133.000 -18.240  87.750   955 -133.000 -18.060  88.740   956 -133.000 -17.830  89.730
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969	-133.000	-11.980	101.020	970	-133.000	-11.210	101.660	971	-133.000	-10.380	102.230	972	-133.000	-9.680	102.640
973	-133.000	-8.760	103.040	974	-133.000	-8.000	103.270	975	-127.000	-17.880	72.640	976	-127.000	-18.120	73.620
977	-127.000	-18.310	74.600	978	-127.000	-18.480	75.590	979	-127.000	-18.620	76.590	980	-127.000	-18.730	77.590
981	-127.000	-18.820	78.590	982	-127.000	-18.860	79.600	983	-127.000	-18.890	80.610	984	-127.000	-18.900	81.630
985	-127.000	-18.860	82.620	986	-127.000	-18.800	83.610	987	-127.000	-18.730	84.600	988	-127.000	-18.620	85.610
989	-127.000	-18.480	86.610	990	-127.000	-18.320	87.600	991	-127.000	-18.120	88.590	992	-127.000	-17.900	89.590
993	-127.000	-17.640	90.550	994	-127.000	-17.360	91.500	995	-127.000	-17.050	92.460	996	-127.000	-16.710	93.400
997	-127.000	-16.320	94.330	998	-127.000	-15.890	95.230	999	-127.000	-15.440	96.130	1000	-127.000	-14.940	97.010
1001	-127.000	-14.400	97.870	1002	-127.000	-13.810	98.690	1003	-127.000	-13.180	99.450	1004	-127.000	-12.500	100.190
1005	-127.000	-11.770	100.870	1006	-127.000	-10.960	101.480	1007	-127.000	-10.120	102.020	1008	-127.000	-9.490	102.350
1009	-127.000	-8.840	102.600	1010	-127.000	-8.000	102.860	1011	-121.000	-17.910	71.520	1012	-121.000	-18.160	72.490
1013	-121.000	-18.360	73.480	1014	-121.000	-18.540	74.460	1015	-121.000	-18.680	75.440	1016	-121.000	-18.790	76.440
1017	-121.000	-18.880	77.440	1018	-121.000	-18.940	78.440	1019	-121.000	-18.970	79.440	1020	-121.000	-18.990	80.450
1021	-121.000	-18.980	81.460	1022	-121.000	-18.940	82.460	1023	-121.000	-18.870	83.460	1024	-121.000	-18.780	84.460
1025	-121.000	-18.660	85.450	1026	-121.000	-18.520	86.440	1027	-121.000	-18.350	87.420	1028	-121.000	-18.140	88.400
1029	-121.000	-17.920	89.380	1030	-121.000	-17.650	90.350	1031	-121.000	-17.360	91.310	1032	-121.000	-17.040	92.280
1033	-121.000	-16.690	93.190	1034	-121.000	-16.290	94.100	1035	-121.000	-15.860	95.020	1036	-121.000	-15.380	95.930
1037	-121.000	-14.880	96.810	1038	-121.000	-14.320	97.660	1039	-121.000	-13.720	98.470	1040	-121.000	-13.060	99.240
1041	-121.000	-12.350	99.970	1042	-121.000	-11.680	100.560	1043	-121.000	-10.850	101.170	1044	-121.000	-9.990	101.700
1045	-121.000	-9.360	102.000	1046	-121.000	-8.780	102.200	1047	-121.000	-8.000	102.440	1048	-115.000	-17.900	70.320
1049	-115.000	-18.150	71.300	1050	-115.000	-18.340	72.290	1051	-115.000	-18.520	73.270	1052	-115.000	-18.680	74.280
1053	-115.000	-18.790	75.270	1054	-115.000	-18.890	76.270	1055	-115.000	-18.960	77.270	1056	-115.000	-19.000	78.270
1057	-115.000	-19.020	79.280	1058	-115.000	-19.020	80.290	1059	-115.000	-18.990	81.280	1060	-115.000	-18.930	82.280
1061	-115.000	-18.850	83.290	1062	-115.000	-18.740	84.290	1063	-115.000	-18.610	85.280	1064	-115.000	-18.460	86.270
1065	-115.000	-18.280	87.270	1066	-115.000	-18.070	88.250	1067	-115.000	-17.820	89.220	1068	-115.000	-17.560	90.190
1069	-115.000	-17.270	91.150	1070	-115.000	-16.930	92.090	1071	-115.000	-16.570	93.010	1072	-115.000	-16.170	93.930
1073	-115.000	-15.730	94.850	1074	-115.000	-15.260	95.710	1075	-115.000	-14.750	96.590	1076	-115.000	-14.190	97.420
1077	-115.000	-13.590	98.220	1078	-115.000	-12.920	98.990	1079	-115.000	-12.360	99.570	1080	-115.000	-11.590	100.210
1081	-115.000	-10.780	100.810	1082	-115.000	-9.900	101.330	1083	-115.000	-8.970	101.730	1084	-115.000	-8.000	102.000
1085	-109.000	-17.880	69.160	1086	-109.000	-18.100	70.160	1087	-109.000	-18.290	71.140	1088	-109.000	-18.460	72.120
1089	-109.000	-18.600	73.130	1090	-109.000	-18.730	74.110	1091	-109.000	-18.820	75.110	1092	-109.000	-18.880	76.090
1093	-109.000	-18.930	77.090	1094	-109.000	-18.940	78.090	1095	-109.000	-18.940	79.100	1096	-109.000	-18.920	80.110
1097	-109.000	-18.870	81.110	1098	-109.000	-18.800	82.120	1099	-109.000	-18.710	83.110	1100	-109.000	-18.580	84.110
1101	-109.000	-18.440	85.100	1102	-109.000	-18.280	86.100	1103	-109.000	-18.080	87.080	1104	-109.000	-17.860	88.070
1105	-109.000	-17.600	89.040	1106	-109.000	-17.340	90.020	1107	-109.000	-17.020	90.970	1108	-109.000	-16.680	91.920
1109	-109.000	-16.320	92.850	1110	-109.000	-15.890	93.770	1111	-109.000	-15.440	94.670	1112	-109.000	-14.970	95.550
1113	-109.000	-14.450	96.390	1114	-109.000	-13.880	97.230	1115	-109.000	-13.250	98.030	1116	-109.000	-12.580	98.770
1117	-109.000	-11.870	99.450	1118	-109.000	-11.320	99.890	1119	-109.000	-10.670	100.350	1120	-109.000	-10.070	100.720

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1125 -103.000 -17.980  68.990  1126 -103.000 -18.180  69.990  1127 -103.000 -18.340  70.960  1128 -103.000 -18.460  71.950
1129 -103.000 -18.600  72.960  1130 -103.000 -18.660  73.950  1131 -103.000 -18.730  74.950  1132 -103.000 -18.780  75.960
1133 -103.000 -18.790  76.960  1134 -103.000 -18.790  77.970  1135 -103.000 -18.760  78.980  1136 -103.000 -18.720  80.000
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1141 -103.000 -18.160  84.970  1142 -103.000 -17.980  85.960  1143 -103.000 -17.790  86.920  1144 -103.000 -17.540  87.900
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1161 -103.000   -8.090 100.560  1162 -103.000   -8.000 100.750  1163  -98.000 -17.680  67.060  1164  -98.000 -17.860  68.060
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1173  -98.000 -18.610  77.070  1174  -98.000 -18.580  78.070  1175  -98.000 -18.530  79.070  1176  -98.000 -18.460  80.080
1177  -98.000 -18.380  81.080  1178  -98.000 -18.280  82.070  1179  -98.000 -18.140  83.060  1180  -98.000 -17.990  84.070
1181  -98.000 -17.810  85.060  1182  -98.000 -17.610  86.050  1183  -98.000 -17.380  87.040  1184  -98.000 -17.120  87.990
1185  -98.000 -16.840  88.960  1186  -98.000 -16.530  89.920  1187  -98.000 -16.200  90.860  1188  -98.000 -15.800  91.800
1189  -98.000 -15.380  92.740  1190  -98.000 -14.930  93.630  1191  -98.000 -14.420  94.520  1192  -98.000 -13.870  95.370
1193  -98.000 -13.430  96.020  1194  -98.000 -12.930  96.660  1195  -98.000 -12.390  97.060  1196  -98.000 -11.740  97.900
1197  -98.000 -11.030  98.480  1198  -98.000 -10.370  98.950  1199  -98.000   -9.730  99.300  1200  -98.000   -9.090  99.600
1201  -98.000   -8.520  99.790  1202  -98.000   -8.000  99.910  1203  -93.000 -17.520  66.080  1204  -93.000 -17.690  67.060
1205  -93.000 -17.840  68.050  1206  -93.000 -17.970  69.050  1207  -93.000 -18.080  70.060  1208  -93.000 -18.180  71.060
1209  -93.000 -18.250  72.070  1210  -93.000 -18.320  73.060  1211  -93.000 -18.360  74.060  1212  -93.000 -18.370  75.070
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1225  -93.000 -16.620  87.990  1226  -93.000 -16.320  88.940  1227  -93.000 -15.990  89.890  1228  -93.000 -15.600  90.840
1229  -93.000 -15.200  91.760  1230  -93.000 -14.750  92.650  1231  -93.000 -14.260  93.550  1232  -93.000 -13.730  94.380
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1237  -93.000 -10.720  97.600  1238  -93.000 -10.040  98.040  1239  -93.000   -9.320  98.400  1240  -93.000   -8.680  98.640
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1273  -87.000 -11.950  94.720  1274  -87.000 -11.360  95.280  1275  -87.000 -10.730  95.780  1276  -87.000   -9.970  96.280
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1289	-81.000	-17.500	72.800	1290	-81.000	-17.470	73.800	1291	-81.000	-17.430	74.800	1292	-81.000	-17.370	75.810
1293	-81.000	-17.280	76.810	1294	-81.000	-17.180	77.810	1295	-81.000	-17.060	78.820	1296	-81.000	-16.900	79.810
1297	-81.000	-16.750	80.820	1298	-81.000	-16.550	81.810	1299	-81.000	-16.340	82.790	1300	-81.000	-16.090	83.770
1301	-81.000	-15.820	84.720	1302	-81.000	-15.500	85.690	1303	-81.000	-15.160	86.640	1304	-81.000	-14.780	87.580
1305	-81.000	-14.360	88.500	1306	-81.000	-13.880	89.400	1307	-81.000	-13.350	90.260	1308	-81.000	-12.780	91.100
1309	-81.000	-12.300	91.620	1310	-81.000	-11.740	92.310	1311	-81.000	-11.150	92.870	1312	-81.000	-10.510	93.360
1313	-81.000	-9.660	93.880	1314	-81.000	-8.830	94.270	1315	-81.000	-8.000	94.500	1316	-74.500	-16.480	62.500
1317	-74.500	-16.580	63.500	1318	-74.500	-16.660	64.500	1319	-74.500	-16.740	65.500	1320	-74.500	-16.780	66.490
1321	-74.500	-16.820	67.490	1322	-74.500	-16.830	68.500	1323	-74.500	-16.840	69.490	1324	-74.500	-16.830	70.490
1325	-74.500	-16.780	71.490	1326	-74.500	-16.740	72.490	1327	-74.500	-16.670	73.490	1328	-74.500	-16.580	74.490
1329	-74.500	-16.460	75.480	1330	-74.500	-16.310	76.470	1331	-74.500	-16.140	77.460	1332	-74.500	-15.940	78.440
1333	-74.500	-15.720	79.430	1334	-74.500	-15.460	80.390	1335	-74.500	-15.180	81.390	1336	-74.500	-14.860	82.320
1337	-74.500	-14.480	83.250	1338	-74.500	-14.150	84.000	1339	-74.500	-13.800	84.710	1340	-74.500	-13.300	85.600
1341	-74.500	-12.760	86.450	1342	-74.500	-12.150	87.230	1343	-74.500	-11.470	87.980	1344	-74.500	-10.880	88.520
1345	-74.500	-10.230	69.000	1346	-74.500	-9.580	89.400	1347	-74.500	-8.840	89.750	1348	-74.500	-8.000	90.000
1349	-70.000	-16.090	61.630	1350	-70.000	-16.160	62.650	1351	-70.000	-16.230	63.650	1352	-70.000	-16.260	64.650
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1357	-70.000	-16.200	69.650	1358	-70.000	-16.110	70.650	1359	-70.000	-16.000	71.660	1360	-70.000	-15.880	72.650
1361	-70.000	-15.740	73.630	1362	-70.000	-15.560	74.610	1363	-70.000	-15.330	75.600	1364	-70.000	-15.090	76.570
1365	-70.000	-14.800	77.550	1366	-70.000	-14.560	78.300	1367	-70.000	-14.170	79.240	1368	-70.000	-13.760	80.170
1369	-70.000	-13.300	81.070	1370	-70.000	-12.780	81.930	1371	-70.000	-12.180	82.750	1372	-70.000	-11.520	83.510
1373	-70.000	-11.000	84.020	1374	-70.000	-10.450	84.470	1375	-70.000	-9.810	84.910	1376	-70.000	-8.920	85.380
1377	-70.000	-8.000	85.700	1378	-65.000	-15.570	60.680	1379	-65.000	-15.620	61.690	1380	-65.000	-15.640	62.670
1381	-65.000	-15.640	63.670	1382	-65.000	-15.620	64.670	1383	-65.000	-15.590	65.690	1384	-65.000	-15.520	66.700
1385	-65.000	-15.440	67.700	1386	-65.000	-15.320	68.690	1387	-65.000	-15.180	69.660	1388	-65.000	-15.010	70.660
1389	-65.000	-14.800	71.650	1390	-65.000	-14.550	72.600	1391	-65.000	-14.270	73.550	1392	-65.000	-13.950	74.480
1393	-65.000	-13.540	75.430	1394	-65.000	-13.090	76.330	1395	-65.000	-12.580	77.210	1396	-65.000	-12.000	78.040
1397	-65.000	-11.470	78.670	1398	-65.000	-10.910	79.240	1399	-65.000	-10.290	79.760	1400	-65.000	-9.620	80.200
1401	-65.000	-8.910	80.590	1402	-65.000	-8.000	80.930	1403	-61.250	-15.120	60.000	1404	-61.250	-15.110	61.000
1405	-61.250	-15.090	61.990	1406	-61.250	-15.050	62.990	1407	-61.250	-14.990	63.990	1408	-61.250	-14.900	64.990
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1413	-61.250	-14.060	69.960	1414	-61.250	-13.780	70.920	1415	-61.250	-13.420	71.860	1416	-61.250	-13.090	72.600
1417	-61.250	-12.720	73.330	1418	-61.250	-12.290	74.000	1419	-61.250	-11.800	74.640	1420	-61.250	-11.290	75.260
1421	-61.250	-10.590	75.910	1422	-61.250	-9.780	76.500	1423	-61.250	-8.910	76.900	1424	-61.250	-8.000	77.380
1425	-59.000	-14.640	62.850	1426	-59.000	-14.570	63.750	1427	-59.000	-14.460	64.720	1428	-59.000	-14.320	65.710
1429	-59.000	-14.150	66.700	1430	-59.000	-13.940	67.680	1431	-59.000	-13.680	68.650	1432	-59.000	-13.370	69.600
1433	-59.000	-12.980	70.520	1434	-59.000	-12.520	71.420	1435	-59.000	-11.980	72.240	1436	-59.000	-11.330	73.020
1437	-59.000	-10.600	73.700	1438	-59.000	-9.780	74.300	1439	-59.000	-8.910	74.800	1440	-59.000	-8.000	75.220

