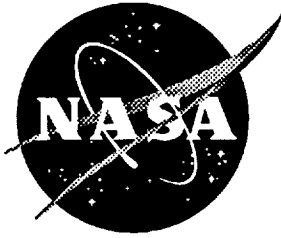


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# Operation of the Computer Model for Microenvironment Solar Exposure

J. R. Gillis, R. J. Bourassa, and P. E. Gruenbaum  
*Boeing Defense & Space Group, Seattle, Washington*

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**OPERATION OF THE COMPUTER  
MODEL FOR MICROENVIRONMENT  
SOLAR EXPOSURE**

**J.R. Gillis  
R.J. Bourassa  
P.E. Gruenbaum**

**For SOLSHAD, version 1.0.**

**BOEING DEFENSE & SPACE GROUP**



# OPERATION OF THE COMPUTER MODEL FOR MICROENVIRONMENT SOLAR EXPOSURE

## FOREWORD

This report describes the operation of the computer model SOLSHAD, which was developed to predict solar exposure to satellite surfaces which may shadow or reflect on one another. Boeing Defense & Space Group's activities were supported by the following NASA Langley Research Center Contracts (LaRC); "LDEF Special Investigation Group Support" contracts NAS1-18224, Tasks 12 and 15 (October 1989 through January 1991), NAS1-19247 Tasks 1 & 2 (May 1991 through October 1992), and NAS1-19247 Task 8 (initiated October 1992). Sponsorship for these programs was provided by National Aeronautics and Space Administration, Langley Research Center, Hampton, VA, and The Strategic Defense Initiative Organization, Key Technologies Office, Washington, D.C.

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Sylvester Hill  
Roger Bourassa  
Dr. James R. Gillis  
Dr. Peter Gruenbaum  
Dr. Gary Pippin

Task Manager  
Modeling  
Scientific Computing  
User Interface Programming  
Project Coordination



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## CHANGES

The following changes have been made since the August 16, 1994 draft version of this manual:

1. The SOLSHAD input file has been changed so that the dates in records B1 and B2 are given in the format Year, Month, and Day of month, rather than Year and Day of year.
2. Minor clarifications have been made.

## GLOSSARY OF COMPUTER PROGRAMS

MDDB	Microenvironment input file builder (Microenvironment Data Deck Builder)
SHADOWV2	Microenvironment atomic oxygen exposure model
SOLSHAD	Microenvironment solar exposure model
TECPLOT	Commercial plotting program

## 1.0 INTRODUCTION

### 1.1 BACKGROUND

A computer model for atomic oxygen exposure of Earth satellite surfaces which may shadow or reflect on one another is described in reference 1. This model is termed the computer model for microenvironment atomic oxygen exposure. Included in the suite of programs comprising the model are the microenvironment atomic oxygen exposure program SHADOWV2, an input file builder for SHADOWV2 called MDDB, and a program to calculate the average atomic oxygen exposure to unshielded surfaces called AVESHAD. Also used with these programs is TECPLOT, a commercially available graphics program.

The computer model for microenvironment solar exposure was developed to predict solar exposure to satellite surfaces which may shadow or reflect on one another. Included in the new model are the microenvironment solar exposure program SOLSHAD and an upgraded version of the microenvironment data deck builder MDDB Version 2.0. As in the atomic oxygen model, TECPLOT is used for graphics display. The new model has many features in common with or similar to those of the computer model for microenvironment atomic oxygen exposure. The application of the new microenvironment solar exposure model is described in this document.

### 1.2 OBJECTIVE

This document describes the technical features of the computer model for microenvironment solar exposure and provides directions for its operation.

### 1.3 SCOPE

Precise treatment of solar reflections requires data on solar spectral reflectance and absorption properties of materials used in satellite design. The current model does not explicitly include the spectral nature of solar reflectance and absorption. Instead, it assumes these properties are constant for a given event and, based on them, calculates solar exposure to surfaces in terms of cumulative equivalent Sun hours (CESH); that is, the number of hours of normal incidence solar exposure to a hypothetical surface which equals the solar exposure on the actual surface. The model assumes a circular satellite orbit around a spherical Earth. This approximation is quite accurate for near-circular orbits, but becomes increasingly less accurate as the orbits become more highly elliptical.

A predecessor of SOLSHAD, which is functionally equivalent to the program described in this document, was used to model solar exposure to the Long Duration Exposure Facility (LDEF) experiment trays (refs. 2 and 3).

## 2.0 PROGRAM OPERATION

### 2.1 DESCRIPTION OF COMPUTER MODEL FOR MICROENVIRONMENT SOLAR EXPOSURE

The computer model for microenvironment solar exposure comprises a suite of programs. The program which calculates solar exposure and the program to create input files were developed at Boeing. The results are displayed using the commercial software package TECPLOT. (TECPLOT is a product of Amtec Engineering, Inc., P.O. Box 3633, Bellevue, WA 98009-3633.) Elements of the model are shown in the conceptual block diagram of figure 2.1-1; this section gives a brief description of these elements. A more detailed description of the model is given in section 3.0.

After the model description, detailed instructions on how to install and operate the various pieces of the model are given. They are presented in the order that they will be used: first, how to construct an input file for SOLSHAD, including the operation of MDDDB; second, how to run SOLSHAD; and last, how to view the results. Appendix A contains sample files generated by these programs. Appendix B contains the formats of files for TECPLOT.

#### 2.1.1 Description of Program Modules

**Microenvironment Computer Model for Solar Exposure.** SOLSHAD is a FORTRAN program which calculates the solar exposure in CESH to satellites in circular orbit around the Earth. The satellite is assumed to have a fixed orientation with respect to its motion in orbit; that is, each surface maintains a constant orientation with respect to the direction of satellite motion and with respect to an axis radially outward from the center of the Earth through the satellite. The LDEF satellite is an example of a satellite with this orientation. The total solar exposure calculated includes direct solar exposure, solar exposure due to specular and diffuse reflection of direct solar exposure from satellite surfaces, Earth-reflected solar exposure, and solar exposure due to specular and diffuse reflection of Earth-reflected solar exposure from satellite surfaces. During all calculations the satellite is assumed to be in a circular orbit around a spherical Earth. Solar exposure for missions or events of arbitrary lengths from fractions of an orbital period to many years may be modeled.

The satellite surface is defined by the following geometrical surface elements: trapezoids and sections of cylinders, cones, disks, and spheres. Using combinations of these elements, complex satellite surfaces may be defined.

SOLSHAD calculates the solar exposure on satellite surfaces as follows. The satellite geometry description is read in and a grid of points is constructed representing each of the surfaces on the satellite structure. A visibility matrix is built up by ray tracing from every point on each surface to every other point to determine which surfaces may reflect light to themselves or to other surfaces. The visibility matrix is used to make ray tracing more efficient later in the program.

Solar exposure is calculated using a large enough number of Sun positions to give a statistically valid representation of all possible Sun positions during the event time. Each Sun position is generated by randomly selecting a day of year and time of day and determining the subsolar Earth latitude and longitude. Along with each Sun position, a random satellite position is chosen from those allowed by the specification of the satellite orbit. The Sun and satellite position determine the orientation of the satellite surfaces with respect to the Sun.

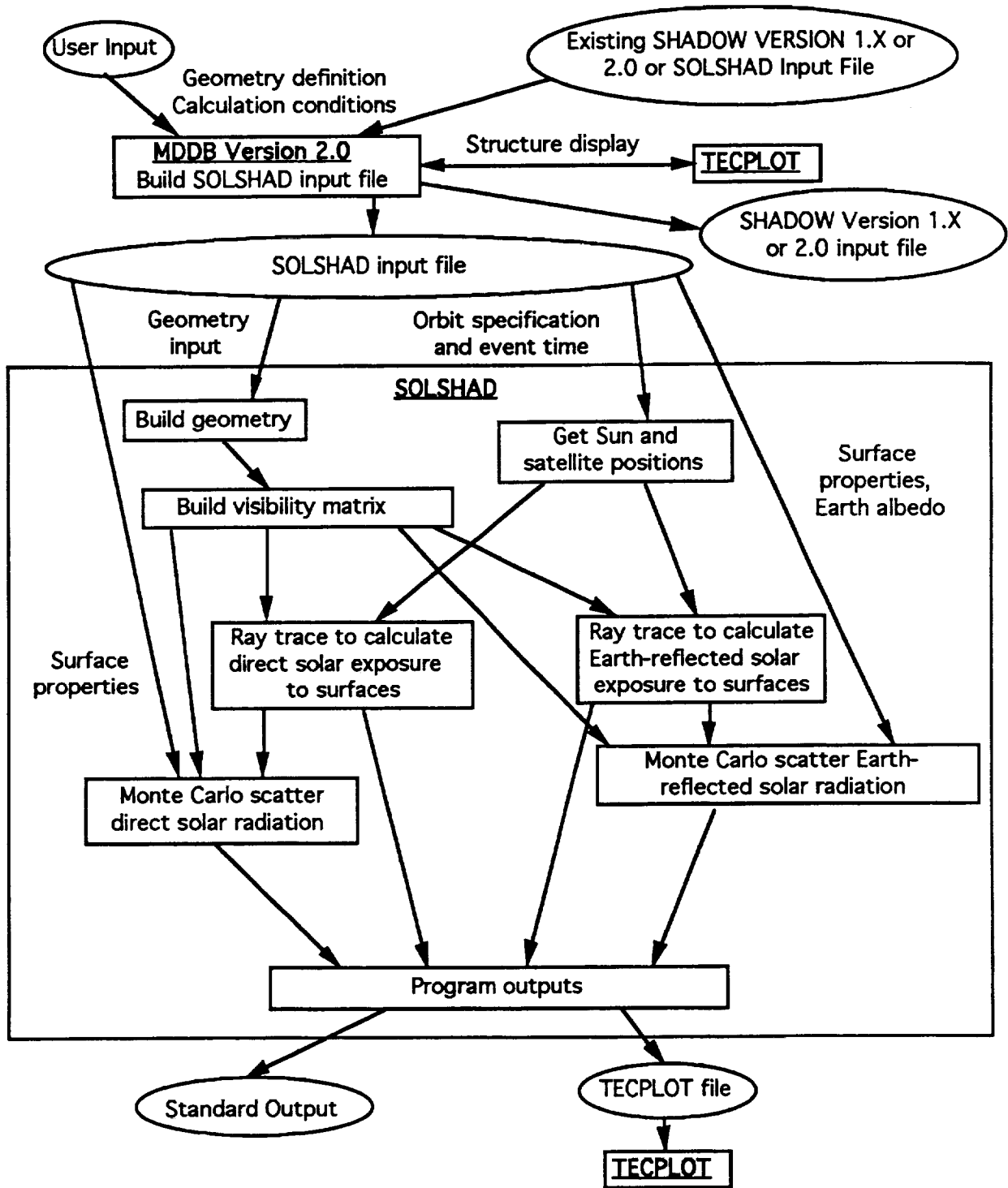


Figure 2.1-1. SOLSHAD Flow Diagram.

For each Sun position a ray is traced from each point on the satellite structure to the Sun. Those rays which are unblocked either by other satellite surfaces or by the Earth result in direct

solar exposure. In this manner, the direct solar exposure is calculated as the fraction of all possible rays from the Sun which reach each point of the structure. Multiplying this fraction by the event time in hours gives the CESH of direct solar exposure for each point.

Each ray from the Sun which strikes a point on the structure is Monte Carlo scattered from random positions near the point based on the surface properties: specular reflectivity, diffuse reflectivity, and absorbtivity. If a scattered ray strikes another surface, it is Monte Carlo scattered again. If the scattered ray is absorbed or scattered to space, scattering is terminated for that ray. In this manner, CESH are built up for specular and diffuse exposure from direct solar exposure.

Earth-reflected solar exposure to the satellite structure is handled in a similar way. The portion of the Earth which can be seen from the satellite is divided into a grid of points. Each point on Earth is tested to see if it is in sunlight. If so, a ray from the Sun to that point is deterministically diffusely reflected to the satellite with a diffuse reflectivity of the Earth defined to be equal to the average Earth albedo under the Satellite orbit. This Earth-reflected ray is treated just as direct solar rays are for exposure on the satellite structure and direct Earth-reflected CESH and scattered Earth-reflected CESH are accumulated.

When all Sun and satellite positions have been considered, the final output of SOLSHAD is written to two files: the first file, written to standard output, contains a complete listing of all the information generated by SOLSHAD including the CESH from direct and scattered solar and Earth-reflected radiation; the second file consists of information that is used by TECPLOT to generate 3D graphs of the structure, which display the solar exposure to surfaces as a color spectrum. Once displayed in TECPLOT, the structure can be rotated, translated, scaled, and printed. One can also draw a line across the surface, and convert CESH along that line into a 2D graph of CESH versus distance.

**Microenvironment Data Deck Builder Version 2.0.** MDDB Version 2.0 is an enhanced and expanded version of the FORTRAN program MDDB Version 1 (ref. 1). While MDDB Version 1 allows users to build or edit input files for the microenvironment atomic oxygen program SHADOW Version 1.X (ref. 1), MDDB Version 2 allows users to build or edit interactively input files for SHADOW Version 1.X, SHADOW Version 2.0 (an unreleased, optimized version of SHADOW developed by Boeing), and SOLSHAD, as well as to create any of these input files from any of the others. This interconversion is allowed because the three input files have large parts in common. The geometry definition sections of all three are identical except for different surface properties for the atomic oxygen programs and SOLSHAD. Input for SHADOW Version 1.X and Version 2.0 is identical except that the Version 2.0 input file does not require a visibility matrix. Calculation control parameters differ between SHADOW and SOLSHAD.

In the remainder of this document, whenever MDDB is mentioned without a version number, the reference is to MDDB Version 2.0.

During the geometry definition phase, MDDB prompts the user for inputs defining surfaces or allows the user to modify or delete existing surfaces, to add new surfaces, or to review or display the surfaces in a structure as far as it has been built. Surface display by the TECPLOT plotting package may be selected throughout the geometry definition phase of input file construction. All surfaces of a structure are displayed with an arrow pointing outward from the active side of each surface. After a surface geometry has been defined, the surface may be translated or rotated to reorient it. This allows the user to define the surface in a convenient set of coordinates and then move it into its true position in a structure.

Because the ray trace routine in SHADOW and SOLSHAD must check every surface to determine which if any surface a ray strikes, the ray trace can be sped up by introducing a matrix, called the visibility matrix, which specifies which surfaces can see a given surface. Only these surfaces need be considered during ray tracing. SHADOW Version 2.0 and SOLSHAD generate the visibility matrix automatically; SHADOW Version 1.X requires the user to input the visibility matrix. When building SHADOW Version 1.X input files, MDDDB prompts the user to input the visibility matrix. The user may review or modify the visibility matrix or display the structure with TECPLOT at any time during entry of the visibility matrix.

It should be noted that at all times during display of the structure, the user is out of MDDDB (even though MDDDB is still opened) and in TECPLOT. Hence, all features of TECPLOT are operative: the plot may be rotated, redisplayed as a wireframe or with shading, probed to determine the coordinates of a surface, printed, etc. When done viewing the TECPLOT display, the user switches back to MDDDB while leaving TECPLOT open.

After completion of geometry definition, MDDDB prompts the user for parameters controlling calculation and writes the newly created input file to a name of the user's choosing.

### 2.1.2 Mainframe and Workstation Platforms

The microenvironments computer model for solar exposure SOLSHAD and its companion program MDDDB generally operate on two platforms, a mainframe and a PC, respectively. MDDDB is designed to operate in a Microsoft Windows Version 3.1 environment in conjunction with the commercial software package TECPLOT Version 5.0x. If TECPLOT is available on a more powerful workstation (e.g., Sun, Silicon Graphics, Apollo, VAX), the FORTRAN code for MDDDB can be compiled and run on any of those platforms as well, although some modifications may have to be made to the MDDDB-generated binary TECPLOT file to be compatible with the installed version of TECPLOT. SOLSHAD was developed on a CONVEX C2 supercomputer. It generates two files: one that contains all the information from the run, and another that can be imported directly into TECPLOT. The TECPLOT file is transferred to the PC or workstation, where 2D and 3D plots are generated.

### 2.1.3 Input Files

**SOLSHAD Input File.** SOLSHAD requires a single input file, which it reads from standard input. This file contains a parametric description of the satellite geometry and surface properties and calculation control parameters. A detailed description of the content of this file is given in section 2.2. Most users will find it convenient to use MDDDB to construct or edit SOLSHAD input files.

**MDDDB Version 2.0 Input File.** All user input to MDDDB is entered interactively from the keyboard in response to prompts displayed on the screen. MDDDB prompts the user to supply input for building new SHADOW or SOLSHAD input files or for editing existing SHADOW or SOLSHAD input files. (See sec. 2.2 for a detailed description of the SOLSHAD input file.)

### 2.1.4 Output Files

**SOLSHAD Output Files.** SOLSHAD produces two output files. The first is directed to standard output. This file contains a copy of the SOLSHAD input file, a summary of the object geometry, statistics about the ray tracing calculations, a table of CESH at each node, and a listing of the connectivity matrix.

The second file, named TAPE7 as a default, is an ASCII file that contains the coordinates of all the nodes, the CESH at each node, and a connectivity matrix that describes how the nodes are connected to each other. This file is formatted for processing by PREPLOT (a companion program to TECPLOT) to create a binary input file for TECPLOT. TECPLOT displays this file as a plot of the object with the CESH color-coded on the surfaces. An exact description of this file is given in Appendix B.

**MDDB Version 2.0 Output Files.** As described in section 2.1.3, MDDB displays prompts on the screen for keyboard input. The output file produced by MDDB is a SHADOW or SOLSHAD input file. MDDB also produces a binary TECPLOT file and an ASCII TECPLOT file whenever a TECPLOT display of the object is selected. The binary file, MDDB.PLT, may be used directly by the PC version of TECPLOT 5.0x. The ASCII file, MDDB.PRE, must be processed by the TECPLOT companion program PREPLOT before a TECPLOT display can be generated. The ASCII file is provided so that TECPLOT displays can be made using versions of TECPLOT which are incompatible with the binary file. An exact description of these two files is given in Appendix B.

## 2.2 INPUT FILE CONSTRUCTION

### 2.2.1 SOLSHAD Input File

The SOLSHAD input file divides itself into two natural parts. The first part is a geometry description which defines the surfaces comprising the object or structure whose solar exposure is to be modeled. The second part is a set of parameters which controls calculations in SOLSHAD. The two parts are arranged in consecutive order to construct the input file. Figure 2.2.1-1 shows an example of a SOLSHAD input file, and figure 2.2.1-2 shows a symbolic representation of the format for the five surfaces. (Experienced users who need only look up the formats of the geometry inputs will find this second figure useful.) The SOLSHAD input file must be directed to standard input when running SOLSHAD.

**Geometry Description.** A structure is constructed from a series of surfaces. These surfaces may be any combination of up to 100 trapezoids or segments of cylinders, cones, disks, or spheres. It must be emphasized that because they are surfaces and not solids, trapezoids and disks have no depth, cylinders and cones are open on the ends, and spheres are hollow. Each surface has a front or positive side and a back or negative side. Only one side of a surface may be selected for exposure to solar radiation. This side is called the active side. Any solar radiation striking the unselected side of a surface will be ignored. This may lead to erroneous results. Therefore, the user must be careful when defining which surfaces will be exposed. If the user wants to model solar radiation exposure to both sides of a physical surface, he or she must model the physical surface with two closely spaced surfaces whose active faces point away from each other.

Each surface in a structure is divided into a grid of nodes. Each surface must have at least one node. The total number of nodes for all surfaces may not exceed 5,000. The number of nodes on a surface is the product of the number of nodes NC in the xi ( $\xi$ ) direction and NN in the eta ( $\eta$ ) direction (see record A2 in fig. 2.2.1-1). Given the choice of constructing a structure having a given total number of nodes with many surfaces and a few nodes on each or a few surfaces with many nodes on each, the latter choice is to be preferred because the time to trace a ray in SOLSHAD is proportional to the number of surfaces. Therefore, the program will execute more quickly with only a few surfaces.



Record 12345678901234567890123456789012345678901234567890123456789012345678901234567890

```
A1 SAMPLE GEOMETRY WITH 5 SURFACES SOLSHAD
A2 1 5 5 T T T
A3 -4.0000 -4.0000 15.0000
A4 -4.0000 4.0000 15.0000
A5 4.0000 4.0000 15.0000
A6 1.0000
A7 PLANE
A8 PLANE MATERIAL
A9 0.5000 0.5000 0.0000 SPEC,DIFFUSE,ABSORPTION
A2 2 5 24 T T T
A3 0.0000 0.0000 1.0000
A4 0.0000 0.0000 0.0000
A5 1.0000 0.0000 0.0000
A6 3.0000 1.6667 360.0000
A7 CYLINDER
A8 CYLINDER MATERIAL
A9 0.2500 0.7000 0.0500 SPEC,DIFFUSE,ABSORPTION
A2 3 6 24 T T T
A3 0.0000 0.0000 1.0000
A4 0.0000 0.0000 5.0000
A5 1.0000 0.0000 0.0000
A6 3.0000 1.6667 0.0000 360.0000
A7 CONE
A8 CONE MATERIAL
A9 0.3000 0.6000 0.1000 SPEC,DIFFUSE,ABSORPTION
A2 4 4 24 T T T
A3 0.0000 0.0000 1.0000
A4 0.0000 0.0000 0.0000
A5 1.0000 0.0000 0.0000
A6 6.0000 0.5000 360.0000
A7 DISK
A8 DISK MATERIAL
A9 0.0500 0.9000 0.0500 SPEC,DIFFUSE,ABSORPTION
A2 5 6 24 T T T
A3 0.0000 0.0000 1.0000
A4 0.0000 0.0000 12.5000
A5 1.0000 0.0000 0.0000
A6 2.5000 0.0000 180.0000 360.0000
A7 SPHERE
A8 SPHERE MATERIAL
A9 0.0500 0.9000 0.0500 SPEC,DIFFUSE,ABSORPTION
A10 0 0 0 F F F END OF GEOMETRY
B1 1994 6 19 0.0000 Y M D H START
B2 1994 10 27 12.0000 Y M D H END
B3 0.0000 360.0000 ORBPOS (1),ORBPOS (2)
B4 0.0000 360.0000 F PRECES (1),PRECES (2),TIMCOR
B5 28.5000 ORBINC
B6 0.2460 6.3780E+03 4.5000E+02 ALBEDO,RE,HSAT
B7 10 1 10 1000 T F T MAXRAY,MAXALB,NALB,ISUNPOS,SHORTL,CHECK,INACT
B8 5 5 NTHETA,NPHI
B9 997531 ISEED
```

Record 12345678901234567890123456789012345678901234567890123456789012345678901234567890

Figure 2.2.1-1. Sample SOLSHAD Input File.

```

Record 12345678901234567890123456789012345678901234567890123456789012345678901234567890
A1 COMMENT ABOUT THE GEOMETRY
A2 1 NC NN T T T (T T T = DEBUG FRONT NODESEL)
A3 P1x P1y P1z
A4 P2x P2y P2z
A5 P3x P3y P3z
A6 λ
A7 COMMENT ABOUT THE TRAPEZOID
A8 MATERIAL TYPE
A9 SPECULAR REFLECTIVITY DIFFUSE REFLECTIVITY ABSORPTION
A2 2 NC NN T T T (T T T = DEBUG FRONT NODESEL)
A3 Ex Ey Ez
A4 Ax Ay Az
A5 Pref x Pref y Pref z
A6 R H/R 0
A7 COMMENT ABOUT THE CYLINDER
A8 MATERIAL TYPE
A9 SPECULAR REFLECTIVITY DIFFUSE REFLECTIVITY ABSORPTION
A2 3 NC NN T T T (T T T = DEBUG FRONT NODESEL)
A3 Ex Ey Ez
A4 Ax Ay Az
A5 Pref x Pref y Pref z
A6 Rmax H/Rmax Rmin/Rmax 0
A7 COMMENT ABOUT THE CONE
A8 MATERIAL TYPE
A9 SPECULAR REFLECTIVITY DIFFUSE REFLECTIVITY ABSORPTION
A2 4 NC NN T T T (T T T = DEBUG FRONT NODESEL)
A3 Ex Ey Ez
A4 Ax Ay Az
A5 Pref x Pref y Pref z
A6 Rout Rin/Rout 0
A7 COMMENT ABOUT THE DISK
A8 MATERIAL TYPE
A9 SPECULAR REFLECTIVITY DIFFUSE REFLECTIVITY ABSORPTION
A2 5 NC NN T T T (T T T = DEBUG FRONT NODESEL)
A3 Ex Ey Ez
A4 Ax Ay Az
A5 Pref x Pref y Pref z
A6 R φ1 φ2 0
A7 COMMENT ABOUT THE SPHERE
A8 MATERIAL TYPE
A9 SPECULAR REFLECTIVITY DIFFUSE REFLECTIVITY ABSORPTION
A10 0 0 0 F F F END OF GEOMETRY
B1 IYR(1) IMO(1) IDM(1) GMT(1) OF EVENT START
B2 IYR(2) IMO(2) IDM(2) GMT(2) OF EVENT END
B3 ORBPOS(1) ORBPOS(2) RANGE OF SATELLITE POSITIONS ON ORBIT
B4 PRECES(1),PRECES(2),TIMCOR NODAL CROSS LONG,PRECESSION RANGE,TIME CORR (T,F)
B5 ORBINC
B6 ALBEDO RE HSAT
B7 MAXRAY MAXALB NALB ISUNPOS SHORTL (T) CHECK (F) INACT
B8 NTHETA NPFI
B9 ISEED

```

Record 1234567890123456789012345678901234567890123456789012345678901234567890  
NOTE: All entries are free format except for record A2 which is format (I2,2I5,3L2) and records A3 through A6 which are format (4F20.10). Some entries in these records are blank.

Figure 2.2.1-2. Symbolic SOLSHAD Input File.

Solar exposure is calculated in each node on the structure. The resolution of detail of exposure on a surface thus depends on the number of nodes on a surface. The user should inspect his structure carefully to select noding which gives high resolution in areas where exposure may be expected to vary greatly and lower resolution where the exposure is expected to be more slowly varying.

Notwithstanding the foregoing, the grid of nodes should always be fine enough so that the grid points approximate the shape of the surface reasonably well. This is because the routine which derives the visibility matrix does so by ray tracing from each grid point to every other grid point in the structure. If the surfaces are not well approximated by the grid, an incorrect visibility matrix may result. The following suggestions for minimum gridding of surfaces may be helpful. Trapezoids and small portions of other surfaces which are approximately plane quadrilaterals should have at least one node which defines the four corners of the quadrilateral. The grid of nodes for sections of disks should be fine enough to approximate the perimeter of the disk. For nonplanar surfaces such as sections of cylinders, cones, and spheres, the grid should be fine enough to give a reasonable representation of the three-dimensional surface.

Because surfaces in SOLSHAD are not solids, they may overlap or intersect in ways that solids cannot. In such cases, a surface may be exposed to solar radiation on one side of the intersection or overlap and shielded from it on the other. In some cases the user may wish to take advantage of this; in others, surfaces may inadvertently intersect or overlap, causing unanticipated results. An example of the latter is when two trapezoids are intended to have a common edge; but due to numerical inaccuracy or roundoff, the two trapezoids intersect or overlap near their intended common edge. Whether intended or not, points on the nodes of the intersecting or overlapping surfaces will often show anomalous (and incorrect) solar exposure. Unintended intersections and overlaps are especially easy to generate when triangles are approximated by trapezoids with a very small (but not zero) ratio of the short-to-long parallel side to avoid trouble with TECPLOT (see Possible Problems at the end of sec. 2.2.3) When unintended intersections or overlaps occur, the user should adjust the geometry of surfaces in the structure to remove the problem. It should be noted that small gaps between the edges of surfaces seldom have a great effect on modeled solar exposures. When the intersections or overlaps are intended, the region of incorrect solar exposure may be minimized by using a fine grid.

Coordinate Axes Orientation. Coordinates defining surfaces in a structure are defined in a single, well specified, orthogonal, right-hand Cartesian coordinate system. In this coordinate system (see fig. 2.2.1-3), the origin is at the satellite. The positive x axis is pointed radially outward along a line from the center of the Earth to space. The positive z axis is pointed perpendicular to the x axis in the direction of satellite motion along its orbit. The positive y axis is oriented so the (x,y,z) form a right-handed coordinate system. Users building structures with MDDB will often find it easiest to build structures in a convenient user-defined coordinate system and then rotate the entire structure to the coordinate system required by SOLSHAD.

Refer to figures 2.2.1-1 and 2.2.1-2 for samples of SOLSHAD input files. The geometry description takes place in records labeled A1 through A10 for this example with five surfaces. Before giving complete definitions for these records, a few words about the structure of the surface definition records are in order. Record A1 is a text description of the structure and is entered only once. Records A2 through A9 are repeated once for each surface in the structure. Records A2 through A6 define the surface type and geometry. Record A7 contains a text description of the surface. Records A8 and A9 describe and define surface properties. Record A10 terminates the geometry input.

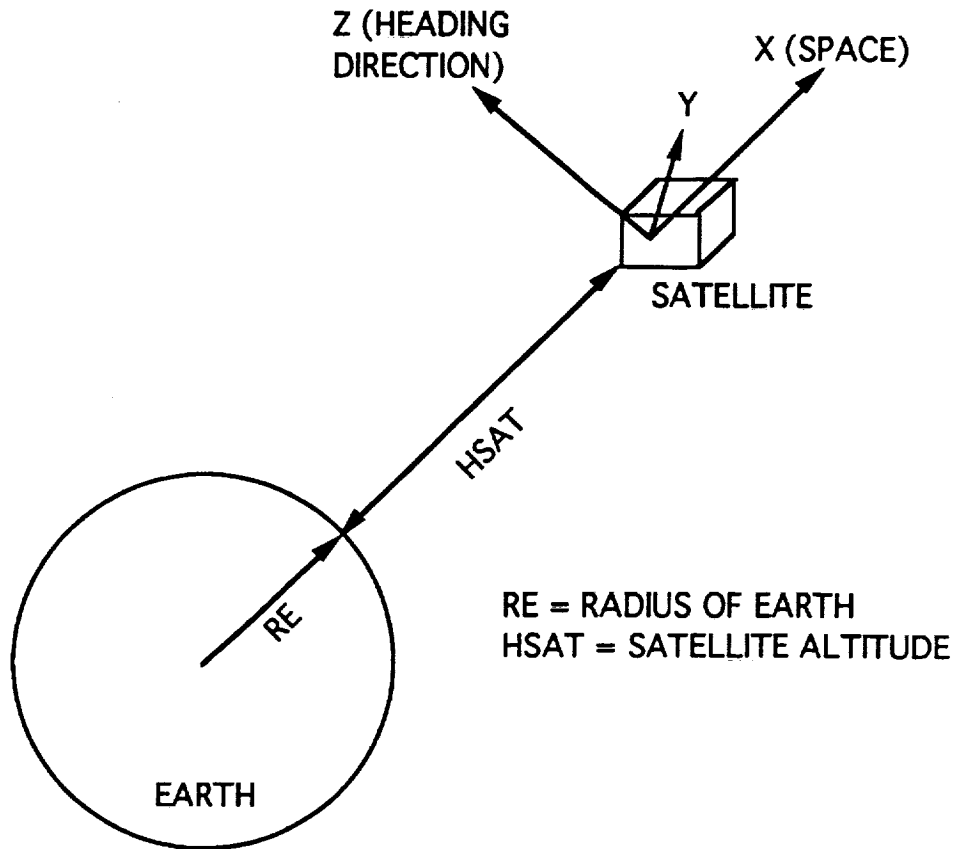


Figure 2.2.1-3. Geometry Coordinate Definition.

**Record A1 Format (A)**

Entry	Columns	Type	Variable
Description of geometry.	1-60	character	HEADER

This record is entered once only.

Records A2 through A9 are repeated in sequence for each surface.

**Record A2 Format (I2,2I5,3L2)**

Entry	Columns	Type	Variable
Surface type 1 = trapezoid 2 = cylinder 3 = cone 4 = disk 5 = sphere.	1-2	integer	IP(IPS,1)
Number of nodes in xi direction. Refer to figures 2.2.1-4 through 2.2.1-8 for orientation of nodes.	3-7	integer	IP(IPS,2) or NC
Number of nodes in eta direction. Refer to figures 2.2.1-4 through 2.2.1-8 for orientation of nodes.	8-12	integer	IP(IPS,3) or NN
Debug flag. If T (true), select normal output <sup>1</sup> . If F (false), select full debug output for geometry. F (false) is rarely used because it generates an excessively large output.	13-14	logical	F(13) or LASTF
Flag to designate active side of surface. If T (true), select front (positive) side of surface. If F (false), select back (negative) side of surface	15-16	logical	F(15) or FRONT
Flag to select whether CESH on this surface is to be calculated. If T (true), calculate CESH on surface <sup>2</sup> . If F (false), do not calculate CESH on surface. F (false) is rarely used because careless use may cause erroneous results.	17-18	logical	F(16) or NODESEL

The contents of records A3 through A6 depend on which surface has been selected in record A2.

**Surface Type 1: TRAPEZOID.** The trapezoid (fig. 2.2.1-4) is defined by three points and the ratio of the lengths of the parallel sides. This ratio,  $\lambda$ , must be  $0 \leq \lambda \leq 1$ . Let P1 and P2 be the points located at the ends of the longer of the two parallel sides. P3 is an end point on the shorter parallel side such that P2 is connected to P1 and P3. A triangle can be made by setting  $\lambda = 0$ . The positive side of the surface is defined such that the corner points are ordered in counterclockwise manner when the positive side is visible. This is the conventional right-hand rule.

**Record A3 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of P1.	1-20	real	P(IPS,1)
Y coordinate of P1.	21-40	real	P(IPS,2)
Z coordinate of P1.	41-60	real	P(IPS,3)

<sup>1</sup>MDDDB automatically selects this entry. Users wishing to enter F (false) must edit their input files outside MDDDB.

<sup>2</sup>MDDDB automatically selects this entry. Users wishing to enter F (false) must edit their input files outside MDDDB.

**Record A4 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of P2.	1-20	real	P(IPS,4)
Y coordinate of P2.	21-40	real	P(IPS,5)
Z coordinate of P2.	41-60	real	P(IPS,6)

**Record A5 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of P3.	1-20	real	P(IPS,7)
Y coordinate of P3.	21-40	real	P(IPS,8)
Z coordinate of P3.	41-60	real	P(IPS,9)

**Record A6 Format (20X,F20.10)**

Entry	Columns	Type	Variable
Ratio of short to long parallel sides of trapezoid, $\lambda$ .	21-40	real	C(4)

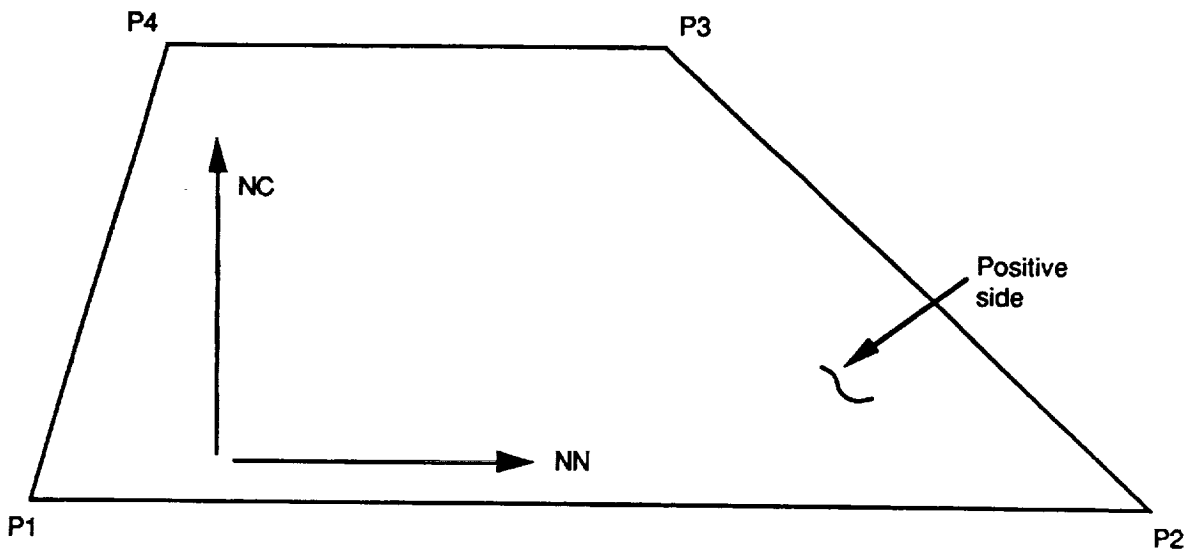


Figure 2.2.1-4. Trapezoid.

**Surface Type 2: CYLINDER.** The cylinder (fig. 2.2.1-5) is defined by an axial vector  $E$ , a center point  $A$ , a reference point  $P_{ref}$ , the radius  $R$ , the ratio of height to the radius  $H/R$ , and the angular extent  $\theta$ . The axial vector  $E$  points from the center point  $A$  through the cylinder. The reference point  $P_{ref}$  and the axial vector  $E$  specify a half plane from which the angular extent of the cylinder  $\theta$  is measured.  $\theta$  is measured in the right hand-rule sense with respect to the direction of  $E$ . The positive side of the cylinder is the outside.

**Record A3 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of axial vector <b>E</b> .	1-20	real	P(IPS,1)
Y coordinate of axial vector <b>E</b> .	21-40	real	P(IPS,2)
Z coordinate of axial vector <b>E</b> .	41-60	real	P(IPS,3)

**Record A4 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of center <b>A</b> .	1-20	real	P(IPS,4)
Y coordinate of center <b>A</b> .	21-40	real	P(IPS,5)
Z coordinate of center <b>A</b> .	41-60	real	P(IPS,6)

**Record A5 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of reference point $P_{ref}$ .	1-20	real	P(IPS,7)
Y coordinate of reference point $P_{ref}$ .	21-40	real	P(IPS,8)
Z coordinate of reference point $P_{ref}$ .	41-60	real	P(IPS,9)

**Record A6 Format (2F20.10,20X,F20.10)**

Entry	Columns	Type	Variable
Radius of cylinder <b>R</b> .	1-20	real	C(2)
Ratio of cylinder height to radius <b>H/R</b> .	21-40	real	C(3)
Angular extent of cylinder $\theta$ . $0 < \theta \leq 360$ degrees.	61-80	real	C(5)

**Surface Type 3: CONE.** The cone (fig. 2.2.1-6) is defined similarly to the cylinder. The cone is defined by an axial vector **E**, a center point **A**, a reference point  $P_{ref}$ , a maximum radius  $R_{max}$ , the ratio of height to the maximum radius  $H/R_{max}$ , the ratio of the minimum to maximum radius  $R_{min}/R_{max}$ , and the angular extent  $\theta$ . The axial vector **E** points from the center point **A** through the cone. The reference point  $P_{ref}$  and the axial vector **E** specify a half plane from which the angular extent of the cone  $\theta$  is measured.  $\theta$  is measured in the right-hand rule sense with respect to the direction of **E**. The positive side of the cone is the outside.

**Record A3 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of axial vector <b>E</b> .	1-20	real	P(IPS,1)
Y coordinate of axial vector <b>E</b> .	21-40	real	P(IPS,2)
Z coordinate of axial vector <b>E</b> .	41-60	real	P(IPS,3)

**Record A4 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of center <b>A</b> .	1-20	real	P(IPS,4)
Y coordinate of center <b>A</b> .	21-40	real	P(IPS,5)
Z coordinate of center <b>A</b> .	41-60	real	P(IPS,6)

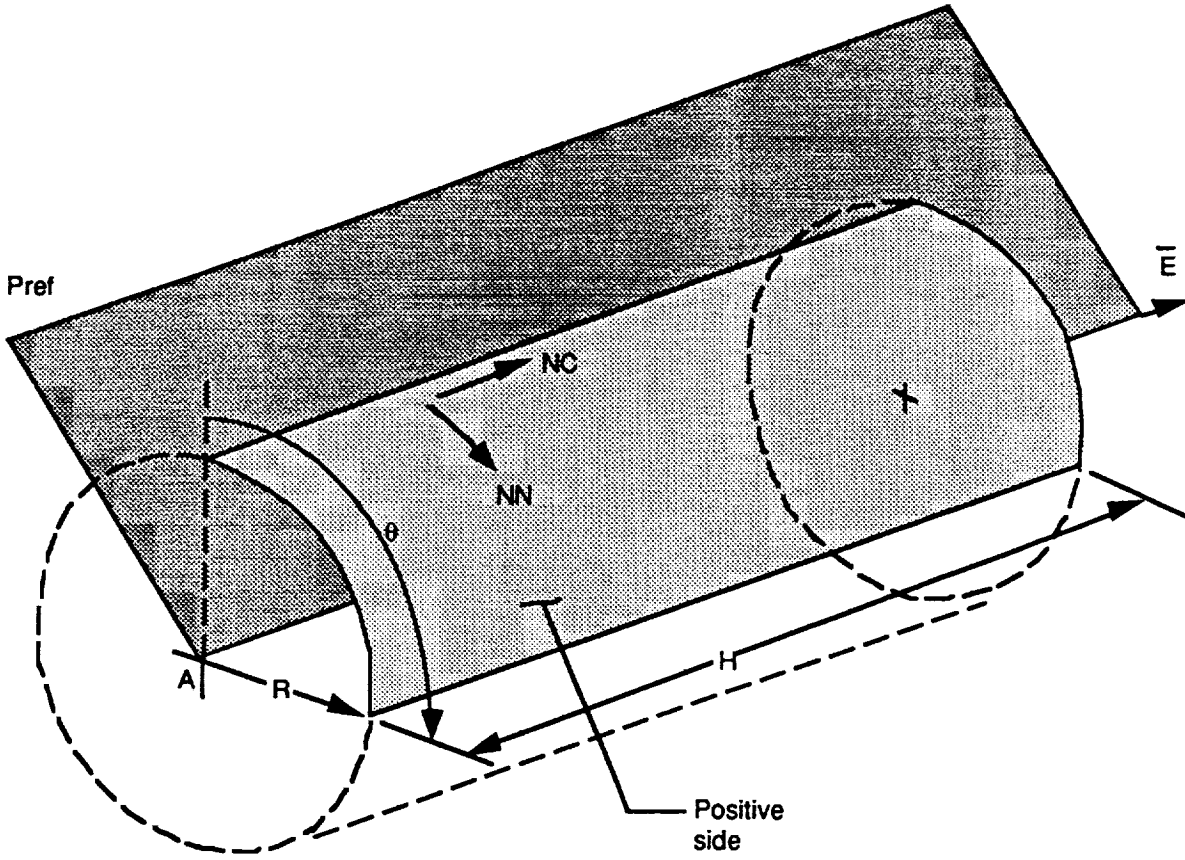


Figure 2.2.1-5. Cylinder.

**Record A5 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of reference point $P_{ref}$ .	1-20	real	P(IPS,7)
Y coordinate of reference point $P_{ref}$ .	21-40	real	P(IPS,8)
Z coordinate of reference point $P_{ref}$ .	41-60	real	P(IPS,9)

**Record A6 Format (4F20.10)**

Entry	Columns	Type	Variable
Maximum radius of cone $R_{max}$ .	1-20	real	C(2)
Ratio of cone height to radius $H/R_{max}$ .	21-40	real	C(3)
Ratio of cone minimum to maximum to radius $R_{min}/R_{max}$ .	41-60	real	C(4)
Angular extent of cone $\theta$ . $0 < \theta \leq 360$ degrees.	61-80	real	C(5)



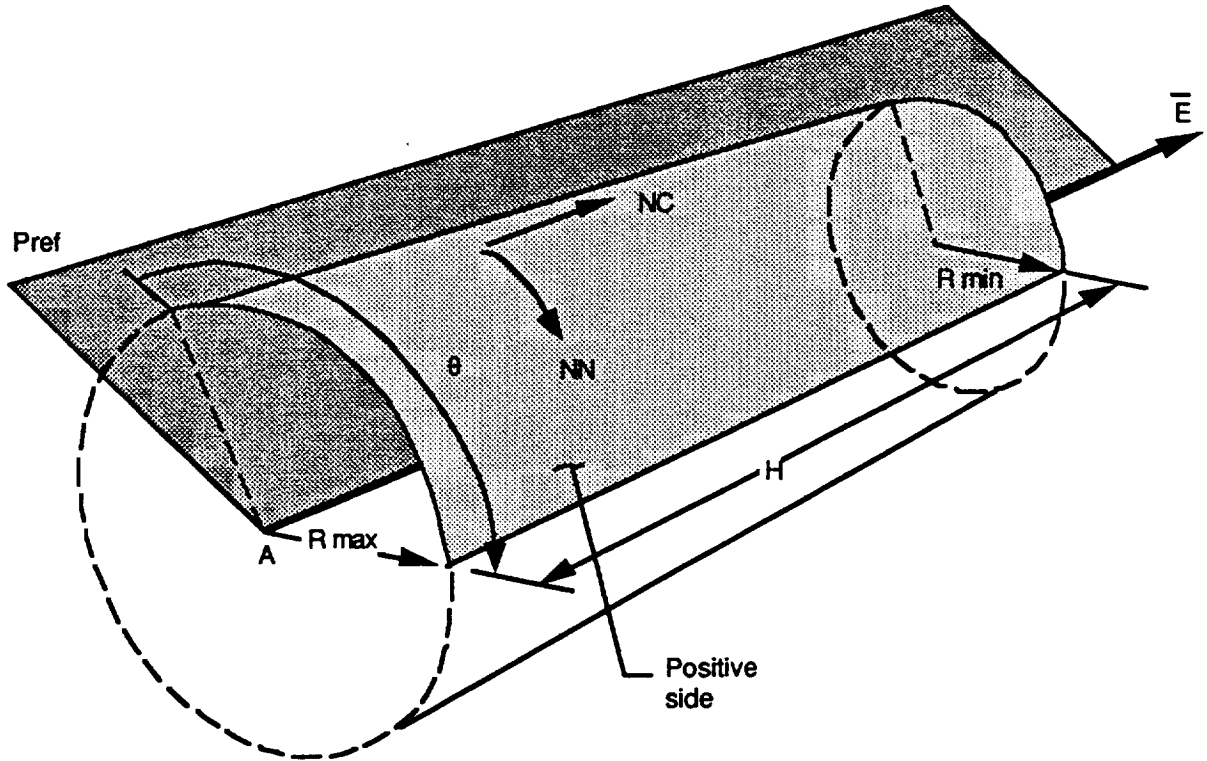


Figure 2.2.1-6. Cone.

**Surface Type 4: DISK.** The disk (fig. 2.2.1-7) is defined by an axial vector  $E$ , a center point  $A$ , a reference point  $P_{ref}$ , an outer radius  $R_{out}$ , an inner radius  $R_{in}$ , the ratio of the inner to outer radius  $R_{in}/R_{out}$ , and the angular extent  $\theta$ . The reference point  $P_{ref}$  and the axial vector  $E$  specify a half plane from which the angular extent of the disk  $\theta$  is measured. Note that  $\theta$  is measured in the left-hand rule sense with respect to the direction of  $E$ . The positive side of the disk is the side whose outward surface normal is parallel to  $E$ .

**Record A3 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of axial vector $E$ .	1-20	real	P(IPS,1)
Y coordinate of axial vector $E$ .	21-40	real	P(IPS,2)
Z coordinate of axial vector $E$ .	41-60	real	P(IPS,3)

**Record A4 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of center $A$ .	1-20	real	P(IPS,4)
Y coordinate of center $A$ .	21-40	real	P(IPS,5)
Z coordinate of center $A$ .	41-60	real	P(IPS,6)

**Record A5 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of reference point $P_{ref}$ .	1-20	real	P(IPS,7)
Y coordinate of reference point $P_{ref}$ .	21-40	real	P(IPS,8)
Z coordinate of reference point $P_{ref}$ .	41-60	real	P(IPS,9)

**Record A6 Format (F20.10,20X,2F20.10)**

Entry	Columns	Type	Variable
Outside radius of disk $R_{out}$ .	1-20	real	C(2)
Ratio of inside to outside radius of disk $R_{in}/R_{out}$ .	41-60	real	C(4)
Angular extent of cone $\theta$ . $0 < \theta \leq 360$ degrees. Note that this is measured in the left-hand rule sense.	61-80	real	C(5)

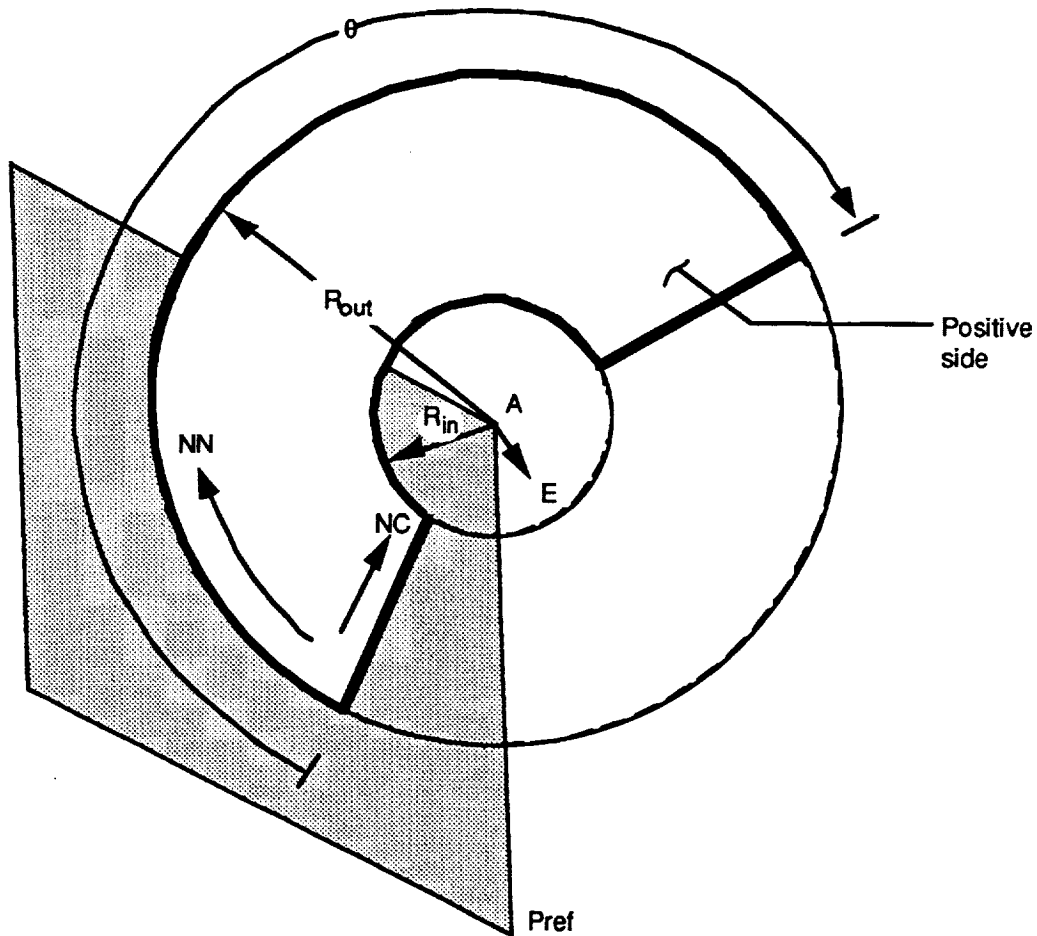


Figure 2.2.1-7. Disk.

**Surface Type 5: SPHERE.** The sphere (fig. 2.2.1-8) is defined by an axial vector  $E$  along the polar axis, a center point  $A$ , a reference point  $P_{ref}$ , the radius  $R$ , the azimuthal angular extent  $\theta$ , and two angles defining the polar (zenith) angular extent  $\phi_1$  and  $\phi_2$ , with  $\phi_1$  being the smaller angle. The axial vector  $E$  points from the center point  $A$  through the north pole of the sphere. The reference point  $P_{ref}$  and the axial vector  $E$  specify a half plane from which the azimuthal angular extent of the sphere  $\theta$  is measured.  $\theta$  is measured in the right-hand rule sense with respect to the direction of  $E$ . The positive side of the sphere is the outside.

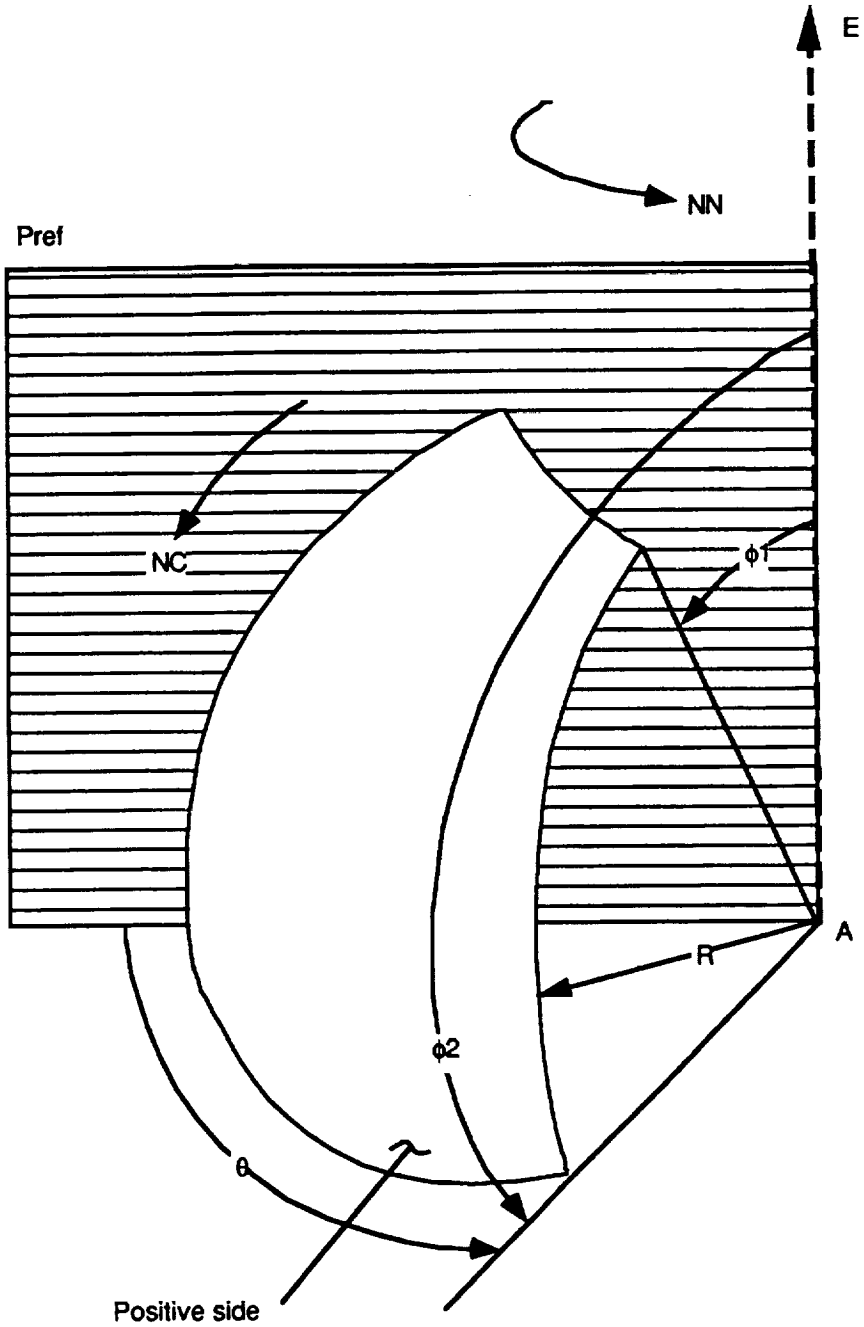


Figure 2.2.1-8. Sphere.

**Record A3 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of axial vector E.	1-20	real	C(1)
Y coordinate of axial vector E.	21-40	real	C(2)
Z coordinate of axial vector E.	41-60	real	C(3)

**Record A4 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of center A.	1-20	real	C(5)
Y coordinate of center A.	21-40	real	C(6)
Z coordinate of center A.	41-60	real	C(7)

**Record A5 Format (3F20.10)**

Entry	Columns	Type	Variable
X coordinate of reference point P <sub>ref</sub> .	1-20	real	C(9)
Y coordinate of reference point P <sub>ref</sub> .	21-40	real	C(10)
Z coordinate of reference point P <sub>ref</sub> .	41-60	real	C(11)

**Record A6 Format (4F20.10)**

Entry	Columns	Type	Variable
Radius of sphere R.	1-20	real	C(13)
Smaller polar angle limit $\phi_1$ . $0 < \phi_1 < \phi_2$ degrees.	21-40	real	C(14)
Larger polar angle limit $\phi_2$ . $\phi_1 < \phi_2 \leq 180$ degrees.	41-60	real	C(15)
Azimuthal extent of cone $\theta$ . $0 < \theta \leq 360$ degrees.	61-80	real	C(16)

**Record A7 Format (A)**

Entry	Columns	Type	Variable
A comment about the surface.	1-40	character	C(31)-C(40) or P(IPS,17)- P(IPS,26)

**Record A8 Format (A)**

Entry	Columns	Type	Variable
The name of the surface material.	1-80	character	SNAME

**Record A9 Free Format**

Entry	Type	Variable
Specular reflectivity of surface for solar radiation.	real	SPROP(1,IPS)
Diffuse reflectivity of surface for solar radiation.	real	SPROP(2,IPS)
Absorptivity solar radiation.	real	SPROP(3,IPS)

The surface properties specify what fraction of incident solar radiation on the surface is specularly reflected, diffusely reflected, and absorbed. These three fractions must sum to one. Table 2.2.1-1 contains surface properties for Fluorinated Ethylene Propylene (FEP) and aluminum used for modeling several cases.

**Table 2.2.1-1  
Solar Surface Properties of Some Materials**

Material	Specular Reflectivity	Diffuse Reflectivity	Absorbivity	Used to Model
FEP	0.83	0.1	0.07	2, 3, 4, 5
Aluminum	0.06	0.6	0.34	1, 2, 3, 4, 5

Used to Model:

1. CRES
2. LDEF M0001 NRL cosmic ray experiment
3. LDEF S0069 row 9A thermal control surfaces experiment
4. LDEF FEP blanket fold tray C5 near row 6 edge
5. LDEF FEP blanket fold tray D1 near row 6 edge

**Record A10 Format (I2,2I5,3L2)**

Entry	Columns	Type	Variable
0	1-2	integer	IP(IPS,1)
0	3-7	integer	IP(IPS,2) or NC
0	8-12	integer	IP(IPS,3) or NN
F (false).	13-14	logical	F(13) or LASTF
F (false).	15-16	logical	F(15) or FRONT
F (false).	17-18	logical	F(16) or NODESEL

This card signals the end of geometry input. It is input only once. The entries are required for proper geometry termination and for compatibility with MDDB.

**Calculation Control Parameters.** The calculation control parameters on the following nine records determine the conditions under which solar exposure takes place.

The following two records define the beginning and end of the event for which solar exposure is to be calculated.

**Record B1 Free Format**

Entry	Type	Variable
Two or four digit year of event start. If two digits are entered, 0 to 49 is assumed to be 2000 to 2049; 50 to 99 is assumed to be 1950 to 1999. The earliest allowed year is 1950. Four digits are always the actual year.	integer	IYR(1)
Month (1 to 12) of event start.	integer	IMO(1)
Day of month (1 to 31) of event start.	integer	IDM(1)
Greenwich Mean Time (GMT) hour and fraction of event start.	real	GMT(1)

**Record B2 Free Format**

Entry	Type	Variable
Two or four digit year of event end. If two digits are entered, 0 to 49 is assumed to be 2000 to 2049; 50 to 99 is assumed to be 1950 to 1999. The earliest allowed year is 1950. Four digits are always the actual year.	integer	IYR(2)
Month (1 to 12) of event end.	integer	IMO(2)
Day of month (1 to 31) of event end.	integer	IDM(2)
GMT hour and fraction of event end.	real	GMT(2)

The next record specifies the angular range on orbit which should be considered. The range is measured from the ascending node crossing. To specify all positions on orbit, set ORBINC(1) to 0 degrees and ORBINC(2) to 360 degrees. A smaller angular range on orbit, which, for example, might be required for a very short event time, can be specified by specifying a restricted range for ORBINC(1) and ORBINC(2). If ORBINC(1) and ORBINC(2) are equal, the satellite is fixed at a single position on orbit relative to the ascending node crossing. Through the entries on records B3 and B4, the user has great freedom to specify the satellite position on orbit during solar exposure.

**Record B3 Free Format**

Entry	Type	Variable
Start of range of satellite positions measured in degrees from ascending node crossing.	real	ORBPOS(1)
End of range of satellite positions measured in degrees from ascending node crossing.	real	ORBPOS(2)

The next record specifies the satellite ascending node crossing at the start of the event and the range which the orbit may precess from there. The use of the variables in record B4 is illustrated in the following examples. If it is known that the nodal crossing is at 20 degrees East longitude at the start of the mission and precesses 30 degrees east to 50 degrees East longitude, the user would enter PRECES(1) = 20 and PRECES(2) = 30. Note that PRECES(2) is positive for precession toward the east and negative for precession toward the west. PRECES(2) may be greater than 360 degrees. If PRECES(2) = 0, the orbit does not precess. For temporally short events the orbital precession is correlated with (proportional to) the time after event start. In such a case, TIMCOR is set to T (true). For longer missions (for example, many months with the orbit precessing about the Earth a number of times), the relationship between ascending node crossing longitude and the time after event start is neither obvious nor important. In such a case, TIMCOR is set to F (false) and the amount of precession is chosen randomly independent of event time. This selection gives equal probability of ascending node crossing for any value allowed in the range of orbit precession. The standard values of the variables in record B4 for long missions are PRECES(1) = 0, PRECES(2) = 360, and TIMCOR = F. This selection gives equal probability of the satellite being over any longitude on Earth.

**Record B4 Free Format**

Entry	Type	Variable
Initial (start of event) ascending node crossing longitude (0 to 360 degrees East longitude).	real	PRECES(1)
Orbital precession (degrees East longitude) allowed from initial ascending node crossing).	real	PRECES(2)
T (true) if orbital precession is correlated to event time. F (false) if orbital precession is not correlated to event time.	logical	TIMCOR

**Record B5 Free Format**

Entry	Type	Variable
Orbit inclination (0 to 180 degrees). Values between 0 and 90 degrees indicate easterly heading orbits and values between 90 and 180 degrees indicate westerly heading orbits.	real	ORBINC

**Record B6 Free Format**

Entry	Type	Variable
Earth albedo for reflected solar radiation. Earth albedo is the average diffuse reflectivity of the portion of the Earth under the satellite orbit. If ALBEDO = 0, no calculation of Earth-reflected radiation is performed. Values of albedo range from 0 to 1, with 0.246 being typical for 28.5-degree orbit inclination.	real	ALBEDO
Average radius of the Earth (km). 6378 km is a nominal value.	real	RE
Circular orbit average satellite altitude (km) above the surface of the Earth.	real	HSAT

The following two records specify parameters which determine the accuracy of the solar exposure calculation and the execution time of SOLSHAD. Sun positions are chosen at random times during the event. Assuming a normal distribution of the error in total solar exposure as a function of number of Sun positions, the average error in calculated solar exposure to a surface is proportional to the square root of the number of Sun positions ISUNPOS. Program execution time is proportional to the number of Sun positions. Typically, the user should use 1000 or more Sun positions to give a statistically accurate estimate of exposure for long missions.

No hard and fast rules may be given for specifying the variables on records B7 and B8. The user must examine his structure's geometry and use his experience to select values for the variables. The following guidelines for long missions may prove helpful. Surfaces which face space do not receive Earth-reflected radiation unless it is reflected from another surface. There is no need to calculate Earth-reflected radiation for surfaces which cannot receive it. Surfaces which face the Earth typically receive several times as much exposure from Earth-reflected solar radiation as from direct solar radiation. Vertical surfaces typically receive several times as much direct solar radiation as Earth-reflected radiation. The numbers of Monte Carlo scattered rays for direct and for Earth-reflected solar radiation should be chosen to reflect the anticipated solar exposure. CESH from scattering (specular and diffuse reflection and absorption) is based on constant ray areal density; that is, a constant number of rays per unit area. For purposes of scattering calculations,

the unit of area is taken to be the average of the nodal areas associated with each grid point in the structure. MAXRAY specifies the number of direct solar rays to be scattered per average area and MAXALB specifies the same for Earth-reflected rays. The number of rays scattered from the area associated with a point equals MAXRAY or MAXALB times the projected area divided by the average area. The projected area is the area times the magnitude of the cosine of the angle between the ray direction and the surface normal of the area.

MAXRAY and MAXALB should be set so that several rays are scattered from most nodes on the structure. Because the areas associated with nodes on the structure may vary by well more than an order of magnitude for many typical situations (for example, the areas associated with nodes near the vertex of a cone may be much smaller than those near the base of the cone), judgment is needed in selecting MAXRAY and MAXALB. A useful way to test whether MAXRAY and MAXALB are appropriate is to submit a SOLSHAD job with trial values. Stop the job after a minute or two (running the job to completion may take much longer) and examine the output for the number of nodes which have no rays scattered from them. If this number is more than a few percent of the total number of nodes, larger values of MAXRAY and MAXALB are probably in order. Typical starting values of MAXRAY and MAXALB might be 10 and 5, respectively.

The portion of the Earth visible from the satellite is divided into a grid of equal angular increments in azimuth angle and in polar angle relative to a line from the satellite to the center of the Earth. Record B8 defines this grid. Solar radiation is diffusely reflected from each point on the grid to every point on the structure (satellite). Because the time to calculate the Earth-reflected radiation exposure from each point on Earth to structure surfaces is approximately as long as the time to calculate the direct solar exposure, one wants to minimize the calculation of Earth-reflected radiation without introducing significant error into the calculation. Toward this end, the user may specify that the Earth-reflected radiation is to be calculated only after a specified number of Sun positions. For geometries which receive only a small fraction of their total solar exposure from Earth-reflected radiation, the user might set NTHETA and NPHI on record B8 to 5 and NALB on record B7 to 10 (calculate Earth-reflected radiation after every tenth Sun position). For an Earth facing geometry, the user might set NTHETA and NPHI to 10 and NALB to 1 to calculate Earth-reflected radiation at every Sun position.



**Record B7 Free Format**

Entry	Type	Variable
Number of direct solar rays per average node area to scatter during Monte Carlo scattering. This areal density of rays is scattered from each node in the structure for each Sun position. If MAXRAY = 0, only direct solar illumination to the structure is calculated.	integer	MAXRAY
Solar rays are diffusely reflected from each of the NTHETA by NPHI grid points on Earth (record B8) to each node on the structure. MAXALB is the number of Earth-reflected rays per average node area scattered during Monte Carlo scattering. This areal density of rays is scattered from each node in the structure. If MAXALB = 0, only radiation reflected from the Earth onto the structure is calculated and no Monte Carlo scattering of this radiation is performed.	integer	MAXALB
Earth-reflected radiation scattered to the structure is calculated once every NALB Sun positions. If NALB > ISUNPOS, no Earth-reflected radiation calculation is done.	integer	NALB
Total number of Sun positions for which solar radiation exposure is calculated.	integer	ISUNPOS
If T (true), do not list the coordinates of each node on the surface of the structure at each step of the ray tracing <sup>3</sup> . If F (false), list coordinates of each point on the surface of the structure at each step of the ray tracing. This option should be used only for debugging; it produces a very lengthy output.	logical	SHORTL
If T (true), calculate coordinates of points on surfaces of structure, but do not calculate solar exposure. If F (false), calculate solar exposure on surfaces of structure <sup>4</sup> .	logical	CHECK
If T (true), do not print out rays which intersect the inactive side of surfaces during the automatic generation of the visibility matrix. If F (false), print out these rays.	logical	INACT

<sup>3</sup>MDDB automatically selects this entry. Users wishing to enter F (false) must edit their input files outside MDDB.

<sup>4</sup>MDDB automatically selects this entry. Users wishing to enter T (true) must edit their input files outside MDDB. The true entry has been rendered obsolete by the development of MDDB.

### Record B8 Free Format

Entry	Type	Variable
Number of polar angle increments for the grid on the part of the Earth seen by the satellite.	integer	NTHETA
Number of azimuth angle increments for the grid on the part of the Earth seen by the satellite.	integer	NPHI

### Record B9 Free Format

Entry	Type	Variable
Random number generator seed (an integer between 1 and 7 digits).	integer	ISEED

## 2.2.2 Installation of the Geometry Builder

The Geometry Builder consists of two separate programs: MDDB (for Microenvironment Data Deck Builder) and TECPLOT (a commercial 3D plotting application). These two programs are run simultaneously, using a windowing system that allows switching between them. MDDB collects information to build a SOLSHAD or SHADOW input file. At various times it is possible to pause in the middle of MDDB, have it write a file for TECPLOT, and then switch to TECPLOT in order to view the progress.

This section describes how to install and run these two programs on a PC in the Microsoft Windows environment (version 3.0 or higher). TECPLOT is also available for other types of workstations, and MDDB and TECPLOT can be run in a similar manner on these workstations. FORTRAN code for MDDB is included; compile it on the workstation and run the two programs in separate windows. To recompile the code for Microsoft Windows on a PC, use the Microsoft FORTRAN compiler (version 5.0 or higher) with the Microsoft Windows compiler option (`/f /FeMDDB2 /MW *.for`).

Note: Users of the microenvironment atomic oxygen exposure program SHADOW (ref 1) will note that MDDB Version 1 and MDDB Version 2.0 share a number of subroutine names in common. Although their names are the same, these subroutines are different and cannot be interchanged between the two codes.

In this section, commands that the user types are written in **bold**, computer displays are written in **helvetica**, and file names are written in **courier**.

### Installation for Microsoft Windows

1. Copy the following files from disk into the same directory that contains TECPLOT:

```
mddb2.exe  
p.mcr  
table.mcr  
shadow.mcr
```

Note: The TECPLOT macro files (those ending in `.mcr`) that you should copy will depend on the version of TECPLOT that you are using. For version 5 on a PC, copy the files from the directory `tec5pc`. For version 5 on a workstation, copy the files from the

directory `tec5ws`. For version 6 on a PC, copy the files from the directory `tec6pc`. For version 6 on a workstation, copy the files from the directory `tec6ws`.

2. Copy the following file from disk into the same directory that contains Windows:  
`tecplot.pif`
3. Edit the TECPLOT configuration file (`tecplot.cfg` in the directory that contains TECPLOT), and make sure that the 3D aspect ratio limit is 100,000 or higher. This will prevent flat figures from becoming distorted.
4. Start up Microsoft Windows by typing `win`.
5. Create a Microenvironments Group.
  - a. Open up the Program Manager Window.
  - b. Choose **New** from the **File** Menu.
  - c. Choose **Program Group** and **OK**.
  - d. In the **Description** box, type **Microenvironments**.
  - e. In the **Group File** box, type `mddb.grp`. Hit **OK**.
6. Add an icon for Mddb. (Except for the Description box, the values typed in are not case sensitive.)
  - a. Choose **New** from the **File** Menu.
  - b. Choose **Program Item** and **OK**.
  - c. In the **Description** box, type **Mddb**.
  - d. In the **Command Line** box, type `mddb2.exe`.
  - e. In the **Working Directory** box, type `C:\tecplot` (or whatever the directory is that contains TECPLOT and `mddb.exe`).
  - f. Leave "None" in the **Shortcut Key** box type.
  - g. Choose an icon by clicking on the **Change Icon** button. We suggest a simple window icon.
  - h. Click on **OK**. The new icon labeled Mddb should appear in the new window.
9. Add an icon for TECPLOT. (Except for the Description box, the values typed in are not case sensitive.)
  - a. Choose **New** from the **File** Menu.
  - b. Choose **Program Item** and **OK**.
  - c. In the **Description** box, type **Tecplot**.
  - d. In the **Command** box, type `c:\windows\tecplot.pif` (or whatever path gets into the windows directory).
  - e. In the **Working Directory** box, type `C:\tecplot` (or whatever the directory is that contains TECPLOT and `mddb.exe`).
  - f. Leave "None" in the **Shortcut Key** box.
  - g. Choose an icon by pressing the **Change Icon** button. We suggest a 3D graph icon if available.
  - h. Click on **OK**. The new icon labeled Tecplot should appear in the window. Size and move the window by clicking and dragging on the bottom corner and top bar, respectively.

### 2.2.3 Constructing Input Geometries Using Mddb and TECPLOT

This section describes how to operate Mddb and TECPLOT simultaneously on Microsoft Windows so that an input file can be viewed as it is being constructed. First, it is necessary to

open two windows: one that contains MDDB, and the other containing TECPLOT. At various times during MDDB operation, you will be asked if you want a TECPLOT display. If you respond "yes," MDDB will generate a file for TECPLOT, and then pause. You will then switch to the TECPLOT window, run a macro to call up the file that was generated and display it. You may then rotate and view the object using standard TECPLOT commands. Once you are finished, you will return to the MDDB window.

MDDB will ask for data with which to build the input file. MDDB version 2 has an improvement over version 1 in that it will display default data and ask if you want to keep this data, or enter new data. By entering an equal sign (=), the default data will be used; any other input will be taken as new data.

### Setting up Windows for TECPLOT and MDDB

1. Start up Microsoft Windows.
2. Double-click on Tecplot. After about 10 seconds, the TECPLOT screen will appear. Hit the spacebar.
3. Type <Cntl><Escape>. Windows will return, and a box will appear. Double-click on **Program Manager**.
4. Double-click on MDDB icon. A window will appear labeled **MDDB - [Unit \*]**.

### Constructing Geometries Using MDDB

1. You are asked for the file format of the file you will be creating. Choose 3 for SOLSHAD. (You also have the option of choosing 1 for SHADOW version 1.x input files, or 2 for SHADOW version 2.x)
2. You are asked whether to create a new file or edit an existing one. Enter 1 for a new file, or 2 for the existing file. If you have modeled a geometry for atomic oxygen exposure using SHADOW, and now want to model the solar exposure, you can edit your previous SHADOW input file and save it as a SOLSHAD file.
3. If a new file is chosen, you are asked for an event description, start and end dates, a mission file name, and a descriptive header for the geometry.
4. If an existing file is chosen, enter the file name at the next prompt. Then enter the file type: 1 for SHADOW version 1.x, 2 for SHADOW version 2.x, or 3 for SOLSHAD (if you give the wrong file type, the program will not detect the problem, and a program error will occur which will halt MDDB). You are then shown the current geometry description and asked to enter a new one (or enter = to accept the current one).
5. You are then presented with the main menu. (If creating a new file, you are automatically sent into option 1.)

```
SELECT AN ACTION BY NUMBER FROM THE LIST
1  ADD ANOTHER SURFACE AT END OF SURFACES
2  MODIFY AN EXISTING SURFACE
3  DELETE A SURFACE
4  INSERT A NEW SURFACE
5  REVIEW SURFACES
6  COPY SURFACE AND INSERT IT AT A NEW POSITION
7  EXIT SURFACE OPERATIONS (DONE)
```

6. To add another surface at the end of the existing surfaces:

- a. Select 1.
- b. MDDDB gives you the "current definition" of the new surface, which is meaningless. Press return to enter the new data.
- c. Choose a surface type (1 = trapezoid, 2 = cylinder, 3 = cone, 4=disk, and 5 = sphere.)
- d. You will be prompted for all the information that describes the geometry. (These values are described in detail in sec. 2.2.1.) If you are prompted for several values on one line, separate them by spaces or commas. For example, to enter the coordinates (4.0, -2, 1.3), type 4.0 -2 1.3 or 4.0,-2,1.3.
- e. You are then asked if you want to see a TECPLOT display. If you answer yes, follow the instructions in the next section.
- f. You are asked to verify if the surface is correct. If not, you are prompted to enter data for the surface again.
- g. You are asked if you want to rotate or translate the surface. If yes, you are given the following menu:

```
SELECT ACTION
T  TRANSLATE SURFACE
X  ROTATE ABOUT X AXIS
Y  ROTATE ABOUT Y AXIS
Z  ROTATE ABOUT Z AXIS
```

- h. Enter the menu choice, and then how you much you want the surface rotated or translated<sup>5</sup>.
- i. Again, you are asked if you want to see a TECPLOT display. If yes, follow the instructions in the next section.
- j. At this point, you have the chance to undo the operation if it doesn't look right.
- k. Further translation and rotation is available at this point.
- l. Finally, the main menu is displayed again.

7. To modify an existing surface:

- a. Select 2.
- b. A list of surfaces is displayed. Choose the number of the surface you want to modify.
- c. The following menu is shown:

```
SELECT AN ACTION BY NUMBER
1  MODIFY DATA FOR THE SURFACE
2  ROTATE OR TRANSLATE THE SURFACE
3  DISPLAY GEOMETRY AND SURFACE DATA FOR THE SURFACE
4  FINISHED MODIFICATION OF THIS SURFACE
```

- d. Choose the appropriate actions until the surface is to your satisfaction. At various times, you will be given the option to view the surface in TECPLOT. When finished with the surface, choose number 4. The main menu will be displayed.

8. To delete a surface:

**Note:** Be careful -- this operation cannot be undone.

- a. Select 3.
- b. A list of surfaces is displayed. Choose the number of the surface you want to delete.
- c. The surface is deleted. The main menu will then be displayed.

---

<sup>5</sup>Note that rotations actually take place about an axis through a user-selected point parallel to the selected coordinate axis of rotation rather than the coordinate axis itself. This allows the user great flexibility when rotating surfaces. For example, consider a rectangle initially in the Y-Z plane and intersecting the X axis at  $x_0$  as shown in figure 2.2.3-1(a). If this rectangle is rotated by 90 degrees about the Z axis, with (0,0,0) as the rotation point, it is transformed to the position shown in figure 2.2.3-1(b). However, if the rotation point is taken to be  $(x_0,0,0)$ , the rectangle is transformed to the position shown in figure 2.2.3-1(c).