NUM	X	Y	Z	NUM	X	Y	Z	NUM	X	Y	Z	NUM	X	Y	Z
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1445	-57.000	-12.910	68.600	1446	-57.000	-12.470	69.500	1447	-57.000	-11.950	70.330	1448	-57.000	-11.310	71.100
1449	-57.000	-10.600	71.780	1450	-57.000	-9.800	72.380	1451	-57.000	-8.940	72.880	1452	-57.000	-8.000	73.320
1453	-55.000	-12.200	68.050	1454	-55.000	-11.900	68.470	1455	-55.000	-11.270	69.250	1456	-55.000	-10.570	69.910
1457	-55.000	-9.780	70.510	1458	-55.000	-8.900	71.020	1459	-55.000	-8.000	71.420	1460	-54.000	-10.180	69.320
1461	-54.000	-9.800	69.580	1462	-54.000	-8.930	70.060	1463	-54.000	-8.000	70.480	1464	-53.500	-8.000	70.000

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                                                NORMAL ALPHA.BETA LISTING
 NUM ALPHA  BETA    NUM ALPHA  BETA    NUM ALPHA  BETA    NUM ALPHA  BETA    NUM ALPHA  BETA    NUM ALPHA  BETA
   1    69    93      2    66    90      3    66    90      4    84    93      5    81    93      6    81    93
   7    78    93      8    78    93      9    75    93     10    75    93     11    75    93     12    72    93
  13    69    90     14    66    90     15    63    90     16    63    90     17    60    90     18    90    96
  19    90    96     20    90    96     21    87    93     22    87    93     23    84    93     24    84    93
  25    81    93     26    81    93     27    78    93     28    78    93     29    75    93     30    75    90
  31    72    90     32    69    90     33    66    90     34    63    90     35    60    87     36    57    87
  37    54    90     38    51    90     39    45    93     40    42    96     41    30    99     42    93    96
  43    93    96     44    93    96     45    90    96     46    90    96     47    87    96     48    87    93
  49    87    93     50    84    93     51    84    93     52    81    93     53    81    93     54    78    93
  55    78    90     56    75    90     57    75    90     58    72    90     59    69    90     60    69    90
  61    66    90     62    63    90     63    60    87     64    57    87     65    54    87     66    51    87
  67    45    84     68    42    84     69    27    81     70    93    96     71    93    96     72    93    96
  73    93    96     74    90    96     75    90    96     76    90    93     77    90    93     78    87    93
  79    87    93     80    87    93     81    84    93     82    84    93     83    81    93     84    81    93
  85    78    93     86    78    90     87    75    90     88    75    90     89    75    90     90    72    90
  91    69    90     92    66    90     93    66    90     94    63    90     95    60    87     96    57    87
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589	87	81	590	87	81	591	84	78	592	84	78	593	84	78	594	81	78
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1225    78   -84   1226    75   -84   1227    75   -81   1228    72   -81   1229    72   -81   1230    69   -81
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1237    48   -69   1238    42   -66   1239    36   -60   1240    33   -51   1241    21   -45   1242    93   -90
1243    96   -90   1244    96   -87   1245    96   -87   1246    93   -87   1247    93   -87   1248    93   -87
1249    90   -87   1250    90   -87   1251    90   -87   1252    90   -84   1253    87   -84   1254    87   -84
1255    87   -84   1256    87   -84   1257    84   -84   1258    84   -84   1259    84   -84   1260    81   -84
1261    81   -84   1262    81   -81   1263    78   -81   1264    78   -81   1265    75   -81   1266    75   -81
1267    72   -78   1268    72   -78   1269    69   -78   1270    66   -75   1271    63   -75   1272    60   -72
1273    57   -69   1274    54   -69   1275    51   -63   1276    45   -57   1277    42   -51   1278    36   -42
1279    24   -33   1280    93   -87   1281    96   -87   1282    96   -87   1283    93   -87   1284    93   -87
1285    93   -87   1286    93   -87   1287    90   -84   1288    90   -84   1289    90   -84   1290    90   -84
1291    87   -84   1292    87   -84   1293    87   -84   1294    84   -81   1295    84   -81   1296    84   -81
1297    84   -81   1298    81   -81   1299    81   -78   1300    78   -78   1301    78   -78   1302    75   -75
1303    75   -75   1304    72   -72   1305    72   -72   1306    69   -72   1307    66   -69   1308    63   -66
1309    63   -63   1310    60   -60   1311    57   -57   1312    54   -51   1313    48   -45   1314    45   -33
1315    33   -27   1316    93   -87   1317    93   -87   1318    93   -87   1319    93   -84   1320    93   -84
1321    90   -84   1322    90   -84   1323    90   -84   1324    90   -84   1325    87   -81   1326    87   -81
1327    87   -81   1328    87   -81   1329    84   -78   1330    84   -78   1331    84   -78   1332    81   -78
1333    81   -75   1334    81   -75   1335    78   -72   1336    78   -72   1337    75   -69   1338    75   -66
1339    72   -66   1340    69   -63   1341    69   -60   1342    66   -57   1343    63   -51   1344    60   -48
1345    57   -42   1346    57   -36   1347    54   -27   1348    39   -21   1349    93   -84   1350    93   -84
1351    93   -84   1352    90   -84   1353    90   -84   1354    90   -81   1355    90   -81   1356    87   -81
1357    87   -81   1358    87   -78   1359    84   -78   1360    84   -78   1361    84   -75   1362    81   -75
1363    81   -75   1364    78   -72   1365    78   -69   1366    75   -69   1367    75   -66   1368    72   -63
1369    72   -60   1370    69   -57   1371    66   -54   1372    63   -48   1373    60   -45   1374    60   -39
1375    57   -33   1376    54   -27   1377    45   -21   1378    90   -84   1379    93   -84   1380    90   -84
1381    90   -81   1382    90   -81   1383    87   -81   1384    87   -81   1385    87   -78   1386    84   -78
1387    84   -78   1388    84   -75   1389    81   -75   1390    81   -72   1391    78   -72   1392    75   -69
1393    75   -66   1394    72   -63   1395    69   -60   1396    66   -54   1397    66   -51   1398    63   -48
1399    60   -42   1400    57   -36   1401    57   -27   1402    45   -21   1403    90   -84   1404    90   -81
1405    90   -81   1406    87   -81   1407    87   -81   1408    87   -78   1409    87   -78   1410    84   -78
1411    84   -75   1412    81   -75   1413    81   -72   1414    78   -69   1415    75   -66   1416    75   -66
1417    72   -63   1418    69   -60   1419    66   -54   1420    66   -51   1421    63   -42   1422    60   -36
1423    60   -30   1424    45   -24   1425    90   -78   1426    87   -78   1427    84   -78   1428    84   -78
1429    84   -75   1430    81   -72   1431    78   -69   1432    75   -66   1433    75   -63   1434    69   -60
1435    66   -57   1436    63   -48   1437    60   -42   1438    60   -36   1439    57   -27   1440    48   -27
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 NUM ALPHA  BETA     NUM ALPHA  BETA     NUM ALPHA  BETA     NUM ALPHA  BETA     NUM ALPHA  BETA     NUM ALPHA  BETA
1441    90   -75    1442    87   -75    1443    78   -69    1444    78   -69    1445    75   -66    1446    72   -63
1447    66   -57    1448    63   -51    1449    60   -42    1450    60   -36    1451    57   -30    1452    48   -27
1453    90   -60    1454    78   -60    1455    66   -51    1456    63   -42    1457    63   -36    1458    60   -30
1459    45   -24    1460    90   -39    1461    75   -36    1462    66   -27    1463    45   -24    1464    90   -45
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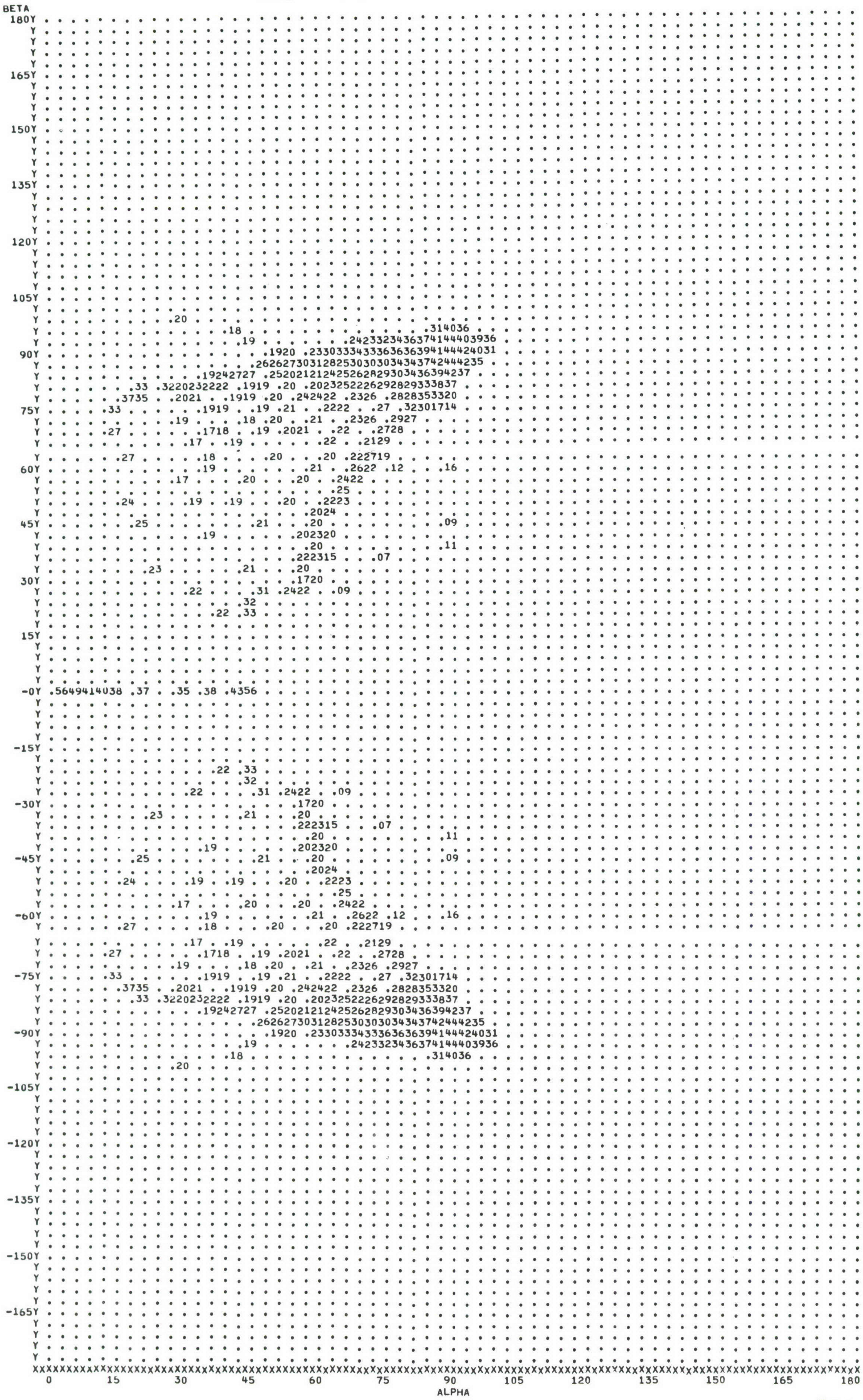
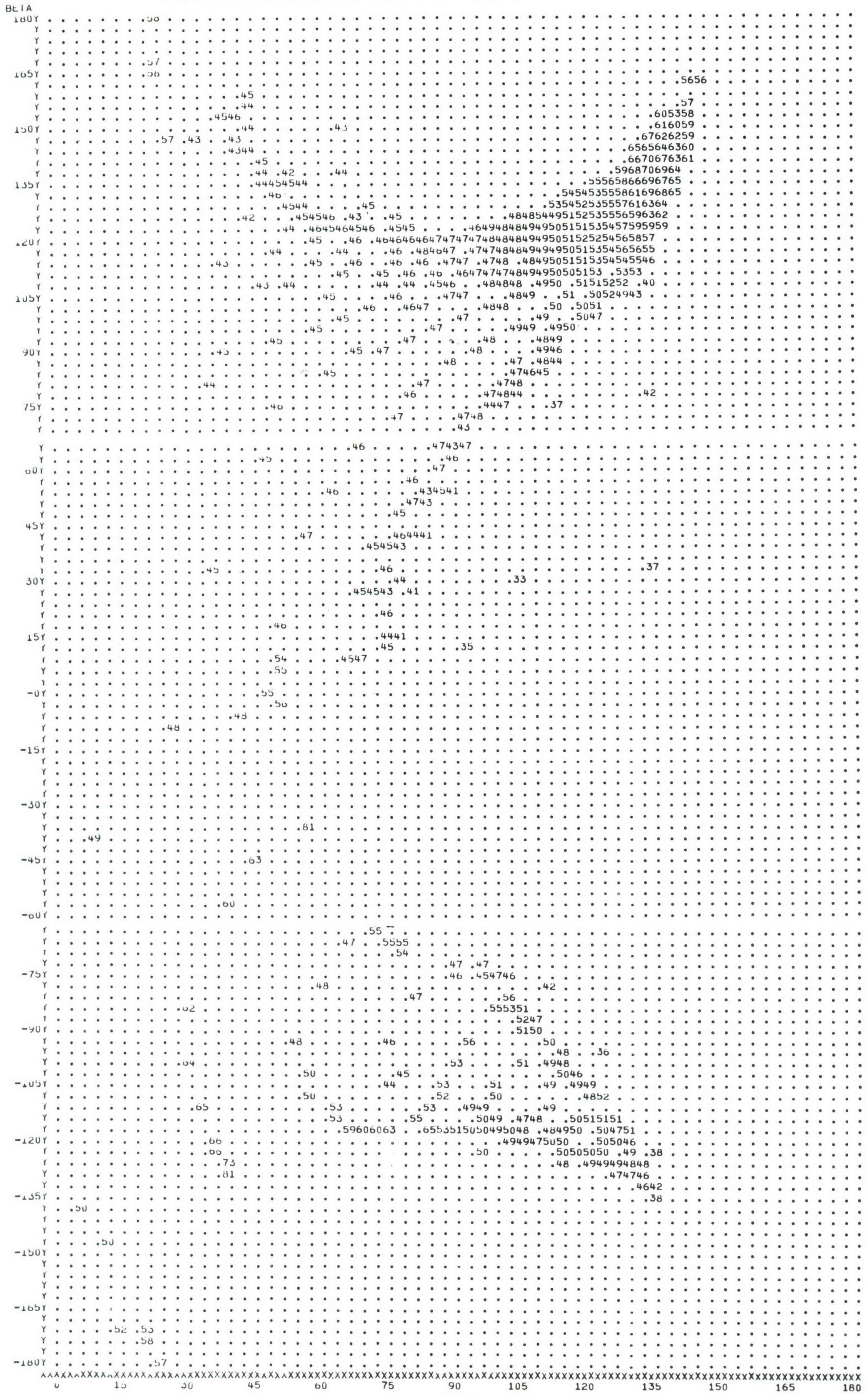
AREA CONTOUR PLOT
SCALE FACTOR: VALUE=10X LOG BASE 10 OF 1000X AREA