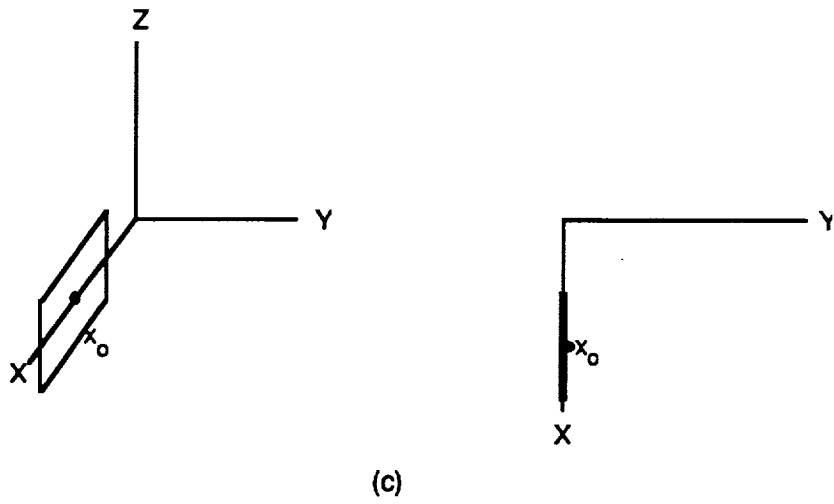
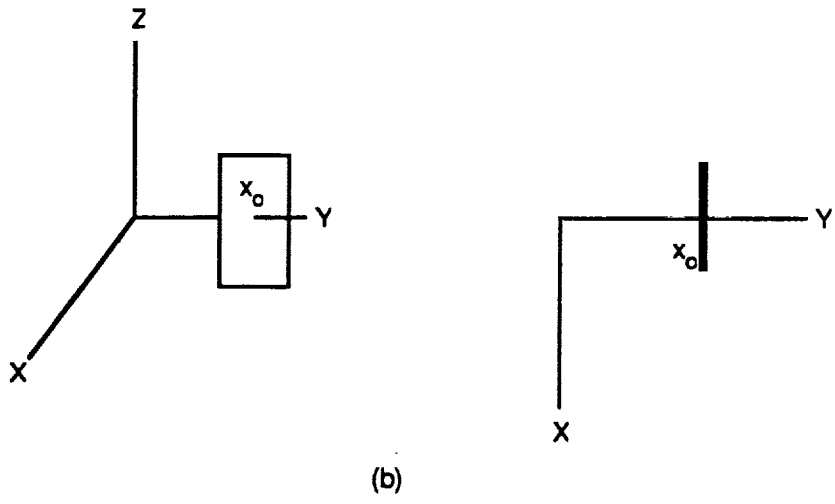
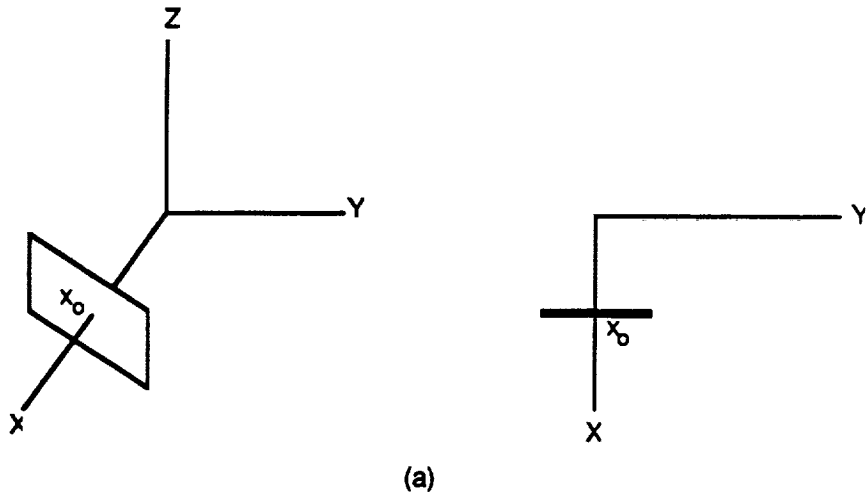


Figure 2.2.3-1. Rotation of a Rectangle About Axes Parallel to the Z Axis.

9. To insert a new surface:
  - a. Select 4.
  - b. A list of surfaces is displayed. Choose the number of the surface in front of which you would like the new surface to be inserted.
  - c. Enter information just as in step 6.
  
10. To review surfaces:
  - a. Select 5.
  - b. A list of surfaces is displayed. Choose the number of the surface you want to review. Zero reviews all surfaces.
  - c. You are shown the properties of that surface, and then given the option to get a TECPLOT display of the structure.
  - d. If you chose to review all surfaces, the program steps you through each surface, asking if you want to see a TECPLOT display at any point.
  
11. To copy a surface:
 

Note: This menu option is very useful for building structures containing surfaces which are identical except for positions.

  - a. Select 6.
  - b. A list of surfaces is displayed. Choose the number of the surface you want to copy.
  - c. A list of surfaces is displayed. Choose the number of the surface after which you want the new surface to be inserted. Zero inserts the new surface before the first surface.
  - d. You are then asked for a comment line for the new surface.
  - e. At this point you have the option of modifying the surface, so that it can be rotated or translated. Follow the instructions in step 7.
  
12. If you are editing a SHADOW file in order to create a SOLSHAD file, you will then be asked for the solar surface properties of all the surfaces that previously only had atomic oxygen properties. You will be given the opportunity to view the structure with TECPLOT, change the material name, and then enter the reflectivity and absorption coefficients.
  
13. At this point, you are given the chance to review or modify any surfaces. This is particularly useful if you made a mistake in entering the solar properties. If you choose Y, then you are returned to the main menu.
  
14. When finished, choose 7 from the main menu.
  
15. You then have the option of translating or rotating the entire structure. Enter the menu choice, and then how much you want the surface rotated or translated.
  
16. If you chose to rotate or translate, you then have the options of viewing the transformed object, and then undoing the translation or rotation if you desire.
  
17. You may continue to translate or rotate the entire structure until it is where you want it to be. At this point you have the option once more to review all surfaces.
  
18. The last section is for the input of various values needed in the calculation. The program displays the current values and asks if you want to modify them. If this is a new file, then the current values are generally zero.
  
19. Enter the start year, day, and hour. First enter the year and day in the format YYYY DDD, where the day is the number of days from the beginning of the year.
  
20. Enter the Greenwich Mean Time hour and fraction.

21. Enter the end year, day, and hour in a similar manner.
22. Enter information on the following values (see sec. 2.2.1 for more information):
  - Range of angular positions on orbit
  - Ascending node longitude and range of precession
23. Enter whether the event time and orbit precession are correlated or uncorrelated.
24. Enter information on the following values (see sec. 2.2.1 for more information):
  - Orbit inclination
  - Earth albedo
  - Earth radius
  - Average circular orbit satellite altitude
  - Maximum number of direct solar rays to scatter
  - Maximum number of Earth-reflected solar rays to scatter
  - Number of Sun positions after which Earth-reflected radiation will be calculated
  - Number of randomly selected Sun positions
25. Enter if you want the surfaces to be flagged if rays intersect with inactive sides during generation of the visibility matrix.
26. Enter information on the following values (see sec. 2.2.1 for more information):
  - The number of zenith and azimuth increments
  - Random number generator seed
27. Enter the name of the file to which the data will be written.
28. Program is complete. Click on "Yes" to exit the window. Return to the TECPLOT window (Type <Cntrl><Escape>. Double-click on **Tecplot**.) Quit. (Type: /fqq)

### Viewing a TECPLOT Display of the Surfaces

1. Wait until the message "SWITCH TO TECPLOT NOW AND DISPLAY SURFACES" is written. Then type <Cntrl><Escape>. The box with available windows will appear. Double-click on **Tecplot**.  
**Note:** With Windows 3.1, you can use <Alt><Tab> to switch between MDDb and TECPLOT once the first switch has been established using <Cntrl><Escape>.
2. You may get a message saying that there is insufficient memory for the display. If this occurs, click **OK**, and then double-click on the Tecplot icon at the bottom of the screen. (What this means is that when TECPLOT first appears after switching from another window, there will be some extraneous garbage on the screen. However, this will disappear as soon as the screen is refreshed.)
3. Type <Cntrl>**p p p**<enter>. This will play a macro called `p.mcr`, which takes the file `mddb.plt` generated by MDDb and plots in on the screen. (If there is extraneous garbage on the screen, this step will eliminate it.) Each of the surfaces will be a different color, and arrows will appear that show which side of each surface is the active side.

**Note:** If an error occurs while trying to run `p.mcr`, this may be due to the binary file format generated by the FORTRAN code not being compatible with the TECPLOT version in use. To fix this, quit TECPLOT, create a DOS shell, copy `p2.mcr` to `p.mcr`, exit the DOS shell, and



start TECPLOT again. Now when you type <Cntrl>p p p<enter>, the macro will run the ASCII file through PREPLOT to generate the binary file. (p2.mcr will take a little longer to run than p.mcr.)

4. To rotate the object or identify surfaces, see the directions below. If the display appears incomplete, refer to the section on possible problems with TECPLOT.
5. To return to MDDB and continue, type <Cntrl><Escape>, and double-click on **MDDB - [Unit \*]**.

**Note:** With Windows 3.1, it is possible to switch back and forth between windows by typing <Alt><Tab>. Refer to the Windows manual.

### Rotating the Structure in TECPLOT

If the view that TECPLOT gives you is not exactly what you want, it is a simple matter to rotate it. Type the following commands:

```
/      Get to main menu.
c      Get to Contour menu
v      Get to view menu
r      Rotate
x,y, or z  Choose x, y, or z axis to rotate about
```

Now use the mouse or the keyboard arrows to rotate the object. <Esc> will bring you out of rotation mode. If the rotation has moved some parts of the object outside of the field of view, type v (for view menu) and then f (for fit).

Type r to regenerate the picture.

**Note:** Every time that MDDB generates a new picture for TECPLOT, it reverts back to its original rotation view. To save a particular view, store it as a style sheet. Once you have the view you want, type /fsw and the filename (such as mddb.sty). To restore this view later on, type /fsr <filename>.

### Determining Surfaces in TECPLOT

The TECPLOT display shows all the surfaces in different colors so that you can determine which surface on the screen corresponds to which surface in the SOLSHAD or SHADOW input file. There are two ways to make this determination: displaying a table of colors with the surfaces they correspond to, and individually examining surfaces.

To generate a table, type the following commands:

1. <Cntrl>p p table<enter>. (This plays a macro called table.mcr.)
2. Wait until the message "Enter total number of surfaces" appears on the bottom of the screen. Press <enter>.
3. Type the total number of surfaces. (This was displayed in MDDB just before transferring to TECPLOT.) Press <enter>.
4. Wait until the message "Place the table" appears at the bottom of the screen. Use the mouse to put the table where you want it. Click with the left button to place it. You can read the table by

matching up the color with the number just directly above it. (The one exception is surface #1, which is always at the very bottom of the table.)

To individually examine surfaces, type the following commands:

/	Get to main menu.
c	Get to Contour menu
p	Get to probe menu
e	Examine

Now use the mouse to place the crosshairs on the region of interest. Click with the left mouse button. A table will appear on the left side of the screen. The second value in the table corresponds to the surface number. (If you get a non-integer number, it is because you have clicked on an arrow instead of a real surface.) To get out of examine mode, hit <escape>. To get rid of the crosshairs, regenerate the screen (/cr).

### Possible Problems

A minimum number of grids are required for certain shapes: for example, you cannot create a disk with only 2x2 grids. The second grid value NN must be at least 3 for TECPLOT to approximate the disk by a triangle; use a value of 8 or more to get anything remotely circular.

TECPLOT has difficulty with mesh units that come to a point, and it will generally not draw them. To avoid this problem, do not use values of zero for ratios in the trapezoid, disk, and cone geometries. Instead, use ratios that are very small (0.001) to approximate triangles (ratio of trapezoid short size to long side), disks with no holes in the center (ratio of inner radius to outer radius), and cones that come to a point (ratio of small radius to large radius). Other coordinates may have to be modified slightly if you are concerned about geometries overlapping. Similarly, spheres' polar angular extent should range from 0.001 to 179.999 instead of 0 to 180 degrees. If you choose not to add this small factor of 0.001, SHADOW will still perform the calculations correctly, but the TECPLOT display may be incomplete, both during input file generation and during the final display of solar exposures.

TECPLOT will occasionally have other quirks as well. Sometimes mesh lines are missing or are drawn where they shouldn't appear. In general, rotating the view to something slightly different will correct these problems.

## 2.3 INSTALLATION AND OPERATION OF THE MICROENVIRONMENT SOLAR EXPOSURE PROGRAM

This section describes installation and operation of SOLSHAD on the CONVEX computer on which it was developed, and gives some suggestions for migrating SOLSHAD to other computers.

### 2.3.1 Installation on a CONVEX Computer

SOLSHAD was developed on a CONVEX C2 supercomputer running under CONVEX operating system release 9.0 and CONVEX version 4.2bsd unix. SOLSHAD is written in CONVEX FORTRAN. This section describes the installation and operation on a machine identical to that on which it was developed. It is suggested that a directory called solmicro and one subdirectory called solshad be created, and that all files be put into these directories. In what follows it is assumed that these directories have been created.

All files for SOLSHAD reside on directory solmicro and its subdirectory solmicro/solshad. Subdirectory solmicro/solshad contains FORTRAN source code for program SOLSHAD and its subroutines as well as a Makefile for building the SOLSHAD executable. These files are listed in tables 2.3.1-1 and 2.3.1-2, respectively.

**Note:** Users of the microenvironment atomic oxygen exposure program SHADOW (ref. 1) will note that SOLSHAD and SHADOW share a number of subroutine names in common. Although their names are the same, many of these subroutines are different and cannot be interchanged between the two codes.

**Table 2.3.1-1**  
**Files in the Directory solmicro**

run.solshad*	solshad.in_sample	solshad.tp7_sample
solshad/	solshad.out_sample	solshad.x

**Table 2.3.1-2**  
**Files in the Directory solmicro/solshad**

Makefile	cwb2int.f	hiterth.f	rayg3.f	switch.f
autovis.f	cwbint.f	les.f	rayg4.f	unitize.f
ceshint.f	cwbsc.f	multi.f	reflect.f	xrot.f
cload.f	dateda.f	packer.f	rglerr.f	yrot.f
connec.f	diffuse.f	prnote.f	solshad.f	zrot.f
cwb.f	dot.f	rayg1.f	store.f	
cwb2.f	doy.f	rayg2.f	subsol.f	

Follow the procedure below for loading SOLSHAD and preparing it to execute. In this procedure, **bold** text indicates commands the installer should type. Press return after each command. Remember that the unix operating system is case sensitive.

1. Create and load the directory solmicro with the files given in table 2.3.1-1 and subdirectory solmicro/solshad with the files in table 2.3.1-2.
2. Get to subdirectory solmicro/solshad by typing **cd /pathname/solmicro/solshad**, where pathname is the appropriate path.
3. Type **make**. This causes the file Makefile to be run, compiling all FORTRAN routines in the subdirectory and creating an executable called solshad.x.
4. Type **cp solshad.x ..** to copy the executable to solmicro.
5. Get to directory solmicro by typing **cd ..**
6. Edit file run.solshad to change the lines  
solshad.x < solshad.in\_sample >! solshad.out\_sample  
to  
solshad.x < solshad.in\_sample >! test.out  
and  
mv TAPE7 solshad.tp7\_sample  
to  
mv TAPE7 solshad.tp7\_test

7. Change the path in the second line to the proper path. Save and exit.
8. Ensure that run.solshad has execute permission by typing `chmod +x run.solshad`.
9. Run the sample test case by typing `run.solshad`. The sample test case takes about 3.5 minutes CPU time. When the run is complete, compare file solshad.out\_sample with test.out and solshad.tp7\_sample with solshad.tp7\_test. These files should give the same results except for minor differences in CPU times.

### 2.3.2 Running the Microenvironment Solar Exposure Program

Before running SOLSHAD, build its input file describing your geometry and operating conditions using MDDDB (per sec. 2.2). Edit the run.solshad file in the solmicro directory to direct your program input file to standard input and to direct standard output to your output file. You may also wish to direct TAPE7, the file containing information for displaying the solar exposure in TECPLOT, to a different file name. Every time SOLSHAD is run, any existing version of TAPE7 is overwritten. SOLSHAD may be run interactively by typing `run.solshad` or in batch mode by typing `qsub -q v run.solshad` where v is the queue to which the job is to be sent. Because SOLSHAD may take significant execution time, running in batch mode is recommended.

As written, SOLSHAD is set to allow up to 100 surfaces and 5,000 nodes. These dimensions are set by PARAMETER statements in the FORTRAN code. Table 2.3.1-3 summarizes these parameters and what they affect. Users who do not run cases which need these large dimensions may find that SOLSHAD runs more quickly if they are reduced.

**Table 2.3.1-3  
Parameters in SOLSHAD**

<b>PARAMETER</b>	<b>Value</b>	<b>Appears in COMMON Block</b>	<b>FORTRAN Routines Affected</b>	<b>PARAMETER usage</b>
MAXPS	100	//, /SURFC/, /SURF/, /SEE/	AUTOVIS, CESHINT, CLOAD, CONNEC, MULTI, RAYG1, RAYG2, RAYG3, RAYG4, SOLSHAD	Maximum number of surfaces.
MAXNOD	5000	//, /FLX/, /RNODE/, /RTR/	AUTOVIS, CESHINT, CLOAD, CONNEC, CWB2INT, MULTI, PACKER, RAYG1, RAYG2, RAYG3, RAYG4, SOLSHAD	Maximum number of nodes.
MAXID	3*MAXNOD	//	AUTOVIS, CESHINT, CONNEC, MULTI, RAYG1, RAYG2, RAYG3, RAYG4, SOLSHAD	Dimension of ID array.

**Notes:**

- All FORTRAN routines are in files of the same name in lower case with a .f extension.
- All files are in directory solmicro/solshad.

### 2.3.3 Some Information for Installation on Other Computers

This section provides information about SOLSHAD which will be useful if SOLSHAD is to be converted to run on computers other than the CONVEX described in section 2.3.1.

SOLSHAD is written in mostly ANSI standard FORTRAN and generally does not call functions specific to any particular operating system or FORTRAN compiler. However, the following exceptions are noted.

Calls are made to CONVEX lveclib8 CPU elapsed time function CPUTIME in program SOLSHAD. This function must be changed to the proper function name for other systems, or, references to it may be deleted without significant effect on program execution. CPUTIME is used to output elapsed CPU time at various stages of SOLSHAD.

RAN is a CONVEX lveclib8 VAX-like random number generator. The appropriate random number generator call must be substituted in subroutines DIFFUSE, MULTI, RAYG4, and in program SOLSHAD. Also, the random number seed initialization must be made proper for the random number generator used. RAN uses a large integer number as a seed. RAN generates uniformly distributed random numbers between 0 and 1.

Numerous seven-character variable names are used in SOLSHAD. It is believed that most can be truncated to the ANSI standard six characters without causing duplicate variable names. However, care should be taken before doing this to ensure that there are indeed no duplicate variable names generated.

SOLSHAD is compiled to run using CONVEX double-precision word length (8 bytes or 64 bits) for all real variables. This word length is needed to maintain numerical accuracy. Real variables in FORTRAN routines in solmicro/solshad are not declared double precision explicitly, but are converted to double precision with a FORTRAN compiler option. Users converting SOLSHAD to run on other computers should be aware that single-precision word length (4 bytes or 32 bits) real variables may not give the same numerical accuracy as double-precision word lengths.

The following CONVEX FORTRAN compiler options are either recommended or mandatory when compiling SOLSHAD:

- or all        Provides full optimization report (recommended).
- O2            Optimize code with vectorization (recommended).
- pd8          All default integer, logical, real, and double-precision values occupy 8 bytes of storage (mandatory).
- rl            Perform loop replication optimizations (loop unrolling, dynamic code selection) when profitable to do so (recommended).
- 72            Process only the first 72 characters of each line. Lines containing tab characters will not compile properly with this option (mandatory).

## 2.4 OUTPUT: 3D PLOT GENERATION

### 2.4.1 Plot Generation

SOLSHAD generates an ASCII file that can be read by TECPLOT to display the structure with colors on its surfaces that correspond to the different levels of CESH solar exposure. This file is named TAPE7, unless otherwise renamed in the batch file. First, the ASCII file must be

converted into a binary file for input into TECPLOT, using a program called PREPLOT. Then a macro can be run to display the structure. Finally, TECPLOT commands can be used to rotate, add text, print, extract data, etc.

For complete instructions on what can be done in TECPLOT, read the software manual. This section contains instructions on how to do the most common tasks for viewing the SOLSHAD output using a PC. To get started, follow these instructions:

1. Change directory to where TECPLOT is located. (Generally, `cd \tecplot`.)
2. Type `preplot <filename.xxx>`, where `<filename.xxx>` is the TECPLOT file generated by SOLSHAD. PREPLOT converts the file into binary, and names the new file `<filename.plt>`.
3. Type `tecplot` to start up TECPLOT.
4. Load the data file. (Commands: `f d r`. Type in the file name with `.plt` extension.)
5. Run the macro `shadow.mcr`. To do this type `<ctrl>p p shadow`. The structure will appear, although it may be difficult to see various parts of it due to the positioning of the x, y and z axis.

### 2.4.2 Plot Manipulation

#### Rotating the Structure

Type the following commands:

<code>/</code>	Get to main menu.
<code>c</code>	Get to Contour menu.
<code>v</code>	Get to View menu
<code>r</code>	Rotate.
<code>x,y, or z</code>	Choose x, y, or z axis to rotate about.

Now use the mouse or the keyboard arrows to rotate the object. `<Esc>` will return bring you out of rotation mode. If the rotation has moved some parts of the object outside of the field of view, type `v` (for View menu) and then `f` (for Fit).

Type `r` to regenerate the picture.

#### Adjusting the Colors and Adding a Color Table

TECPLOT will automatically choose a color scale, based on the highest and lowest values of the CESH. In general, this scaling is good, but sometimes a small number of nodes will have extreme values that will throw off the scale. To adjust the color scale, type the following commands:

<code>/</code>	Get to main menu.
<code>c</code>	Get to Contour menu.
<code>c</code>	Get to Contour Value menu.
<code>l</code>	Levels.
<code>n</code>	New Range.
<code>n</code>	New Minimum and Maximum.

Choose a number of levels. (15 is a good value.) Enter the minimum. Enter the maximum. Type <cntl>r to regenerate the picture. Redo the steps from "New Range" to adjust until you get a good set of contours.

To add a table that shows which colors correspond to which levels, type the following:

```

/      Get to main menu.
c      Get to Contour menu.
c      Get to Contour Value menu.
t      Table.

```

In this menu, you may adjust the text fonts and colors, the spacing in the table, and whether you have a bar outline. Finally, type p to place, and use the mouse to put the table where you want it to be. Click the mouse to finalize the table location.

### Plotting Specific Ray Groups

The total CESH on a surface can be divided into primary CESH, specularly-reflected CESH, diffusely-reflected CESH, and absorbed CESH. (These groups can then be divided into direct solar CESH and Earth-reflected solar CESH.) It is possible to view the structure looking at only exposure from each of these groups. Table 2.4.2-1 shows the variable numbers and names that correspond to the various ray groups.

**Table 2.4.2-1  
TECPLOT Variable Numbers and Names**

<u>Variable number</u>	<u>Variable name</u>	<u>Value</u>
1	NODE	Node index
2	PRIM	Primary direct solar CESH
3	SPEC	Specularly-reflected direct solar CESH
4	DIFF	Diffusely-reflected direct solar CESH
5	ABSOR	Absorbed direct solar CESH
6	TOTAL	Total direct solar CESH
7	PRIMA	Primary Earth-reflected solar CESH
8	SPECA	Specularly-reflected Earth-reflected solar CESH
9	DIFFA	Diffusely-reflected Earth-reflected solar CESH
10	ABSA	Absorbed Earth-reflected solar CESH
11	TOTAL	Total Earth-reflected solar CESH
12	GRTOT	Total of direct and Earth-reflected solar CESH
13	X	x-coordinate
14	Y	y-coordinate
15	Z	z-coordinate

Type the following commands:

```

/      Get to main menu.
c      Get to Contour menu.
c      Get to Contour Value menu.
v      Get to the Variable menu
Use arrows to choose your CESH group. Press enter
<esc> Get to Contour menu
r      Regenerate the image

```

## Style Sheets

A style sheet contains all the information as to how a data file is displayed. It can be used on the data that it was generated with or on new data that is similar in format. To save or restore a style sheet, type the following:

/            Get to main menu.  
f            Get to File menu.  
s            Get to StyleSheet menu.  
w or r      Write or Read.  
filename    Filename that ends with .sty.

## Printing

Type the following commands:

/            Get to main menu.  
f            Get to File menu.  
p            Get to Print menu.

In this menu, you may adjust the paper size and orientation, the device configurations, the printer format, number of copies, the file path for hardcopy files, and where to route the output. When done, type g for GoPrint. Now you can position and scale the picture. Again, type g for GoPrint when done, and the print will be made.

## Probing Data

TECPLOT allows you to pick a spot on the surface and get the exact exposure value there. Type the following commands:

/            Get to main menu.  
c            Get to Contour menu.  
p            Get to Probe menu.  
e            Examine.

Use the mouse to place the cursor where you want the exposure value. Click with the left button. A table appears on the left side of the screen. You can read off the values next to the variable numbers. (See table 2.4.2-1 for an explanation of these numbers.) You can continue clicking on new points. Press esc or right mouse button when done.

## Extracting Data

TECPLOT allows you to draw a path across your surface, extract the CESH values, and generate a 2D plot of CESH versus distance. Type the following commands:

/            Get to main menu.  
c            Get to Contour menu.  
p            Get to Probe menu.  
x            Extract data.

Use the mouse to place the cursor at the beginning of the path. Click with the left button. Move the mouse to the end of the first line segment. Click with the left button again. Continue



until you get to the end of the path. Then click the right mouse button. Enter y to accept the polyline, or n to redo it. Enter the number of points for your x-y curve. Enter a filename and a header.

A new file has been created with this data. You can look at it by loading the new file. (Commands: / f d r. This new file will be automatically inserted as the default name.) Plot it as an X-Y plot. (Commands: / x). You will need to set the variables (x should set to the X, Y, or Z variable, and y should be set to an exposure value, such as GRTOT. Command: / x o v) and refit the graph to the axis (Command: / x v f).

### 3.0 TECHNICAL FEATURES OF THE COMPUTER MODEL

#### 3.1 PROGRAM FLOWS

##### 3.1.1 Program Flow for the Microenvironment Solar Exposure Model

Figure 3.1.1-1 shows the SOLSHAD block diagram. The names of major subroutines in the block diagram are given in parenthesis. Figure 3.1.1-2 is a subroutine tree for SOLSHAD and shows all subroutines and functions and their calling hierarchy. This section describes the general order of program execution; details of the algorithms used are given in section 3.2.1.

SOLSHAD starts execution by echoing its input file to output. The input file is then rewound. Subroutine RAYG1 reads the geometry definition and surface properties for all surfaces and sets up the grid of nodes for each surface and other quantities needed for ray tracing. Calculation control parameters, including event start and end dates, satellite orbit description, Earth albedo, the number of Sun and orbit positions for which to trace rays, and whether multiple scattering is required, are read.

All surfaces have previously been divided into a grid of nodes by subroutine RAYG1. SOLSHAD defines a set of points at which solar exposure in CESH will be calculated so that nearly the entire surface is covered. This grid for solar exposure has points at one corner (call it the lower left) of each node plus points in the lower right corner of the right-most column of nodes, at the upper left of the topmost row of nodes, and in the upper right corner of the upper right node. Each point is set in 1% of the node size from the nearest edge of the node. This gives nearly full coverage of the surface and avoids any ambiguity as to which node the point belongs to. The coordinates of each grid point in Cartesian (x, y, z) space are calculated by subroutine RAYG2. Subroutine RAYG3 calculates the surface normal vector and two orthogonal tangent vectors. These data are saved for repeated use in subroutine AUTOVIS.

Subroutine AUTOVIS calculates a visibility matrix for the surfaces defining the geometry of the object. The visibility matrix indicates which surfaces can be shielded by themselves or other surfaces, or can reflect solar radiation to other surfaces or to themselves. The visibility matrix is analyzed to determine which, if any, surfaces have solar radiation reflected to them by any surface. This information is used to speed up program execution in two ways. First, when surfaces are being checked to see if a ray to or from them will be blocked by any surface, only those surfaces which can see the first surface need be checked. Other surfaces can be ignored. Second, if a surface cannot have solar exposure reflected on to it, there is no need to ray trace reflected solar exposure from that surface.

The visibility matrix is calculated by ray tracing from each point on every surface to every other point and ray tracing along the surface normal from the active side of the surface at each point. The process is sped up by noting that plane surfaces (trapezoids and disks) and the positive sides of cones, cylinders, and spheres can never reflect onto themselves. During this ray tracing, rays which hit the inactive sides of surfaces are flagged. Such rays often indicate that the object geometry is not properly constructed and that surfaces may be exposed to solar radiation which were not intended to be exposed.

After the visibility matrix has been calculated, data for the centers of all the nodes in the structure are calculated and saved for repeated use during CESH calculations later in the program. These data include the coordinates of the center points and the surface normals and tangent vectors at the points. Also at this time the average area of a node is calculated. The average area is used to determine how many rays of CESH to scatter from each node.

# SOLSHAD BLOCK DIAGRAM

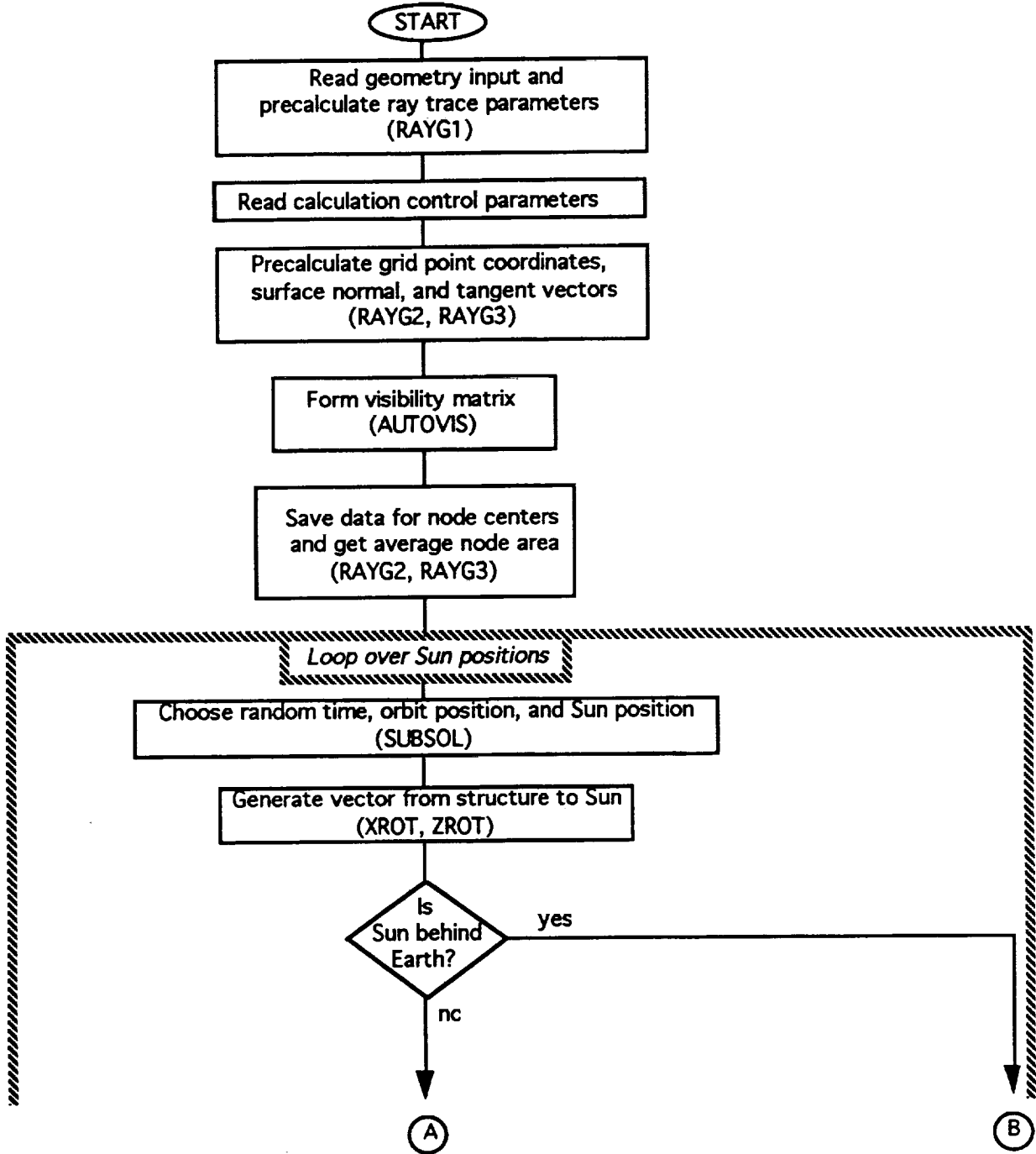


Figure 3.1.1-1. SOLSHAD Block Diagram (Sheet 1 of 4).

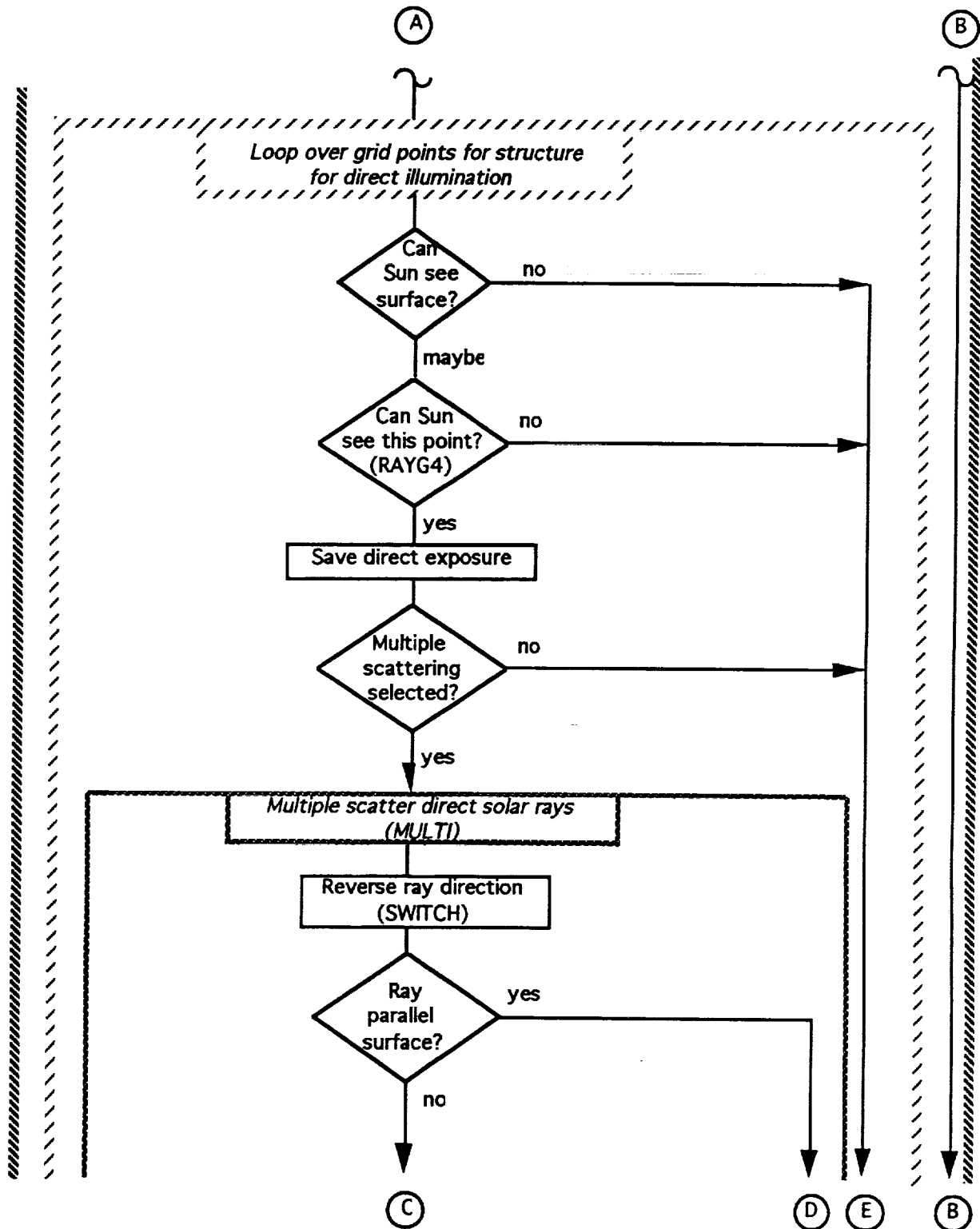


Figure 3.1.1-1. SOLSHAD Block Diagram (Sheet 2 of 4).

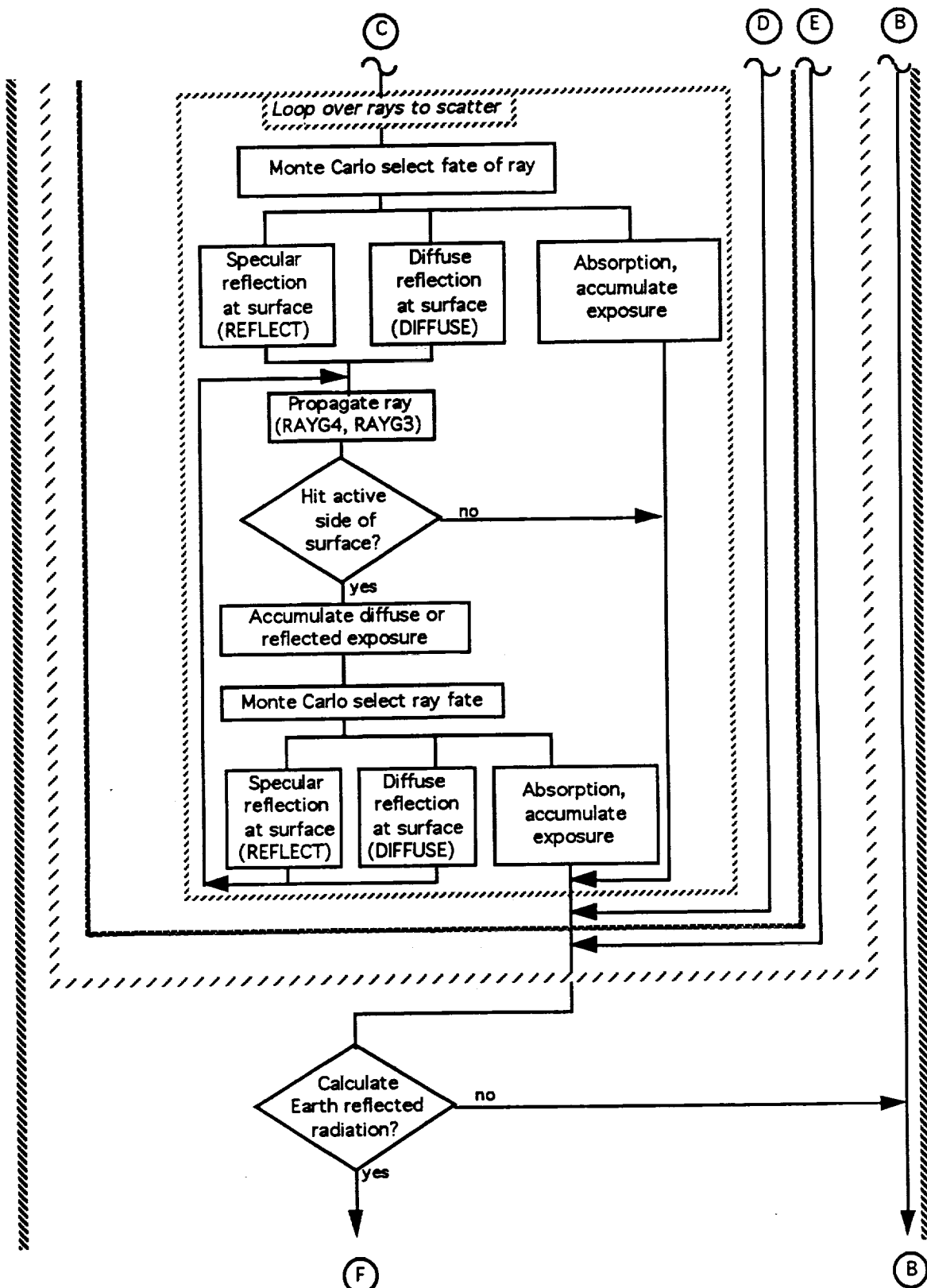


Figure 3.1.1-1. SOLSHAD Block Diagram (Sheet 3 of 4).

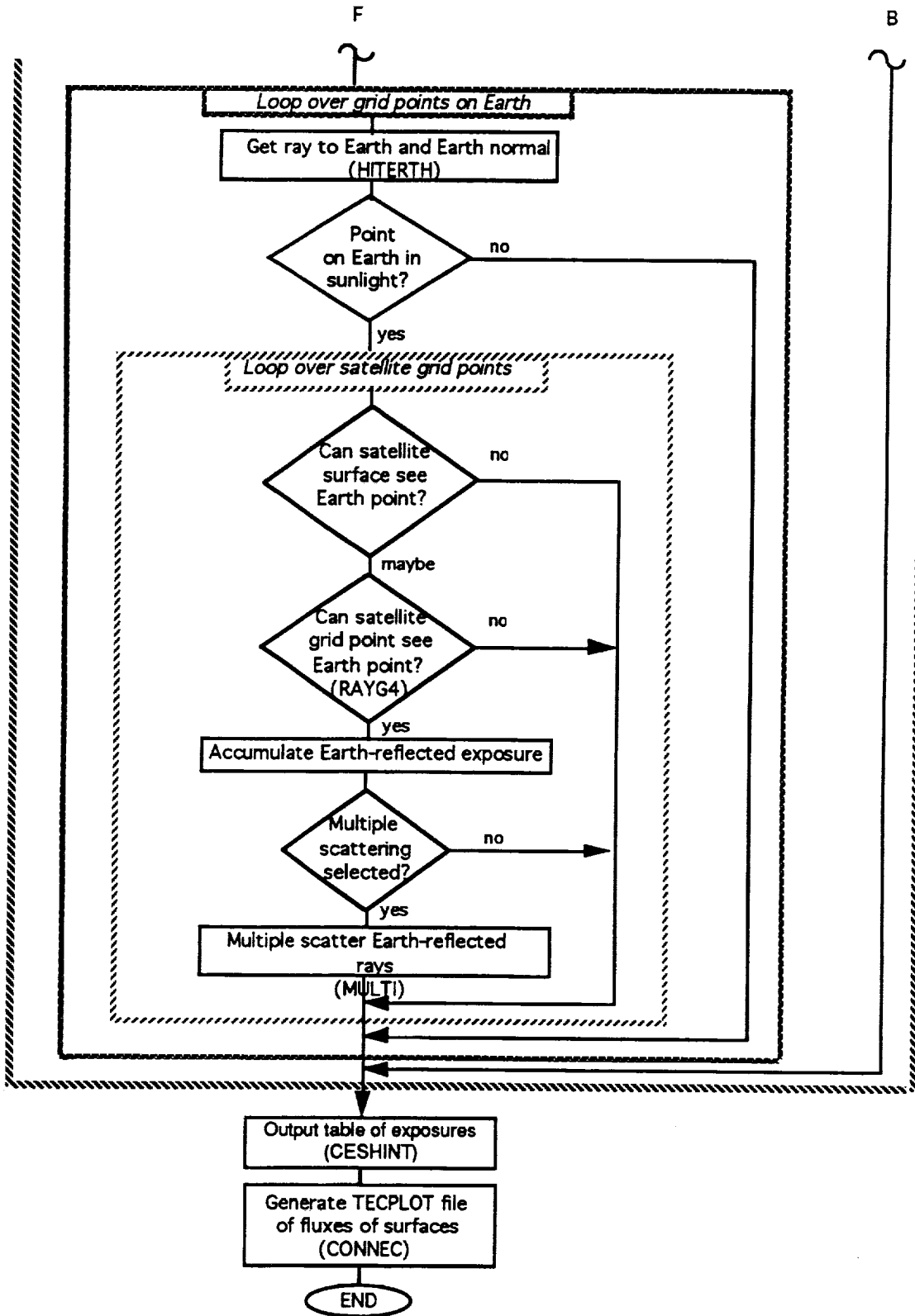


Figure 3.1.1-1. SOLSHAD Block Diagram (Sheet 4 of 4).

## SOLSHAD Subroutine Tree

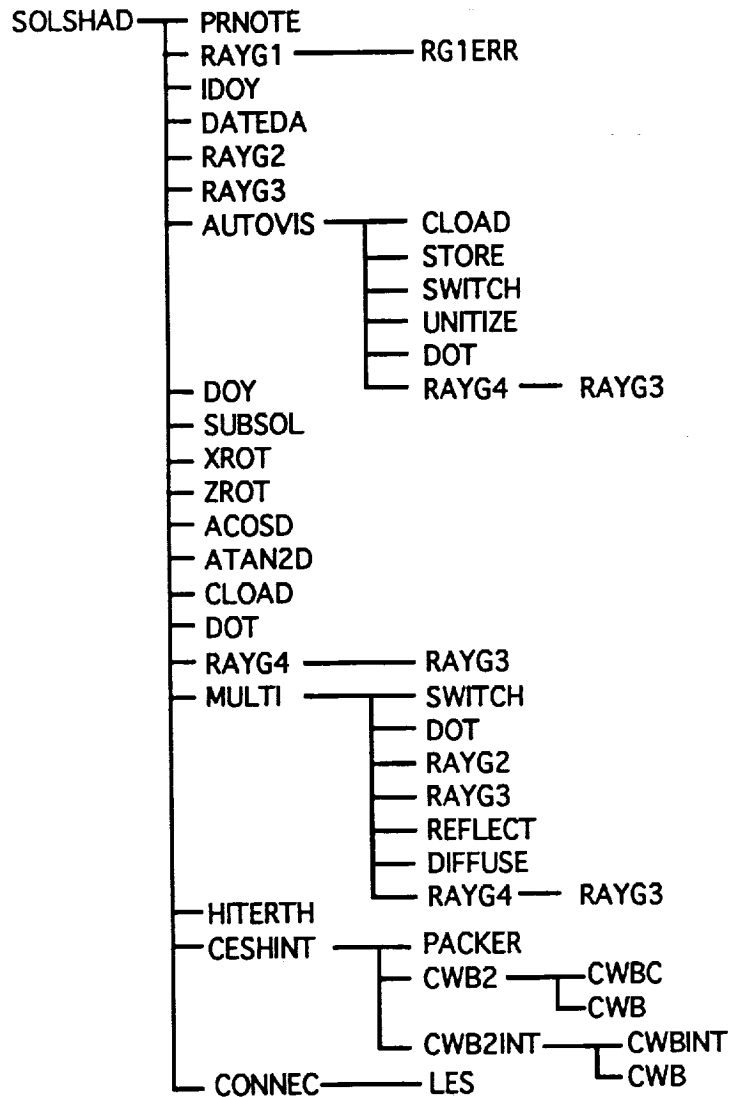


Figure 3.1.1-2. SOLSHAD Subroutine Tree.

The portion of the surface of the Earth seen by the satellite is divided into a grid of points spaced equally in zenith and azimuth angles relative to a set of spherical coordinates centered at the satellite and with polar axis directed from the satellite to the center of the Earth. The sines and cosines of the angular coordinates of these points are stored for later use during ray tracing of Earth-reflected solar radiation to the satellite surfaces.

At this point, SOLSHAD is ready to start calculating the solar exposure to the points of the surfaces of the object. An allowed random position along the satellite orbit is chosen. A random day of year and time of day are fed to subroutine SUBSOL, which returns the subsolar latitude and longitude on Earth; that is, the latitude and longitude at which the Sun is directly overhead. The Sun position coordinates are translated into the coordinates used by the object geometry and the

vector from the satellite to the Sun is saved. A check is made to see if the Earth is between the Sun and the satellite. If so, no solar exposure to the satellite occurs and new Sun and satellite positions are chosen. By choosing a large number of Sun and satellite positions, a statistically valid approximation of the solar exposure to the satellite is generated.

A Sun and satellite position having been chosen that allows solar exposure to the satellite surfaces, each node on the object is considered in order. The procedure for every node on a surface after the first node on each surface is identical. For all direct solar illumination calculations, the center of the node is used as the proxy for the entire node.

For the first node on a surface, flags are set indicating that ray tracing from the point at the center of the node to the Sun must be done to determine if the point is exposed to direct solar illumination. The previously calculated coordinates, normal vector, and tangent vectors of the surface at the point are retrieved. A check is made if the Sun is shining on the active side of the surface. If not and the surface is a trapezoid or disk, the Sun cannot shine on any point on the surface, and flags are set to indicate that the surface is not exposed to solar illumination. In this case, no ray tracing is necessary for the surface. The rest of the procedure for determining solar exposure is identical for all nodes on the object.

If the node could perhaps be exposed to solar radiation, subroutine RAYG4 is called to determine if any surface blocks exposure. If the ray to the Sun is unblocked, direct solar exposure is accumulated. If selected, subroutine MULTI performs multiple scattering of the ray. The number of rays to Monte Carlo scatter is determined as the dot product of the surface normal at the point and the ray to the Sun times the number of rays per average node area times the ratio of the node area to the average node area. This ensures that each surface is illuminated with the same areal density of CESH rays. The scattering procedure is the same for each scattered ray.

For each scattered ray, subroutine MULTI reverses the direction of the ray so that it is directed toward the center of the node rather than to the Sun. A check is made to see if the ray is parallel to the surface or very nearly so. If it is, the ray is given no further consideration; the ray tracing routine has difficulty handling such rays properly and, in any event, they contribute only a very small solar exposure. Rays not parallel to the surface are Monte Carlo scattered by the following procedure.

A ray of solar CESH striking a surface may undergo one of three fates: specular reflection, diffuse reflection, or absorption. In the event of absorption, propagation of the ray stops and the exposure due to the absorption is accumulated. The fate of a ray is determined by a Monte Carlo (random) selection in which the probability of selection is proportional to the surface property value of the fate. The surface properties sum to one, so one of the three fates is guaranteed to be selected.

If reflection is selected, a random point on the node is chosen and its coordinates, surface normal, and tangent vectors are calculated by RAYG2 and RAYG3. For nonplanar surfaces, the surface normal is a function of position on the surface and the tangent vectors may also be functions of position. Choosing random positions on a node for reflecting CESH ensures that surfaces which are exposed to reflected CESH receive the proper exposure independent of their area or orientation with respect to the ray direction.

If specular reflection is selected, the normal component of the ray is reversed to give the reflected ray. Diffuse reflection has a probability of scattering uniform in cosine of zenith angle measured from the surface normal and uniform in azimuth angle. These two angles are chosen randomly and the ray is directed along them. Subroutine RAYG4 propagates the reflected ray and determines whether it strikes the active side of a surface or not. If the ray does not strike the active side of a surface, consideration of that ray is terminated. If the ray does intersect the active side of



a surface, subroutine RAYG4 determines the location (node) on the surface and subroutine RAYG3 determines the surface normal and tangent vectors at the intersection. The specular or diffuse solar exposure at this point is assigned to the node and accumulated there. The ray itself is Monte Carlo scattered from the point of intersection on the node and propagated or terminated in the same manner as for the initial scattering. This process continues until the ray is removed from consideration or until a maximum of 100 scatters has occurred.

After primary and direct reflected solar exposure have been calculated for all nodes, Earth-reflected solar radiation to the object is calculated if the Earth albedo is nonzero and calculation of Earth-reflected radiation is selected. The portion of the Earth viewed by the satellite is divided into a grid of points. The calculation of Earth-reflected solar exposure to the satellite from each point takes approximately as long as the total direct solar exposure calculation. Because of this, the user is given the option of calculating Earth-reflected solar exposure after every NALB<sup>th</sup> direct solar calculation, where NALB may range from 1 to the total number of Sun positions. In the former case, one Earth-reflected solar exposure calculation is done per Sun position; in the latter, only one Earth-reflected solar exposure calculation is performed. If NALB is greater than the total number of Sun positions, no Earth-reflected solar exposure is calculated. The procedure for calculating Earth-reflected solar exposure from each grid point on Earth is the same.

A unit vector ray from the satellite to the grid point on Earth is formed and saved. The ray is propagated to Earth and the outward normal vector from the intersection point with the surface of the Earth is calculated. The dot product between this normal and the ray to the Sun determines whether the point on Earth is illuminated by the Sun. If it is not illuminated, no Earth-reflected solar exposure calculation need be done. Otherwise the solar radiation from the Earth grid point is deterministically diffusely reflected toward the satellite. This diffusely reflected solar radiation is the incident solar exposure multiplied by the albedo times the projected area of the Earth grid element times the solid angle of the Earth grid element as seen by the satellite. Exposure to satellite surfaces using this Earth-reflected solar radiation is calculated in exactly the same manner as direct solar exposure to satellite surfaces. Direct Earth-reflected solar exposure, specular and diffuse Earth-reflected (from one satellite surface onto another) solar exposure, and absorption of Earth-reflected radiation are accumulated.

When all solar exposure calculations have been completed, subroutine CESHINT interpolates the CESH (which to this point have assumed to be calculated at the center of the nodes) to the corners of the nodes using Stineman's consistently well-behaved method of interpolation (ref. 4). This gives full coverage of the surfaces to ensure proper looking plots of the CESH in TECPLOT.

SOLSHAD generates a table of direct primary, specular-reflected, diffuse-reflected, absorbed, and the total of primary and specular- and diffuse-reflected solar exposure at each point on the structure, as well as the same for Earth-reflected solar exposure. This table is written to standard output. Execution of SOLSHAD concludes by calling subroutine CONNEC to generate a text file suitable for plotting by TECPLOT after processing by the TECPLOT PREPLOT module. This file contains the various solar exposures in CESH at each point and a connectivity matrix which tells TECPLOT how to connect the points making up the structure.

### 3.1.2 Program Flow for MDDB Version 2.0

Figure 3.1.2-1 shows the MDDB block diagram. The names of major subroutines in the block diagram are given in parenthesis. Figure 3.1.2-2 is a subroutine tree for MDDB and shows all subroutines and functions and their calling hierarchy. The majority of MDDB execution involves user responses to prompts printed to screen by MDDB. Major computational routines to specify surfaces point by point from the geometry definition such as CONNECM, RAYG1M,

RAYG2M, and RAYG3M are stripped down versions of the subroutines of similar name in SOLSHAD. Consequently, detailed description of the algorithms used in MDDDB is unnecessary.

## MDDDB Block Diagram

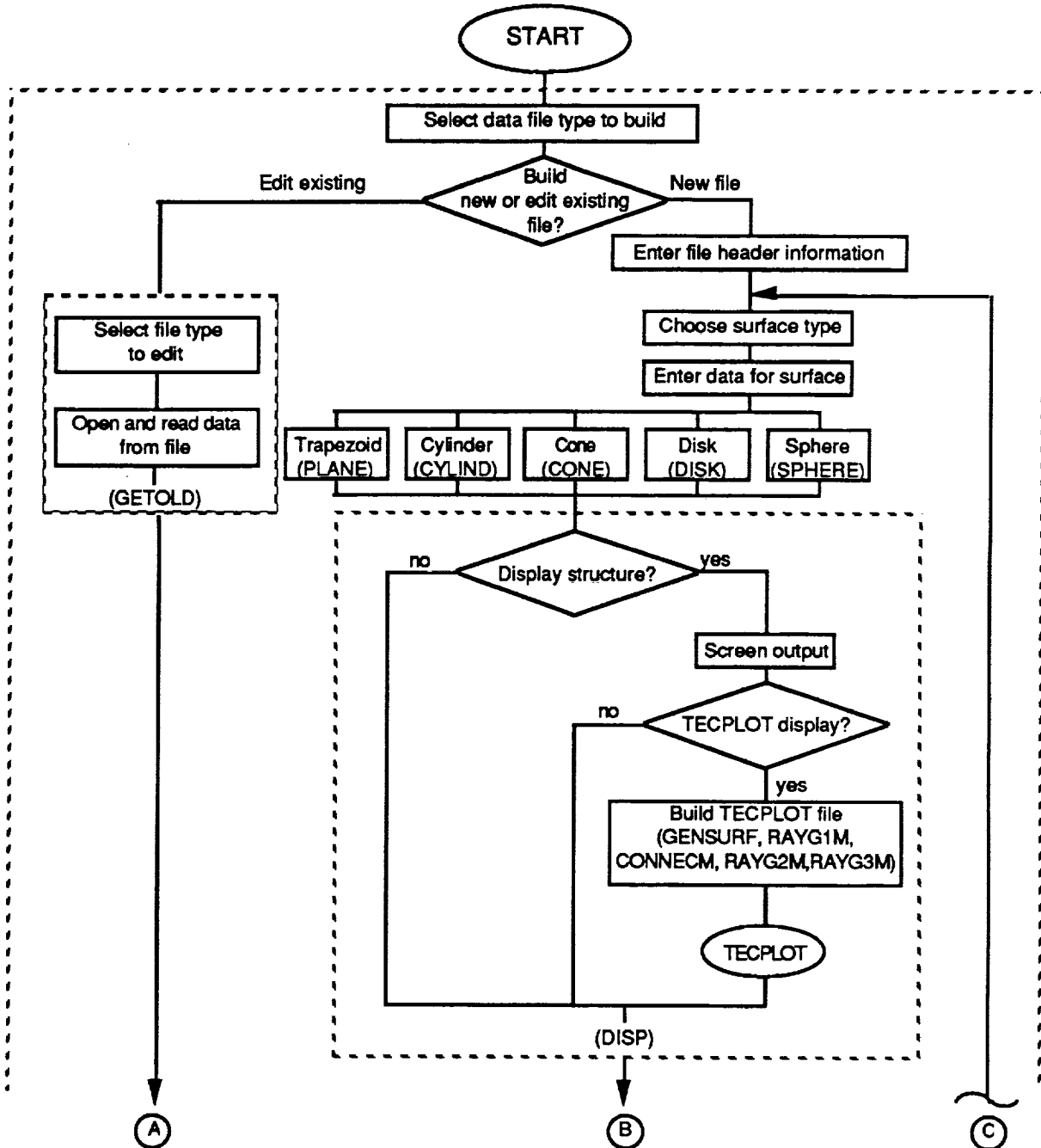


Figure 3.1.2-1. MDDDB Block Diagram (Sheet 1 of 3).

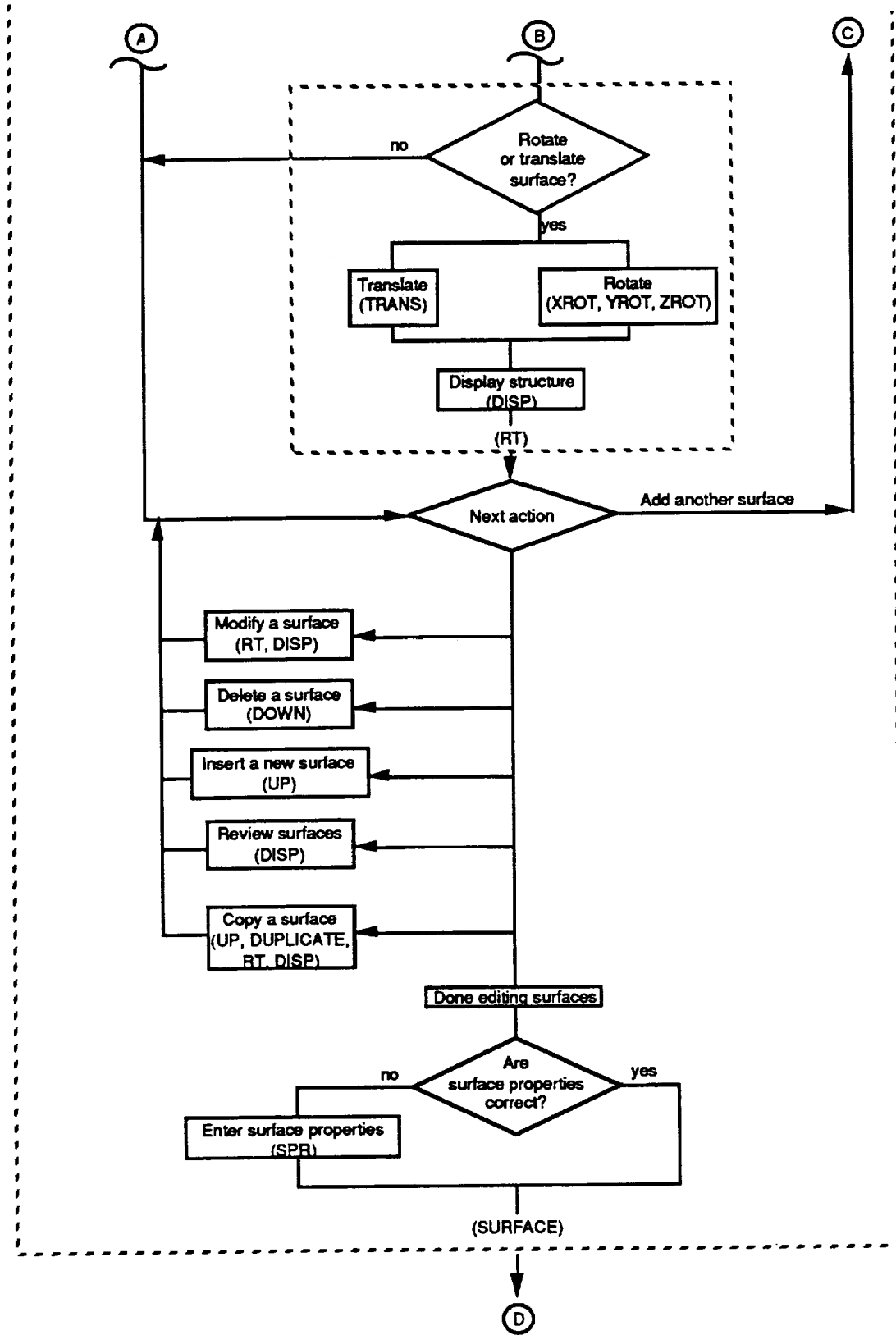


Figure 3.1.2-1. MDDB Block Diagram (Sheet 2 of 3).

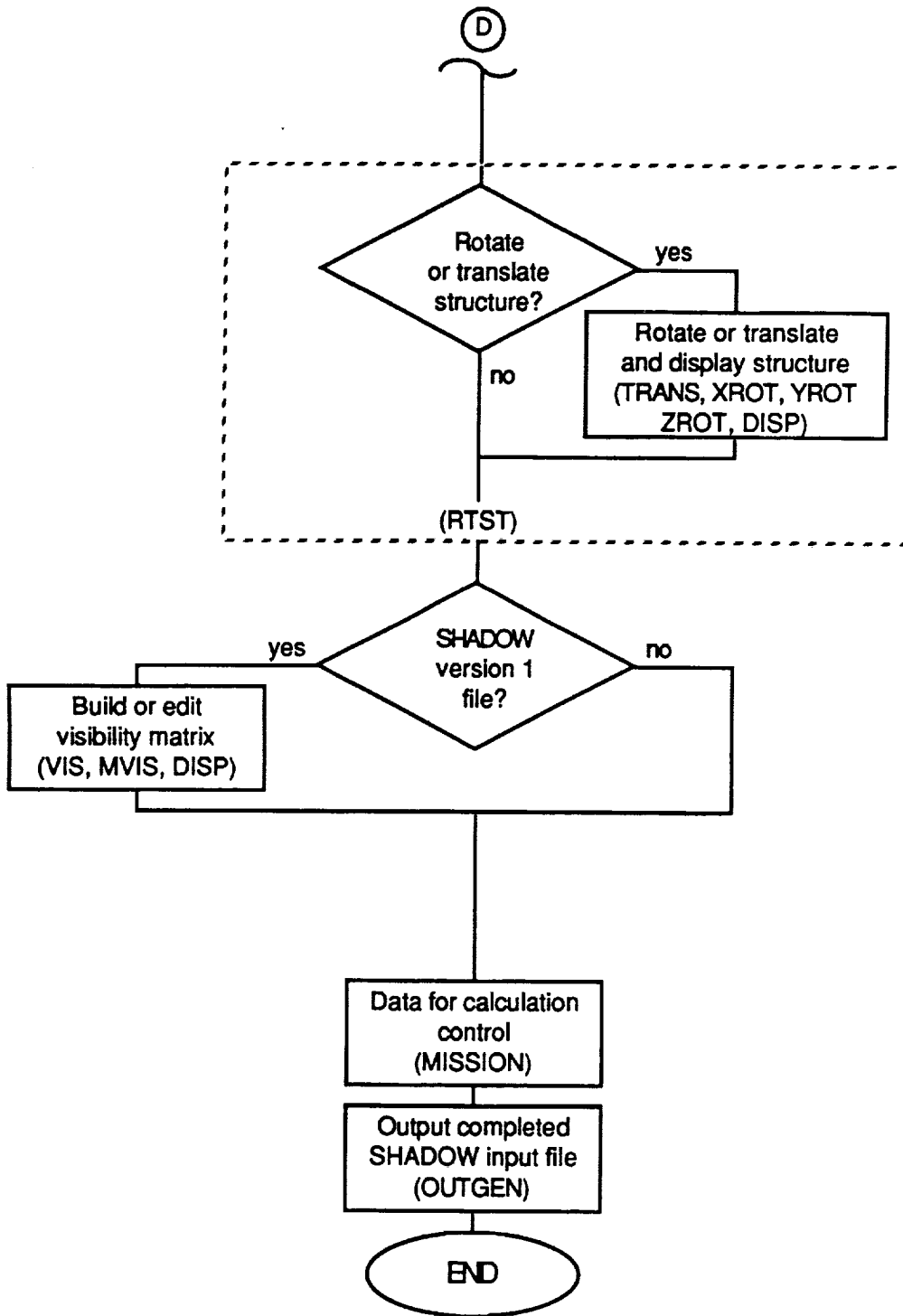


Figure 3.1.2-1. MDDDB Block Diagram (Sheet 3 of 3).

### MDDDB Version 2.0 Subroutine Tree

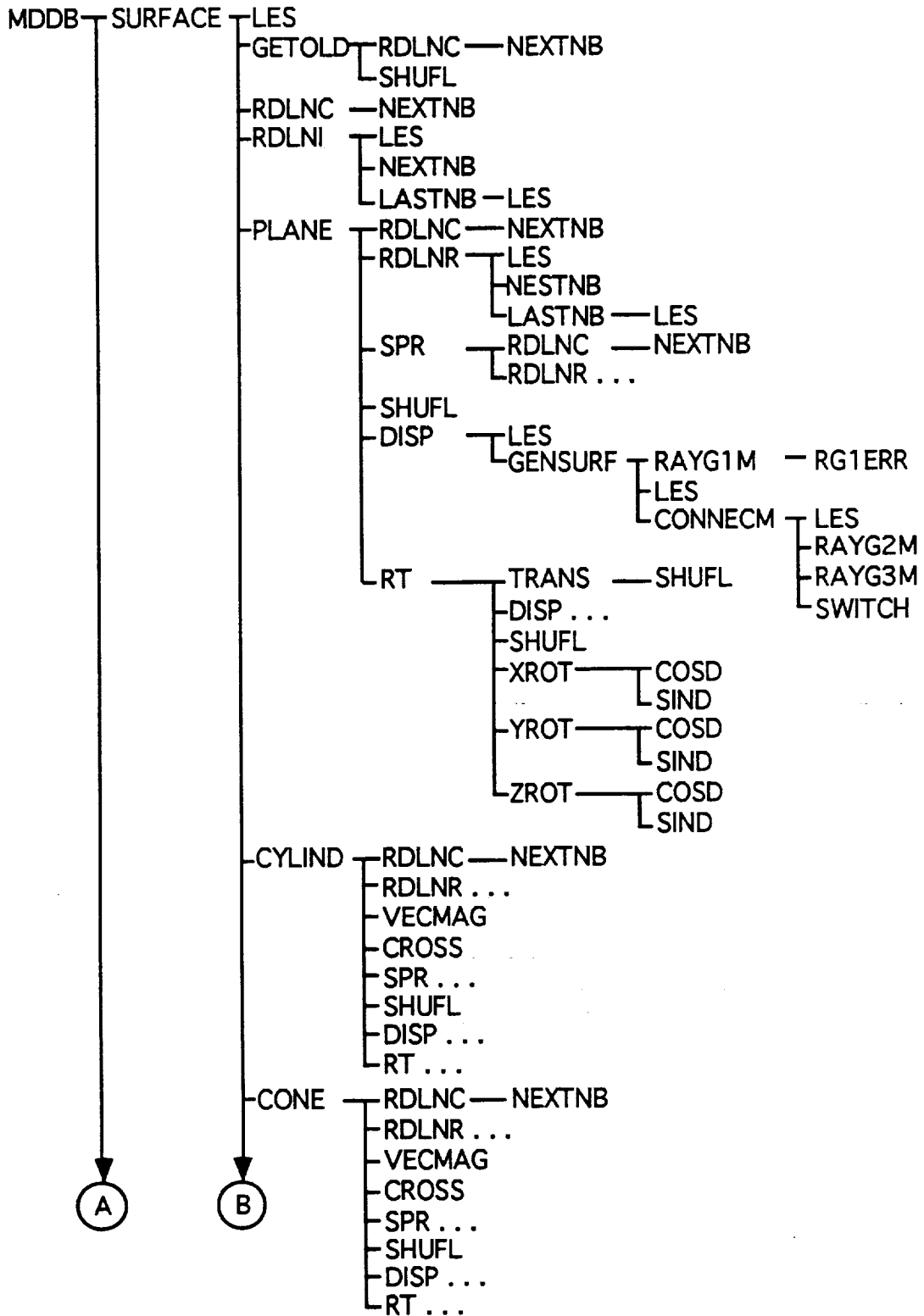


Figure 3.1.2-2. MDDDB Subroutine Tree (Sheet 1 of 2).

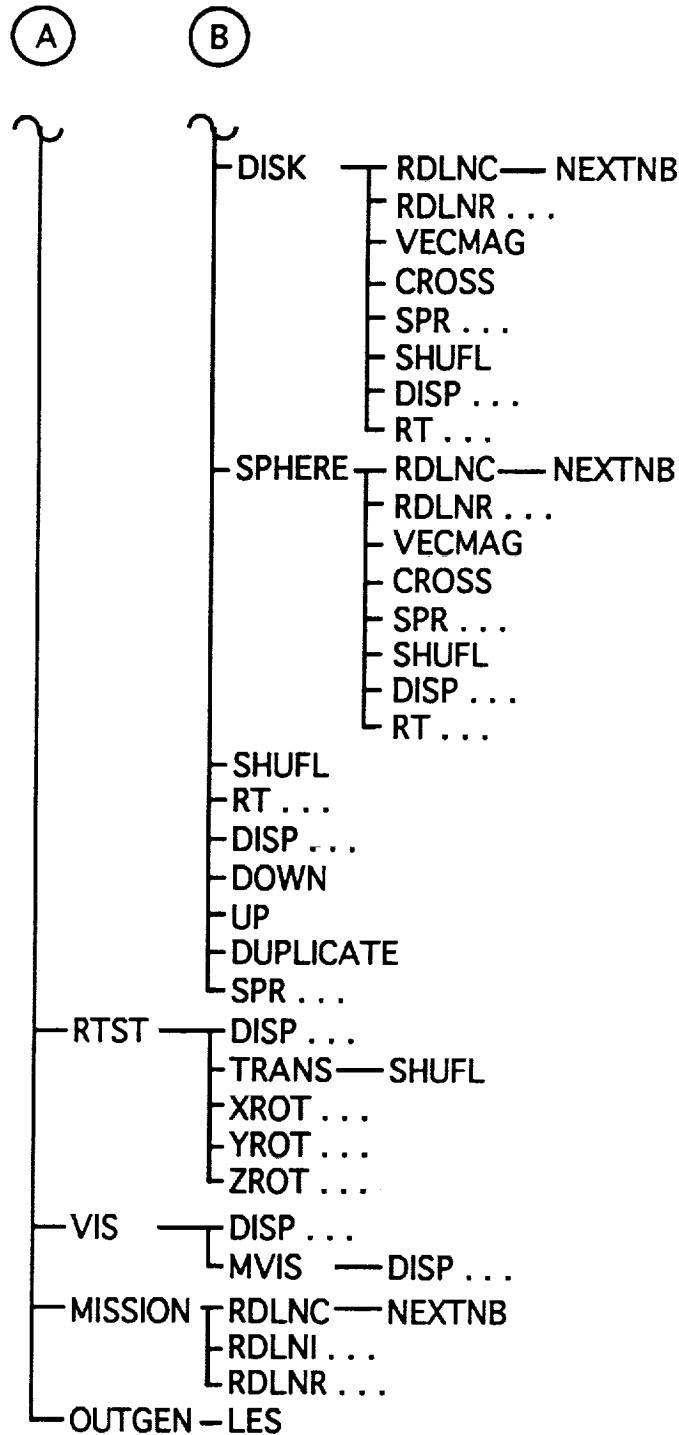


Figure 3.1.2-2. MDDDB Subroutine Tree (Sheet 2 of 2).

MDDDB starts execution by asking the user whether he or she wishes to create an input file for SHADOW Version 1.X or Version 2.X or SOLSHAD and whether to create a new input file or to edit an existing one. If the user chooses to edit an existing input file, MDDDB asks the user to

specify the program to which the file to be edited applies and asks for the filename. The data from the file are read in. At this point the user has access to edit all of the surfaces in the object. In addition, the user may perform any of the file building and editing operations available when a new input file is being created. These operations are described below.

If a new input file is chosen, the user is prompted to enter the geometry and surface property definition for the first surface. When the data have been entered, the user is given the opportunity to display the surface using TECPLOT. When display mode is selected, the geometry specifications are written to a scratch file on unit 11. This file is read by subroutine RAYG1M which does preliminary setup and interpretation on the geometry inputs. Subroutine CONNECM calls subroutine RAYG2M to locate the Cartesian coordinates of each point on the surface of the structure. These points are written to a binary file directly readable by TECPLOT and to an ASCII file which may be used by PREPLOT. Outward normal arrows from the active side of surfaces are also generated and written to these files. Last, the finite element connectivity matrix specifying how points on surfaces are to be connected are generated and written to the files. The TECPLOT display shows all surfaces comprising the structure with direction arrows pointed outward from the active side of each surface.

The user may choose to rotate or translate the surface and look at it again with TECPLOT. If the user does not like the operation just performed, he or she may undo it. Surface rotations take place about rotation axes parallel to the Cartesian x, y, and z axes. The user specifies the position of these axes. This gives greater freedom to move a surface than a rotation about one of the coordinate axes.

When the first surface specification is complete or if the user is editing an existing input file, a menu of actions is presented. Actions include adding a new surface after the last entered surface or inserting a new one between existing surfaces, deleting a surface, reviewing surface (listing them with an optional TECPLOT display of the structure), modifying an existing surface, or copying an existing surface. The user repeats these actions until he or she is satisfied with the geometry and surface properties of the structure.

After the user has finished building the geometry for the structure, MDDDB checks to see if surface properties are correct for the type of input file being built. For example, if the user is building a SOLSHAD input file by editing an existing SHADOW input file, the surface properties must be changed even though the object geometry has not been changed.

After the user has finished building the geometry for the structure, the entire structure may be rotated or translated in the same manner as described for individual surfaces.

For SHADOW Version 1.X input files only, MDDDB prompts the user to enter or edit the visibility file, which specifies which surfaces can see themselves or other surfaces. The user has similar options to those available during geometry building: he or she may display the structure, review the visibility matrix, modify it, or build it from scratch.

Last, the user enters new parameters or modifies existing parameters which control the atomic oxygen flux calculations for SHADOW or the CESH calculations for SOLSHAD. MDDDB finishes execution by writing the completed input file to disk.

### **3.1.3 TECPLOT Macros**

There are three macros to generate plots in TECPLOT. This section briefly describes what these macros do.

File: **p.mcr**

1. Load the file MDDDB.PLT.
2. Turn off graphics.
3. Create a mesh plot in 3D. Assign the Z axis to the last variable.
4. Assign the x, y, and z axes to the last three variables.
5. Choose to make a hidden line plot.
6. Export the mesh so that it will show up in the contour plot.
7. Create a contour plot using the surface number (second variable) as the contour variable.
8. Set zones as filled.
9. Rotate it 30 deg in the x, y, and z directions to give it better perspective.
10. Make sure the rotated plot fits in the screen.
11. Activate the graphics and generate the plot.

**Note:** If **p2.mcr** is used, then the first step is to run PREPLOT with the file MDDDB.PRE to generate MDDDB.PLT. Otherwise, it's the same as **p.mcr**.

File: **table.mcr**

1. Choose new contour levels: maximum, minimum, and delta.
2. Set minimum level to 1.
3. Put the message "Enter total number of surfaces" at the bottom of the screen.
4. Get user input for maximum level.
5. Set delta level to 1.
6. Place the table.
7. Get user input on where to place table, while displaying the message "Place the table."
8. Regenerate plot.

File: **shadow.mcr**

1. Turn off graphics.
2. Create a mesh plot in 3D. Assign the Z axis to the last variable.
3. Assign the X, Y, and Z axis to the last three variables.
4. Choose to make a hidden line plot.
5. Export the mesh so that it will show up in the contour plot.
6. Create a contour plot using the total solar exposure CESH (fourth variable from the end) as the contour variable.
8. Set zones as filled.
9. Activate the graphics and generate the plot.

## **3.2 ALGORITHMS IN THE MICROENVIRONMENT SOLAR EXPOSURE PROGRAM**

### **3.2.1 SOLSHAD Algorithms**

This section describes the algorithms used in SOLSHAD. Each algorithm is described independently of the others. Refer to section 3.1.1 for information on where the algorithms are used in SOLSHAD.

**Sun Position Determination.** A Sun position is chosen by randomly choosing a day of year and time of day as GMT hour and fraction. These data are input to subroutine SUBSOL, which was adapted from the LOWTRAN7 code (ref. 5). SUBSOL produces an approximate (within 1 degree) subsolar latitude and longitude. The equation of time (minutes) and declination angle (degrees) for the day of year (small year-to-year variations of these quantities are ignored) are solved by interpolation from 25-point lookup tables. The declination angle is the same as the subsolar latitude SOLAT. The subsolar east longitude (degrees) is given by



$$\text{SOLONG} = 180 - 15 (t + E_t)$$

(3.2.1.1)

where  $t$  is the GMT hour and fraction and  $E_t$  is the equation of time solution for the day of year. If needed, 360 degrees is added to the longitude to keep it in the range 0 to 360 degrees east.