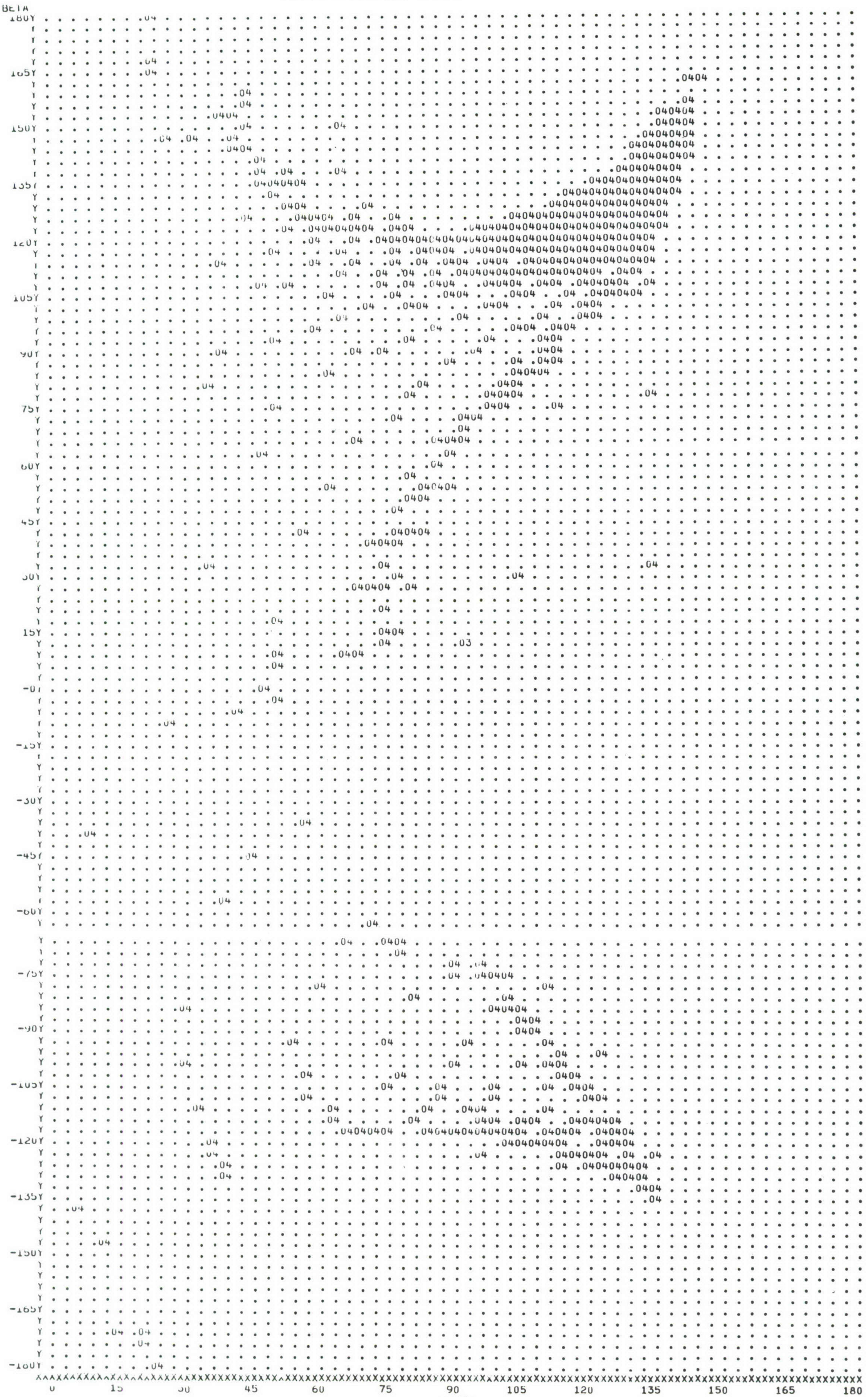
RHD-1

SUN ZENITH= 45. SUN AZIMUTH= 45.
BRIGHTNESS PLOT
SCALE FACTOR: VALUE=10X LOG BASE 10 OF AREA X REFLECTIVITY X 10 TO THE 7TH POWER



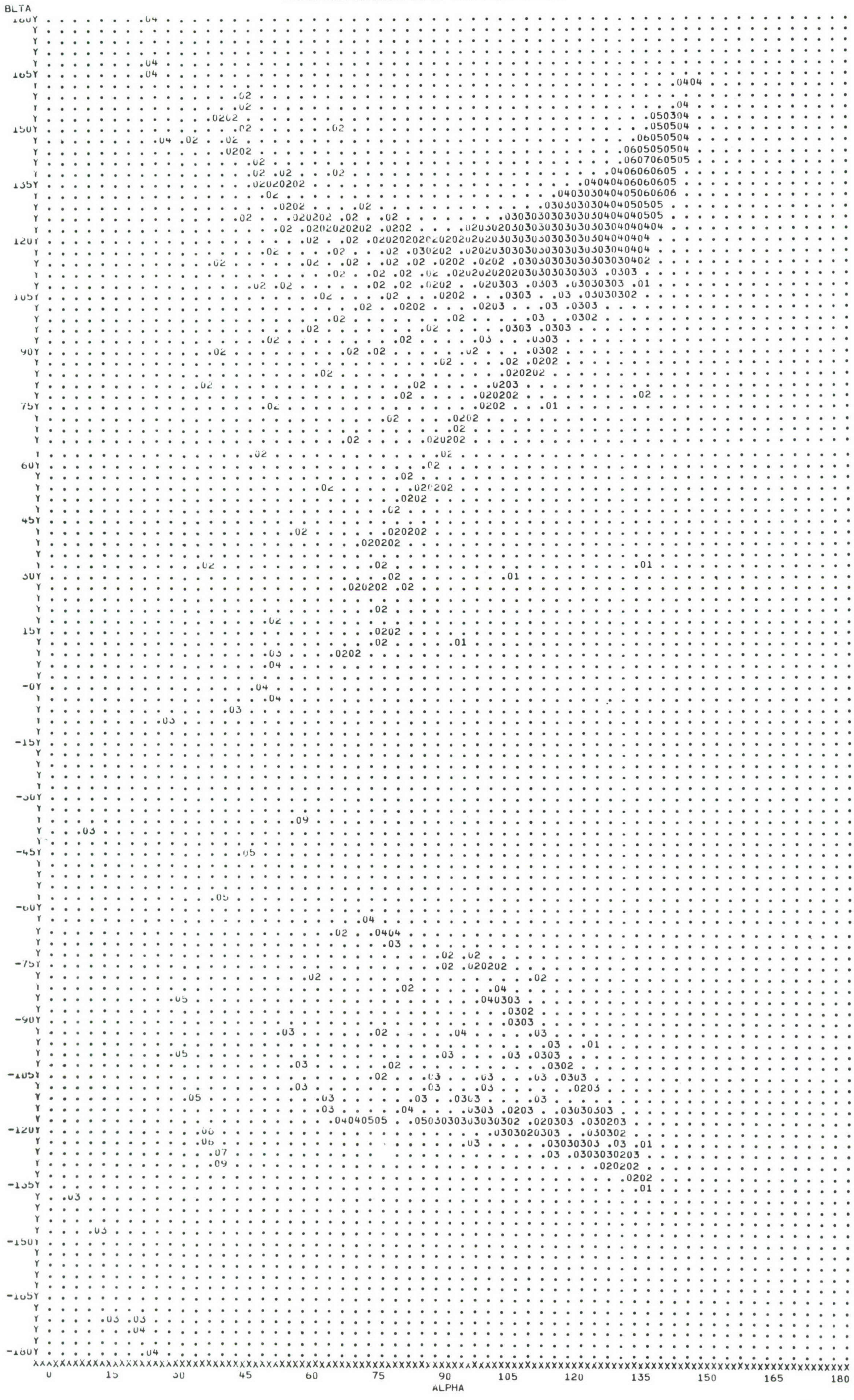
RHD-2

HELICOPTER DETECTION RANGE CONTOUR
SCALE FACTOR:VALUE=RANGE IN NAUTICAL MILES



RHD-3

WINDOW DETECTION RANGE CONTOUR
SCALE FACTOR:VALUE=RANGE IN NAUTICAL MILES



RHD-4

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                                REFLECTED RAY ALPHA, BETA, ANGLE OF INCIDENCE, DETECTION RANGE LISTING
NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE
  1    99   123    45    3.    2    96   123    43    2.    3    93   120    42    2.    4   123   135    57    3.
  5   123   135    56    4.    6   120   132    55    3.    7   117   132    53    4.    8   117   129    52    3.
  9   114   129    51    3.   10   111   126    49    3.   11   111   126    50    3.   12   105   126    47    3.
 13   102   123    45    2.   14    96   120    43    2.   15    90   120    40    2.   16    90   120    40    2.
 17    84   117    37    3.   18   135   147    64    6.   19   135   147    63    6.   20   132   144    62    6.
 21   132   141    60    6.   22   129   138    59    4.   23   126   135    58    4.   24   126   135    56    3.
 25   123   132    55    3.   26   120   129    54    3.   27   117   129    52    3.   28   114   129    51    3.
 29   114   126    50    3.   30   108   126    49    3.   31   105   123    47    2.   32    99   123    45    2.
 33    96   123    43    2.   34    93   120    42    2.   35    87   120    40    2.   36    81   123    38    2.
 37    78   126    37    2.   38    72   129    37    2.   39    66   138    38    2.   40    66   150    40    2.
 41    45   159    36    2.   42   138   153    66    4.   43   138   153    66    5.   44   138   150    65    5.
 45   135   147    63    5.   46   132   144    62    6.   47   132   141    61    6.   48   132   138    60    6.
 49   129   138    59    4.   50   126   135    58    4.   51   126   132    56    3.   52   123   132    55    3.
 53   120   129    54    3.   54   117   129    52    3.   55   114   126    51    3.   56   114   126    50    3.
 57   111   123    49    3.   58   108   123    47    2.   59   105   123    46    2.   60    99   120    44    2.
 61    96   120    43    2.   62    90   120    41    2.   63    87   120    39    2.   64    81   120    38    2.
 65    78   123    36    2.   66    69   123    35    2.   67    60   126    33    2.   68    57   135    33    2.
 69    27   147    28    4.   70   138   150    65    4.   71   138   150    65    4.   72   138   150    65    5.
 73   138   150    65    5.   74   138   147    64    5.   75   135   144    63    5.   76   135   144    63    5.
 77   135   141    61    6.   78   132   141    61    6.   79   132   138    60    5.   80   129   135    58    4.
 81   126   135    57    3.   82   126   132    56    3.   83   123   132    55    3.   84   120   129    54    3.
 85   126   129    53    3.   86   117   126    52    3.   87   114   126    50    2.   88   111   126    49    2.
 89   108   123    48    2.   90   108   123    47    2.   91   102   123    45    2.   92    99   123    44    2.
 93    96   120    43    2.   94    90   120    41    2.   95    87   120    39    2.   96    81   123    38    2.
 97    72   123    35    2.   98    69   126    35    2.   99    57   129    32    2.  100    54   138    33    2.
101    24   165    30    4.  102   141   150    66    3.  103   144   153    67    4.  104   141   150    65    4.
105   141   147    65    5.  106   138   144    64    5.  107   135   144    63    5.  108   135   141    62    6.
109   132   138    61    6.  110   132   138    60    5.  111   132   135    59    5.  112   129   135    58    4.
113   126   132    56    3.  114   123   132    55    3.  115   123   129    54    3.  116   120   129    53    3.
117   117   126    52    3.  118   117   126    51    3.  119   114   126    50    3.  120   111   126    49    3.
121   111   123    48    2.  122   102   123    46    2.  123   102   123    44    2.  124    96   120    43    2.
125    93   120    42    2.  126    90   120    40    2.  127    84   120    38    2.  128    78   120    37    2.
129    72   123    35    2.  130    63   123    33    2.  131    57   129    32    2.  132    48   135    31    2.
133    42   144    51    2.  134    24   168    30    4.  135   141   147    65    4.  136   141   150    66    4.
137   141   150    66    4.  138   141   147    65    5.  139   138   147    64    5.  140   138   144    63    5.
141   138   141    62    6.  142   135   138    61    6.  143   132   138    60    6.  144   132   135    59    5.
145   129   135    58    4.  146   129   132    57    4.  147   126   132    56    3.  148   123   129    55    3.
149   123   129    54    3.  150   120   129    53    3.  151   117   126    52    3.  152   117   126    51    3.
153   114   126    50    3.  154   111   123    49    3.  155   108   123    47    2.  156   105   123    46    2.
157   102   123    45    2.  158    99   120    43    2.  159    93   120    42    2.  160    90   120    40    2.
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NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE
161	87	120	39	2.	162	81	120	37	2.	163	72	123	35	2.	164	66	123	34	2.
165	57	129	33	2.	166	48	141	32	2.	167	24	165	30	4.	168	141	153	67	3.
169	144	156	68	4.	170	144	153	67	4.	171	141	150	66	4.	172	141	147	65	5.
173	138	144	64	5.	174	138	141	63	5.	175	135	141	61	6.	176	135	138	61	6.
177	132	135	60	6.	178	132	135	59	4.	179	129	132	57	4.	180	126	132	56	4.
181	120	129	55	3.	182	123	129	54	3.	183	120	129	53	3.	184	120	126	52	3.
185	117	126	51	3.	186	114	123	50	3.	187	111	123	48	3.	188	108	123	47	3.
189	105	123	46	3.	190	102	120	45	2.	191	99	120	44	2.	192	96	120	42	2.
193	90	120	40	2.	194	87	120	39	2.	195	81	120	37	2.	196	75	120	35	2.
197	69	123	34	2.	198	60	126	32	2.	199	51	135	32	2.	200	45	150	32	2.
201	24	168	30	4.	202	144	156	68	3.	203	144	162	70	4.	204	144	153	67	4.
205	141	150	66	4.	206	141	150	65	5.	207	141	147	64	5.	208	138	144	63	5.
209	135	141	62	7.	210	135	138	61	6.	211	135	138	60	6.	212	132	135	59	5.
213	129	132	58	4.	214	129	132	57	4.	215	126	129	56	4.	216	123	129	55	3.
217	123	129	54	3.	218	120	126	53	3.	219	117	126	52	3.	220	114	123	50	3.
221	114	123	49	3.	222	111	123	48	3.	223	108	123	47	3.	224	102	120	45	3.
225	102	120	44	2.	226	99	120	43	2.	227	93	120	42	2.	228	90	120	40	2.
229	84	120	38	2.	230	81	120	37	2.	231	75	120	35	2.	232	66	123	34	2.
233	57	126	32	2.	234	54	135	33	2.	235	42	153	32	2.	236	24	-180	31	4.
237	144	156	68	3.	238	144	162	70	4.	239	144	156	68	4.	240	144	153	67	4.
241	141	150	66	4.	242	141	147	65	5.	243	138	144	64	5.	244	138	141	62	6.
245	135	138	62	6.	246	135	138	60	6.	247	132	135	59	5.	248	132	132	58	5.
249	129	132	58	4.	250	126	129	56	4.	251	126	129	55	3.	252	123	129	54	3.
253	123	126	53	3.	254	120	126	52	3.	255	117	123	51	3.	256	114	123	50	3.
257	114	123	49	3.	258	111	123	48	3.	259	105	120	46	3.	260	102	120	45	3.
261	102	120	44	2.	262	96	120	43	2.	263	93	120	41	2.	264	87	120	39	2.
265	84	120	38	2.	266	78	120	36	2.	267	72	123	35	2.	268	63	126	33	2.
269	54	129	31	2.	270	48	138	32	2.	271	45	156	33	2.	272	24	180	31	4.
273	144	156	68	3.	274	147	162	70	4.	275	144	156	68	4.	276	144	153	67	4.
277	141	150	66	4.	278	141	147	64	5.	279	141	144	64	5.	280	138	141	62	6.
281	138	138	61	6.	282	135	138	61	6.	283	135	135	60	6.	284	132	132	58	5.
285	129	132	57	4.	286	129	129	56	4.	287	126	129	55	4.	288	126	126	55	3.
289	123	126	53	3.	290	120	126	52	3.	291	120	123	52	3.	292	117	123	50	3.
293	114	123	49	3.	294	111	120	48	3.	295	108	120	47	3.	296	105	120	46	3.
297	102	120	45	3.	298	99	120	43	2.	299	96	120	42	2.	300	90	117	40	2.
301	87	120	39	2.	302	81	120	37	2.	303	75	120	35	2.	304	69	123	34	2.
305	63	126	33	2.	306	51	132	31	2.	307	45	144	32	2.	308	45	159	34	2.
309	24	180	31	4.	310	144	156	68	3.	311	147	162	70	4.	312	144	156	68	4.
313	144	153	67	4.	314	144	150	66	4.	315	141	144	64	5.	316	141	144	64	5.
317	138	141	62	5.	318	138	138	61	6.	319	135	135	60	6.	320	135	135	59	6.

NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE
321	132	132	58	5.	322	132	129	57	4.	323	129	129	56	4.	324	126	126	55	4.
325	126	126	55	3.	326	123	126	54	3.	327	123	123	53	3.	328	120	123	51	3.
329	117	123	50	3.	330	117	120	50	3.	331	114	120	48	3.	332	111	120	47	3.
333	108	120	46	3.	334	105	117	45	3.	335	102	117	43	2.	336	99	117	42	2.
337	90	117	41	2.	338	90	117	39	2.	339	87	117	38	2.	340	78	117	35	2.
341	75	120	35	2.	342	69	120	33	2.	343	60	123	32	2.	344	51	132	31	2.
345	42	153	32	2.	346	21	-174	32	4.	347	144	150	66	3.	348	144	156	68	4.
349	144	153	67	4.	350	144	150	66	4.	351	141	147	65	4.	352	141	144	64	5.
353	141	141	63	5.	354	138	138	62	6.	355	138	135	61	6.	356	135	132	60	6.
357	135	132	59	6.	358	132	129	58	5.	359	132	129	57	4.	360	129	129	56	4.
361	129	126	55	4.	362	126	123	54	3.	363	126	123	54	3.	364	123	123	53	3.
365	120	120	51	3.	366	120	120	50	3.	367	117	120	49	3.	368	114	120	49	3.
369	111	117	47	3.	370	111	117	46	3.	371	108	117	45	3.	372	102	117	43	3.
373	102	114	42	2.	374	99	114	41	2.	375	93	114	40	2.	376	90	114	38	2.
377	84	114	36	2.	378	78	114	34	2.	379	69	114	32	2.	380	66	117	32	2.
381	60	120	31	2.	382	54	123	30	2.	383	48	135	31	2.	384	39	153	31	2.
385	21	-171	31	3.	386	141	147	65	3.	387	144	153	67	4.	388	144	153	67	4.
389	144	147	65	4.	390	141	144	64	5.	391	141	141	64	5.	392	138	138	62	5.
393	138	138	62	5.	394	138	135	61	6.	395	135	132	59	6.	396	135	132	59	5.
397	132	129	58	5.	398	132	129	57	4.	399	132	126	56	4.	400	129	126	55	4.
401	126	123	54	3.	402	126	123	53	3.	403	123	123	53	3.	404	123	120	52	3.
405	120	120	51	3.	406	117	117	49	3.	407	117	117	49	3.	408	114	117	48	3.
409	111	117	47	3.	410	108	114	45	3.	411	108	114	44	2.	412	102	114	43	2.
413	99	114	41	2.	414	96	111	40	2.	415	93	111	38	2.	416	87	111	37	2.
417	81	111	34	2.	418	75	111	33	2.	419	66	111	31	2.	420	60	114	29	2.
421	51	117	28	2.	422	45	126	29	2.	423	42	147	30	2.	424	15	-171	29	3.
425	141	144	65	3.	426	144	150	66	4.	427	144	147	66	4.	428	144	147	65	4.
429	141	141	63	5.	430	141	138	63	5.	431	141	138	62	5.	432	138	135	61	5.
433	138	132	60	6.	434	135	132	59	5.	435	135	129	58	5.	436	132	126	57	4.
437	132	126	56	4.	438	129	126	56	4.	439	129	123	55	4.	440	126	123	54	3.
441	126	120	53	3.	442	123	120	52	3.	443	123	120	51	3.	444	120	117	50	3.
445	117	117	49	3.	446	117	117	48	3.	447	114	114	47	3.	448	111	114	46	3.
449	108	114	45	3.	450	105	111	43	2.	451	102	111	42	2.	452	99	111	40	2.
453	96	111	39	2.	454	90	108	36	2.	455	87	108	36	2.	456	75	108	31	2.
457	81	108	34	2.	458	78	105	31	2.	459	63	105	28	2.	460	54	108	27	2.
461	48	108	26	2.	462	39	114	26	2.	463	33	147	28	2.	464	12	-147	28	3.
465	141	144	64	4.	466	144	147	66	4.	467	144	144	65	4.	468	141	141	64	5.
469	141	138	63	5.	470	141	138	62	5.	471	138	135	61	6.	472	138	135	61	6.
473	138	132	59	5.	474	135	129	58	5.	475	135	126	58	5.	476	132	126	57	4.
477	132	123	56	4.	478	129	123	55	4.	479	129	123	54	4.	480	126	120	53	4.

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NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE
481   120   120    52    3.  482   123   117    51    3.  483   123   117    51    3.  484   120   117    49    3.
485   117   114    46    3.  486   114   114    47    3.  487   114   111    46    3.  488   111   111    45    3.
489   108   111    44    3.  490   105   108    42    3.  491   102   108    41    3.  492    99   108    39    2.
493    93   105    37    2.  494    90   105    35    2.  495    84   102    32    2.  496    81   102    32    2.
497    72   102    29    2.  498    66    99    26    2.  499    60    96    25    2.  500    51    93    23    2.
501    39    90    23    2.  502    36    81    25    2.  503     6  -138    25    3.  504   141   141    63    4.
505   144   144    64    4.  506   144   141    64    5.  507   141   138    63    5.  508   141   135    62    5.
509   141   135    61    5.  510   138   132    60    6.  511   138   129    59    5.  512   138   129    59    5.
513   135   126    58    5.  514   135   126    57    5.  515   132   123    56    4.  516   132   123    55    4.
517   129   120    54    4.  518   129   120    54    4.  519   126   117    53    3.  520   126   117    52    3.
521   123   114    51    3.  522   123   114    50    3.  523   120   114    49    3.  524   120   111    48    3.
525   117   111    46    3.  526   114   108    45    3.  527   111   108    44    3.  528   108   105    42    3.
529   105   105    41    3.  530   102   102    39    3.  531    99   102    37    2.  532    93    99    35    2.
533    87    96    32    2.  534    81    93    30    2.  535    75    90    26    2.  536    69    90    25    2.
537    63    84    23    2.  538    51    75    20    2.  539    48    63    21    2.  540    36    33    22    2.
541     9   -39    22    3.  542   141   135    62    4.  543   141   138    63    5.  544   141   138    62    5.
545   141   135    61    5.  546   141   132    61    6.  547   138   129    59    5.  548   138   129    59    5.
549   138   126    58    5.  550   135   126    58    5.  551   135   123    56    4.  552   132   120    55    4.
553   132   120    55    4.  554   129   117    54    4.  555   129   117    53    4.  556   126   114    52    3.
557   126   114    51    3.  558   123   111    50    3.  559   123   111    49    3.  560   120   108    47    3.
561   117   105    46    3.  562   117   105    44    3.  563   114   102    43    3.  564   111    99    41    3.
565   108    96    40    3.  566   105    96    38    3.  567    99    93    36    3.  568    96    90    33    2.
569    90    87    31    2.  570    84    81    27    2.  571    81    78    26    2.  572    78    72    24    2.
573    69    66    21    2.  574    63    54    19    2.  575    57    42    18    2.  576    51    18    19    2.
577    27    -9    18    3.  578   138   132    60    5.  579   141   135    61    5.  580   141   132    60    5.
581   138   129    60    5.  582   138   126    59    5.  583   138   126    58    4.  584   135   123    57    4.
585   135   123    57    4.  586   135   120    55    4.  587   132   117    54    4.  588   132   117    54    4.
589   129   114    53    3.  590   129   111    51    3.  591   126   108    58    3.  592   123   108    49    3.
593   123   105    47    3.  594   120   102    46    3.  595   120    99    45    3.  596   117    96    43    3.
597   114    96    42    3.  598   111    93    40    3.  599   105    87    37    2.  600   105    84    36    2.
601   102    81    35    2.  602    99    78    32    2.  603    93    72    29    2.  604    87    66    26    2.
605    81    57    23    2.  606    78    48    22    2.  607    72    39    21    2.  608    69    27    21    2.
609    60     9    23    2.  610    42    -6    18    3.  611   138   129    59    4.  612   138   129    60    5.
613   138   126    59    4.  614   138   123    58    4.  615   138   123    57    4.  616   135   120    56    4.
617   132   117    55    4.  618   132   114    54    4.  619   129   114    52    3.  620   129   111    51    3.
621   126   108    50    3.  622   126   105    49    3.  623   123   102    47    3.  624   120    99    45    3.
625   117    96    43    3.  626   114    93    42    3.  627   111    90    39    3.  628   111    87    38    2.
629   105    81    35    3.  630   102    78    33    2.  631    96    72    30    2.  632    93    66    27    2.
633    87    60    24    2.  634    81    51    21    2.  635    78    42    20    2.  636    75    33    20    2.
637    75    21    22    2.  638    69     9    23    2.  639    51    -3    17    4.  640   138   123    58    4.
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NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGF	NUM	ALPHA	BETA	ANGLF	RANGE
641	138	123	58	4.	642	135	120	57	4.	643	135	120	55	4.	644	135	117	54	4.
645	132	114	53	3.	646	129	111	52	3.	647	129	108	51	3.	648	126	105	49	3.
649	126	105	48	3.	650	123	102	47	3.	651	120	99	45	3.	652	117	96	42	3.
653	114	93	41	3.	654	111	87	38	2.	655	105	84	35	2.	656	102	75	32	2.
657	96	72	30	2.	658	90	63	26	2.	659	87	54	24	2.	660	81	51	22	2.
661	75	39	21	2.	662	72	27	21	2.	663	75	12	25	2.	664	48	0	16	4.
665	135	120	56	3.	666	135	117	55	3.	667	132	117	54	3.	668	132	114	53	3.
669	132	111	52	3.	670	129	111	51	3.	671	129	108	50	3.	672	126	105	49	3.
673	123	102	47	3.	674	120	99	45	3.	675	117	96	43	2.	676	114	90	40	2.
677	108	84	37	2.	678	105	81	35	2.	679	99	78	32	2.	680	93	69	29	2.
681	90	63	27	2.	682	87	54	25	2.	683	81	42	23	2.	684	78	30	23	2.
685	75	15	25	2.	686	51	6	15	4.	687	135	114	54	2.	688	129	105	50	3.
689	126	105	49	3.	690	123	102	48	3.	691	123	99	46	2.	692	117	96	43	2.
693	114	90	41	2.	694	111	84	37	2.	695	105	78	34	2.	696	96	72	30	2.
697	90	63	26	2.	698	84	51	23	2.	699	78	39	21	2.	700	75	27	21	2.
701	75	12	24	2.	702	51	9	14	3.	703	135	108	53	1.	704	132	105	51	2.
705	114	87	41	2.	706	111	87	38	2.	707	105	81	35	2.	708	99	75	31	2.
709	90	66	26	2.	710	84	54	22	2.	711	78	39	21	2.	712	75	27	21	2.
713	75	15	23	2.	714	51	9	14	3.	715	135	78	47	2.	716	114	75	38	1.
717	90	54	25	2.	718	84	42	24	2.	719	81	27	24	2.	720	78	15	26	2.
721	51	6	14	3.	722	135	33	46	1.	723	105	30	35	1.	724	93	12	32	1.
725	51	9	14	3.	726	135	138	60	2.	727	57	-36	31	9.	728	57	-36	31	6.
729	45	-45	30	5.	730	39	-57	31	5.	731	30	-84	34	5.	732	30	-99	36	5.
733	33	-111	38	5.	734	36	-120	40	6.	735	36	-123	41	6.	736	39	-126	42	7.
737	39	-129	42	7.	738	39	-129	42	9.	739	0	0	0	0.	740	0	0	0	0.
741	0	0	0	0.	742	0	0	0	0.	743	0	0	0	0.	744	0	0	0	0.
745	0	0	0	0.	746	0	0	0	0.	747	0	0	0	0.	748	0	0	0	0.
749	0	0	0	0.	750	0	0	0	0.	751	0	0	0	0.	752	0	0	0	0.
753	0	0	0	0.	754	0	0	0	0.	755	0	0	0	0.	756	0	0	0	0.
757	0	0	0	0.	758	0	0	0	0.	759	0	0	0	0.	760	0	0	0	0.
761	0	0	0	0.	762	0	0	0	0.	763	0	0	0	0.	764	0	0	0	0.
765	0	0	0	0.	766	0	0	0	0.	767	0	0	0	0.	768	0	0	0	0.
769	0	0	0	0.	770	0	0	0	0.	771	0	0	0	0.	772	0	0	0	0.
773	0	0	0	0.	774	0	0	0	0.	775	132	-132	87	2.	776	126	-129	84	2.
777	120	-126	81	3.	778	114	-126	78	3.	779	96	-123	69	3.	780	0	0	0	0.
781	0	0	0	0.	782	0	0	0	0.	783	0	0	0	0.	784	0	0	0	0.
785	0	0	0	0.	786	0	0	0	0.	787	0	0	0	0.	788	0	0	0	0.
789	0	0	0	0.	790	0	0	0	0.	791	0	0	0	0.	792	0	0	0	0.
793	0	0	0	0.	794	0	0	0	0.	795	0	0	0	0.	796	0	0	0	0.
797	0	0	0	0.	798	0	0	0	0.	799	0	0	0	0.	800	0	0	0	0.