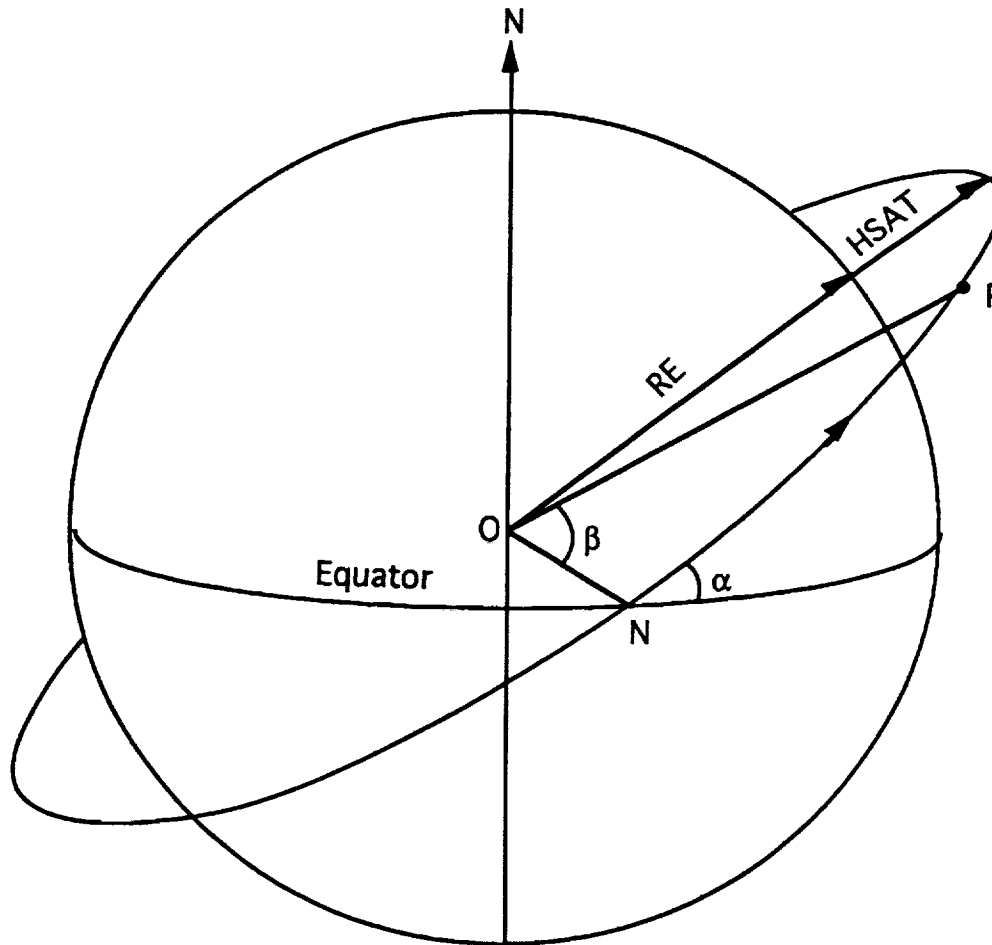
**Orbit Position Determination.** All calculations in SOLSHAD assume a circular satellite orbit around a spherical Earth. Such an orbit can be specified by its altitude HSAT, inclination  $\alpha$ , and east longitude of ascending node (fig. 3.2.1-1); that is, the longitude at which the orbit crosses the equator in a northerly direction. The position of the satellite on the orbit can be specified by the angle  $\beta$  between a line from the center of the Earth to the ascending nodal crossing and a line from the center of the Earth to the satellite position. In SOLSHAD the satellite position on orbit is restricted to be between two limiting angles, ORBPOS(1) and ORBPOS(2). The range of these angles is arbitrary. A whole orbit is specified by setting them to 0 and 360 degrees. Part of an orbit may be specified by restricting their range. The instantaneous position angle  $\beta$  is selected by uniform random choice of angle between ORBPOS(1) and ORBPOS(2).

The satellite orbit plane precesses with the precession rate dependent on orbit geometry. This precession may be accounted for by specifying the longitude of ascending node at the event start PRECES(1) and the range of precession during the event PRECES(2). The precessed position of the orbit plane during an event may be generated in either of two ways. The precessed position of the orbit plane is chosen randomly from the range PRECES(1) to PRECES(1) + PRECES(2) using a uniform distribution. This choice ensures a statistically uniform coverage of all possible precessed positions of the orbit. This is the preferred method for lengthy missions during which the precessed orbit position is not well known.

Alternatively, the orbit plane may be chosen to precess at a constant rate from its initial position at event start to its final position at the event end. To do this, the orbit precession is forced to be proportional to mission time. This choice is appropriate for brief missions during which the precession of the orbit plane with time is well known.

At this point, the orbit plane precession is in terms of Earth east longitude at event start; however, in the time  $t$  days since event start the Earth has rotated to the east 360 degrees/day times  $t$  days. This Earth rotation during time  $t$  is subtracted from the longitude at event start to give RANPRE, the Earth longitude at time  $t$ .

**Transformation of Sun Position to Satellite Coordinates.** The satellite coordinate system is attached to the satellite and is defined for satellites which maintain a constant orientation with respect to an axis radially outward from the center of the Earth through the satellite (fig. 3.2.1-2). In this coordinate system the origin is at the satellite position. The X axis is defined to be radially outward from the center of the Earth through the satellite. The Z axis is defined to be perpendicular to the X axis and in the satellite heading direction on orbit. The Y axis is defined so that (X,Y,Z) form an orthogonal right hand coordinate system. In this coordinate system the center of the Earth is at (-RE-HSAT, 0, 0).



- $\alpha$  = Orbit inclination
- $\beta$  = Orbit position angle
- HSAT = Satellite altitude above Earth
- N = Longitude of ascending node
- O = Center of Earth
- P = Satellite position
- RE = Radius of Earth

Figure 3.2.1-1. Satellite Orbit Geometry.

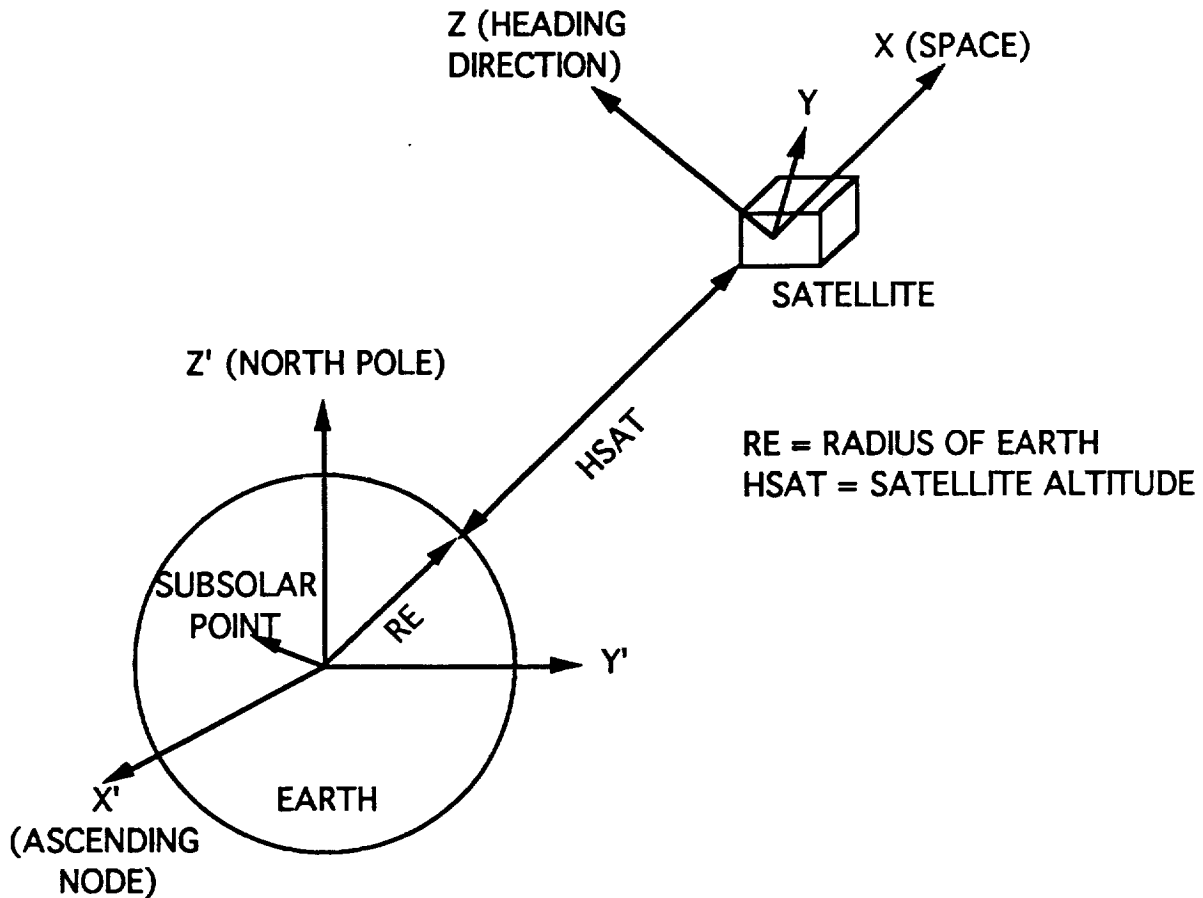


Figure 3.2.1-2. Coordinate System Definition.

The Sun position vector, which is defined as a unit vector from the center of the Earth through the subsolar latitude and longitude (that is, to the Sun), must be translated to be defined in terms of the satellite coordinate system.

First, consider a coordinate system with its origin at the center of the Earth, the Z' axis through the North Pole, the X' axis through the satellite orbit ascending node longitude, and the Y' axis such that (X', Y', Z') form an orthogonal right hand coordinate system. In this coordinate set the subsolar latitude is unchanged, but the subsolar longitude is modified by subtracting off the ascending node longitude RANPRE, so

$$\text{SOLAT}' = \text{SOLAT} \quad (3.2.1.2)$$

$$\text{SOLONG}' = \text{SOLONG} - \text{RANPRE} \quad (3.2.1.3)$$

where, if needed, 360 degrees is added to SOLONG' to put it in the range 0 to 360 degrees. Then, the unit vector to the Sun in the ' coordinate system is (**bold print indicates unit vectors**; all vectors described in this section are unit vectors)

$$\mathbf{S}' = \cos(\text{SOLAT}') \cos(\text{SOLONG}') \mathbf{i}' + \cos(\text{SOLAT}') \sin(\text{SOLONG}') \mathbf{j}' + \sin(\text{SOLAT}') \mathbf{k}' \quad (3.2.1.4)$$

or

$$\mathbf{S}' = S'_x \mathbf{i}' + S'_y \mathbf{j}' + S'_z \mathbf{k}' \quad (3.2.1.5)$$

where  $\mathbf{i}'$ ,  $\mathbf{j}'$ , and  $\mathbf{k}'$  are unit vectors in the X', Y', and Z' directions, respectively.

Next,  $\mathbf{S}'$  must be rotated about the X' axis by the negative of the orbit inclination, -ORBINC, so that the rotated Y' axis is in the orbit plane and the rotated Z' axis is perpendicular to the orbit plane. Call this rotated axis set (X'', Y'', Z''). Then,

$$\mathbf{S}'' = \begin{pmatrix} S''_x \\ S''_y \\ S''_z \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos(-\text{ORBINC}) & -\sin(-\text{ORBINC}) \\ 0 & \sin(-\text{ORBINC}) & \cos(-\text{ORBINC}) \end{pmatrix} \begin{pmatrix} S'_x \\ S'_y \\ S'_z \end{pmatrix} \quad (3.2.1.6)$$

Here the sign applied to ORBINC has been chosen to be consistent with the form of the rotation matrix in subroutine XROT.

Now,  $\mathbf{S}''$  must be rotated by the negative of the orbit position angle  $\beta$ , -RANORB, about the Z'' axis to align the new X''' axis with the satellite X axis using

$$\mathbf{S}''' = \begin{pmatrix} S'''_x \\ S'''_y \\ S'''_z \end{pmatrix} = \begin{pmatrix} \cos(-\text{RANORB}) & -\sin(-\text{RANORB}) & 0 \\ \sin(-\text{RANORB}) & \cos(-\text{RANORB}) & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} S''_x \\ S''_y \\ S''_z \end{pmatrix} \quad (3.2.1.7)$$

where the sign applied to RANORB has been chosen to be consistent with the form of the rotation matrix in subroutine ZROT.

Last we rename the axes to the corresponding names of the satellite axes:

$$\begin{aligned} X''' &\rightarrow X \\ Y''' &\rightarrow Z \\ Z''' &\rightarrow Y \end{aligned} \quad (3.2.1.8)$$

so that the unit vector to the Sun becomes in satellite coordinates

$$\mathbf{S} = S''_x \mathbf{i} + S''_z \mathbf{j} + S''_y \mathbf{k} \quad (3.2.1.9)$$

where  $\mathbf{i}$ ,  $\mathbf{j}$ , and  $\mathbf{k}$  are unit vectors in the X, Y, and Z directions. Because the distance to the Sun from the Earth is large compared to the distance from the center of the Earth to the satellite, parallax effects in the coordinate transformations have been ignored.

Having determined the direction to the Sun in satellite coordinates, it must be determined whether the Sun is behind the Earth when viewed from the satellite. It is obvious that the Sun is behind the Earth if the distance of closest approach of a ray to the Sun to the center of the Earth is less than the radius of the Earth. The task is to determine this distance of closest approach. Consider the unit vector  $\mathbf{S}$  to the Sun (fig. 3.2.1-3). Take the dot product of  $\mathbf{S}$  and  $\mathbf{OC}$ , the vector from the satellite to the center of the Earth. If this dot product is negative, the Sun is on the opposite side of the satellite from the Earth and is unblocked by the Earth.

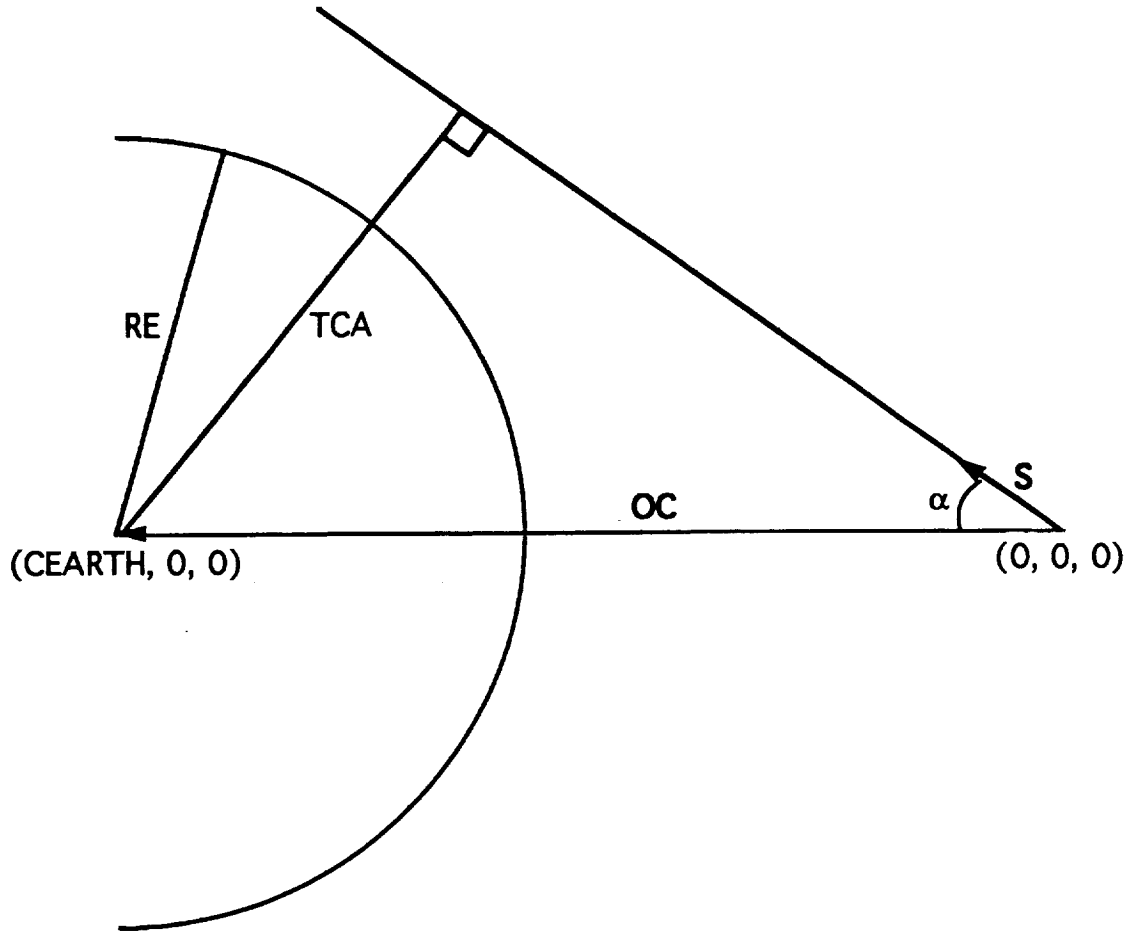


Figure 3.2.1-3. Sun Ray Intersection With Earth.

If the dot product is positive,  $S$  may intersect the Earth. Noting explicitly that the satellite coordinate system is chosen so that the origin is at the satellite and the center of the Earth is at  $(\text{CEARTH}, 0, 0)$ , where  $\text{CEARTH}$  is the negative of the sum of the radius of the Earth  $RE$  and the satellite altitude, the distance of closest approach is

$$\text{TCA} = \text{CEARTH} \sin \alpha \quad (3.2.1.10)$$

Noting that

$$\text{OC} \cdot \mathbf{S} = \text{CEARTH} \cos \alpha = \text{CEARTH} \cdot S_x = \text{RAYCTR} \quad (3.2.1.11)$$

$$\sin^2 \alpha = 1 - \cos^2 \alpha \quad (3.2.1.12)$$

and squaring equation (3.2.1.10) and substituting leads to

$$\text{TCA} = \text{CEARTH}^2 - \text{RAYCTR}^2 \quad (3.2.1.13)$$

If  $\text{TCA}$  is greater than  $RE$ , the ray to the Sun is unblocked.

**Ray Intersection With the Earth and Earth-Reflected Solar Radiation.** For the calculation of Earth-reflected radiation the portion of the Earth visible from the satellite is divided into a grid of spherical rectangles of equal azimuth angle and zenith angle extent relative to the satellite coordinate system with the X axis as the polar axis. The azimuth grid angles range from 0 to 360 degrees and the zenith grid angles range from 180 degrees directly under the satellite to 180 - THETAMX degrees at Earth tangent as seen by the satellite. Here,

$$\text{THETAMX} = \text{asin}(\text{RE}/\text{CEARTH}) \quad (3.2.1.14)$$

A ray is generated from the satellite to the angular center of each of the spherical rectangles in the grid. If  $\theta$  and  $\phi$  are the zenith and azimuth angles, respectively, of the angular center of a spherical rectangle in the grid, the Cartesian satellite coordinates of a unit vector in the  $(\theta, \phi)$  direction is

$$\mathbf{RD} = \cos \theta \mathbf{i} + \cos \phi \sin \theta \mathbf{j} + \sin \phi \sin \theta \mathbf{k} = \text{RD}_x \mathbf{i} + \text{RD}_y \mathbf{j} + \text{RD}_z \mathbf{k} \quad (3.2.1.15)$$

where, as before,  $\mathbf{i}$ ,  $\mathbf{j}$ , and  $\mathbf{k}$  are unit vectors in the X, Y, and Z directions, respectively.

The ray tracing algorithm given by Glassner (ref.6) has been adapted for determining the intersection point of  $\mathbf{RD}$  with the Earth and the Earth outward normal. Consider the geometry of figure 3.2.1-4. In this geometry  $\text{OC} = \text{CEARTH}$  is a ray from the satellite to the center of the Earth. The distance of closest approach to the Earth's center along  $\mathbf{RD}$  is

$$\text{TCA} = \text{OC} \cdot \mathbf{RD} = \text{CEARTH} \text{RD}_x \quad (3.2.1.16)$$

Because  $\mathbf{RD}$  is guaranteed to intersect the Earth, TCA is always positive. The half chord distance squared is given by

$$\text{THC}^2 = \text{RE}^2 - \text{CEARTH}^2 + \text{TCA}^2 \quad (3.2.1.17)$$

and, therefore, the distance along  $\mathbf{RD}$  to Earth intersection is

$$\text{T} = \text{TCA} - \text{THC} \quad (3.2.1.18)$$

Remembering that the satellite is at the origin and that  $\mathbf{RD}$  is a unit vector, the intersection point coordinates are

$$\mathbf{PT} = \mathbf{RD} \text{T} = (\text{RD}_x \text{T}, \text{RD}_y \text{T}, \text{RD}_z \text{T}) \quad (3.2.1.19)$$

The outward unit normal vector of the Earth at  $\mathbf{PT}$  is [the center of the Earth is at  $(\text{CEARTH}, 0, 0)$ ]

$$\mathbf{NRM} = (\text{RD}_x \text{T} - \text{CEARTH})/\text{RE} \mathbf{i}, \text{RD}_y \text{T}/\text{RE} \mathbf{j}, \text{RD}_z \text{T}/\text{RE} \mathbf{k} \quad (3.2.1.20)$$

If the dot product of  $\mathbf{NRM}$  and the vector to the Sun  $\mathbf{S}$  (equation 3.2.1.9) is positive; that is,

$$\text{SUNNRM} = \mathbf{S} \cdot \mathbf{NRM} > 0 \quad (3.2.1.21)$$

$\mathbf{PT}$  is illuminated by the Sun. The fraction of solar fluence diffusely reflected toward the satellite from the spherical rectangle about  $\mathbf{PT}$  is

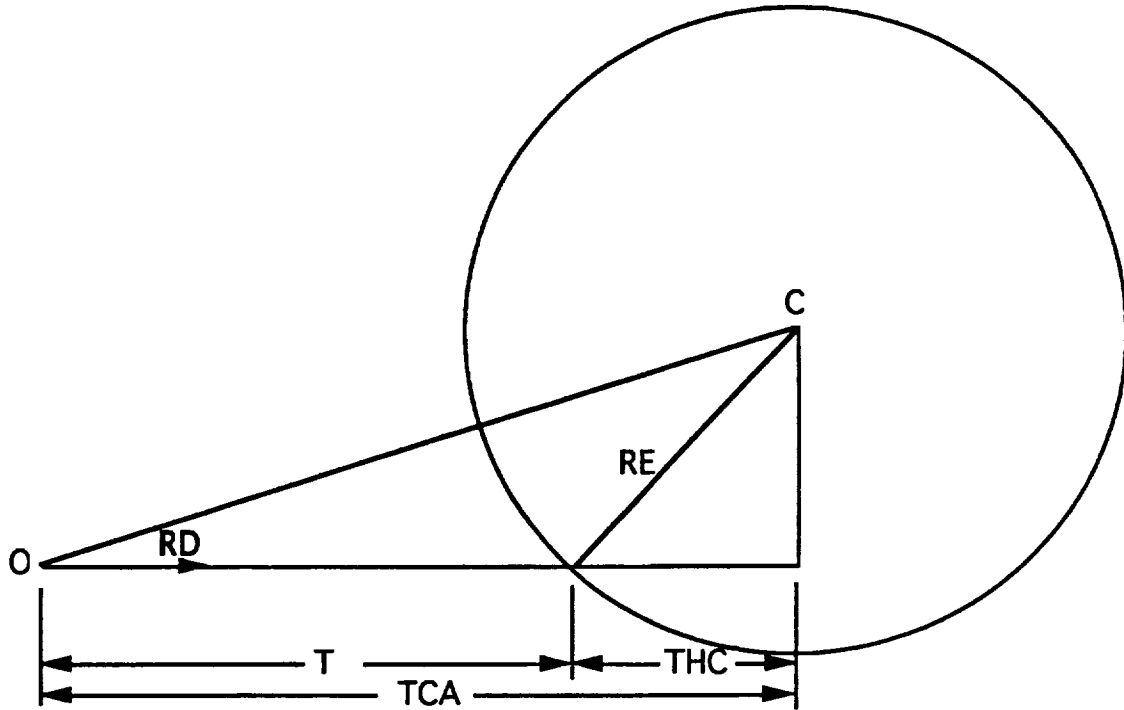


Figure 3.2.1-4. Ray Tracing Geometry for Earth Intersection.

$$F = (\text{SUNNRM}) (\text{ALBEDO}) (d\Omega/\pi) \quad (3.2.1.22)$$

where SUNNRM is the cosine of the angle between the solar ray and the Earth surface normal at the center of the spherical rectangle given by equation (3.2.1.21); ALBEDO is the average Earth albedo under the satellite orbital envelope; and  $d\Omega$  is the solid angle of the spherical rectangle as seen by the satellite.

$$d\Omega = \sin \theta \Delta\theta \Delta\phi \quad (3.2.1.23)$$

where  $\Delta\theta$  and  $\Delta\phi$  are, respectively, the zenith angle and azimuth angle extents of the spherical rectangle.

**Monte Carlo Scattering.** When a ray of solar fluence strikes a surface, it may undergo one of three fates: specular reflection, diffuse reflection, or absorption. The probability of these fates depends on the surface properties of the surface being struck. The surface property of a fate is defined as the probability of that fate occurring.

A Monte Carlo selection of the fate of the ray is made by choosing a random number between 0 and 1. The three surface property probabilities are arranged in the cumulative order shown in figure 3.2.1-5 and the fate is assigned to the bin which contains the random number. For example, if the specular reflection is 0.40, diffuse reflection 0.25, absorption 0.35, and the random number is 0.53, the ray will be diffusely reflected from the surface.

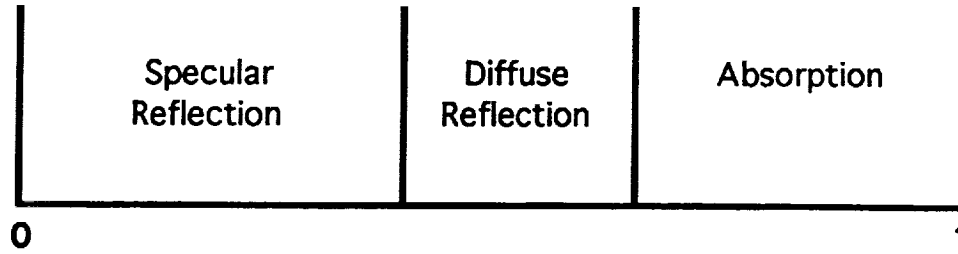


Figure 3.2.1-5. Cumulative Order of Surface Properties.

If absorption is selected, the CESH due to the ray is accumulated under the proper heading and no further consideration is given the ray.

If specular reflection is selected, the ray is reflected from the surface as shown in figure 3.2.1-6; that is, the component of the ray normal to the surface is reversed. In the figure  $\mathbf{R}$  is the ray to be reflected,  $\mathbf{N}$  is the surface normal, and  $\mathbf{S}$  is the specularly reflected ray.  $\mathbf{R}$ ,  $\mathbf{N}$ , and  $\mathbf{S}$  are all unit vectors. The normal component of  $\mathbf{R}$  is  $\mathbf{R} \cdot \mathbf{N}$ , so

$$\mathbf{S} = \mathbf{R} - 2(\mathbf{R} \cdot \mathbf{N}) \mathbf{N} \quad (3.2.1.24)$$

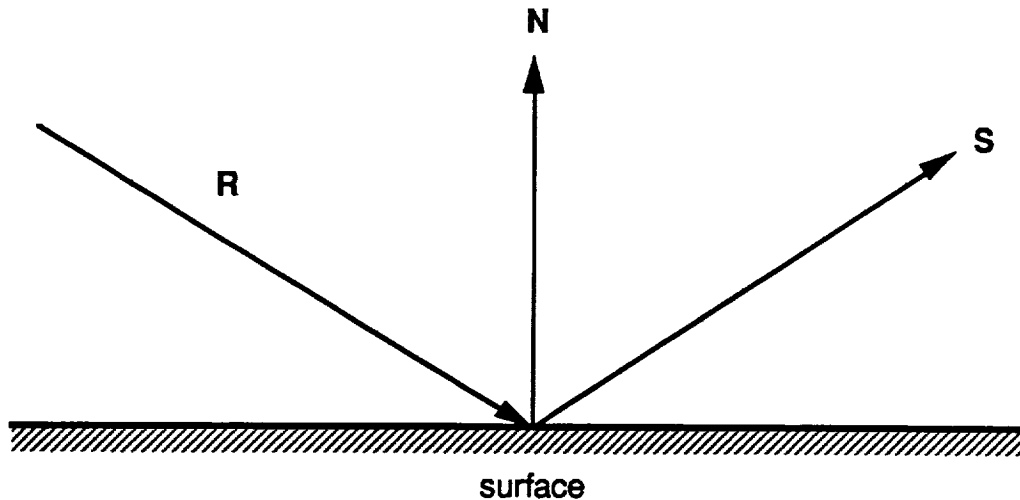


Figure 3.2.1-6. Specular Reflection.

Diffuse reflection is defined as having equal probability for any direction above the surface independent of the direction of the incident ray to be reflected. The reflection direction is randomly selected as follows (fig. 3.2.1-7). In the following all vectors are unit vectors. The surface normal vector at the point of ray intersection with the surface is  $\mathbf{N}$  and  $\mathbf{T}_x$  and  $\mathbf{T}_y$  are tangent vectors. The normal component of the diffusely reflected direction vector  $\mathbf{D}$  is chosen to be a random number  $r_n$  between 0 and 1 (the normal component of the reflected ray is always parallel to the surface normal vector). The components in the  $\mathbf{T}_x$  and  $\mathbf{T}_y$  directions are chosen as random  $r_x$  and  $r_y$  between -1 and +1. Last,  $r_n$ ,  $r_x$ , and  $r_y$  are normalized so that  $r_n^2 + r_x^2 + r_y^2 = 1$ . Then,

$$\mathbf{D} = r_x \mathbf{T}_x + r_y \mathbf{T}_y + r_n \mathbf{N} \quad (3.2.1.25)$$



The reflected ray, either **S** or **D**, is ray traced to determine if it hits another surface or not. If no surface is struck, the ray is not considered further. If a surface is struck, the ray is checked to see if the active side has been struck; if not, the ray is removed from further consideration. If the active side has been struck, the point at which the ray strikes the surface is assigned to the proper grid point on the surface and the CESH from the ray is added specular or diffuse, as appropriate, to the fluence at that point.

The fate of the ray at this point is Monte Carlo selected and the ray is propagated as described above. This process continues until the ray is terminated by absorption, striking the inactive side of a surface, or propagation to space, or 100 reflections have taken place. This last condition prevents the possibility of an endless loop for rays trapped between perfectly reflecting surfaces.

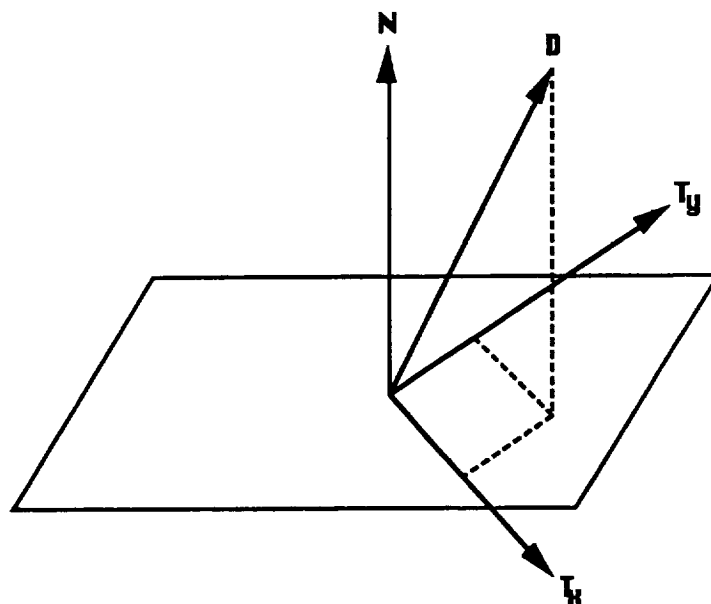


Figure 3.2.1-7. Diffuse Reflection.

Calculation of the solar exposure to a node on the surface requires that the intensity normalization of solar rays be discussed. Cumulative equivalent Sun hours (CESH) exposure to a flat unshielded surface is the same whether the surface area is large or small or whether one considers the exposure to the whole surface or only to a portion of it. Therefore, the exposure is a fluence; that is, exposure per unit area. A single direct solar ray is given a fluence of  $SUNTOT / ISUNPOS$  where  $SUNTOT$  is the event time in hours and  $ISUNPOS$  is the total number of Sun positions. A single direct ray of Earth-reflected solar radiation is given a fluence of  $F (NALB) (SUNTOT / ISUNPOS)$  where  $F$  is given by equation (3.2.1.22) and the factor of  $NALB$  accounts for the fact that Earth-reflected radiation is calculated once every  $NALB$  Sun positions. The direct exposure to a point on a surface due to a single ray of either direct solar or Earth-reflected solar radiation is the fluence of the ray times the magnitude of the cosine of the angle between the surface normal at the point and the ray direction. For direct exposure, a single point represents the CESH to all points in the nodal area associated with the point.

Figure 3.2.1-8 shows a typical surface divided into six nodes in  $(\xi, \eta)$  space. In the figure, numbers indicate the node number. Direct exposure is calculated at the center of each node in  $(\xi, \eta)$  space.

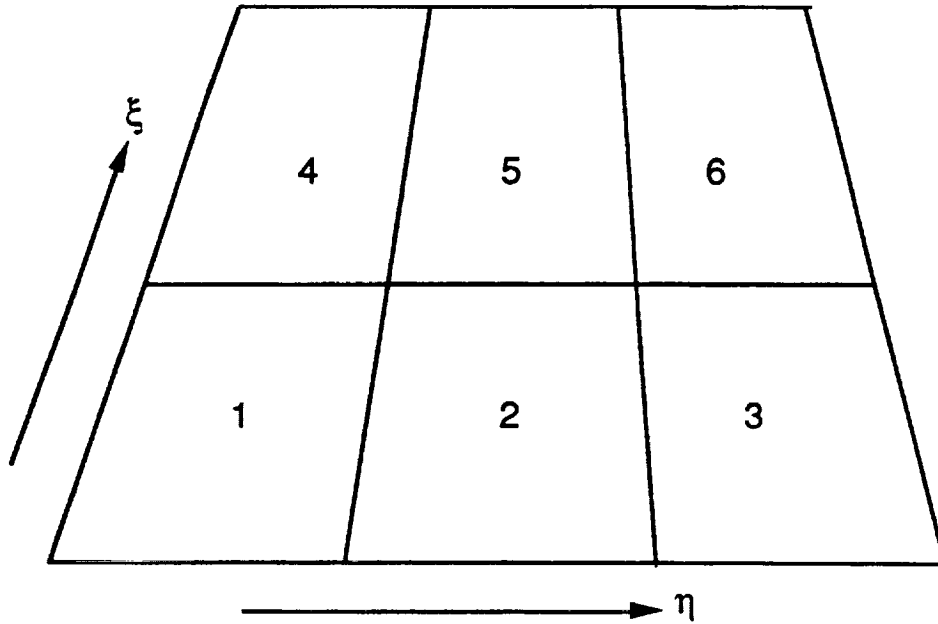


Figure 3.2.1-8. Nodes and Gridding on a Surface

A somewhat more sophisticated approach must be taken for calculating scattered CESH than for calculating direct CESH. Here, the areas of the nodes on the scattering surface and the receiving surface must be taken into account. Calculation of the areas of nodes is discussed in the Geometric Calculation and Ray Tracing Theory section. Consider figure 3.2.1-9. In the left half of the figure, a large area node scatters a uniform fluence (energy/area, represented by equally spaced arrows) toward a small area node. It is clear that only part of the energy scattered from the large node is deposited on the small node; however, if the two nodes are parallel to each other, the small node receives the same average fluence as the large node reflected. Now, consider the opposite case shown in the right half of the figure: a small area node scattering energy to a large area node. Here (again, assuming that the two nodes are parallel to each other), all of the energy scattered from the small node is deposited on the large node. However, the fluence on the large node is smaller than that on the small node because the energy scattered from the small node is averaged over the whole area of the large node. The scheme described below properly accounts for scattered radiation from one node to another.

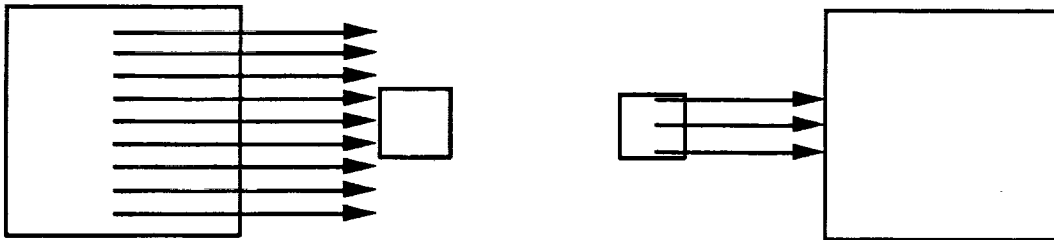


Figure 3.2.1-9. Scattering to Different Sized Areas.

The energy from direct solar or Earth-reflected radiation falling on a node is the direct fluence times the projected area, where the projected area is the actual area times the magnitude of the cosine of the angle between the ray direction and the node normal. This energy is divided into NRAY rays of energy to be scattered from the area.

$$NRAY = NINT[(AREA \text{ RAY} \cdot NRM) \text{ MAXRAY} / \text{ARMIN}] \quad (3.2.1.26)$$

for direct solar illumination where MAXRAY / ARMIN is the number of rays MAXRAY per average nodal area ARMIN and the term in parenthesis is the projected area of the directly illuminated node. The NINT function indicates that its argument should be rounded to the nearest integer. For Earth-reflected radiation, equation (3.2.1.26) holds if MAXALB is substituted for MAXRAY. The energy in each of the NRAY scattered rays is

$$E_{Sun} = \frac{SUNTOT \text{ ARMIN}}{ISUNPOS \text{ MAXRAY}} \quad (3.2.1.27)$$

for scattered direct solar exposure and

$$E_{Earth} = \frac{F \text{ SUNTOT} \text{ NALB} \text{ ARMIN}}{ISUNPOS \text{ MAXALB}} \quad (3.2.1.28)$$

for scattered Earth-reflected radiation, with F defined in equation (3.2.1.22).

When one of these rays of scattered energy strikes a surface, the energy in the ray is assigned to node which the ray struck. The fluence contributed by this ray is the energy divided by the area of the node to which the energy has been assigned. To account for the distribution of scattered energy from the node, each ray is scattered from a randomly selected point in the node.

**Geometric Calculation and Ray Tracing Theory.** The surface geometry description and ray tracing algorithms used in SOLSHAD were developed by Dr. R. C. Corlett some years ago. The four geometry and ray tracing subroutines used, RAYG1, RAYG2, RAYG3, and RAYG4, are little modified except for style from those originally developed by Corlett. The algorithm description given below follows closely the description originally given by Corlett (ref. 7). Briefly, the four subroutines perform the following functions. RAYG1 reads the parametric description of the surfaces making the object and converts this description to the form used internally. RAYG2 returns the Cartesian coordinates of a point specified in internal coordinates. RAYG3 returns the normal to a surface at a given point as well as two orthogonal vectors tangent to the surface at the point. RAYG4 traces a ray in a given direction from a point and determines the closest surface which it intersects.

**Surface Geometry Definition.** Figures 3.2.1-10 through 3.2.1-14 describe the geometry of the five primary surfaces: the trapezoid, cylinder, cone, disk, and sphere, respectively, or portions of them. Each surface has an unambiguously defined positive (+) side and negative (-) side and a curvilinear coordinate system ( $\xi, \eta$ ). The ( $\xi, \eta$ ) coordinate system is normalized such that the primary surface occupies the region  $[0 \leq \xi \leq 1, 0 \leq \eta \leq 1]$  exactly.