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 NUM ALPHA  BETA ANGLE RANGE   NUM ALPHA  BETA ANGLE RANGE   NUM ALPHA  BETA ANGLE RANGE   NUM ALPHA  BETA ANGLE RANGE
 801     0     0     0    0.   802     0     0     0    0.   803   129  -129    87    2.   804   123  -126    83    3.
 805   114  -123    77    3.   806   105  -120    73    2.   807    84  -117    63    5.   808     0     0     0    0.
 809     0     0     0    0.   810     0     0     0    0.   811     0     0     0    0.   812     0     0     0    0.
 813     0     0     0    0.   814     0     0     0    0.   815     0     0     0    0.   816     0     0     0    0.
 817     0     0     0    0.   818     0     0     0    0.   819     0     0     0    0.   820     0     0     0    0.
 821     0     0     0    0.   822     0     0     0    0.   823     0     0     0    0.   824     0     0     0    0.
 825     0     0     0    0.   826     0     0     0    0.   827     0     0     0    0.   828     0     0     0    0.
 829     0     0     0    0.   830     0     0     0    0.   831     0     0     0    0.   832     0     0     0    0.
 833     0     0     0    0.   834   132  -132    89    1.   835   126  -129    85    2.   836   120  -126    81    2.
 837   111  -120    75    2.   838   102  -120    71    2.   839    75  -117    59    5.   840     0     0     0    0.
 841     0     0     0    0.   842     0     0     0    0.   843     0     0     0    0.   844     0     0     0    0.
 845     0     0     0    0.   846     0     0     0    0.   847     0     0     0    0.   848     0     0     0    0.
 849     0     0     0    0.   850     0     0     0    0.   851     0     0     0    0.   852     0     0     0    0.
 853     0     0     0    0.   854     0     0     0    0.   855     0     0     0    0.   856     0     0     0    0.
 857     0     0     0    0.   858     0     0     0    0.   859     0     0     0    0.   860     0     0     0    0.
 861     0     0     0    0.   862     0     0     0    0.   863     0     0     0    0.   864     0     0     0    0.
 865     0     0     0    0.   866   132  -132    89    2.   867   129  -129    85    2.   868   117  -123    80    3.
 869   111  -120    75    2.   870    99  -117    70    3.   871    90  -117    66    3.   872    72  -117    58    4.
 873     0     0     0    0.   874     0     0     0    0.   875     0     0     0    0.   876     0     0     0    0.
 877     0     0     0    0.   878     0     0     0    0.   879     0     0     0    0.   880     0     0     0    0.
 881     0     0     0    0.   882     0     0     0    0.   883     0     0     0    0.   884     0     0     0    0.
 885     0     0     0    0.   886     0     0     0    0.   887     0     0     0    0.   888     0     0     0    0.
 889     0     0     0    0.   890     0     0     0    0.   891     0     0     0    0.   892     0     0     0    0.
 893     0     0     0    0.   894     0     0     0    0.   895     0     0     0    0.   896     0     0     0    0.
 897     0     0     0    0.   898     0     0     0    0.   899     0     0     0    0.   900   135  -135    90    1.
 901   120  -129    85    2.   902   120  -123    81    3.   903   108  -120    75    2.   904    96  -117    68    3.
 905    75  -117    59    5.   906     0     0     0    0.   907     0     0     0    0.   908     0     0     0    0.
 909     0     0     0    0.   910     0     0     0    0.   911     0     0     0    0.   912     0     0     0    0.
 913     0     0     0    0.   914     0     0     0    0.   915     0     0     0    0.   916     0     0     0    0.
 917     0     0     0    0.   918     0     0     0    0.   919     0     0     0    0.   920     0     0     0    0.
 921     0     0     0    0.   922     0     0     0    0.   923     0     0     0    0.   924     0     0     0    0.
 925     0     0     0    0.   926     0     0     0    0.   927     0     0     0    0.   928     0     0     0    0.
 929     0     0     0    0.   930     0     0     0    0.   931     0     0     0    0.   932     0     0     0    0.
 933   135  -135    90    1.   934   129  -129    86    2.   935   120  -126    82    3.   936   111  -120    77    3.
 937    99  -117    71    3.   938    90  -117    66    3.   939    72  -117    58    5.   940     0     0     0    0.
 941     0     0     0    0.   942     0     0     0    0.   943     0     0     0    0.   944     0     0     0    0.
 945     0     0     0    0.   946     0     0     0    0.   947     0     0     0    0.   948     0     0     0    0.
 949     0     0     0    0.   950     0     0     0    0.   951     0     0     0    0.   952     0     0     0    0.
 953     0     0     0    0.   954     0     0     0    0.   955     0     0     0    0.   956     0     0     0    0.
 957     0     0     0    0.   958     0     0     0    0.   959     0     0     0    0.   960     0     0     0    0.
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  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE
  961     0     0     0    0.  962     0     0     0    0.  963     0     0     0    0.  964     0     0     0    0.
  965     0     0     0    0.  966     0     0     0    0.  967     0     0     0    0.  968   135  -135    89    1.
  969   129  -129    86    2.  970   120  -123    81    3.  971   111  -120    76    3.  972   102  -120    72    3.
  973    87  -117    64    3.  974    69  -117    56    4.  975     0     0     0    0.  976     0     0     0    0.
  977     0     0     0    0.  978     0     0     0    0.  979     0     0     0    0.  980     0     0     0    0.
  981     0     0     0    0.  982     0     0     0    0.  983     0     0     0    0.  984     0     0     0    0.
  985     0     0     0    0.  986     0     0     0    0.  987     0     0     0    0.  988     0     0     0    0.
  989     0     0     0    0.  990     0     0     0    0.  991     0     0     0    0.  992     0     0     0    0.
  993     0     0     0    0.  994     0     0     0    0.  995     0     0     0    0.  996     0     0     0    0.
  997     0     0     0    0.  998     0     0     0    0.  999     0     0     0    0. 1000     0     0     0    0.
 1001     0     0     0    0. 1002     0     0     0    0. 1003     0     0     0    0. 1004   132  -132    88    2.
 1005   126  -126    84    3. 1006   117  -123    79    3. 1007   105  -120    74    3. 1008    96  -117    69    3.
 1009    90  -117    64    3. 1010    69  -117    56    4. 1011     0     0     0    0. 1012     0     0     0    0.
 1013     0     0     0    0. 1014     0     0     0    0. 1015     0     0     0    0. 1016     0     0     0    0.
 1017     0     0     0    0. 1018     0     0     0    0. 1019     0     0     0    0. 1020     0     0     0    0.
 1021     0     0     0    0. 1022     0     0     0    0. 1023     0     0     0    0. 1024     0     0     0    0.
 1025     0     0     0    0. 1026     0     0     0    0. 1027     0     0     0    0. 1028     0     0     0    0.
 1029     0     0     0    0. 1030     0     0     0    0. 1031     0     0     0    0. 1032     0     0     0    0.
 1033     0     0     0    0. 1034     0     0     0    0. 1035     0     0     0    0. 1036     0     0     0    0.
 1037     0     0     0    0. 1038     0     0     0    0. 1039     0     0     0    0. 1040   135  -135    90    1.
 1041   129  -129    86    2. 1042   123  -126    83    3. 1043   114  -123    78    3. 1044   102  -120    72    3.
 1045    93  -117    66    3. 1046    87  -117    63    3. 1047    69  -117    56    4. 1048     0     0     0    0.
 1049     0     0     0    0. 1050     0     0     0    0. 1051     0     0     0    0. 1052     0     0     0    0.
 1053     0     0     0    0. 1054     0     0     0    0. 1055     0     0     0    0. 1056     0     0     0    0.
 1057     0     0     0    0. 1058     0     0     0    0. 1059     0     0     0    0. 1060     0     0     0    0.
 1061     0     0     0    0. 1062     0     0     0    0. 1063     0     0     0    0. 1064     0     0     0    0.
 1065     0     0     0    0. 1066     0     0     0    0. 1067     0     0     0    0. 1068     0     0     0    0.
 1069     0     0     0    0. 1070     0     0     0    0. 1071     0     0     0    0. 1072     0     0     0    0.
 1073     0     0     0    0. 1074     0     0     0    0. 1075     0     0     0    0. 1076     0     0     0    0.
 1077     0     0     0    0. 1078   132  -132    88    2. 1079   129  -129    86    2. 1080   120  -123    81    3.
 1081   114  -120    77    3. 1082   102  -117    71    3. 1083    87  -117    64    3. 1084    66  -117    54    4.
 1085     0     0     0    0. 1086     0     0     0    0. 1087     0     0     0    0. 1088     0     0     0    0.
 1089     0     0     0    0. 1090     0     0     0    0. 1091     0     0     0    0. 1092     0     0     0    0.
 1093     0     0     0    0. 1094     0     0     0    0. 1095     0     0     0    0. 1096     0     0     0    0.
 1097     0     0     0    0. 1098     0     0     0    0. 1099     0     0     0    0. 1100     0     0     0    0.
 1101     0     0     0    0. 1102     0     0     0    0. 1103     0     0     0    0. 1104     0     0     0    0.
 1105     0     0     0    0. 1106     0     0     0    0. 1107     0     0     0    0. 1108     0     0     0    0.
 1109     0     0     0    0. 1110     0     0     0    0. 1111     0     0     0    0. 1112     0     0     0    0.
 1113     0     0     0    0. 1114     0     0     0    0. 1115     0     0     0    0. 1116   132  -129    87    2.
 1117   123  -123    82    3. 1118   120  -123    80    3. 1119   111  -120    76    3. 1120   105  -117    72    2.
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 NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE  NUM ALPHA  BETA ANGLE RANGE
1121    96  -114    67    3. 1122    81  -114    61    4. 1123    63  -114    53    3. 1124     0     0     0    0.
1125     0     0     0    0. 1126     0     0     0    0. 1127     0     0     0    0. 1128     0     0     0    0.
1129     0     0     0    0. 1130     0     0     0    0. 1131     0     0     0    0. 1132     0     0     0    0.
1133     0     0     0    0. 1134     0     0     0    0. 1135     0     0     0    0. 1136     0     0     0    0.
1137     0     0     0    0. 1138     0     0     0    0. 1139     0     0     0    0. 1140     0     0     0    0.
1141     0     0     0    0. 1142     0     0     0    0. 1143     0     0     0    0. 1144     0     0     0    0.
1145     0     0     0    0. 1146     0     0     0    0. 1147     0     0     0    0. 1148     0     0     0    0.
1149     0     0     0    0. 1150     0     0     0    0. 1151     0     0     0    0. 1152     0     0     0    0.
1153     0     0     0    0. 1154     0     0     0    0. 1155   132  -132    89    2. 1156   126  -126    84    2.
1157   120  -123    80    3. 1158   111  -117    75    2. 1159    99  -114    70    3. 1160    93  -111    65    3.
1161    84  -111    60    3. 1162    63  -111    52    3. 1163     0     0     0    0. 1164     0     0     0    0.
1165     0     0     0    0. 1166     0     0     0    0. 1167     0     0     0    0. 1168     0     0     0    0.
1169     0     0     0    0. 1170     0     0     0    0. 1171     0     0     0    0. 1172     0     0     0    0.
1173     0     0     0    0. 1174     0     0     0    0. 1175     0     0     0    0. 1176     0     0     0    0.
1177     0     0     0    0. 1178     0     0     0    0. 1179     0     0     0    0. 1180     0     0     0    0.
1181     0     0     0    0. 1182     0     0     0    0. 1183     0     0     0    0. 1184     0     0     0    0.
1185     0     0     0    0. 1186     0     0     0    0. 1187     0     0     0    0. 1188     0     0     0    0.
1189     0     0     0    0. 1190     0     0     0    0. 1191     0     0     0    0. 1192     0     0     0    0.
1193     0     0     0    0. 1194   126  -126    85    2. 1195   129  -129    86    2. 1196   129  -126    85    2.
1197   114  -117    77    3. 1198   105  -114    73    2. 1199    96  -111    68    3. 1200    87  -108    62    3.
1201    75  -105    56    2. 1202    57  -108    49    3. 1203     0     0     0    0. 1204     0     0     0    0.
1205     0     0     0    0. 1206     0     0     0    0. 1207     0     0     0    0. 1208     0     0     0    0.
1209     0     0     0    0. 1210     0     0     0    0. 1211     0     0     0    0. 1212     0     0     0    0.
1213     0     0     0    0. 1214     0     0     0    0. 1215     0     0     0    0. 1216     0     0     0    0.
1217     0     0     0    0. 1218     0     0     0    0. 1219     0     0     0    0. 1220     0     0     0    0.
1221     0     0     0    0. 1222     0     0     0    0. 1223     0     0     0    0. 1224     0     0     0    0.
1225     0     0     0    0. 1226     0     0     0    0. 1227     0     0     0    0. 1228     0     0     0    0.
1229     0     0     0    0. 1230     0     0     0    0. 1231     0     0     0    0. 1232     0     0     0    0.
1233   132  -132    88    2. 1234   129  -129    86    2. 1235   123  -123    82    3. 1236   117  -117    78    3.
1237   108  -114    74    3. 1238    99  -108    68    3. 1239    87  -105    62    3. 1240    78  -102    56    2.
1241    57  -102    49    3. 1242     0     0     0    0. 1243     0     0     0    0. 1244     0     0     0    0.
1245     0     0     0    0. 1246     0     0     0    0. 1247     0     0     0    0. 1248     0     0     0    0.
1249     0     0     0    0. 1250     0     0     0    0. 1251     0     0     0    0. 1252     0     0     0    0.
1253     0     0     0    0. 1254     0     0     0    0. 1255     0     0     0    0. 1256     0     0     0    0.
1257     0     0     0    0. 1258     0     0     0    0. 1259     0     0     0    0. 1260     0     0     0    0.
1261     0     0     0    0. 1262     0     0     0    0. 1263     0     0     0    0. 1264     0     0     0    0.
1265     0     0     0    0. 1266     0     0     0    0. 1267     0     0     0    0. 1268     0     0     0    0.
1269     0     0     0    0. 1270     0     0     0    0. 1271   135  -132    89    2. 1272   129  -126    86    2.
1273   123  -120    81    3. 1274   117  -114    78    3. 1275   111  -111    73    3. 1276    99  -105    67    3.
1277    90   -99    62    3. 1278    75   -93    54    2. 1279    54   -93    46    3. 1280     0     0     0    0.
```

NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE
1281	0	0	0	0.	1282	0	0	0	0.	1283	0	0	0	0.	1284	0	0	0	0.
1285	0	0	0	0.	1286	0	0	0	0.	1287	0	0	0	0.	1288	0	0	0	0.
1289	0	0	0	0.	1290	0	0	0	0.	1291	0	0	0	0.	1292	0	0	0	0.
1293	0	0	0	0.	1294	0	0	0	0.	1295	0	0	0	0.	1296	0	0	0	0.
1297	0	0	0	0.	1298	0	0	0	0.	1299	0	0	0	0.	1300	0	0	0	0.
1301	0	0	0	0.	1302	0	0	0	0.	1303	0	0	0	0.	1304	0	0	0	0.
1305	0	0	0	0.	1306	0	0	0	0.	1307	132	-132	88	2.	1308	126	-120	83	3.
1309	123	-117	81	3.	1310	120	-114	79	3.	1311	111	-105	73	3.	1312	105	-99	68	3.
1313	93	-93	61	4.	1314	81	-81	54	2.	1315	60	-78	44	2.	1316	0	0	0	0.
1317	0	0	0	0.	1318	0	0	0	0.	1319	0	0	0	0.	1320	0	0	0	0.
1321	0	0	0	0.	1322	0	0	0	0.	1323	0	0	0	0.	1324	0	0	0	0.
1325	0	0	0	0.	1326	0	0	0	0.	1327	0	0	0	0.	1328	0	0	0	0.
1329	0	0	0	0.	1330	0	0	0	0.	1331	0	0	0	0.	1332	0	0	0	0.
1333	0	0	0	0.	1334	0	0	0	0.	1335	0	0	0	0.	1336	0	0	0	0.
1337	0	0	0	0.	1338	0	0	0	0.	1339	0	0	0	0.	1340	132	-129	88	2.
1341	129	-123	84	3.	1342	123	-114	80	3.	1343	117	-105	75	3.	1344	111	-99	70	3.
1345	105	-90	65	3.	1346	99	-84	61	4.	1347	90	-75	54	2.	1348	66	-66	44	2.
1349	0	0	0	0.	1350	0	0	0	0.	1351	0	0	0	0.	1352	0	0	0	0.
1353	0	0	0	0.	1354	0	0	0	0.	1355	0	0	0	0.	1356	0	0	0	0.
1357	0	0	0	0.	1358	0	0	0	0.	1359	0	0	0	0.	1360	0	0	0	0.
1361	0	0	0	0.	1362	0	0	0	0.	1363	0	0	0	0.	1364	0	0	0	0.
1365	0	0	0	0.	1366	0	0	0	0.	1367	0	0	0	0.	1368	135	-135	90	1.
1369	132	-126	86	3.	1370	129	-117	83	3.	1371	123	-108	78	3.	1372	114	-102	73	3.
1373	111	-93	69	3.	1374	105	-87	65	3.	1375	102	-81	60	4.	1376	90	-72	54	2.
1377	72	-63	45	4.	1378	0	0	0	0.	1379	0	0	0	0.	1380	0	0	0	0.
1381	0	0	0	0.	1382	0	0	0	0.	1383	0	0	0	0.	1384	0	0	0	0.
1385	0	0	0	0.	1386	0	0	0	0.	1387	0	0	0	0.	1388	0	0	0	0.
1389	0	0	0	0.	1390	0	0	0	0.	1391	0	0	0	0.	1392	0	0	0	0.
1393	0	0	0	0.	1394	135	-132	89	2.	1395	132	-126	86	2.	1396	126	-114	80	3.
1397	120	-105	76	3.	1398	114	-99	72	3.	1399	108	-90	67	3.	1400	102	-84	62	3.
1401	90	-72	57	2.	1402	75	-66	46	4.	1403	0	0	0	0.	1404	0	0	0	0.
1405	0	0	0	0.	1406	0	0	0	0.	1407	0	0	0	0.	1408	0	0	0	0.
1409	0	0	0	0.	1410	0	0	0	0.	1411	0	0	0	0.	1412	0	0	0	0.
1413	0	0	0	0.	1414	0	0	0	0.	1415	0	0	0	0.	1416	0	0	0	0.
1417	135	-132	89	1.	1418	129	-120	84	2.	1419	126	-114	80	2.	1420	120	-108	77	2.
1421	114	-96	70	3.	1422	105	-84	64	3.	1423	99	-75	58	2.	1424	78	-66	48	4.
1425	0	0	0	0.	1426	0	0	0	0.	1427	0	0	0	0.	1428	0	0	0	0.
1429	0	0	0	0.	1430	0	0	0	0.	1431	0	0	0	0.	1432	0	0	0	0.
1433	0	0	0	0.	1434	132	-126	87	2.	1435	126	-114	81	2.	1436	117	-102	74	2.
1437	111	-93	68	3.	1438	102	-84	62	3.	1439	99	-75	57	2.	1440	78	-69	49	3.

NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE	NUM	ALPHA	BETA	ANGLE	RANGE
1441	0	0	0	0.	1442	0	0	0	0.	1443	0	0	0	0.	1444	0	0	0	0.
1445	0	0	0	0.	1446	132	-129	88	2.	1447	126	-117	81	2.	1448	117	-105	75	2.
1449	111	-93	68	3.	1450	102	-84	62	3.	1451	96	-75	57	2.	1452	78	-69	49	3.
1453	0	0	0	0.	1454	0	0	0	0.	1455	123	-108	77	2.	1456	114	-96	70	2.
1457	108	-87	65	2.	1458	102	-75	59	2.	1459	78	-69	49	3.	1460	135	-123	86	1.
1461	125	-96	74	1.	1462	111	-78	63	2.	1463	78	-69	49	3.	1464	0	0	0	0.

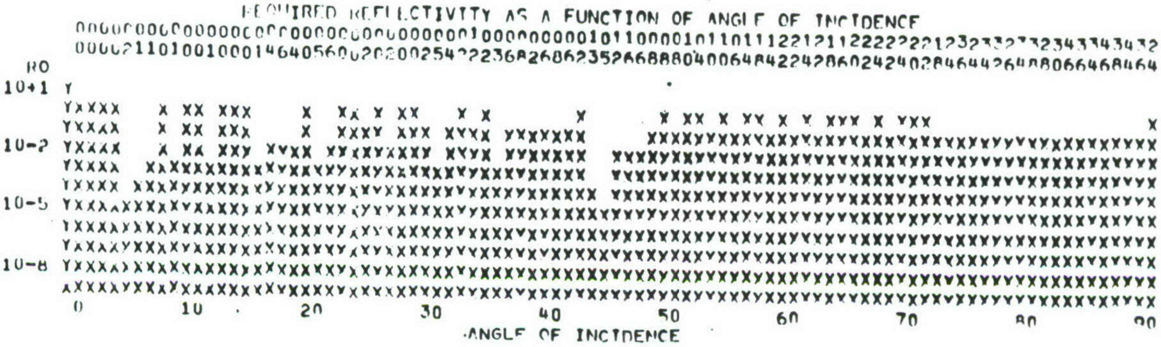
```
                       REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE          0        1        2        3        4        5        6        7        8        9
  0     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 10     ******** ******** ******** ********  .054297  .042046  .037069  .031225  .216112  .331653
 20      .505169  .486715  .213959  .247891  .464866  .134858  .560137  .485047  .036218  .084756
 30      .011751  .000171  .021894  .453444  .014821  .460485  .011198  .407770  .008480  .417643
 40      .006866  .006570  .000244  .359509  .320802  .096464  .122596  .262292  .129019  .158949
 50      .209615  .175298  .160232  .141172  .062352  .078226  .067988  .059843  .042315  .032424
 60      .033165  .038908  .030233  .054803  .054268  .128891  .156531  .224997  .261403 1.914056
 70      .320812 2.026948 2.179306 1.802839 2.428542 2.341416 2.767450 2.988529 2.218915 2.815054
 80     3.136613 3.657446 4.446417 3.470840 4.903486 7.796664 6.005301 ******** ******** ********
 90     ********
```