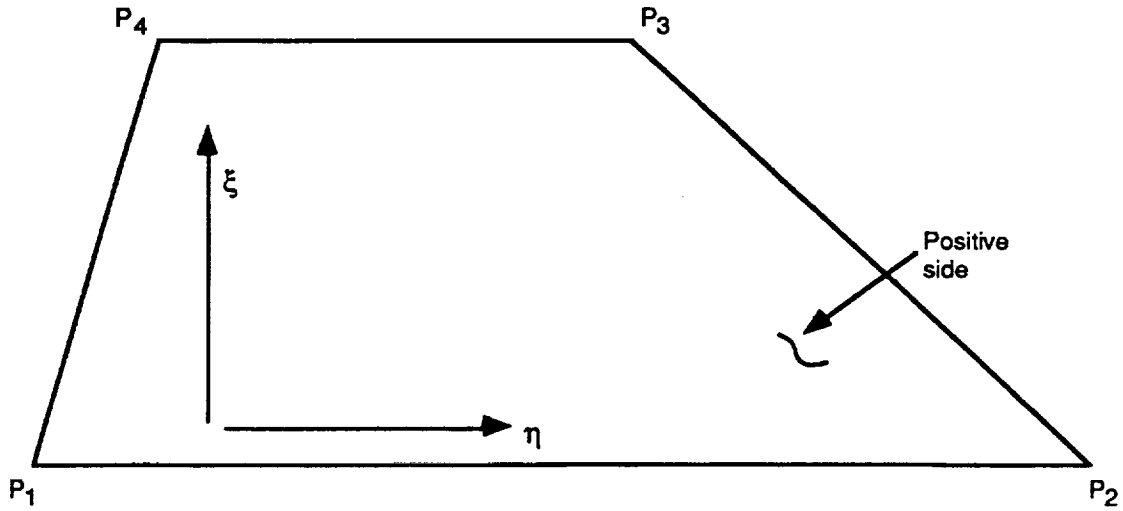


Figure 3.2.1-10. Trapezoid Geometry Definition.

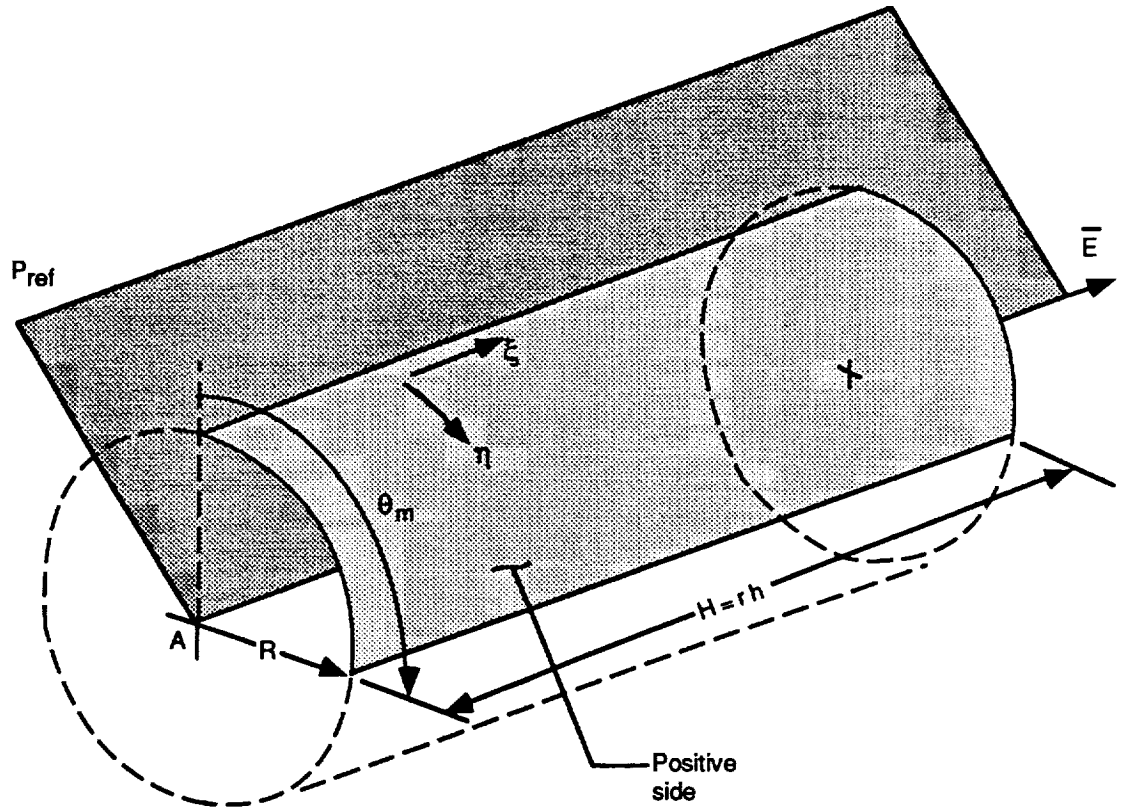


Figure 3.2.1-11. Cylinder Geometry Definition.

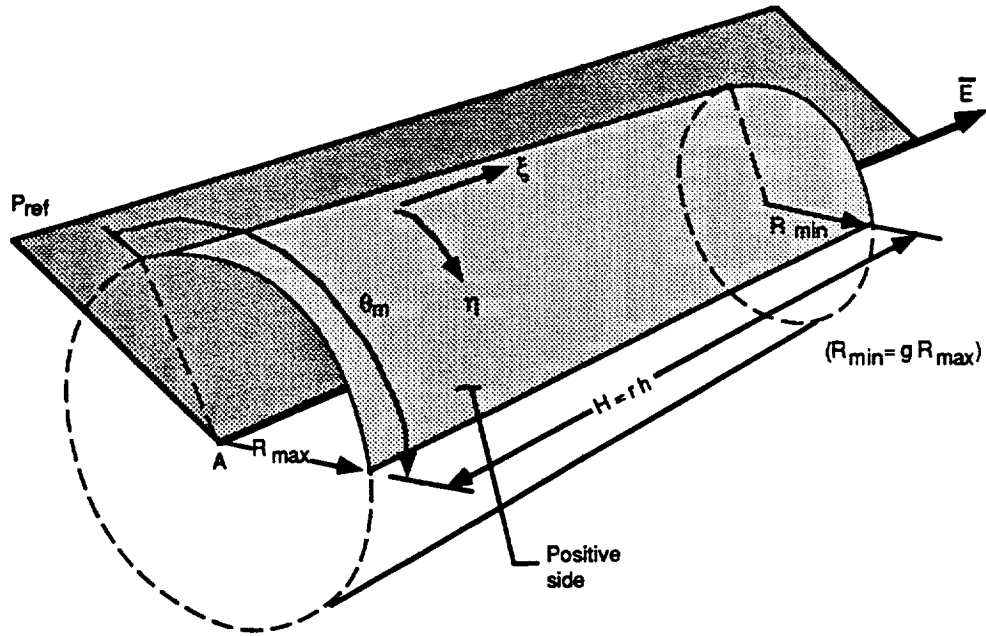


Figure 3.2.1-12. Cone Geometry Definition.

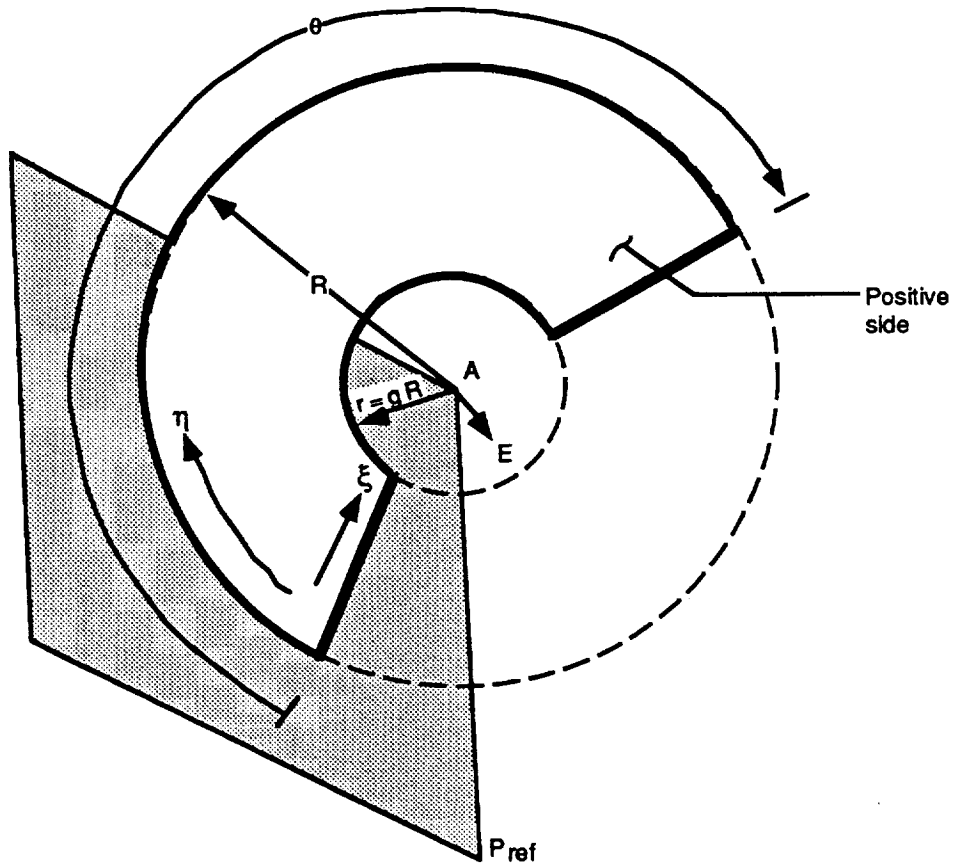


Figure 3.2.1-13. Disk Geometry Definition.

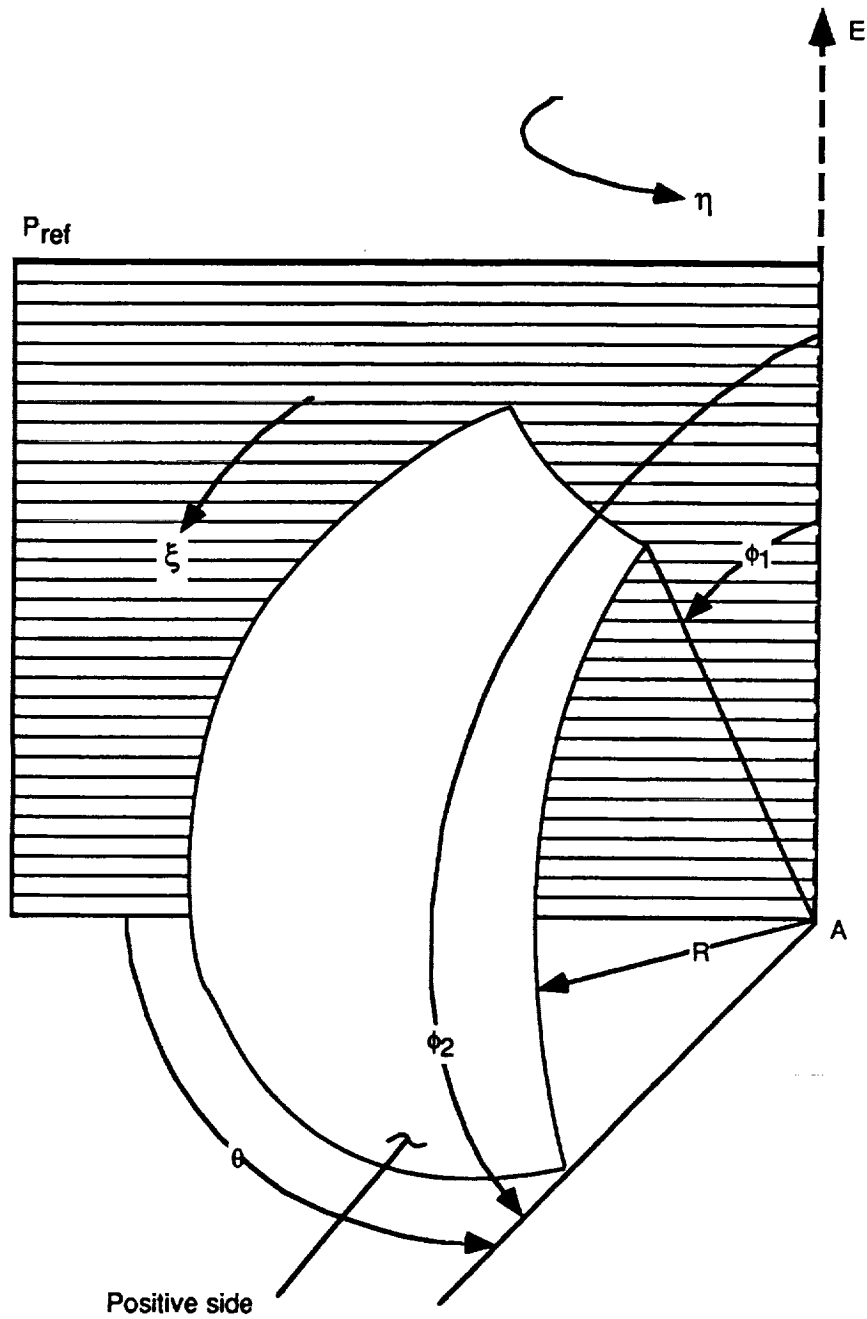


Figure 3.2.1-14. Sphere Geometry Definition.

Each primary surface is divided into nodal surfaces. Each nodal surface is bounded by constant  $\xi$  and  $\eta$  boundaries. The positive and negative sides of the nodal surfaces match those of their primary surfaces. Figure 3.2.1-15 illustrates the layout of the nodal surfaces for  $NC =$  two nodes in the  $\xi$  direction and  $NN =$  three nodes in the  $\eta$  direction. The primary surfaces are defined in physically convenient parameters as described below.

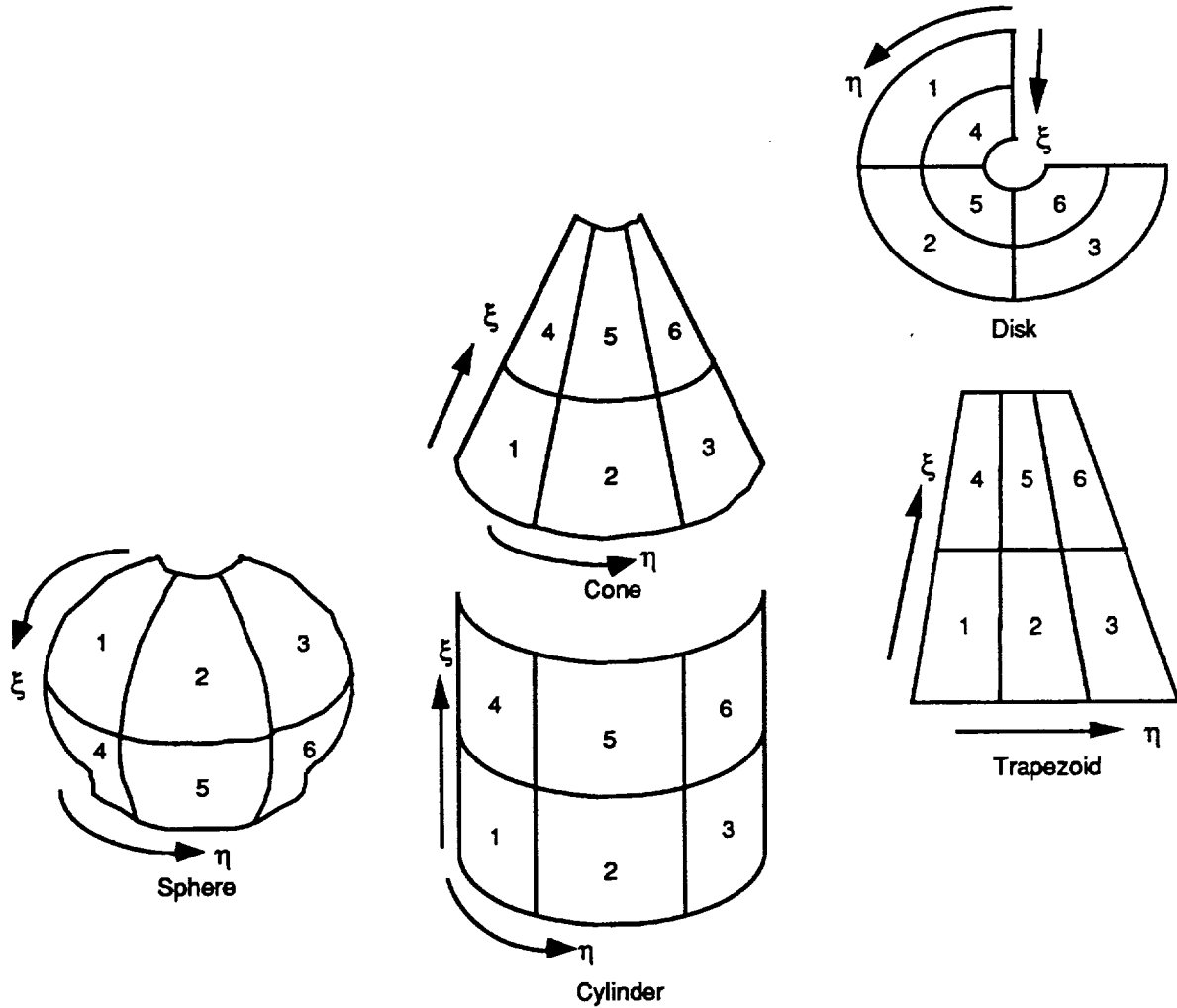


Figure 3.2.1-15. Node Arrangement on Surfaces.

The trapezoid is described by three points  $P_1$ ,  $P_2$ , and  $P_3$  oriented as shown in figure 3.2.1-10 and the ratio

$$\lambda = \frac{|P_3 - P_4|}{|P_2 - P_1|} \quad (3.2.1.29)$$

where  $0 \leq \lambda \leq 1$  and  $(P_2 - P_1) \parallel (P_3 - P_4)$ . When  $P_1$ ,  $P_2$ , and  $P_3$  are oriented in clockwise order, the positive side of the trapezoid is visible. This is the normal right hand rule.

The cone and cylinder sections (figs. 3.2.1-11 and 3.2.1-12) are defined in similar manner because the cylinder is a special case of the cone. Point A is the center of the circle of radius  $R$  (cylinder) or  $R_{\max}$  (cone) at the base of the cylinder or cone and normal to the axis. Vector  $E$  is parallel to and co-directed with the axis of the cone.  $h$  is the ratio the height  $H$  to  $R$  (cylinder) or  $R_{\max}$  (cone). Reference point  $P_{\text{ref}}$  defines azimuthal angle  $\theta = 0$  and  $\theta$  is measured in the right

hand direction about the axis vector  $\mathbf{E}$ .  $\theta_m$  is the maximum value of  $\theta$ . For the cone  $R_{\min} = g R_{\max}$  where  $g$  is a dimensionless constant between 0 and 1. From this we see that the cylinder is a cone with  $g = 1$ .

The disk (fig. 3.2.1-13) is defined similarly to the cone with  $h$  deleted,  $R_{\min} = r$ , and  $\theta$  measured in the left hand direction about the axis vector  $\mathbf{E}$ .

The sphere (fig. 3.2.1-14) is defined in similar manner to the cone with  $g$  and  $h$  deleted and bounding polar angles  $\phi_1$  and  $\phi_2$  added to define the polar extent of the sphere section. Vector  $\mathbf{E}$  is co-directed with the half line  $\phi = 0$ .

A fundamental reference coordinate system for each primary surface is defined as follows.

For the trapezoid,

$$\mathbf{z} = \frac{(\mathbf{P}_2 - \mathbf{P}_1) \times (\mathbf{P}_3 - \mathbf{P}_1)}{|(\mathbf{P}_2 - \mathbf{P}_1) \times (\mathbf{P}_3 - \mathbf{P}_1)|} \quad (3.2.1.30)$$

$$\mathbf{y}_1 = \frac{(\mathbf{P}_2 - \mathbf{P}_1)}{|(\mathbf{P}_2 - \mathbf{P}_1)|} \quad (3.2.1.31)$$

$$\mathbf{y}_2 = \mathbf{z} \times \mathbf{y}_1 \quad (3.2.1.32)$$

and for the cylinder, cone, disk, and sphere,

$$\mathbf{z} = \frac{\mathbf{E}}{|\mathbf{E}|} \quad (3.2.1.33)$$

$$\mathbf{y}_2 = \frac{\mathbf{E} \times (\mathbf{P}_{\text{ref}} - \mathbf{A})}{|\mathbf{E} \times (\mathbf{P}_{\text{ref}} - \mathbf{A})|} \quad (3.2.1.34)$$

$$\mathbf{y}_1 = \mathbf{y}_2 \times \mathbf{z} \quad (3.2.1.35)$$

To avoid numerical computation problems, the following restrictions are placed on the above definitions. For the trapezoid, the included angles between sides must be greater than  $c_A$ , where  $c_A$  is set to 0.1 degree in RAYG1. This requirement prevents two adjacent sides of the trapezoid from being parallel.

For the other primary surfaces, the magnitude of the angle included by  $(\mathbf{P}_{\text{ref}} - \mathbf{A})$  and  $\mathbf{E}$  must be less than  $c_A$ , where  $c_A$  is as defined above. Other variables used to define cylinders, cones, disks, and spheres are restricted to the following ranges:



$$\begin{aligned}
0 < \theta_m < 360 \text{ deg,} \\
0 < g < 1, \\
0 \leq \phi_1 < \phi_2 < 180 \text{ deg,} \\
\phi_2 - \phi_1 \geq 0.
\end{aligned}$$

Surface points on each type of primary surface are defined in terms of input parameters and the dimensionless coordinates  $\xi$  and  $\eta$ . For the trapezoid a point P is located at

$$\begin{aligned}
P &= P_1 + \eta(P_2 - P_1) + \xi[P_4 + \eta(P_3 - P_4) - P_1 - \eta(P_2 - P_1)] \\
&= P_1 + \xi(P_4 - P_1) + \eta(P_2 - P_1) + \xi\eta(P_1 - P_2 + P_3 - P_4)
\end{aligned} \tag{3.2.1.36}$$

For the cylinder, cone, and disk

$$P = A + \xi r h z + r y [1 + \xi(g - 1)] \tag{3.2.1.37}$$

where  $g = 1$  for a cylinder and  $h = 0$  for a disk. For the sphere,

$$P = A + r [z \cos \phi + y \sin \phi] \tag{3.2.1.38}$$

In the above two equations,

$$\theta = \eta \theta_{\max} \tag{3.2.1.39}$$

$$\phi = \phi_1 + \xi(\phi_2 - \phi_1) \tag{3.2.1.40}$$

$$y = y_1 \cos \theta + y_2 \sin \theta \tag{3.2.1.41}$$

Differential areas  $dA$  for the five primary surface types may be expressed in terms of input parameters and  $\xi$  and  $\eta$  as follows. For the trapezoid

$$dA = [(P_2 - P_1) \cdot y_1] [(P_3 - P_1) \cdot y_2] [1 + (g - 1) \xi] d\xi d\eta \tag{3.2.1.42}$$

For the cylinder, cone, and disk

$$dA = R^2 \theta_m [h^2 + (g - 1)^2]^{1/2} [1 + (g - 1) \xi] d\xi d\eta \tag{3.2.1.43}$$

with  $g = 1$  for the cylinder and  $h = 0$  for the disk. For the sphere

$$dA = R^2 \theta_m (\phi_2 - \phi_1) \sin [\phi_1 + \xi(\phi_2 - \phi_1)] d\xi d\eta \tag{3.2.1.44}$$

Because an individual nodal surface is bounded by  $\xi_1 < \xi < \xi_2$  and  $\eta_1 < \eta < \eta_2$ , the areas of nodal surfaces can be determined by integrating

$$A = \int_{\xi_1}^{\xi_2} \int_{\eta_1}^{\eta_2} d\xi d\eta dA(\xi, \eta) \quad (3.2.1.45)$$

which yields for the trapezoid

$$A = [(P_2 - P_1) \cdot y_1] [(P_3 - P_1) \cdot y_2] (\eta_2 - \eta_1) (\xi_2 - \xi_1) [1 + (\xi_2 + \xi_1) (\lambda - 1)/2] \quad (3.2.1.46)$$

For the cylinder, cone, and disk

$$A = R^2 \theta_m [h^2 + (g-1)^2]^{1/2} (\eta_2 - \eta_1) (\xi_2 - \xi_1) [1 + (\xi_2 + \xi_1) (g - 1)/2] \quad (3.2.1.47)$$

with, as before,  $g = 1$  for the cylinder and  $h = 0$  for the disk. For the sphere

$$A = R^2 \theta_m (\eta_2 - \eta_1) \{ \cos [\phi_1 + \xi_1 (\phi_2 - \phi_1)] - \cos [\phi_1 + \xi_2 (\phi_2 - \phi_1)] \} \quad (3.2.1.48)$$

Note that in equations (3.2.1.46) through (3.2.1.48) that the areas are directly proportional to  $\eta$ , but are nonlinear in  $\xi$ . Further, the expressions for area may be separated into three factors: a constant factor, the factor  $(\eta_2 - \eta_1)$ , and a  $\xi$  dependent factor  $f(\xi_2, \xi_1)$ . Thus, if the area of a node is known, the area of a portion of the node  $A_p$  bounded by  $\eta_1 < \eta < \eta_p$ ,  $\eta_p < \eta_2$ , and  $\xi_1 < \xi < \xi_2$  is given by

$$A_p = A (\eta_p - \eta_1) / (\eta_2 - \eta_1) \quad (3.2.1.49)$$

Similarly if  $A_p$  bounded by  $\eta_1 < \eta < \eta_2$  and  $\xi_1 < \xi < \xi_p$ ,  $\xi_p < \xi_2$ ,

$$A_p = A f(\xi_p, \xi_1) / f(\xi_2, \xi_1) \quad (3.2.1.50)$$

A nodal surface is bounded by  $\xi_1 < \xi < \xi_2$  and  $\eta_1 < \eta < \eta_2$ . It is desirable to determine the  $(\xi, \eta)$  position of a point given its relative position  $R_j$  and  $R_k$  on a nodal surface, where  $0 \leq R_j \leq 1$  is in the  $\eta$  direction and  $0 \leq R_k \leq 1$  is in the  $\xi$  direction.

$$R_j = (\eta - \eta_1) / (\eta_2 - \eta_1) \quad \text{or} \quad \eta = \eta_1 + R_j (\eta_2 - \eta_1) \quad (3.2.1.51)$$

and

$$R_k = \frac{[1 + (p-1)\xi]^2 - [1 + (p-1)\xi_1]^2}{[1 + (p-1)\xi_2]^2 - [1 + (p-1)\xi_1]^2} \quad (3.2.1.52)$$

or

$$\begin{aligned} \xi &= \xi_1 + R_k (\xi_2 - \xi_1) && \text{if } p = 1 \\ &= \frac{\left(1 - \sqrt{[1 + (p-1)\xi_1]^2 + R_k(\xi_2 - \xi_1)(p-1)[2 + (p-1)(\xi_2 - \xi_1)]}\right)}{1-p} && \text{if } p \neq 1 \end{aligned} \quad (3.2.1.53)$$

For the trapezoid,  $p = \lambda$ ; for the cylinder,  $p = 1$ ; for the cone and disk,  $p = g$ .

For the sphere,

$$R_k = \frac{\cos[\phi_1 + \xi_1(\phi_2 - \phi_1)] - \cos[\phi_1 + \xi(\phi_2 - \phi_1)]}{\cos[\phi_1 + \xi_1(\phi_2 - \phi_1)] - \cos[\phi_1 + \xi_2(\phi_2 - \phi_1)]} \quad (3.2.1.54)$$

or

$$\begin{aligned} \xi &= [\cos^{-1}(\cos[\phi_1 + \xi_1(\phi_2 - \phi_1)]) + \\ &R_k \{ \cos[\phi_1 + \xi_2(\phi_2 - \phi_1)] - \cos[\phi_2 + \xi_1(\phi_2 - \phi_1)] \} \\ &- \phi_1] (\phi_2 - \phi_1) \end{aligned} \quad (3.2.1.55)$$

To avoid the inverse cosine operation in the above equation and to simplify other calculations, it is convenient to rewrite the equation using the following change of variable

$$\frac{\cos\phi_1 - \cos[\phi_1 + \xi(\phi_2 - \phi_1)]}{\cos(\phi_1) - \cos(\phi_2)} \rightarrow \xi \quad (3.2.1.56)$$

Then

$$\cos\phi = \cos\phi_1 + \xi(\cos(\phi_2) - \cos(\phi_1)) \quad (3.2.1.57)$$

which leads to the following simplified equation for the sphere section which will be used hereafter

$$\xi = \xi_1 + R_k (\xi_2 - \xi_1) \quad (3.2.1.58)$$

**Generation of Local Unit Normal and Tangent Vectors.** The unit normal vector  $\mathbf{N}$  directed outward from the positive side of a nodal surface at point  $P$  corresponding to  $(\xi, \eta)$  on some primary surface and the orthogonal unit tangent vectors  $\mathbf{T}_1$  and  $\mathbf{T}_2$  are defined such that

$$\mathbf{T}_1 \times \mathbf{T}_2 = \mathbf{N} \quad (3.2.1.59)$$

Then, for the trapezoid and disk

$$\mathbf{N} = \mathbf{z}, \quad \mathbf{T}_1 = \mathbf{y}_1, \quad \mathbf{T}_2 = \mathbf{y}_2 \quad (3.2.1.60)$$

For the cone and cylinder, define

$$\cos\alpha = h / \sqrt{h^2 + (g-1)^2} \quad (3.2.1.61)$$

$$\sin\alpha = (1-g) / \sqrt{h^2 + (g-1)^2} \quad (3.2.1.62)$$

where  $g = 1$  for the cylinder and  $g$  is the ratio of the minimum to the maximum radius for the cone. Then, for the cone and the cylinder

$$\mathbf{N} = \mathbf{y} \cos\alpha + \mathbf{z} \sin\alpha \quad (3.2.1.63)$$

$$\mathbf{T}_1 = -\mathbf{y} \sin\alpha + \mathbf{z} \cos\alpha \quad (3.2.1.64)$$

$$\mathbf{T}_2 = \mathbf{N} \times \mathbf{T}_1 = -\mathbf{y}_2 \cos\theta + \mathbf{y}_1 \sin\theta \quad (3.2.1.65)$$

and for the sphere

$$\mathbf{N} = \mathbf{z} \cos\phi + \mathbf{y} \sin\phi \quad (3.2.1.66)$$

$$\mathbf{T}_2 = -\mathbf{y}_2 \cos\theta + \mathbf{y}_1 \sin\theta \quad (3.2.1.67)$$

$$\mathbf{T}_1 = \mathbf{T}_2 \times \mathbf{N} = \mathbf{z} \sin\phi - \mathbf{y} \cos\phi \quad (3.2.1.68)$$

In the above equations  $\theta$ ,  $\phi$ , and  $\mathbf{y}$  are defined in equations (3.2.1.39) through (3.2.1.41).

**Ray Tracing.** This section describes the method for determining whether a ray in a given direction from a point on a nodal surface intersects another surface, and, if so, whether that surface is the nearest surface intersected. Suppose  $L_m$  is the shortest ray length previously found from the point of origin  $P_O$  and that the ray is co-directed with unit vector  $\mathbf{v}$  to an intercept on some nodal surface. The problem is to consider some new primary surface and answer the following questions:

1. Does this ray intercept the primitive surface<sup>6</sup> containing primary surface of concern with positive intercept distance  $L < L_m$ ?
2. If so, is the intercept point within the primary surface?
3. If so, where within a nodal surface is the intercept point contained?

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<sup>6</sup>The primitive surface of a trapezoid or a disk section is the infinite plane which contains it. The primitive surface of a cylinder section is the complete infinite length cylinder. The primitive surface of a cone section is the complete infinite cone. The primitive surface of a sphere section is the complete sphere.

If the primitive surface is quadratic, that is, a cylinder, cone, or sphere, there will in general be two intercept points. The nearer one (the one with the shorter  $L$ ) is considered first until one of the above questions has a negative answer, after which the sequence of questions is asked of the further point. If the first two questions have positive answers, the point of intercept is taken as interim ray termination point  $P$  and  $L_m$  is replaced by  $L$  and the nodal surface within the primary surface is calculated. If the first question has a negative answer, the remaining questions need not be considered. The process is repeated until all primary surfaces have been considered.

The three questions are considered separately in the following subsections.

Does the ray intercept the primitive surface with  $0 < L < L_m$ ? The intercept point  $P$  may be expressed

$$P = P_o + L v \quad (3.2.1.69)$$

Using equations (3.2.1.36) through (3.2.1.38) as appropriate to express  $P$ , this vector equation contains three scalar unknowns,  $L$ ,  $\xi$ , and  $\eta$ . In dealing with this equation, it is convenient to introduce the quantity  $B$ ,

$$B = P_1 - P_o \quad (3.2.1.70)$$

for the trapezoid or

$$B = A - P_o \quad (3.2.1.71)$$

for cylinder, cone, disk, or sphere sections.

For the trapezoid and disk section primary surface types, taking the dot product of each side of equation (3.2.1.69) with the vector  $z$  gives directly

$$L(v \cdot z) = (B \cdot z) \quad (3.2.1.72)$$

from which  $\text{sign}(B \cdot z) = \text{sign}(v \cdot z)$  and the criterion  $0 < L < L_m$  may be written as

$$0 < |B \cdot z| < L_m |v \cdot z| \quad (3.2.1.73)$$

For the cylinder section or cone section primary surface types the calculations are more complex. Taking the dot product of each side of equation (3.2.1.69) with the vector  $z$  yields

$$\xi r h = L (v \cdot z) - (B \cdot z) \quad (3.2.1.74)$$

Then, after rearranging equation (3.2.1.69) so that the term  $r y [1 + \xi (g-1)]$  is alone on one side, squaring each side, and substituting for  $\xi$  using equation (3.2.1.74), there results

$$A L^2 - 2 B L - C = 0 \quad (3.2.1.75)$$

where

$$A = 1 - (\mathbf{v} \cdot \boldsymbol{\epsilon})^2 \quad (3.2.1.76)$$

$$B = (\mathbf{v} \cdot \mathbf{B}) - (\mathbf{v} \cdot \boldsymbol{\epsilon}) [(\mathbf{B} \cdot \boldsymbol{\epsilon}) - \delta] \quad (3.2.1.77)$$

$$C = (\mathbf{B} \cdot \boldsymbol{\epsilon}) [(\mathbf{B} \cdot \boldsymbol{\epsilon}) - 2 \delta] + r^2 - \mathbf{B} \cdot \mathbf{B} \quad (3.2.1.78)$$

$$\boldsymbol{\epsilon} = \mathbf{z} (1 + \gamma^2)^{1/2} \quad (3.2.1.79)$$

$$\delta = r \gamma (1 + \gamma^2)^{1/2} \quad (3.2.1.80)$$

$$\gamma = (g - 1)/h \quad (3.2.1.81)$$

and  $r = R$  for the cylinder and  $R_{\max}$  for the cone.

For the sphere section primary surface type, after rearranging equation (3.2.1.69) so that the term  $R [z \cos \phi + y \sin \phi]$  is alone on one side and squaring each side, there results similarly

$$A L^2 - 2 B L - C = 0 \quad (3.2.1.82)$$

where  $A = 1$ ,  $B = (\mathbf{v} \cdot \mathbf{B})$ ,  $C = r^2 - \mathbf{B} \cdot \mathbf{B}$ .

Thus, for all three quadratic primary surface types

$$L A = B \pm \sqrt{D} \quad (3.2.1.83)$$

with  $D = B^2 + A C$ .

Note that the vector  $\boldsymbol{\epsilon}$  and the scalar  $\delta$  are independent of ray direction or point or origin. In stating a criterion for the existence of  $L$  such that  $0 < L < L_m$ , it is convenient to take  $A$  positive.

The case  $A = 0$  may be disregarded because its probability is negligibly small with  $\mathbf{v}$  chosen randomly. If  $A < 0$ , the quadratic equation (3.2.1.83) for  $L$  is preserved if the sign of each of the three coefficients  $A$ ,  $B$ , and  $C$  is arbitrarily reversed, which will be assumed to have been done if necessary to make  $A$  positive.

Is  $P$  within the primary surface? In this subsection it is assumed that there does exist  $L$  such that  $0 < L < L_m$  and that  $L$  has been calculated from equation (3.2.1.72), (3.2.1.74), or (3.2.1.83) as appropriate for the primary surface type. For all primary surface types but the disk section, the first step is to calculate the normalized coordinate  $\xi$  directly and to test for  $0 < \xi < 1$ . Only for the disk section primary surface type do computational savings result from an indirect calculation.

For the trapezoid primary surface type, taking the dot product of each side of equation (3.2.1.69) with unit vector  $\mathbf{y}_2$  gives

$$\xi = \mathbf{w} \cdot (L \mathbf{v} - \mathbf{B}) \quad (3.2.1.84)$$

where  $w = y_2 / [y_2 \cdot (P_4 - P_1)]$ .

For the cylinder and cone section primary surface types, equation (3.2.1.74) can be rewritten as

$$\xi = w \cdot (L v - B) \quad (3.2.1.85)$$

where  $w = z / (r h)$ .

For the disk section primary surface type, inspection of (3.2.1.69) (noting that  $h = 0$ ) shows that

$$|L v - B| = R [1 + \xi (g-1)] \quad (3.2.1.86)$$

or

$$\xi = [1 - |L v - B|/R] / (1 - g) \quad (3.2.1.87)$$

For this primary surface type the criterion  $0 < \xi < 1$  is most conveniently applied in the form

$$R^2 > L^2 + B \cdot B - 2 L (v - B) > R^2 g^2. \quad (3.2.1.88)$$

For the sphere section primary surface type, taking the dot product of each side of equation (3.2.1.69) with unit vector  $z$  yields

$$\cos \phi = z \cdot (L v - B) / R \quad (3.2.1.89)$$

which, upon use of equation (3.2.1.57), becomes

$$\xi = v - w \cdot (L v - B) \quad (3.2.1.90)$$

where  $w = z / [R (\cos \phi_1 - \cos \phi_2)]$  and  $v = \cos \phi_1 / (\cos \phi_1 - \cos \phi_2)$ .

If  $0 < \xi < 1$ , then the second step, determining if  $0 < \eta < 1$ , is carried out. It is assumed that both  $L$  and  $\xi$  have been evaluated.

For the trapezoid primary surface type, taking the dot product of each side of equation (3.2.1.57) with  $y_1$  and noting the definition of the length ratio  $\lambda$  yields

$$\eta [1 + \xi (\lambda - 1)] = u \cdot (L v - B) - v \xi \quad (3.2.1.91)$$

where  $u = y_1 / [y_1 \cdot (P_2 - P_1)]$  and  $v = y_1 \cdot (P_4 - P_1) / [y_1 \cdot (P_2 - P_1)]$ .

For the other four primary surface types, equation (3.2.1.69) is solved for  $\cos \theta$  through dot multiplication by  $y_1$  and for  $\sin \theta$  through dot multiplication by  $y_2$ . The solutions are

$$[1 + \xi (g - 1)] \cos \theta = Y_1 \cdot (L v - B) \quad (3.2.1.92)$$

$$[1 + \xi (g - 1)] \sin \theta = Y_2 \cdot (L v - B) \quad (3.2.1.93)$$

where  $Y_1 = y_1 / r$  and  $Y_2 = y_2 / r$  and  $r = R$  or  $R_{\max}$  depending on surface type. Then,  $0 < \eta < 1$  if  $\sin \theta_m \geq 0$  and  $\sin \theta > 0$  and  $\cos \theta > \cos \theta_m$  or if  $\sin \theta_m < 0$  and  $\sin \theta > 0$  or  $\cos \theta < \cos \theta_m$ .