```
                   REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
     0000000000000000000001010010001221110111111121112222222212222212211100000000000000000010000
     0000000000000041113231606804561023099461638920794800018459530338228353934546365269345504674
RO
10+1 Y
     YXXXXXXXXXXXXX                                                       X XXXXXXXXXXXXXXXXXXXX
     YXXXXXXXXXXXXX    XXXXXXXXXX     X X X X   XX XXXXXXXX           XXXXXXXXXXXXXXXXXXXXXXXXXX
10-2 1XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXX X   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-5 YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-8 YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     0        10        20        30        40        50        60        70        80        90
                                      ANGLE OF INCIDENCE
```

APPENDIX C

REQUIRED REFLECTIVITY
FOR COBRA WINDOW

```
                        REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0         1         2         3         4         5         6         7         8         9
  0     ******** ******** ******** ********   .000098   .000507   .002612 ********   .002886 ********
 10     ********   .003631 ******** ******** ********   .004900   .033839   .044335   .036657 ********
 20      .006522   .000333 ******** ********   .319596 ********   .054866 ******** ********   .824323
 30      .009295   .702715 1.141053   .318117 1.112452   .004217   .797339   .965742   .994353   .823004
 40      .314001   .904622 1.230533   .000767   .000036   .051390   .072302   .091031   .672689 1.032641
 50      .982402 1.003619 1.266639   .766031 1.022784   .585821 1.046435 1.019704   .828934 1.054266
 60      .683817 1.050209   .993465 1.061723 1.051681 1.020980   .993104 1.050777   .818283 1.039075
 70     1.023730 1.019074   .994547   .999099   .351126   .406705   .949691   .432718   .421819   .901543
 80      .470092   .746505   .534266   .726146   .694954   .686099   .646018   .631027   .654677   .779754
 90     2.171874
```

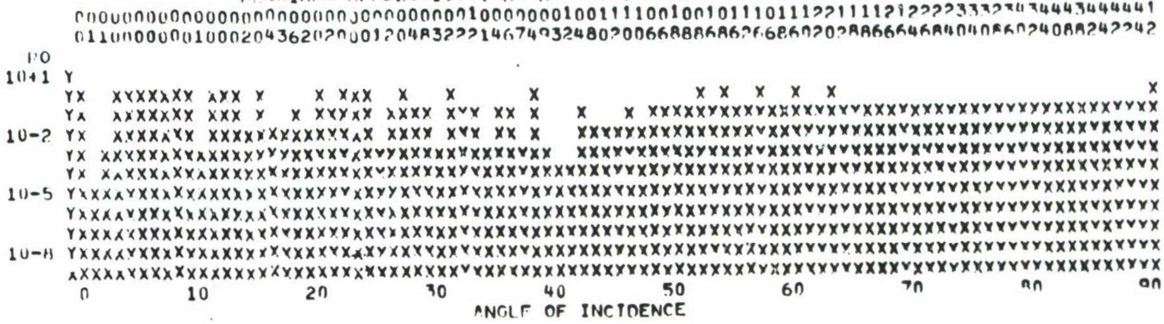


Sun Zenith = 0°

Sun Azimuth = 0°

```
                              REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0          1          2          3          4          5          6          7          8          9
  0     *********   .000076    .001598  ********* ********* ********* ********* ********* ********* *********
 10      .005551  ********* ********* *********   .059875 *********   .076502    .011043    .112234    .009216
 20     *********   .371406  ********* ********* *********   .007321    .510319  *********   .340877    .509794
 30      .005657  2.126677    .676334    .237811    .004293    .635890    .244572    .003476  1.000530    .003198
 40      .000626    .000122    .932411    .039438    .042842    .047126    .829408    .064108    .698680    .854811
 50      .851715    .871234  1.105339    .767180  1.190694    .836211    .777242  1.028746    .901284    .784848
 60     1.179338    .950567    .791402  1.148794    .804383    .954248    .971840    .783700    .800485    .762710
 70      .734557    .735433    .695366    .711214    .699165    .661998    .756521    .598338    .494169    .471879
 80      .418006    .427803    .397467    .368548    .323473    .293023    .295870    .253668    .403898    .501939
 90     2.384390
```

REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE

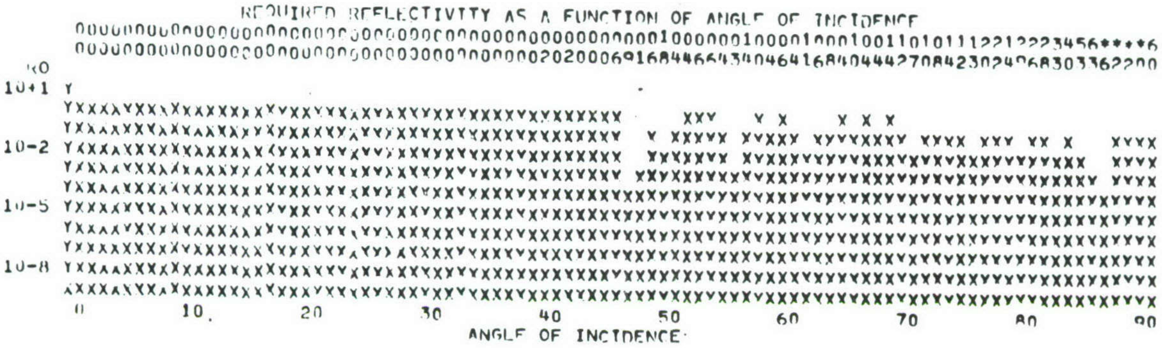


Sun Zenith = 45°

Sun Azimuth = 0°