Within what nodal surface is P? It is assumed in this subsection that  $\xi$  and  $\eta$  have already been calculated and that the number of nodes in the  $\xi$  direction  $NC$  and the number of nodes in the  $\eta$  direction  $NN$  for the primary surface are known. The primary surface is a square in  $(\xi, \eta)$  space, that is,  $0 < \xi < 1$  and  $0 < \eta < 1$ , and each nodal surface is a rectangle in  $(\xi, \eta)$  space bounded by  $0 \leq \xi_1 < \xi < \xi_2 \leq 1$  and  $0 \leq \eta_1 < \eta < \eta_2 \leq 1$ . Each nodal surface on a primary surface is given an index number. Figure 3.2.1-15 shows the arrangement of nodal surfaces on each of the five primary surfaces for  $NC = 2$  and  $NN = 3$ . The position of  $\xi$  in terms of nodal surfaces within the primary surface is given by

$$N\xi = (\xi NC) \quad (3.2.1.94)$$

where the term in parenthesis is rounded up to the next integer. The position of  $\eta$  in terms of nodal surfaces within the primary surface is given by

$$N\eta = (\eta NN) \quad (3.2.1.95)$$

where again the term in parenthesis is rounded up to the next integer. Now, given the nodal surface coordinates as  $N\xi$  and  $N\eta$ , the index  $IN$  of the nodal surface containing  $\xi$  and  $\eta$  is given by

$$IN = N\eta + NN (N\xi - 1). \quad (3.2.1.96)$$

**Two-Dimensional Interpolation.** CESH are calculated at the  $(\xi, \eta)$  centers of the nodes on surfaces. However, for proper display during plotting, CESH are needed near the corners of the nodes<sup>7</sup>. The following scheme interpolates CESH from the  $(\xi, \eta)$  centers of the nodes to the corners of the nodes. It is most convenient to perform the interpolation in  $(\xi, \eta)$  space rather than in Cartesian  $(x, y, z)$  coordinates.

As noted previously, each surface is a square in  $(\xi, \eta)$  space with  $0 \leq \xi \leq 1$  and  $0 \leq \eta \leq 1$ . For a surface divided into  $NC$  equal nodes in the  $\xi$  direction and  $NN$  equal nodes in the  $\eta$  direction, the dimensions of each nodes are  $1/NC$  in the  $\xi$  direction and  $1/NN$  in the  $\eta$  direction. The node centers are at  $(^c\xi_j, ^c\eta_i) = [(j-0.5)/NC, [i-0.5]/NN)$  with  $j = 1, 2, \dots, NC$  and  $i = 1, 2, \dots, NN$ . Figure 3.2.1-16 shows a typical surface representation in  $(\xi, \eta)$  space with  $NC = 2$  and  $NN = 3$ . The figure also shows the location of the points near the corners of the nodes, whose

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<sup>7</sup>To avoid ambiguity in node assignment, the points "near the corners" are chosen to be set in from the corners by 1% of the node dimension. Hereafter, references to the corners of nodes will be synonymous with "near the corners."



values of CESH are to be interpolated. Inspection of the figure shows that only two of the points whose values are to be interpolated lie within the perimeter of the points at the centers of the nodes. Because extrapolation is, in general, less accurate than interpolation, the edges of open surfaces<sup>8</sup> are padded with extra rows and columns as follows: The lower edge is padded by repeating the CESH values for  $c_{\xi j}^c$  below the surface and the top edge by repeating the CESH values for  $c_{\xi NC}^c$  above the surface. The left and right edges are padded using the CESH values for  $c_{\eta i}^c$  and  $c_{\eta NN}^c$ , respectively; and the corners by repeating the CESH values at the corresponding node centers at the corners of the surface. Closed surfaces are padded in similar manner except that the left column is padded with CESH values of the  $c_{\eta NN}^c$  column and the right column with CESH values from the  $c_{\eta 1}^c$  column. The centers of the nodes added for padding are at  $(c_{\xi j}^c, c_{\eta} = -0.5/NN)$  and  $(c_{\xi j}^c, c_{\eta} = 1 + 0.5/NN)$  for the left and right columns, respectively, and  $(c_{\xi}^c = -0.5/NC, c_{\eta i}^c)$  and  $(c_{\xi}^c = 1 + 0.5/NC, c_{\eta i}^c)$  for the bottom and top rows, respectively.

These preliminaries concluded, the description of the interpolation algorithm may begin. Suppose one wishes to interpolate the value of CESH  $y(\xi, \eta)$  at  $(\xi, \eta)$ , given that  $c_{\xi j}^c \leq \xi \leq c_{\xi j+1}^c$  and  $c_{\eta i}^c \leq \eta \leq c_{\eta i+1}^c$ . The interpolation is performed in two steps. First, one-dimensional interpolations are performed on the rows for each  $c_{\xi j}^c$  row,  $1 \leq j \leq NC$ , to give the one-dimensional array of CESH  $(c_{\xi j}^c | \eta)$  where  $(c_{\xi j}^c | \eta)$  indicates that  $\eta$  is fixed. Then, this array is interpolated to give the value of CESH at  $\xi$ .

The interpolation scheme used is Stineman's consistently well-behaved method of interpolation (ref.4). The following explanation of the method quotes parts of reference 4 directly except for changes of equation and figure numbers to be consistent with this document and additions and deletions specific to the problem addressed by this document.

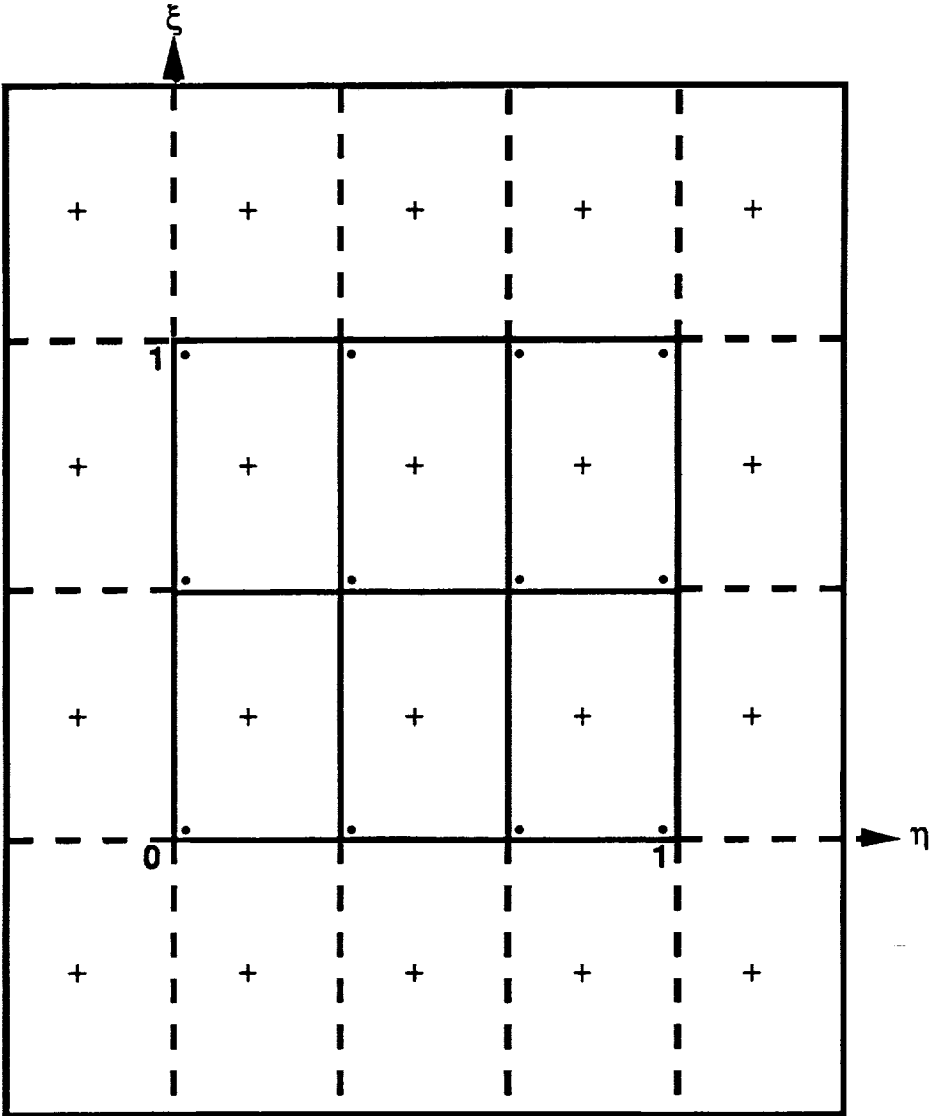
The interpolation scheme has the following three properties. First, if values of the ordinates of adjacent specified points (the CESH at the node centers in the  $\xi$  or  $\eta$  direction) change monotonically and the slopes of the line segments joining the points change monotonically, then the interpolating curve and its slope will change monotonically. Second, if the slopes of the line segments joining the adjacent points change monotonically, then the slope of the interpolating curve will change monotonically. Third, suppose that the first two conditions are satisfied by a set of points, but that a small change in the ordinate or slope at one of the points will result in one of the conditions no longer being satisfied. Then, making this small change in the ordinate or slope at a point will cause no more than a small change in the interpolating curve.

The interpolation scheme is implemented as follows. Assume that the ordered sequence of data  $(x_j, y_j)$ ,  $j = 1, 2, \dots, n$  is given where  $(x_j, y_j)$  are the rectangular coordinates of the  $j^{\text{th}}$  point on the curve (here  $x_j$  may be either  $c_{\xi j}^c$  or  $c_{\eta i}^c$  and  $n$  may be  $NC + 2$  or  $NN + 2$  as appropriate and  $y_j$  is the corresponding CESH). Let  $y_j'$  be the slope of the curve at the  $j^{\text{th}}$  point and require that  $x_j < x_{j+1}$  for  $j = 1, 2, \dots, n-1$ . Calculation of  $y_j'$  will be considered presently. Before doing so, it is noted that the  $y_j'$  are calculated most accurately if the  $x_j$  and  $y_j$  have roughly equal ranges. To

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<sup>8</sup>An open surface is defined as one such that the Cartesian coordinates of  $(\xi, \eta = 0)$  and  $(\xi, \eta = 1)$  are different, for example, a trapezoid. A closed surface is defined as one such that the Cartesian coordinates of  $(\xi, \eta = 0)$  and  $(\xi, \eta = 1)$  are identical; for example, an annulus of a cylinder or of a sphere.

ensure this, the values of  $c_{\xi_j}$ ,  $c_{\eta_i}$  and  $CESH(c_{\xi_j}, c_{\eta_i})$  are each scaled to be in the range 0 to 1 before interpolation begins. After completion of interpolation, the interpolated  $y$  are rescaled back to their true values.



- + Points at centers of nodes
- Points near corners of nodes
- Node boundaries on surface
- - Rows and columns of nodes padded onto surface perimeter

Figure 3.2.1-16. Surface in  $(\xi, \eta)$  Space With  $NC = 2$ ,  $NN = 3$ .

Given  $x$  such that  $x_j \leq x \leq x_{j+1}$ , the procedure for calculating  $y$  (the corresponding interpolated value) is the following. The slope of the line segment joining the two points is

$$s_j = \frac{y_{j+1} - y_j}{x_{j+1} - x_j} \quad (3.2.1.97)$$

On the line segment the ordinate corresponding to  $x$  is

$$y_0 = y_j + s_j (x - x_j) \quad (3.2.1.98)$$

Next,

$$\Delta y_j = y_j + y'_j (x - x_j) - y_0 \quad (3.2.1.99)$$

where  $\Delta y_j$  is the vertical distance from the point  $(x, y_0)$  to a line through  $(x_j, y_j)$  with slope  $y'_j$ , as shown in figure 3.2.1-17. Similarly,

$$\Delta y_{j+1} = y_{j+1} + y'_{j+1} (x - x_{j+1}) - y_0 \quad (3.2.1.100)$$

is the vertical distance from the point  $(x, y_0)$  to a line through  $(x_{j+1}, y_{j+1})$  with slope  $y'_{j+1}$ , also shown in figure 3.2.1-17. The product  $\Delta y_j \Delta y_{j+1}$  is then calculated and tested.

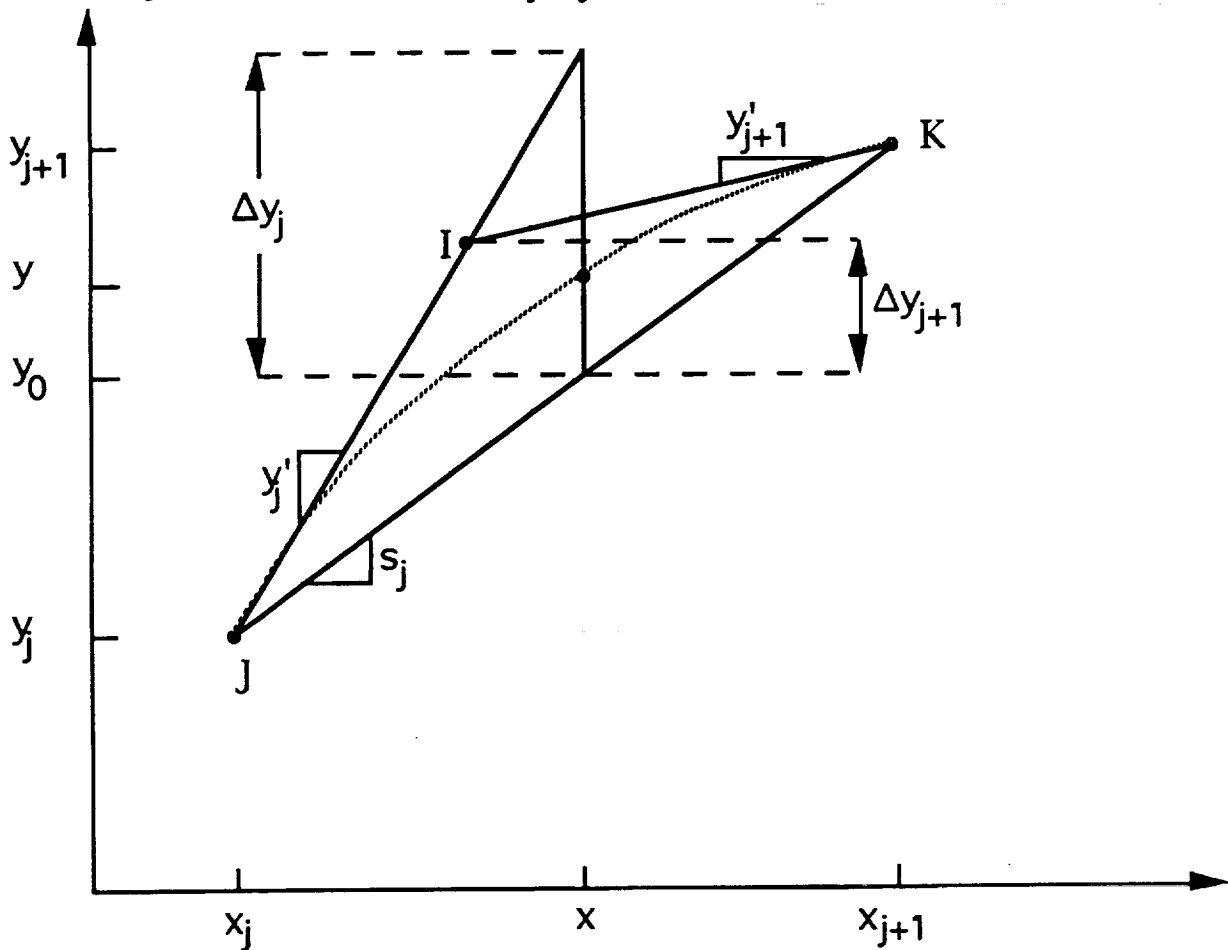


Figure 3.2.1-17. Consistently Well-Behaved Interpolation for  $\Delta y_j \Delta y_{j+1} > 0$ .

If  $y_j' = s_j$ , then the line through point  $(x_j, y_j)$  will coincide with the line segment joining points  $(x_j, y_j)$  and  $(x_{j+1}, y_{j+1})$ , and  $\Delta y_j = 0$ . Similarly, if  $y_{j+1}' = s_j$ , then  $\Delta y_{j+1} = 0$ . If either or both  $\Delta y_j$  or  $\Delta y_{j+1}$  are zero, then the product  $\Delta y_j \Delta y_{j+1} = 0$  and  $y$  is simply

$$y = y_0 \quad (3.2.1.101)$$

If  $\Delta y_j \Delta y_{j+1} > 0$ , then (as in fig. 3.2.1-17)  $\Delta y_j$  and  $\Delta y_{j+1}$  have the same sign, and

$$y = y_0 + \frac{\Delta y_j \Delta y_{j+1}}{\Delta y_j + \Delta y_{j+1}} \quad (3.2.1.102)$$

Equation (3.2.1.102) always determines the point  $(x, y)$  inside the triangle IJK of figure 3.2.1-17. The slope of the interpolating curve matches the given slopes at the given points. The slope changes monotonically between  $x_j$  and  $x_{j+1}$ , so the interpolating curve is always concave toward the line segment joining the two points.

If  $\Delta y_j \Delta y_{j+1} < 0$ , then the geometry is as in figure 3.2.1-18 and there must be an inflection point between  $x_j$  and  $x_{j+1}$ . In this case,

$$y = y_0 + \frac{\Delta y_j \Delta y_{j+1} (x - x_j + x - x_{j+1})}{(\Delta y_j - \Delta y_{j+1}) (x_{j+1} - x_j)} \quad (3.2.1.103)$$

Equation (3.2.1.103) always determines the point  $(x, y)$  inside the quadrilateral JIKL of figure 3.2.1-18, where the vertical distance LO equals the vertical distance OI. The slope of the interpolating curve matches the slopes at the given points  $x_j$  and  $x_{j+1}$ . The interpolating curve intersects the line segment JK at its midpoint.

The rationale for equation (3.2.1.103) may be understood by considering the case where  $y_j$  is significantly greater than  $s_j$ , the slope of line segment JK, but  $y_{j+1}$  is nearly equal to  $s_j$  (fig. 3.2.1-17 or 3.2.1-18). Regardless of whether  $y_{j+1}$  is greater or less than  $s_j$ , points I and L will be very close to point J and the interpolating curve will be very close to line segment JK. Thus, a change of  $y_{j+1}$  from slightly more than  $s_j$  to slightly less than  $s_j$  will cause only a slight change in the interpolating curve. This illustrates the third property, described above, of the interpolation scheme.

The derivatives  $y_j'$  are calculated by the following procedure, which ensures that they have the properties required by the interpolation method. In figure 3.2.1-19 let I, J, and K be any three consecutive points. Point J may be above or below the line segment joining I and K as shown in figures 3.2.1-19a and 3.2.1-19b, respectively. The requirements on the derivatives are satisfied if  $y_j'$  has a value between the slopes of the line segments IJ and JK. That is, for figure 3.2.1-19a, it is necessary that  $\text{slope}(IJ) > y_j' > \text{slope}(JK)$ , while for figure 3.2.1-19b,  $\text{slope}(IJ) < y_j' < \text{slope}(JK)$ . Another point is that if, for example, line segment IJ is much shorter than JK, it may easily be seen that a smoother overall interpolation curve will result if  $y_j'$  is nearly equal to the slope of IJ.

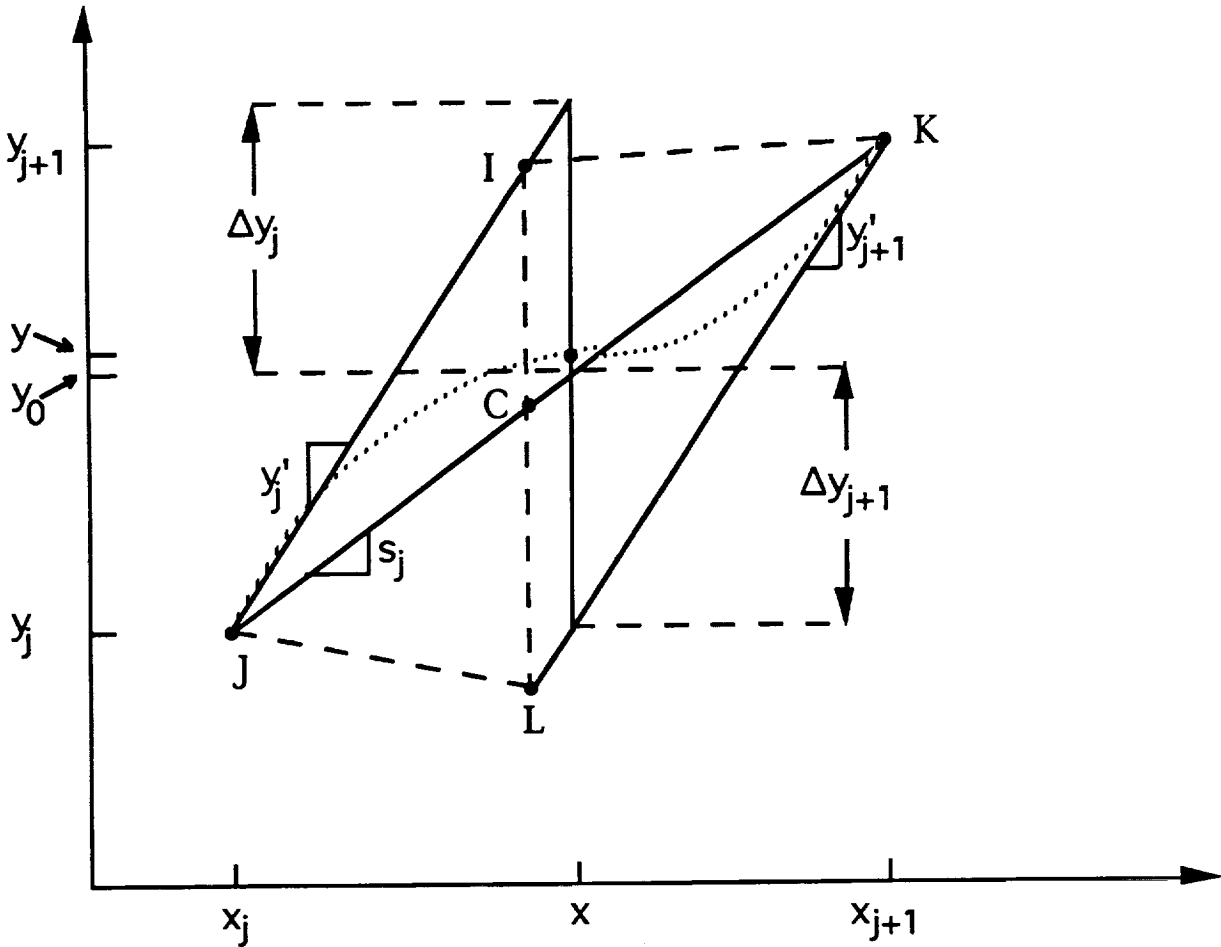


Figure 3.2.1-18. Consistently Well-Behaved Interpolation for  $\Delta y_j \Delta y_{j+1} < 0$ .

All of the above considerations are satisfied by setting  $y'_j$  equal to the slope at point J of a circle through points I and K. Thus,

$$y'_j = \frac{(y_j - y_i) ((x_k - x_j)^2 + (y_k - y_j)^2) + (y_k - y_j) ((x_j - x_i)^2 + (y_j - y_i)^2)}{(x_j - x_i) ((x_k - x_j)^2 + (y_k - y_j)^2) + (x_k - x_j) ((x_j - x_i)^2 + (y_j - y_i)^2)} \quad (3.2.1.104)$$

Equation (3.2.1.104) takes care of all interior points. The end points require special attention. From the requirements on the  $y'_j$  it may be seen that the slope at an end point must have the same sign as the line segment from the end point to the next point. In line with the use of equation (3.2.1.104), one might draw a circle through the first (or last) three points. However, if either point I or K of figure 3.2.1-19 is an end point, the particular arrangement of the points causes the slope of the circle at I or K to have the wrong sign. The sign of the slope is not necessarily wrong at the end point, but it may be wrong.

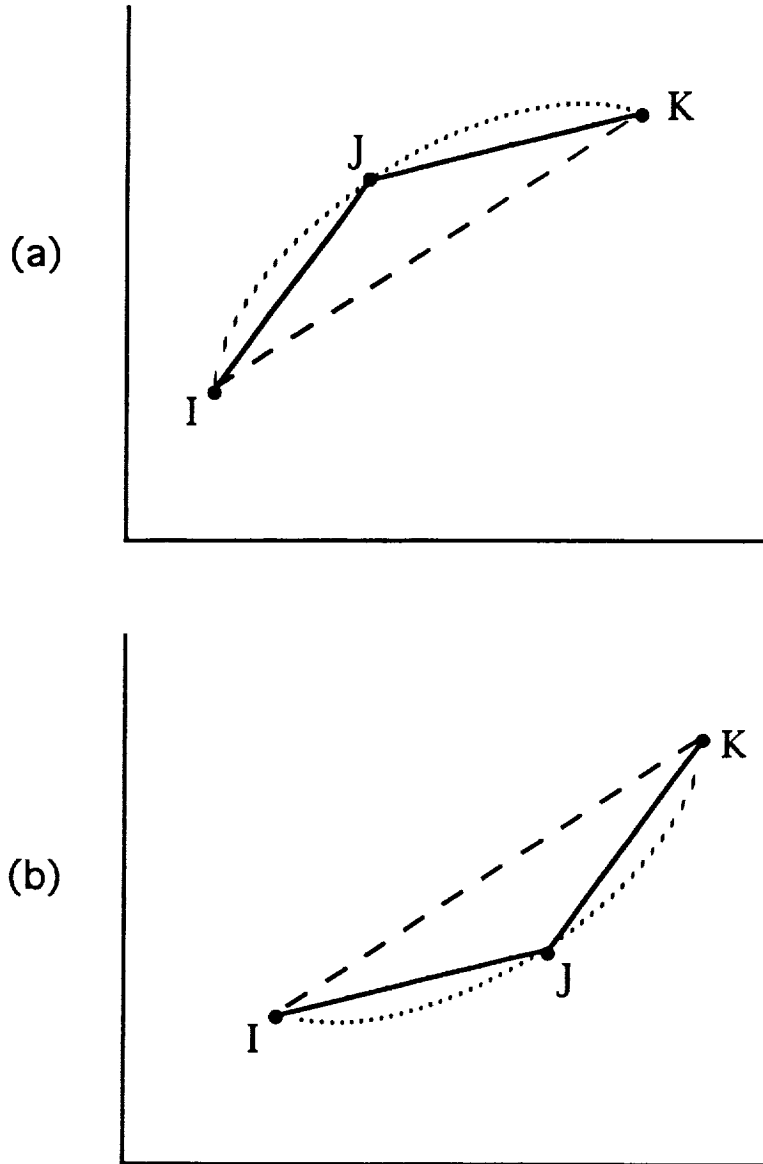


Figure 3.2.1-19. Calculation of Derivatives.

The problem divides into two cases. To simplify the notation, let  $M$  and subscript  $m$  designate either point  $I$  or  $K$ , whichever is an end point, and let  $s$  be the slope of the line segment joining points  $J$  and  $M$ . The first case occurs when  $s$  is steeper than  $y_j'$ . In this case, a parabola through  $J$  and  $M$  with slope  $y_j'$  at  $J$  has a slope at  $M$  which meets the requirements and is reasonable. Stated more precisely, if  $s > 0$  and  $s > y_j'$  or if  $s < 0$  and  $s < y_j'$ , then

$$y_m' = s + (s - y_j') = 2s - y_j' \quad (3.2.1.105)$$

The second case occurs if neither condition for the first case is satisfied. In this case, the term in parenthesis in equation (3.2.1.105) is multiplied by a factor between zero and one which assures that  $y_m'$  is always the same sign as  $s$ . The result is

$$y_m' = s + \frac{|s| (s - y_i')}{|s| + |s - y_i'|} \quad (3.2.1.106)$$

### 3.2.2 MDDDB Version 2.0 Algorithm

The primary mode of operation of MDDDB is one of interactive prompt and user response to the prompts. Major computational routines to specify the positions of points on surfaces for TECPLOT display are CONNECM, RAYG1M, RAYG2M, and RAYG3M. These are modified versions of subroutines of similar name in SHADOW (ref. 1) and in SOLSHAD. Users interested in the algorithms used in these routines should refer to the algorithm descriptions in section 3.2.1.

## REFERENCES

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3. R. J. Bourassa, H. G. Pippin, and J. R. Gillis, LDEF Microenvironments, Observed and Predicted, *LDEF - 69 Months in Space, Second Post-Retrieval Symposium*, NASA Conference Publication 3194 (1992).
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7. R. C. Corlett, private communication (1993).



## APPENDIX A: SAMPLE PROGRAM RUN

Appendix A contains a series of sample files that have been constructed by taking a sample geometry and running it through the entire process to its final output. The sample geometry structure was devised so that each of the five primary surface types is used once and so that, when SOLSHAD is run, the effects of multiple reflections are apparent. The active side of the sphere, cone, and cylinder are on the outside. The active side of the disk and the trapezoid are toward the center of the structure. The surfaces have a variety of different surface properties. The ram direction (direction of the satellite velocity vector) is along the positive z axis; that is, from the center of the disk and pointing through the point of the cone. The orbit is chosen to be a 28.5 deg. inclination and a 450 km altitude, with all possible random sun and satellite positions.

### A.1 3D Graph of Surfaces

Figure A1 is a black and white image of an MDDDB TECPLOT color display of the sample file geometry. (The structure has been rotated from its original position so that it can be viewed more clearly.) An MDDDB TECPLOT display will be colored as labeled in figure A1. The active side of each surface is indicated by a surface normal direction arrow. The direction arrow for the blue square is not visible because it points down into the sphere.

When the structure is viewed from the top, the intersection of the sphere and square is an example of where TECPLOT sometimes draws lines where it is not supposed to. (See section 2.2.3 about problems with TECPLOT.) However, this is not shown in Figure A1.

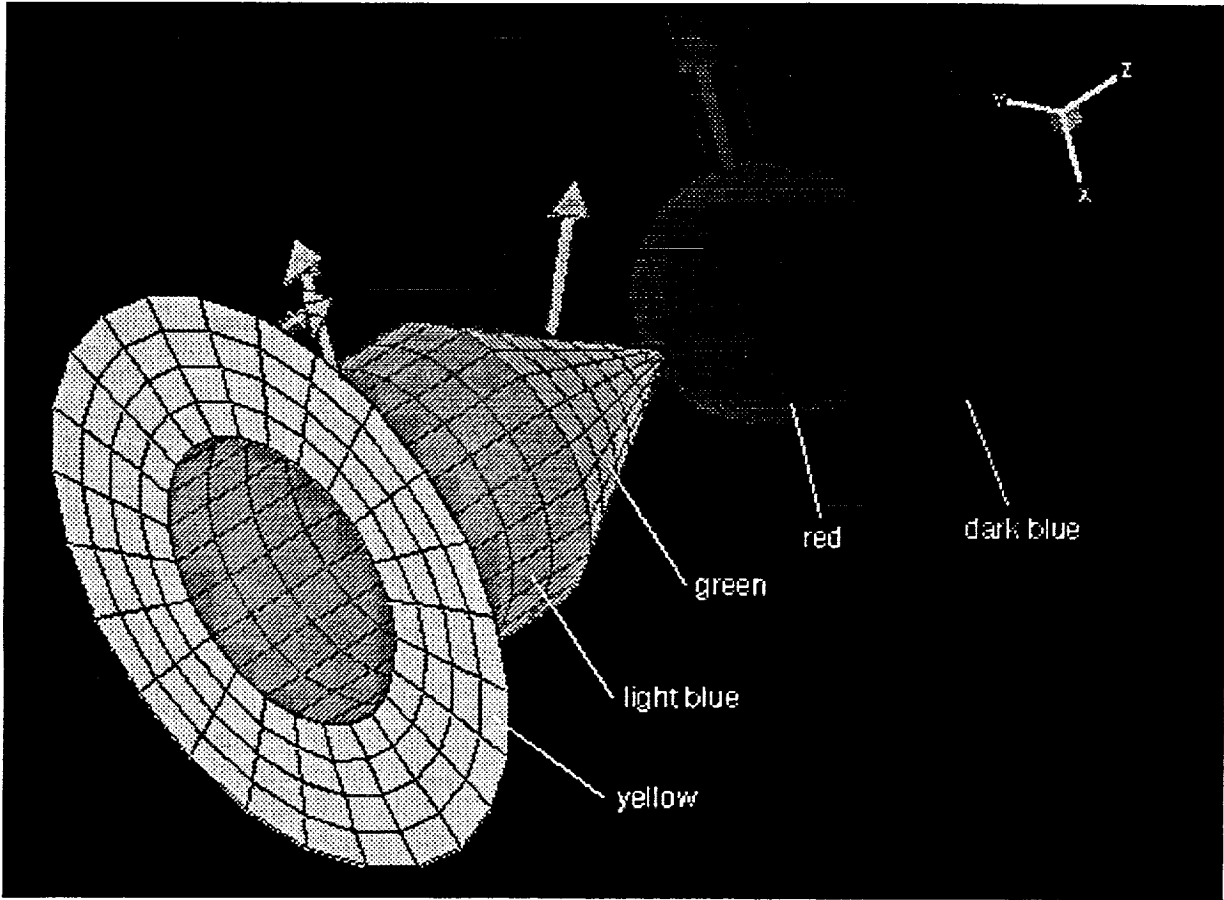


Figure A1. Black and White Image of the Sample Geometry as Viewed Using MDDB and TECPLOT.

## A.2 Input File Generated by MDDB

This is the file generated by MDDB. Note that the cone ratio is taken to be 0.001 instead of 0.000. (See sec. 2.2.3 about problems with TECPLOT.)

File on PC: sample.sol

File on convex: solmicro/solshad.in\_sample

SOLSHAD sample input with 5 surfaces

```

1 5 5 T T T
      -4.0000      -4.0000      15.1000
      -4.0000       4.0000      15.1000
       4.0000       4.0000      15.1000
                                1.0000

```

PLANE

```

PLANE MATERIAL
.5000 .5000 .0000 SPEC,DIFFUSE,ABSORPTION
2 5 24 T T T
.0000 .0000 1.0000
.0000 .0000 .0000
1.0000 .0000 .0000
3.0000 1.6667 360.0000

CYLINDER
CYLINDER MATERIAL
.2500 .7000 .0500 SPEC,DIFFUSE,ABSORPTION
3 6 24 T T T
.0000 .0000 1.0000
.0000 .0000 5.0000
1.0000 .0000 .0000
3.0000 1.6667 .0010 360.0000

CONE
CONE MATERIAL
.3000 .6000 .1000 SPEC,DIFFUSE,ABSORPTION
4 4 24 T T T
.0000 .0000 1.0000
.0000 .0000 .0000
1.0000 .0000 .0000
6.0000 .5000 360.0000

DISK
DISK MATERIAL
.0500 .9000 .0500 SPEC,DIFFUSE,ABSORPTION
5 6 24 T T T
.0000 .0000 1.0000
.0000 .0000 12.5000
1.0000 .0000 .0000
2.5000 .0000 180.0000 360.0000

SPHERE
SPHERE MATERIAL
.0500 .9000 .0500 SPEC,DIFFUSE,ABSORPTION
0 0 0 F F F END OF GEOMETRY
1994 6 19 0.0000 Y M D H START
1994 10 27 12.0000 Y M D H END
.0000 360.0000 ORBPOS (1),ORBPOS (2)
.0000 360.0000 F PRECES (1),PRECES (2),TIMCOR
28.5000 ORBINC
.2460 6.3780E+03 4.5000E+02 ALBEDO,RE,HSAT
10 5 10 1000 T F F MAXRAY,MAXALB,NALB,ISUNPOS,SHORTL,CHECK,INACT
5 5 NTHETA,NPHI
997531 ISEED

```

### A.3 Output File

This is the file that is generated by SOLSHAD as standard output, which is generally redirected to a file.