```
                          REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE       0         1         2         3         4         5         6         7         8         9
  0     ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 10     ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 20     ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 30     ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 40     ********* 9.650987 ********* ********* ********* 1.576195   .000120   .002533   .854842   .071235
 50       .941068 1.071376 1.136059 1.108212   .466404   .009595   .886472 *********   .769733 1.080618
 60       .921728   .021044   .533197   .369252 1.059686   .848369 1.026463   .941772 1.045967   .964821
 70       .016656   .585760   .821557   .620440   .581441   .014414   .456408   .442967   .407641   .012413
 80       .345074   .278926   .011540   .223609   .012672   .002878   .000612   .125708   .144186   .184402
 90       .799229
```

REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE

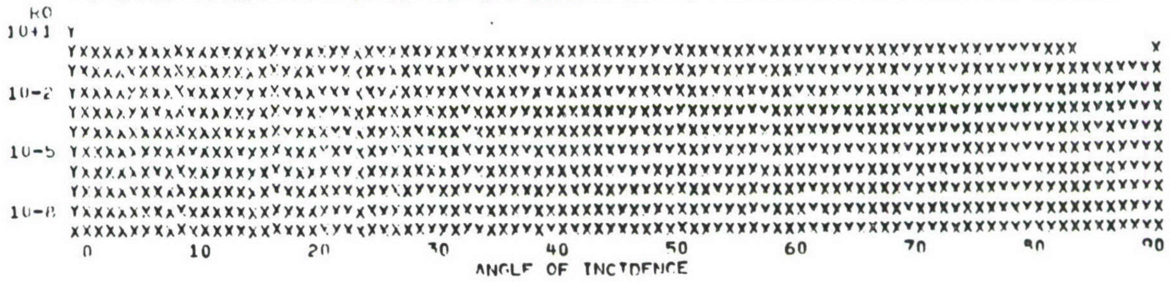


Sun Zenith = 90°

Sun Azimuth = 0°

```
                     REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE          0        1        2        3        4        5        6        7        8        9
  0     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 10     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 20     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 30     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 40     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 50     ******** ******** ******** ******** ******** ******** ******** 9.279870 ******** ********
 60     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 70     4.462324 ******** ******** ******** ******** ******** ******** ******** ******** ********
 80     ******** ******** 6.539168 3.503263  .369055  .369816  .266903  .301390  .341883  .365381
 90     1.586299
```

```
                     REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
```



Sun Zenith = 135°

Sun Azimuth = 0°

```
                        REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE          0        1        2        3        4        5        6        7        8        9
  0        ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 10        ******** ******** ******** ******** .054297  .042046  .037069  .031225  .216112  .331653
 20         .505169  .486713  .213959  .247891  .464866  .134858  .560137  .485047  .036218  .084756
 30         .011751  .000171  .021894  .453444  .014921  .460485  .011108  .407770  .008480  .417643
 40         .006866  .006370  .000244  .339509  .320802  .096464  .122506  .262292  .120019  .158949
 50         .209613  .175298  .160232  .141172  .062352  .078226  .067988  .059843  .042315  .032424
 60         .033185  .038908  .030233  .054803  .054268  .128891  .156531  .224997  .261403 1.914056
 70         .326812 2.026948 2.179306 1.802839 2.428542 2.341416 2.767450 2.988529 2.218915 2.815054
 80        3.138613 3.657446 4.446417 3.470840 4.903486 7.796664 6.005301 ******** ******** ********
 90        ********
```

```
                        REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
      0000000000000000000000101001000122111011111111211122222222122222122111000000000000000000010000
      000000000000000041113231606804561023099461638920794800018459530338228353934546365269345504674
1:0
10+1  X
      XXXXXXXXXXXXXXX                                                      X XXXXXXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXX    XXXXXXXXXX     X X X X  XX XXXXXXXXX          XXXXXXXXXXXXXXXXXXXXXXXXXX
10-2  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXX  X  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-5  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-8  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      0         10        20        30        40        50        60        70        80        90
                                     ANGLE OF INCIDENCE
```

Sun Zenith = 45°

Sun Azimuth = 45°

```
                     REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE       0         1         2         3         4         5         6         7         8         9
  0     ******** ******** ******** ******** ******** ******** ******** 3.442951 ******** ********
 10     ******** ******** ******** ******** ******** ******** 1.708606 ******** ******** ********
 20     ******** ******** ******** ******** ******** 4.945838 ********  .438725  .422363  .367988
 30      .319677  .276244  .235059  .196707  .172789  .134938  .104435  .083169  .074312  .054497
 40      .043635  .037743  .030162  .022668  .023118  .037381  .032052  .020674  .044721  .055931
 50      .050965  .032457  .102026  .562292  .560510  .570599  .564570  .549986  .537938  .549521
 60      .639951  .000351  .799013  .900186  .945819 1.163669  .028007  .828598 1.777367 1.661601
 70      .063413 2.669130 ********  .111342  .141906  .128950  .055543 3.354671 ******** ********
 80      .053431 ********  .051436 4.463946  .053353 7.958373  .065900  .003623 ******** ********
 90     ********
```

```
                     REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
      00000000000000000000000000000111111111102123333457432100000000000000000000000000000000000000
      0000000100000000100000000010541201111458286421269145159795654854633543181045785003045212723 0
 1.0
10+1  Y
      YXXXXXXXXXXXXXXXXXXXXXXXXXXX                                      X  XX XX    XXX X X X XXX
      YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX              XXXXXXXXXX XXXX XXX XXXXX XXX X X X XXX
10-2  YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXX XXX
      YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXX
      YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-5  YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10-8  YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      0         10        20        30        40        50        60        70        80        90
                                        ANGLE OF INCIDENCE
```

Sun Zenith = 90°

Sun Azimuth = 45°

```
                              REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE         0         1         2         3         4         5         6         7         8         9
  0       ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 10       ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 20       ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 30       ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 40       ******** ******** ******** ******** ******** 5.167035 ******** 2.354520 ******** ********
 50       ******** ******** ******** 4.401995 .159123  .099161  .060344  .053195  .052569  .072241
 60        .029738  .049277  .034114  .094490  .054265  .098939  .165502  .225909  .281172  .108366
 70        .205305  .429687  .180415  .201600  .207191  .191701  .759859  .836279 1.024102  .991037
 80       1.436759 1.945629 2.066856 2.903176 3.193451 2.711518 6.446977 8.302135 ******** ********
 90       ********
```

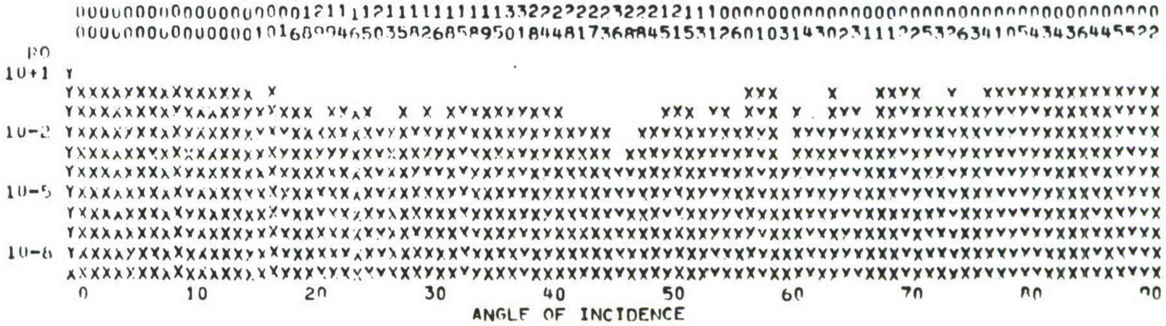
```
                              REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
       0000000000000000000000000000000000000000000000000000000001247223222222211111111111101010000000000
       0000000000000000000000000000000000000000000000001010000017275660770731988876806322069257075773
```

Sun Zenith = 135°

Sun Azimuth = 45°

```
                              REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0         1         2         3         4         5         6         7         8         9
   0     ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
  10     ********* ********* ********* ********* *********  .358695 *********  .724848  .588824  .448445
  20      .029076   .527816   .495081   .344733   .450679   .022846   .029442   .313381   .026464   .128929
  30      .027088   .110213   .140757   .189603   .128630   .150213   .217437   .149864   .178179   .148501
  40      .132857   .099010   .074762   .052272   .035124   .000286   .008425   .014634   .020321   .101005
  50      .125518   .158722   .034166   .212719   .234932   .018413 ********* 8.022140 *********  .000294
  60      .277949   .077095   .084567 *********  .927463   .112361   .096976 3.375254 1.070710 2.338638
  70     2.818750   .151194   .270253 2.520895   .309845   .404529 3.545074 4.491861 ********* 3.930949
  80     3.142184 4.393442 4.085316 6.326991 8.351261 7.770634 9.511791 ********* ********* *********
  90     *********
```

REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE

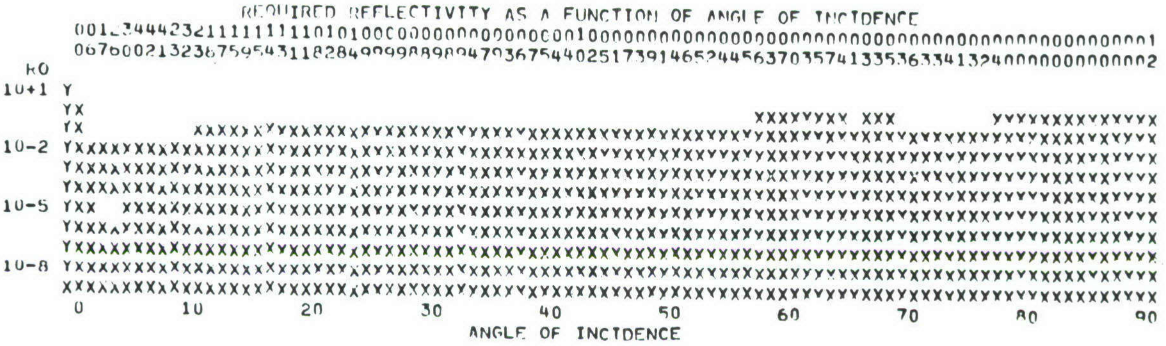


Sun Zenith = 45°

Sun Azimuth = 90°

```
                     REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE       0          1          2          3          4          5          6          7          8          9
   0    ********   .019297    .017359    .031047    .025236    .035949    .031275    .057016    .070168    .088270
  10     .104196   .114317    .109366    .147049    .121840    .125243    .200915    .116385    .232976    .258275
  20     .245320   .276049    .273560    .300772    .314085    .362454    .326508    .396888    .411110    .353719
  30     .358953   .351256    .422193    .315891    .338249    .369294    .436151    .322726    .406063    .360940
  40     .318430   .438847    .402643    .359798    .329813    .402952    .271151    .472037    .455163    .954681
  50     .442992   .625027    .738703    .743392    .783528    .776351    .756851   1.011179   1.055480   1.133055
  60    ********  1.749858   1.020522   1.436898   1.314726    .108449   1.545966   2.749042   2.120916    .110781
  70     .175608   .142733    .369563    .131773    .140114    .324497    .283479   1.172090   ********   ********
  80    ********  ********   ********   ********   ********   ********   ********   ********   ********   ********
  90    4.699064
```

REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE



Sun Zenith = 90°

Sun Azimuth = 90°

```
                          REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE       0        1        2        3        4        5        6        7        8        9
   0    ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
  10    ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
  20    ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
  30    ******** ******** ******** ******** ********  .253471  .221904  .200654  .176885  .149654
  40     .122254  .100211  .081970  .044636  .023583  .025932  .034732  .053565  .077899  .104698
  50     .125575  .156721  .187282  .168903  .231036  .173041  .284281  .150667  .147872  .316140
  60     .152773  .142222  .371215  .419864  .399231  .441315  .429660  .390260  .504836  .588923
  70     .635182  .779912  .892899  .872335 1.105762  .860737 1.448520 1.579241 1.973130 2.002440
  80    2.570051 2.957856 3.475804 3.930561 4.942731 7.479308 9.526771 9.890507 ******** ********
  90    ********
```

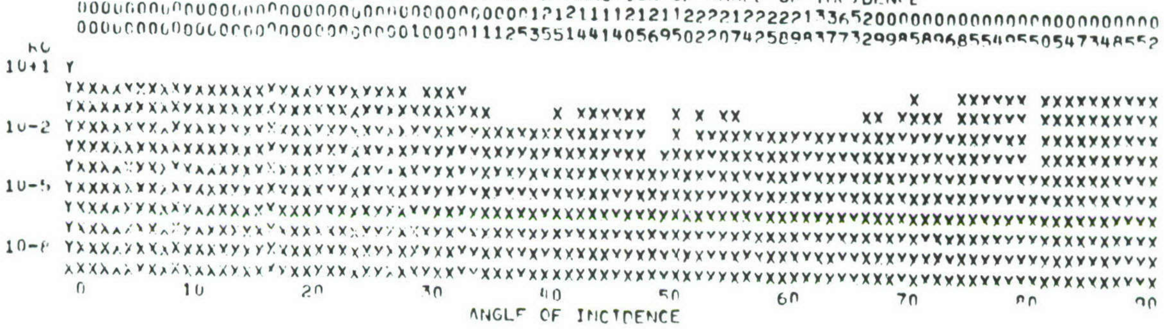
REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE

Sun Zenith = 135°

Sun Azimuth = 90°

```
                    REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE      0         1         2         3         4         5         6         7         8         9
  0    ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 10    ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 20    ********* ********* ********* ********* ********* ********* ********* *********   .545744 *********
 30    ********* ********* *********   .066232   .884028   .036108   .024597   .028021   .023104   .024357
 40      .418011   .093044   .103059   .573706   .541368   .510486   .155524   .170278   .000262   .007092
 50      .180912   .007995   .263953   .010358   .165192   .129326   .014706   .052130   .043562   .038135
 60      .019119   .032910   .043670   .055308   .056675   .095155   .159700   .117321   .030441   .638248
 70     1.237008   .180057   .158858   .027732  1.612830  1.467915  1.465533  1.457647  2.467889  3.575870
 80      .000856 ********* 2.680187  6.005896  5.746583  7.342781  7.894595  1.246926 ********* 5.432113
 90    *********
```

REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE

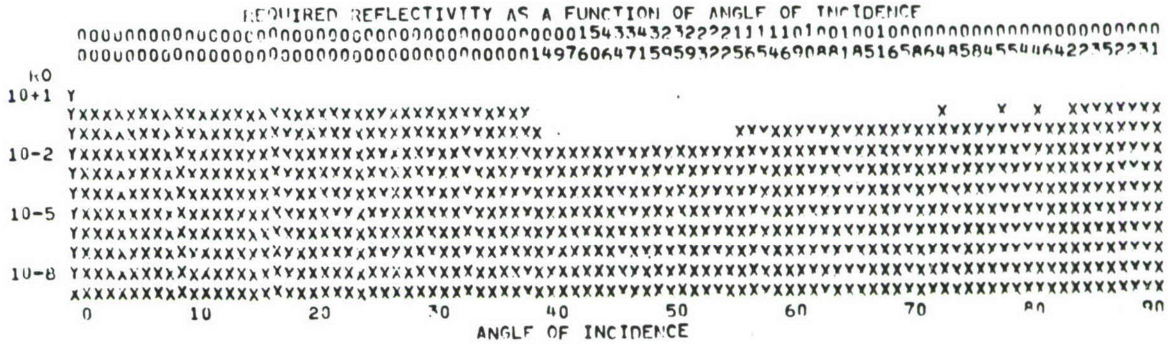


Sun Zenith = 45°

Sun Azimuth = 135°

```
                                   REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE          0         1         2         3         4         5         6         7         8         9
  0        ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 10        ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 20        ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 30        ********* ********* ********* ********* ********* ********* ********* *********   .260655   .037260
 40          .058572   .064372   .045196   .020785   .032127   .037365   .023043   .022544   .036708   .029796
 50          .037326   .047464   .060381   .072250   .090532   .115143   .131649   .147514   .165339   .193167
 60          .261959   .218695   .221475   .272723   .226559   .256447   .222150   .246460   .298486   .497466
 70          .479572   .442594  1.310850   .635909   .884059   .153940   .979641  1.563936   .162881   .213600
 80         2.068616   .202772   .232343  2.696936  1.031766  1.421999  7.655040  7.839233 *********  8.431180
 90        *********
```

REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE

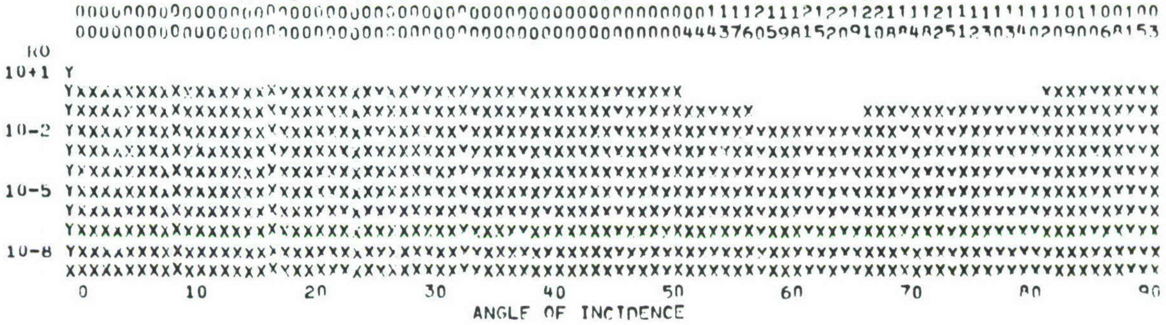


Sun Zenith = 90°

Sun Azimuth = 135°

```
                    REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0         1         2         3         4         5         6         7         8         9
  0      ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 10      ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 20      ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 30      ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 40      ********* ********* ********* ********* ********* ********* ********* ********* ********* *********
 50      *********   .223455   .244643   .216324   .156123   .133023   .115006   .052417   .029269   .038345
 60        .033296   .032729   .054093   .044161   .070966   .075137   .111444   .122482   .146261   .105476
 70        .211799   .203966   .191554   .304316   .333805   .401262   .458068   .638128   .594731   .848447
 80        .860290  1.200797  1.437098  2.146164  1.902144  2.983633  4.043001  7.701043  8.192090 *********
 90      *********
```

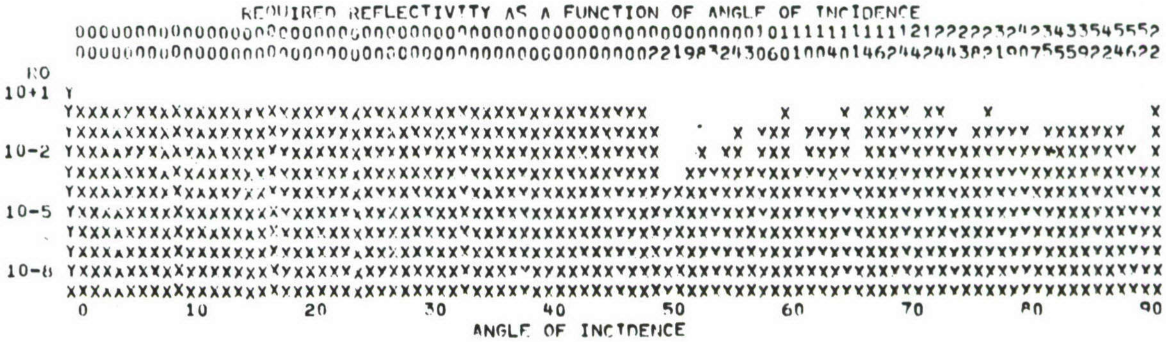
REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE



Sun Zenith = 135°

Sun Azimuth = 135°

```
                         REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0         1         2         3         4         5         6         7         8         9
  0      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 10      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 20      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 30      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 40      ********  ********  ********  ********  ********  ********  ********  ********   .960304   .000123
 50       .000633   .003240   .043268   .003520   .066616   .149701   .004308   .245004   .935747  1.061721
 60       .005469   .245067   .984776   .999642  1.024326   .005413  1.262591  1.194812  1.241765  1.396555
 70       .839015  1.406036  1.233206   .930074   .021630   .649498  1.145766   .384746   .399451   .368528
 80       .023513   .489503   .786355   .726803   .579713   .416310   .232591   .469914   .055433   .002967
 90      3.050709
```

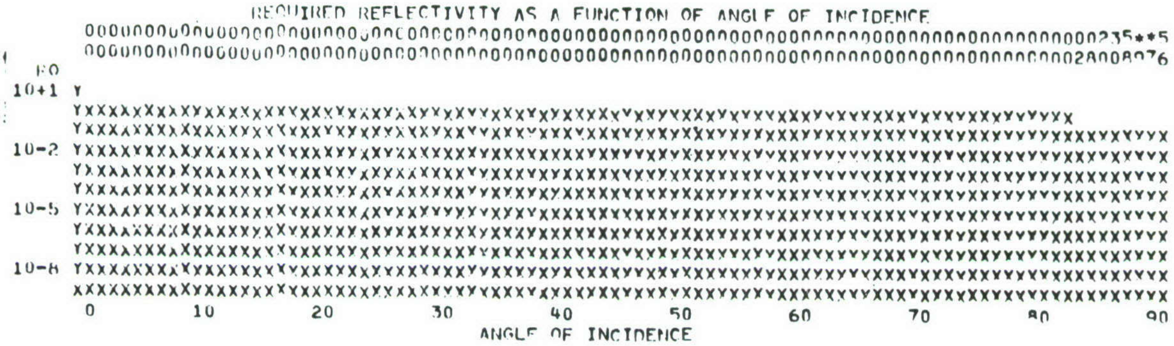


Sun Zenith = 45°

Sun Azimuth = 180°

```
                   REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE       0        1        2        3        4        5        6        7        8        9
  0     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 10     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 20     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 30     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 40     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 50     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 60     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 70     ******** ******** ******** ******** ******** ******** ******** ******** ******** ********
 80     ******** ******** ********  .807620  .123129  .213097  .257932  .203781  .128318  .261005
 90      .671355
```

REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE



Sun Zenith = 90°

Sun Azimuth = 180°

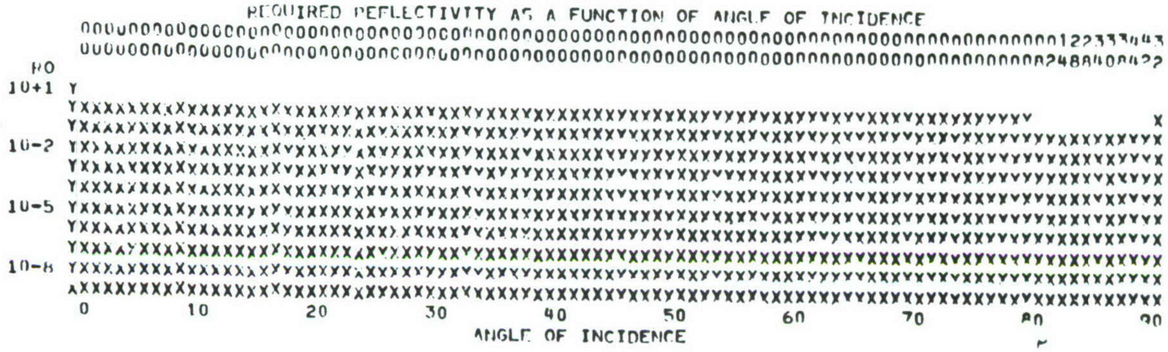
```
                  REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE       0         1         2         3         4         5         6         7         8         9
  0     ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 10     ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 20     ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 30     ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 40     ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 50     ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 60     ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 70     ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 80     ********   .801245   .803625   .497451   .660835   .489105   .251649   .538785   .257892   .434770
 90     1.840982
```

REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE

Sun Zenith = 135°

Sun Azimuth = 180°

```
                         REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0         1         2         3         4         5         6         7         8         9
  0      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 10      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 20      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 30      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 40      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 50      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 60      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 70      ********  ********  ********  ********  ********  ********  ********  ********  ********  ********
 80       .760003   .750847   .736485   .724701   .688032   .651730   .641145   .660377   .618038   .564181
 90      1.801698
```

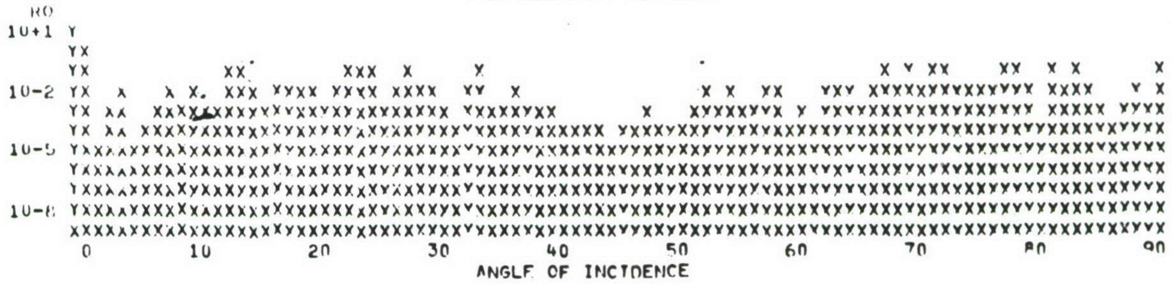


Sun Zenith = 180°

Sun Azimuth = 0°

```
                         REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
ANGLE        0         1         2         3         4         5         6         7         8         9
   0     ********  .000076   .001598   .031047   .000098   .000507   .002612   .057016   .002886   .088270
  10      .005551  .003631   .109366   .147049   .054297   .004900   .033839   .011043   .036657   .000216
  20      .006522  .040333   .213959   .247891   .314085   .007321   .029442   .313391   .026464   .084756
  30      .005657  .000171   .021894   .189603   .004293   .004217   .011108   .003476   .009480   .003199
  40      .000626  .000122   .000244   .000767   .000036   .000286   .000120   .002533   .000262   .000123
  50      .000633  .003240   .034166   .003520   .062352   .009595   .004308   .052130   .020269   .000294
  60      .005469  .000351   .030233   .044161   .054265   .005413   .028087   .117321   .030441   .110781
  70      .016656  .142733   .158858   .027732   .021630   .014414   .055543   .384746   .162881   .012413
  80      .000856  .292772   .011540   .223609   .012672   .002878   .000612   .003623   .055433   .002967
  90      .671355
```

SUMMARY OF
REQUIRED REFLECTIVITY AS A FUNCTION OF ANGLE OF INCIDENCE
FOR ALL SUN POSITIONS



Summary Chart

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P.O. Box 235
ATTN: Mr. A. Akerman
Buffalo, NY 14221

CALSPAN Corporation 1
P.O. Box 235
ATTN: Mr. Harry Hammill
Buffalo, NY 14221

Dept. of the Air Force 1
Headquarters, ASD
ATTN: ASD/ENADE/P. G. Wiegert
Wright Patterson AFB, OH 45433

Bell Helicopter Company 1
P. O. Box 482
ATTN: Mr. Charles M. Seibel
Fort Worth, TX 76101

Commander 1
US Air Force Avionics Laboratory
ATTN: AFAL/WRD (J. D. MacAulay)
Wright Patterson AFB, OH 45433

Bell Helicopter Company 2
P.O. Box 482
ATTN: Mr. Jerry Jaggers
Fort Worth, TX 76101

Commander 1
US Army Aviation Systems Command
ATTN: AMSAV - EFA (L. Howard)
P.O. Box 209
St. Louis, MO 63166

Commander 1
US Army Aviation Systems Command
ATTN: AMSAV - EFS (R. Lutz)
P.O. Box 209
St. Louis, MO 63166

Commander 1
US Army Aviation Systems Command
ATTN: AMSAV - EEH (J. McDermott)
P. O. Box 209
St. Louis, MO 63166

The Franklin Institute Research Laboratories 2
20th & Race Streets
ATTN: John A. DeBenedictis
Philadelphia, PA 19103

The Franklin Institute Research Laboratories 2
20th & Race Streets
ATTN: William Collins
Philadelphia, PA 19103

Commander 2
US Army Mobility Equipment R & D Center
ATTN: STSFB - M (R. Murphy)
Ft. Belvoir, VA 22060

Bell Helicopter Company 1
P.O. Box 482
ATTN: Mr. R. Norwine, Govt Marketing
Ft. Worth, TX 76101

Bell Helicopter Company 1
P.O. Box 482
ATTN: Mr. Kenneth Bradford
Ft. Worth, TX 76101

Headquarters 1
Dept. of the Army
ATTN: DARD - ZC
Washington, DC 20310

Headquarters 1
Dept. of the Army
ATTN: DARD - DDA
Washington, DC 20310

Headquarters 1
Dept. of the Army
ATTEN: DARD - ZCA
Washington, DC 20310

Commander 2
US Army Electronics Command
ATTN: AMSEL - VL
Ft. Monmouth, NJ 07703

Commander 1
US Army Electronics Command
ATTN: AMSEL - WL - N (R. Giordano)
Ft. Monmouth, NJ 07703

Optical Coating Laboratory Inc. 1
P.O. Box 1599
ATTN: Mr. George Lundgren
Santa Rosa, CA 95403

Optical Coating Laboratory Inc. 1
P.O. Box 1599
ATTN: Mr. John Walker
Santa Rosa, CA 95403

Commander 1
US Army Aviation Systems Command
ATTN: AMCPM - UA
P.O. Box 209
St. Louis, MO 63166

Sikorsky Aircraft 1
Division of United Aircraft Corp
ATTN: Mr. Michael J. Salkind
Stratford, CT 06602

Optical Science Consultants 2
P.O. Box 388
ATTN: Dr. David L. Fried
Yorba Linda, CA 92686

Commander
US Army Combat Developments Experimentation Command 2
ATTN: CDCEC - EX
Fort Ord, CA 93941

Sierracin Corporation 1
12780 San Fernando Road
ATTN: Mr. John A. Haynes
Sylmar, CA 91324

Hughes Helicopters 1
Div of Summa Corp
ATTN: Mr. E. P. Phiesendorfer
Culver City, CA 90230

Westinghouse Defense & Electronic Systems Center 6
Systems Development Division
ATTN: MS 434 (Daumit, Higby, Goodell, Kiesel)
Baltimore, MD 21203