Convex file: solmicro/solshad.out\_sample

1 PROGRAM SOLSHAD - SOLAR EXPOSURE MICROENVIRONMENT CODE

DATE : 14-Feb-95 TIME : 06:52:36

ECHO OF INPUT DECK

SOLSHAD sample input with 5 surfaces

1	5	5	T	T	-4.0000	15.1000
					4.0000	15.1000
					4.0000	15.1000
						1.0000

PLANE MATERIAL	0.5000	0.5000	0.0000	SPEC, DIFFUSE, ABSORPTION
2	5	24	T T T	0.0000
				0.0000
				0.0000
				1.6667

360.0000

CYLINDER MATERIAL	0.2500	0.7000	0.0500	SPEC, DIFFUSE, ABSORPTION
3	6	24	T T T	0.0000
				0.0000
				5.0000
				0.0000
				1.6667

360.0000

CONE MATERIAL	0.3000	0.6000	0.1000	SPEC, DIFFUSE, ABSORPTION
4	4	24	T T T	0.0000
				0.0000
				0.0000
				0.0000
				0.5000

360.0000

DISK MATERIAL	0.0500	0.9000	0.0500	SPEC, DIFFUSE, ABSORPTION
5	6	24	T T T	0.0000
				0.0000
				12.5000
				0.0000
				180.0000

360.0000

SPHERE MATERIAL	0.0500	0.9000	0.0500	SPEC, DIFFUSE, ABSORPTION
0	0	0	F F F	END OF GEOMETRY
1994	6	19	0.0000	Y M D H START
1994	10	27	12.0000	Y M D H END
	0.0000	360.0000		ORBPPOS (1), ORBPPOS (2)
	0.0000	360.0000	F	PRECES (1), PRECES (2), TIMCOR
	28.5000			ORBINC
	0.2460	6.3780E+03	4.5000E+02	ALBEDO, RE, HSAT

0-2

10 5 10 1000 T F MAXRAY, MAXALB, NALB, ISUNFOS, SHORTL, CHECK, INACT  
 5 5 NTHETA, NPHI  
 997531 ISEED

SOLSHAD sample input with 5 surfaces  
 OPRMARY SURFACE 1 PLANE  
 COORDINATES OF CORNERS (X,Y,Z) -4.0000 15.1000  
 POINT P1 -4.0000 4.0000 15.1000  
 POINT P2 -4.0000 4.0000 15.1000  
 POINT P3 4.0000 -4.0000 15.1000  
 POINT P4 4.0000 -4.0000 15.1000  
 LENGTH RATIO 1.000000

SURFACE PROPERTIES  
 PLANE MATERIAL  
 SPECULAR REFLECTIVITY 0.500  
 DIFFUSE REFLECTIVITY 0.500  
 ABSORPTION 0.000  
 OPRMARY SURFACE 2 CYLINDER  
 COORDINATES (X,Y,Z) OF AXIS VECTOR E CENTER A OF MAXIMUM RADIUS CIRCLE, AND REFERENCE POINT PR  
 VECTOR E 0.0000 1.0000  
 POINT A 0.0000 0.0000 0.0000  
 POINT PR 1.0000 0.0000 0.0000  
 MAXIMUM RADIUS R = 3.0000  
 RATIO H OF AXIS LENGTH TO RADIUS R = 1.66670000  
 RADIUS RATIO G = 1.00000000  
 SECTOR AZIMUTH UPPER LIMIT THETAM = 360.0000 DEGREES

SURFACE PROPERTIES  
 CYLINDER MATERIAL  
 SPECULAR REFLECTIVITY 0.250  
 DIFFUSE REFLECTIVITY 0.700  
 ABSORPTION 0.050  
 OPRMARY SURFACE 3 CONE  
 COORDINATES (X,Y,Z) OF AXIS VECTOR E CENTER A OF MAXIMUM RADIUS CIRCLE, AND REFERENCE POINT PR  
 VECTOR E 0.0000 0.0000 1.0000  
 POINT A 0.0000 0.0000 5.0000  
 POINT PR 1.0000 0.0000 0.0000  
 MAXIMUM RADIUS R = 3.0000  
 RATIO H OF AXIS LENGTH TO RADIUS R = 1.66670000  
 RADIUS RATIO G = 0.00100000  
 SECTOR AZIMUTH UPPER LIMIT THETAM = 360.0000 DEGREES

SURFACE PROPERTIES  
 CONE MATERIAL  
 SPECULAR REFLECTIVITY 0.300  
 DIFFUSE REFLECTIVITY 0.600  
 ABSORPTION 0.100  
 OPRMARY SURFACE 4 DISK  
 COORDINATES (X,Y,Z) OF AXIS VECTOR E, CENTER A, AND REFERENCE POINT PR  
 VECTOR E 0.00000E+00 0.00000E+00 0.10000E+01  
 POINT A 0.00000E+00 0.00000E+00 0.00000E+00  
 POINT PR 0.10000E+01 0.00000E+00 0.00000E+00  
 OUTER RADIUS R = 6.0000  
 RATIO OF INNER TO OUTER RADIUS G = 0.5000  
 NOZ SURFACE AZIMUTH UPPER LIMIT THETAM = 360.0000 DEGREES

SURFACE PROPERTIES  
 DISK MATERIAL  
 SPECULAR REFLECTIVITY 0.050  
 DIFFUSE REFLECTIVITY 0.900

SPHERE SEGMENT

ABSORPTION 0.050  
 PRIMARY SURFACE 5 SPHERE  
 COORDINATES (X,Y,Z) OF AXIS VECTOR E, CENTER A, AND REFERENCE POINT PR  
 VECTOR E 0.0000 0.0000 1.0000  
 POINT A 0.0000 0.0000 12.5000  
 POINT PR 1.0000 0.0000 0.0000  
 RADIUS R= 2.5000  
 ANGLES IN DEGREES PHI1= 0.00 PHI2=180.00 THETA=360.00

SURFACE PROPERTIES  
 SPHERE MATERIAL  
 SPECULAR REFLECTIVITY 0.050  
 DIFFUSE REFLECTIVITY 0.900  
 ABSORPTION 0.050  
 TOTAL PRIMARY SURFACES 5  
 TOTAL NODAL SURFACES 529

CPU TIME AFTER LEAVING RAYC1 0.0611 S  
 TOTAL AREA OF OBJECT NODES IS 298.02890  
 SOLAR EXPOSURE MISSION AND ORBIT PARAMETERS  
 MISSION START (YEAR, MONTH, DAY, GHT HOUR) 1994 6 19 0.0000  
 MISSION END (YEAR, MONTH, DAY, GHT HOUR) 1994 10 27 12.0000  
 RANGE OF POSITIONS IN ORBIT (DEGREES) 0.000 TO 360.000  
 ORBIT INCLINATION (DEGREES) 28.500  
 INITIAL NODAL CROSSING LONGITUDE (DEGREES E) 0.0000  
 RANGE OF ORBIT PRECESSION (DEGREES) 360.0000  
 ORBIT PRECESSION IS NOT CORRELATED TO MISSION TIME

MISSION DURATION IN HOURS 3132.00  
 DUP TO 10 RAYS PER AVERAGE GRID AREA WILL BE CONSIDERED FOR  
 EACH POINT IN THE MONTE CARLO SIMULATION FOR DIRECT SOLAR ILLUMINATION  
 DUP TO 5 RAYS PER AVERAGE GRID AREA WILL BE CONSIDERED FOR  
 EACH POINT IN THE MONTE CARLO SIMULATION FOR EARTH REFLECTED ILLUMINATION  
 ONE OF EVERY 10 SUN POSITIONS WILL BE USED FOR CALCULATING EARTH REFLECTED RADIATION  
 0 1000 RANDOM SUN POSITIONS WILL BE CHOSEN  
 0 THE EARTH IS CENTERED AT X = -6.8280E+03 Y = 0, Z = 0  
 AND HAS RADIUS 6.3780E+03  
 THE SATELLITE IS AT HEIGHT 4.5000E+02 ABOVE THE EARTH  
 AND IS PLACED AT THE COORDINATE ORIGIN  
 0 THE VIEW OF THE EARTH FROM THE SATELLITE IS DIVIDED INTO  
 5 EQUAL 28NTH ANGLE INCREMENTS OF 13.8165 DEGREES FROM 0 TO 69.08 DEGREES  
 5 EQUAL AZIMUTH ANGLE INCREMENTS OF 72.0000 DEGREES FROM 0 TO 360 DEGREES

THE EARTH ALBEDO IS 0.2460  
 Iseed used is 997531  
 OSURFACE TO SURFACE VISIBILITY MATRIX ISEE

FTTTT  
 TFFTF  
 TFFFT  
 TFFFT  
 TFFTF

MSCAT ARRAY FOR SURFACES:  
 SURFACE 1 2 3 4 5  
 MSCAT T T T T T

CPU TIME AFTER VISIBILITY MATRIX GENERATION 8.8697 S  
 AREA OF SMALLEST NODE = 6.3607E-02  
 THIS NODE MAY HAVE UP TO 1 DIRECT SOLAR RAYS SCATTERED FROM IT  
 AND UP TO 0 EARTH REFLECTED RAYS SCATTERED FROM IT  
 PER POINT ON EARTH

AREA OF LARGEST NODE = 2.5600E+00  
 THIS NODE MAY HAVE UP TO 36 DIRECT SOLAR RAYS SCATTERED FROM IT  
 AND UP TO 18 EARTH REFLECTED RAYS SCATTERED FROM IT

PER POINT ON EARTH

AREA OF AVERAGE NODE - 7.1185E-01  
 THIS NODE MAY HAVE UP TO 10 RAYS DIRECT SOLARSCATTERED FROM IT  
 AND UP TO 5 EARTH REFLECTED RAYS SCATTERED FROM IT  
 PER POINT ON EARTH

USING THE CURRENT VALUE OF MAXRAY = 10  
 0 NODES OF 529 TOTAL NODES WILL HAVE NO DIRECT SOLAR RAYS  
 SCATTERED FROM THEM

USING THE CURRENT VALUE OF MAXALB = 5  
 529 TOTAL NODES WILL HAVE NO EARTH REFLECTED RAYS  
 SCATTERED FROM THEM

CPU TIME AFTER PRECALCULATIONS 8.9152 S

SUN POSITION	100 OF 1000	CPUTIME	29.792
SUN POSITION	200 OF 1000	CPUTIME	55.855
SUN POSITION	300 OF 1000	CPUTIME	75.322
SUN POSITION	400 OF 1000	CPUTIME	104.101
SUN POSITION	500 OF 1000	CPUTIME	130.324
SUN POSITION	600 OF 1000	CPUTIME	155.394
SUN POSITION	700 OF 1000	CPUTIME	182.335
SUN POSITION	800 OF 1000	CPUTIME	207.111
SUN POSITION	900 OF 1000	CPUTIME	230.369
SUN POSITION	1000 OF 1000	CPUTIME	247.301

CPU TIME AFTER FLUX CALCULATIONS 247.4531 S

MEAN AND STANDARD DEVIATION OF SUN VECTORS WITH RESPECT TO COORDINATE AXES  
 ONLY SUN POSITIONS WHICH ILLUMINATE THE SATELLITE ARE INCLUDED

AXIS	MEAN COMPONENT	STANDARD DEVIATION
X	0.4077	0.3952
Y	-0.1568	0.3792
Z	-0.0355	0.7136

MEAN AND STANDARD DEVIATION OF SUN ZENITH AND AZIMUTH ANGLES (DEGREES)  
 WITH RESPECT TO COORDINATE AXES

ZENITH IS MEASURED WITH RESPECT TO THE X AXIS	MEAN COMPONENT	STANDARD DEVIATION
ANGLE	62.4320	27.9020
ZENITH	-22.9764	109.5455
AZIMUTH	655 OF 1000 SUN POSITIONS ILLUMINATE THE SATELLITE	2133310

OTOTAL RAYS INCLUDED IN THIS CALCULATION = 341487  
 OTOTAL RAYS INCLUDED IN EARTH REFLECTION = 341487

CPU TIME AFTER INTERPOLATION 248.1326 S  
 1 CUMULATIVE EQUIVALENT SUN HOURS (CESH) FOR EACH POINT

CESH ARE CALCULATED FOR A MISSION LENGTH OF 3132.00 HOURS

CESH ARE DUE TO SOLAR AND EARTH REFLECTED RADIATION  
 FIRST LINE OF ENTRIES IS FOR SOLAR RADIATION  
 SECOND LINE OF ENTRIES IS FOR EARTH REFLECTED RADIATION  
 THIRD LINE OF ENTRIES IS FOR TOTAL RADIATION EXPOSURE

SURFACE	TYPE	POINT	PRIMARY	SPECULAR REFL	SOLAR EXPOSURE (CESH)	DIFFUSE REFL	ABSORPTION	TOTAL	X	Y	Z
1	TRAPEZOID	1	4.83E+02	1.09E+01	4.54E+01	0.00E+00	5.39E+02	-3.984	-3.984	15.100	0.00E+00
			6.11E+01	3.92E+00	2.10E+01	0.00E+00	8.60E+01				
			5.44E+02	1.48E+01	6.64E+01	0.00E+00	6.25E+02				

1	TRAPEZOID	2	4.46E+02	9.32E+00	4.66E+01	0.00E+00	5.03E+02	-3.984	-2.384	15.100
			6.11E+01	3.70E+00	2.66E+01	0.00E+00	9.14E+01			
1	TRAPEZOID	3	5.07E+02	1.30E+01	7.32E+01	0.00E+00	5.94E+02	-3.984	-0.784	15.100
			3.39E+02	7.62E+00	4.42E+01	0.00E+00	3.91E+02			
1	TRAPEZOID	4	6.11E+01	3.71E+00	3.58E+01	0.00E+00	1.01E+02	-3.984	0.816	15.100
			4.00E+02	1.33E+01	8.01E+01	0.00E+00	4.92E+02			
1	TRAPEZOID	5	2.89E+02	6.87E+00	3.73E+01	0.00E+00	3.32E+02	-3.984	2.416	15.100
			6.11E+01	3.64E+00	3.53E+01	0.00E+00	1.00E+02			
1	TRAPEZOID	6	3.48E+02	7.16E+01	7.26E+01	0.00E+00	4.32E+02	-3.984	3.984	15.100
			6.11E+01	2.67E+00	3.18E+01	0.00E+00	3.87E+02			
1	TRAPEZOID	7	4.09E+02	9.84E+00	2.58E+01	0.00E+00	8.96E+01	-3.984	-3.984	15.100
			3.85E+02	7.93E+00	5.76E+01	0.00E+00	4.77E+02			
1	TRAPEZOID	8	6.11E+01	2.12E+00	2.05E+01	0.00E+00	4.24E+02	-3.984	0.816	15.100
			4.46E+02	1.00E+01	5.11E+01	0.00E+00	5.08E+02			
1	TRAPEZOID	9	4.76E+02	1.02E+01	5.98E+01	0.00E+00	5.45E+02	-2.384	-0.784	15.100
			6.11E+01	2.92E+00	2.20E+01	0.00E+00	8.60E+01			
1	TRAPEZOID	10	5.37E+02	1.31E+01	8.18E+01	0.00E+00	6.31E+02	-2.384	0.816	15.100
			4.24E+02	8.84E+00	6.55E+01	0.00E+00	5.04E+02			
1	TRAPEZOID	11	6.11E+01	3.02E+00	3.11E+01	0.00E+00	9.52E+01	-2.384	-0.784	15.100
			4.86E+02	1.19E+01	9.66E+01	0.00E+00	5.99E+02			
1	TRAPEZOID	12	2.58E+02	6.93E+00	7.07E+01	0.00E+00	3.41E+02	-2.384	2.416	15.100
			6.11E+01	3.64E+00	4.95E+01	0.00E+00	1.14E+02			
1	TRAPEZOID	13	3.19E+02	1.06E+01	1.20E+02	0.00E+00	4.55E+02	-2.384	0.816	15.100
			1.92E+02	6.02E+00	5.44E+01	0.00E+00	2.58E+02			
1	TRAPEZOID	14	6.11E+01	3.69E+00	4.79E+01	0.00E+00	1.13E+02	-2.384	-0.784	15.100
			2.53E+02	9.72E+00	1.02E+02	0.00E+00	3.70E+02			
1	TRAPEZOID	15	3.00E+02	6.70E+00	3.75E+01	0.00E+00	3.48E+02	-2.384	2.416	15.100
			6.11E+01	2.79E+00	2.87E+01	0.00E+00	9.26E+01			
1	TRAPEZOID	16	3.62E+02	7.57E+00	6.62E+01	0.00E+00	4.41E+02	-2.384	3.984	15.100
			6.11E+01	2.36E+00	3.43E+01	0.00E+00	4.06E+02			
1	TRAPEZOID	17	4.23E+02	9.93E+00	2.14E+01	0.00E+00	8.48E+01	-0.784	-0.784	15.100
			5.65E+01	1.77E+00	2.11E+01	0.00E+00	7.95E+01			
1	TRAPEZOID	18	4.01E+02	1.31E+01	1.24E+02	0.00E+00	6.74E+02	-0.784	0.816	15.100
			5.60E+01	2.22E+01	1.52E+02	0.00E+00	5.64E+02			
1	TRAPEZOID	19	4.57E+02	1.35E+01	3.39E+01	0.00E+00	9.19E+01	-0.784	-2.384	15.100
			1.62E+02	1.23E+01	1.86E+02	0.00E+00	6.55E+02			
1	TRAPEZOID	20	4.14E+01	3.45E+00	5.98E+01	0.00E+00	3.86E+02	-0.784	0.816	15.100
			2.04E+02	1.58E+01	2.82E+02	0.00E+00	1.07E+02			
1	TRAPEZOID	21	8.23E+01	1.04E+01	1.72E+02	0.00E+00	4.93E+02	-0.784	3.984	15.100
			3.86E+01	3.41E+00	5.63E+01	0.00E+00	2.55E+02			
1	TRAPEZOID	22	1.21E+02	1.38E+01	2.28E+02	0.00E+00	3.51E+02	-0.784	2.416	15.100
			2.51E+02	7.75E+00	7.69E+01	0.00E+00	3.39E+02			
1	TRAPEZOID	23	5.48E+01	2.43E+00	2.84E+01	0.00E+00	8.65E+01	-0.784	-0.784	15.100
			3.06E+02	1.02E+01	1.05E+02	0.00E+00	4.26E+02			
1	TRAPEZOID	24	6.11E+01	2.30E+00	1.95E+01	0.00E+00	8.39E+01	-0.784	0.816	15.100
			4.09E+02	1.02E+01	7.26E+01	0.00E+00	4.92E+02			
1	TRAPEZOID	25	5.13E+02	1.48E+01	1.41E+02	0.00E+00	6.66E+02	0.816	-3.984	15.100
			4.58E+01	1.23E+00	1.35E+01	0.00E+00	6.05E+01			
1	TRAPEZOID	26	5.59E+02	1.60E+01	1.54E+02	0.00E+00	7.27E+02	0.816	-2.384	15.100
			4.66E+02	1.63E+01	2.17E+02	0.00E+00	6.85E+02			
1	TRAPEZOID	27	3.46E+01	1.38E+00	1.99E+01	0.00E+00	5.56E+01	-0.784	0.816	15.100
			5.00E+02	1.76E+01	2.36E+02	0.00E+00	7.41E+02			
1	TRAPEZOID	28	2.85E+02	1.96E+01	3.38E+02	0.00E+00	6.37E+02	0.816	-0.784	15.100
			5.62E+00	1.89E+00	3.16E+01	0.00E+00	4.45E+01			
1	TRAPEZOID	29	2.96E+02	2.15E+01	3.70E+02	0.00E+00	6.82E+02	0.816	0.816	15.100
			2.28E+02	1.64E+01	2.79E+02	0.00E+00	5.18E+02			
1	TRAPEZOID	30	1.36E+01	1.71E+00	2.91E+01	0.00E+00	4.35E+01	-0.784	0.816	15.100
			2.41E+02	1.81E+01	3.08E+02	0.00E+00	5.61E+02			
1	TRAPEZOID	31	3.52E+02	1.11E+01	1.24E+02	0.00E+00	4.88E+02	0.816	2.416	15.100
			3.77E+01	1.50E+00	1.62E+01	0.00E+00	5.62E+01			
1	TRAPEZOID	32	3.90E+02	1.26E+01	1.41E+02	0.00E+00	5.44E+02			



1	TRAPEZOID	24	4.07E+02	1.05E+01	8.14E+01	0.00E+00	5.03E+02	0.816	3.984	15.100
			4.62E+01	1.74E+00	1.26E+01	0.00E+00	6.05E+01			
			4.54E+02	1.23E+01	9.39E+01	0.00E+00	5.64E+02			
1	TRAPEZOID	25	5.56E+02	1.60E+01	1.33E+02	0.00E+00	7.08E+02	2.416	-3.984	15.100
			4.04E+01	6.56E-01	6.49E+00	0.00E+00	4.73E+01			
			5.96E+02	1.66E+01	1.40E+02	0.00E+00	7.55E+02			
1	TRAPEZOID	26	5.46E+02	1.77E+01	1.81E+02	0.00E+00	7.38E+02	2.416	-2.384	15.100
			2.84E+01	5.52E-01	6.28E+00	0.00E+00	3.61E+01			
			5.77E+02	1.83E+01	1.87E+02	0.00E+00	7.47E+02			
1	TRAPEZOID	27	4.94E+02	2.05E+01	2.58E+02	0.00E+00	7.63E+02	2.416	-0.784	15.100
			1.21E+01	3.46E-01	5.38E+00	0.00E+00	1.81E+01			
			5.07E+02	2.09E+01	2.63E+02	0.00E+00	7.81E+02			
1	TRAPEZOID	28	4.73E+02	1.92E+01	2.25E+02	0.00E+00	7.08E+02	2.416	0.816	15.100
			1.56E+01	5.21E-01	4.96E+00	0.00E+00	2.21E+01			
			4.89E+02	1.97E+01	2.30E+02	0.00E+00	7.31E+02			
1	TRAPEZOID	29	5.07E+02	1.52E+01	1.25E+02	0.00E+00	6.42E+02	2.416	2.416	15.100
			2.59E+01	8.76E-01	5.65E+00	0.00E+00	3.25E+01			
			5.28E+02	1.61E+01	1.31E+02	0.00E+00	6.75E+02			
1	TRAPEZOID	30	5.09E+02	1.37E+01	9.07E+01	0.00E+00	6.17E+02	2.416	3.984	15.100
			2.78E+01	1.07E+00	6.12E+00	0.00E+00	3.47E+01			
			5.37E+02	1.48E+01	9.69E+01	0.00E+00	6.52E+02			
1	TRAPEZOID	31	5.77E+02	1.55E+01	1.20E+02	0.00E+00	7.12E+02	3.984	-3.984	15.100
			4.04E+01	5.21E-01	5.14E+00	0.00E+00	4.61E+01			
			6.17E+02	1.60E+01	1.25E+02	0.00E+00	7.58E+02			
1	TRAPEZOID	32	5.66E+02	1.75E+01	1.48E+02	0.00E+00	7.31E+02	3.984	-2.384	15.100
			3.51E+01	4.69E-01	4.46E+00	0.00E+00	4.01E+01			
			6.01E+02	1.80E+01	1.52E+02	0.00E+00	7.71E+02			
1	TRAPEZOID	33	5.53E+02	2.05E+01	1.82E+02	0.00E+00	7.56E+02	3.984	-0.784	15.100
			2.29E+01	2.42E-01	3.14E+00	0.00E+00	2.63E+01			
			5.76E+02	2.07E+01	1.85E+02	0.00E+00	7.82E+02			
1	TRAPEZOID	34	5.44E+02	2.07E+01	1.65E+02	0.00E+00	7.26E+02	3.984	0.816	15.100
			1.98E+01	5.11E-01	2.91E+00	0.00E+00	2.32E+01			
			5.64E+02	2.12E+01	1.67E+02	0.00E+00	7.49E+02			
1	TRAPEZOID	35	5.49E+02	1.79E+01	1.14E+02	0.00E+00	6.79E+02	3.984	2.416	15.100
			2.45E+01	7.91E-01	3.83E+00	0.00E+00	2.92E+01			
			5.74E+02	1.83E+01	1.18E+02	0.00E+00	7.08E+02			
1	TRAPEZOID	36	5.62E+02	1.53E+01	8.60E+01	0.00E+00	6.63E+02	3.984	3.984	15.100
			2.54E+01	6.93E-01	4.29E+00	0.00E+00	3.04E+01			
			5.87E+02	1.60E+01	9.02E+01	0.00E+00	6.94E+02			
2	CONE	37	5.31E+02	2.02E+01	4.80E+02	5.02E+01	1.03E+03	3.000	0.008	0.010
			0.00E+00	0.00E+00	8.62E+00	3.92E-01	8.61E+00			
			5.31E+02	2.02E+01	4.89E+02	5.06E+01	1.04E+03			
2	CONE	38	4.82E+02	1.97E+01	4.49E+02	4.51E+01	9.50E+02	2.896	0.784	0.010
			0.00E+00	0.00E+00	1.09E+01	4.43E-01	1.08E+01			
			4.82E+02	1.97E+01	4.60E+02	4.55E+01	9.61E+02			
2	CONE	39	4.08E+02	1.60E+01	4.10E+02	3.87E+01	8.33E+02	2.594	1.507	0.010
			3.79E-01	6.52E-02	1.36E+01	8.51E-01	1.41E+01			
			4.08E+02	1.61E+01	4.24E+02	3.96E+01	8.47E+02			
2	CONE	40	3.17E+02	1.25E+01	3.85E+02	3.74E+01	7.14E+02	2.116	2.127	0.010
			3.36E+00	1.78E-01	1.77E+01	1.36E+00	2.12E+01			
			3.20E+02	1.26E+01	4.03E+02	3.88E+01	7.36E+02			
2	CONE	41	2.29E+02	9.33E+01	3.57E+02	3.30E+01	5.96E+02	1.493	2.602	0.010
			1.03E+01	5.80E-01	2.41E+01	1.56E+00	3.50E+01			
			2.39E+02	9.31E+00	3.81E+02	3.46E+01	6.31E+02			
2	CONE	42	1.56E+02	6.94E+00	3.25E+02	2.56E+01	4.88E+02	0.769	2.900	0.010
			2.00E+01	1.03E+00	3.40E+01	3.18E+00	5.51E+01			
			1.76E+02	7.97E+00	3.59E+02	2.88E+01	5.43E+02			
2	CONE	43	9.80E+01	5.23E+00	3.01E+02	2.04E+01	4.06E+02	-0.008	3.000	0.010
			1.22E+01	4.43E+01	3.80E+00	3.80E+00	7.61E+01			
			1.29E+02	6.45E+00	2.42E+02	2.42E+01	4.82E+02			
2	CONE	44	6.14E+01	3.24E+00	2.65E+02	1.71E+01	3.32E+02	-0.784	2.896	0.010
			4.35E+00	1.55E+00	4.95E+01	3.94E+00	9.50E+01			
			1.05E+02	4.79E+00	3.14E+02	2.11E+00	4.27E+02			
2	CONE	45	4.28E+01	2.71E+00	2.26E+02	1.39E+01	2.71E+02	-1.907	2.594	0.010
			6.07E+01	2.30E+00	5.36E+01	5.20E+00	1.17E+02			
			1.04E+02	5.01E+00	2.79E+02	1.91E+01	3.88E+02			

2	CONE	46	3.26E+01	2.54E+00	2.00E+02	1.07E+01	2.36E+02	-2.127	2.116	0.010
			7.95E+01	3.05E+00	5.53E+01	6.97E+00	1.38E+02			
2	CONE	47	1.12E+02	5.59E+00	2.56E+02	1.77E+01	3.73E+02	-2.602	1.493	0.010
			2.76E+01	2.28E+00	1.99E+02	9.96E+00	2.30E+02			
2	CONE	48	9.82E+01	3.32E+00	5.75E+01	8.82E+00	1.59E+02	-2.900	0.769	0.010
			2.67E+01	1.97E+00	1.98E+02	1.17E+01	3.89E+02			
2	CONE	49	1.15E+02	3.52E+00	6.33E+01	9.15E+00	1.82E+02	-3.000	-0.008	0.010
			4.1E+02	5.49E+00	2.61E+02	2.08E+01	4.09E+02			
2	CONE	50	3.07E+01	1.49E+00	1.99E+02	1.09E+01	2.31E+02	-2.896	-1.507	0.010
			1.25E+02	3.76E+00	6.58E+01	9.17E+00	1.94E+02			
2	CONE	51	4.08E+01	2.25E+00	2.65E+02	2.01E+01	4.25E+02	-2.594	-0.784	0.010
			1.26E+02	3.20E+00	2.19E+02	1.07E+01	2.63E+02			
2	CONE	52	1.67E+02	6.07E+00	2.85E+02	1.97E+01	4.59E+02	-2.116	-2.602	0.010
			5.45E+01	4.12E+00	2.38E+02	1.18E+01	2.97E+02			
2	CONE	53	1.20E+02	2.71E+00	6.24E+01	8.53E+00	1.64E+02	-1.493	-2.900	0.010
			1.74E+02	6.83E+00	3.00E+02	2.03E+01	4.81E+02			
2	CONE	54	1.08E+02	6.30E+00	2.56E+02	1.54E+01	3.37E+02	0.008	-3.000	0.010
			1.84E+02	8.32E+00	3.13E+02	2.37E+01	5.04E+02			
2	CONE	55	1.16E+02	8.00E+00	2.93E+02	2.03E+01	4.17E+02	0.784	-2.896	0.010
			9.22E+01	1.30E+00	5.47E+01	7.09E+00	1.48E+02			
2	CONE	56	2.08E+02	9.31E+00	3.47E+02	2.74E+01	5.65E+02	-2.127	2.116	0.010
			1.71E+02	6.21E+00	3.51E+02	2.56E+01	5.30E+02			
2	CONE	57	7.35E+01	1.14E+00	4.91E+01	5.63E+00	1.24E+02	1.507	-2.594	0.010
			2.45E+02	7.35E+00	4.00E+02	3.13E+01	6.54E+02			
2	CONE	58	2.42E+02	9.36E+00	3.94E+02	2.92E+01	6.46E+02	0.008	-3.000	0.010
			3.26E+01	6.38E-01	4.10E+01	4.73E+00	9.44E+01			
2	CONE	59	2.95E+02	1.00E+01	4.35E+02	3.40E+01	7.40E+02	2.127	-2.116	0.010
			3.28E+02	1.42E+01	3.94E+02	3.15E+01	7.36E+02			
2	CONE	60	3.61E+02	1.44E+01	3.25E+01	3.47E+00	6.59E+01	2.602	-1.493	0.010
			4.15E+02	1.74E+01	4.27E+02	4.49E+01	8.02E+02			
2	CONE	61	1.74E+01	2.66E-02	2.53E+01	2.41E+00	4.29E+01	2.900	-0.769	0.010
			4.32E+02	1.57E+01	4.30E+02	4.52E+01	8.77E+02			
2	CONE	62	4.88E+02	1.81E+01	4.38E+02	4.89E+01	9.44E+02	2.127	-2.116	0.010
			6.97E+00	-8.44E-03	1.95E+01	1.34E+00	2.65E+01			
2	CONE	63	4.95E+02	1.80E+01	4.57E+02	5.02E+01	9.71E+02	2.602	-1.493	0.010
			5.37E+02	1.84E+01	4.52E+02	4.95E+01	1.01E+03			
2	CONE	64	1.24E+00	3.85E-02	1.31E+01	4.58E-01	1.44E+01	2.900	-0.769	0.010
			5.38E+02	1.85E+01	4.66E+02	4.99E+01	1.02E+03			
2	CONE	65	5.53E+02	1.75E+01	4.70E+02	4.96E+01	1.04E+03	2.900	-0.769	0.010
			0.00E+00	3.65E-02	8.85E+00	3.64E-01	8.63E+00			
2	CONE	66	5.36E+02	1.76E+01	4.79E+02	5.01E+01	1.05E+03	3.000	-0.008	0.010
			0.00E+00	0.00E+00	8.16E+00	4.58E-01	8.07E+00			
2	CONE	67	5.36E+02	1.85E+01	4.90E+02	4.91E+01	1.05E+03	3.000	0.008	1.010
			5.90E+02	1.52E+01	3.24E+02	4.53E+01	9.27E+02			
2	CONE	68	0.00E+00	0.00E+00	6.81E+00	3.42E-01	6.81E+00	2.896	0.784	1.010
			5.90E+02	1.52E+01	3.31E+02	4.56E+01	9.34E+02			
2	CONE	69	5.35E+02	1.45E+01	3.07E+02	4.15E+01	8.57E+02	2.594	1.507	1.010
			0.00E+00	0.00E+00	8.12E+00	4.41E-01	8.05E+00			
2	CONE	70	5.35E+02	1.45E+01	3.15E+02	4.19E+01	8.65E+02	2.594	1.507	1.010
			4.48E+02	1.35E+01	2.80E+02	3.63E+01	7.42E+02			
2	CONE	71	3.78E-01	6.34E-02	9.99E+00	7.57E-01	1.05E+01	2.116	2.127	1.010
			4.48E+02	1.36E+01	2.90E+02	3.71E+01	7.55E+02			
2	CONE	72	3.48E+02	1.17E+01	2.61E+02	3.09E+01	6.21E+02	2.116	2.127	1.010
			3.36E+00	2.53E-01	1.29E+01	1.07E+00	1.65E+01			
2	CONE	73	3.52E+02	1.20E+01	2.74E+02	3.20E+01	6.37E+02	1.493	2.602	1.010
			2.52E+02	8.94E+00	2.41E+02	2.53E+01	5.02E+02			
2	CONE	74	1.02E+01	5.88E-01	1.78E+01	1.37E+00	2.85E+01	0.769	2.900	1.010
			2.62E+02	9.52E+00	2.59E+02	2.67E+01	5.31E+02			
2	CONE	75	1.68E+02	6.86E+00	2.24E+02	2.13E+01	4.01E+02	0.769	2.900	1.010
			2.09E+01	8.95E-01	2.43E+01	2.63E+00	4.66E+01			
			1.89E+02	7.75E+00	2.49E+02	2.39E+01	4.47E+02			

2	CONE	68	1.02E+02	4.70E+00	2.09E+02	1.67E+01	3.18E+02	-0.008	3.000	1.010
			3.35E+01	9.44E-01	3.06E+01	3.69E+00	6.61E+01			
2	CONE	69	1.35E+02	5.64E+00	2.39E+02	2.04E+01	3.85E+02	-0.784	2.896	1.010
			6.21E+01	2.69E+00	1.86E+02	1.24E+01	2.53E+02			
2	CONE	70	4.80E+01	1.14E+00	3.35E+01	4.21E+00	8.45E+01	-1.507	2.594	1.010
			1.10E+02	3.82E+00	2.19E+02	1.66E+01	3.37E+02			
2	CONE	71	4.28E+01	2.42E+00	1.60E+02	1.02E+01	2.06E+02	-2.127	2.116	1.010
			7.33E+01	1.67E+00	3.58E+01	5.27E+00	1.11E+02			
2	CONE	72	1.16E+02	4.09E+00	1.96E+02	1.54E+01	3.17E+02	-2.602	1.493	1.010
			3.24E+01	2.32E+00	1.43E+02	8.26E+00	1.78E+02			
2	CONE	73	9.90E+01	2.33E+00	3.73E+01	6.62E+00	1.38E+02	0.769	1.010	1.010
			1.31E+02	4.65E+00	1.80E+02	1.49E+01	3.16E+02			
2	CONE	74	2.75E+01	1.43E+00	1.43E+02	8.46E+00	1.73E+02	-3.000	-0.008	1.010
			1.14E+02	2.72E+00	3.88E+01	7.97E+00	1.56E+02			
2	CONE	75	1.42E+02	4.37E+00	1.82E+02	1.64E+01	3.29E+02	-2.900	0.769	1.010
			2.66E+01	1.86E+00	1.43E+02	9.73E+00	1.72E+02			
2	CONE	76	1.26E+02	2.81E+00	4.22E+01	8.36E+00	1.72E+02	-2.116	-2.127	1.010
			1.52E+02	4.68E+00	1.85E+02	1.81E+01	3.44E+02			
2	CONE	77	3.07E+01	1.50E+00	1.45E+02	9.30E+00	1.77E+02	-2.594	-1.507	1.010
			1.36E+02	3.14E+00	4.35E+01	8.19E+00	1.84E+02			
2	CONE	78	1.67E+02	4.64E+00	1.88E+02	1.75E+01	3.61E+02	-2.896	-0.784	1.010
			4.08E+01	2.14E+00	1.54E+02	8.98E+00	1.97E+02			
2	CONE	79	1.78E+02	5.14E+00	4.33E+01	8.39E+00	1.84E+02	-2.594	-1.507	1.010
			1.78E+02	5.14E+00	1.97E+02	1.74E+01	3.81E+02			
2	CONE	80	5.44E+01	3.47E+00	1.67E+02	9.99E+00	2.26E+02	-2.116	-2.127	1.010
			1.29E+02	2.44E+00	4.09E+01	8.24E+00	1.72E+02			
2	CONE	81	1.83E+02	5.91E+00	2.08E+02	1.82E+01	3.97E+02	-2.594	-1.507	1.010
			7.67E+01	5.19E+00	1.82E+02	1.29E+01	2.64E+02			
2	CONE	82	1.13E+02	1.98E+00	3.72E+01	7.45E+00	1.52E+02	-2.602	1.493	1.010
			1.90E+02	7.18E+00	2.11E+02	2.03E+01	4.17E+02			
2	CONE	83	9.06E+01	6.30E+00	2.04E+02	1.57E+01	3.29E+02	0.008	-3.000	1.010
			1.18E+02	5.14E+00	3.67E+01	6.46E+00	1.33E+02			
2	CONE	84	9.46E+01	1.50E+00	3.67E+01	6.46E+00	1.33E+02	-2.900	-0.784	1.010
			2.13E+02	7.79E+00	2.41E+02	2.22E+01	4.63E+02			
2	CONE	85	1.78E+02	6.48E+00	2.43E+02	2.08E+01	4.32E+02	0.784	-2.896	1.010
			7.44E+01	1.14E+00	3.32E+01	5.41E+00	1.09E+02			
2	CONE	86	2.52E+02	7.61E+00	2.76E+02	2.62E+01	5.41E+02	-2.594	-1.507	1.010
			2.59E+02	9.52E+00	2.68E+02	2.50E+01	5.42E+02			
2	CONE	87	5.27E+01	6.37E-01	2.78E+01	4.27E+00	8.12E+01	2.127	-2.116	1.010
			3.12E+02	1.02E+01	2.96E+02	2.93E+01	6.24E+02			
2	CONE	88	3.62E+02	1.31E+01	2.67E+02	2.94E+01	6.44E+02	-2.896	-0.784	1.010
			3.29E+01	1.90E-01	2.31E+01	2.93E+00	5.65E+01			
2	CONE	89	3.95E+02	1.32E+01	2.90E+02	3.24E+01	7.01E+02	1.507	-2.594	1.010
			4.65E+02	1.42E+01	2.77E+02	3.96E+01	7.94E+02			
2	CONE	90	1.74E+01	2.42E-02	1.87E+01	1.99E+00	3.62E+01	2.127	-2.116	1.010
			4.82E+02	1.42E+01	2.95E+02	4.16E+01	7.90E+02			
2	CONE	91	5.47E+02	1.61E+01	2.97E+02	4.50E+01	8.60E+02	2.602	-1.493	1.010
			6.97E+00	-4.11E-03	1.45E+01	1.22E+00	2.16E+01			
2	CONE	92	6.00E+02	1.70E+01	3.03E+02	4.56E+01	9.20E+02	2.900	-0.769	1.010
			1.24E+00	1.88E-02	1.05E+01	4.49E-01	1.17E+01			
2	CONE	93	1.24E+00	1.88E-02	1.05E+01	4.49E-01	1.17E+01	2.900	-0.769	1.010
			6.02E+02	1.70E+01	3.14E+02	4.61E+01	9.32E+02			
2	CONE	94	6.00E+00	0.00E+00	3.12E+02	4.62E+01	9.42E+02	3.000	0.008	2.010
			0.00E+00	1.78E-02	8.11E+00	3.90E-01	7.98E+00			
2	CONE	95	6.16E+02	1.49E+01	3.20E+02	4.56E+01	9.49E+02	2.896	0.784	2.010
			5.94E+02	1.42E+01	6.84E+00	4.44E-01	6.79E+00			
2	CONE	96	0.00E+00	0.00E+00	3.20E+02	4.57E+01	9.31E+02	3.000	0.008	2.010
			5.94E+02	1.42E+01	3.20E+02	4.57E+01	9.31E+02			
2	CONE	97	5.94E+02	1.42E+01	3.20E+02	4.57E+01	9.31E+02	2.896	0.784	2.010
			6.97E+02	8.70E+00	1.20E+02	4.62E+01	9.38E+02			
2	CONE	98	6.97E+02	8.70E+00	1.20E+02	4.62E+01	9.38E+02	3.000	0.008	2.010
			0.00E+00	0.00E+00	3.87E+00	1.49E-01	3.88E+00			
2	CONE	99	0.00E+00	0.00E+00	3.87E+00	1.49E-01	3.88E+00	2.896	0.784	2.010
			6.27E+02	9.00E+00	1.18E+02	3.74E+01	7.55E+02			
2	CONE	100	6.27E+02	9.00E+00	1.18E+02	3.74E+01	7.55E+02	2.896	0.784	2.010
			5.20E+02	1.03E+01	1.09E+02	3.77E+01	7.58E+02			
2	CONE	101	5.20E+02	1.03E+01	1.09E+02	3.77E+01	7.58E+02	2.594	1.507	2.010
			3.74E-01	2.87E-02	4.37E+00	3.28E+01	6.38E+02			
2	CONE	102	3.74E-01	2.87E-02	4.37E+00	3.28E+01	6.38E+02	2.594	1.507	2.010
			5.20E+02	1.03E+01	1.13E+02	3.32E+01	6.43E+02			

2	CONE	90	4.00E+02	1.03E+01	1.01E+02	2.49E+01	5.12E+02	2.116	2.127	2.010
			3.46E+00	2.94E-01	5.64E+00	5.41E-01	9.19E+00			
			4.04E+02	1.06E+01	1.07E+02	2.54E+01	5.21E+02			
2	CONE	91	2.85E+02	7.61E+00	9.44E+01	1.84E+01	3.87E+02	1.493	2.602	2.010
			1.46E+01	4.89E-01	8.16E+00	1.23E+00	2.37E+01			
			3.00E+02	8.10E+00	1.03E+02	1.97E+01	4.11E+02			
2	CONE	92	1.87E+02	5.20E+00	9.11E+01	1.45E+01	2.83E+02	0.769	2.900	2.010
			3.20E+01	4.06E-01	1.07E+01	2.29E+00	4.36E+01			
			2.19E+02	5.61E+00	1.02E+02	1.68E+01	3.26E+02			
2	CONE	93	1.12E+02	3.81E+00	8.79E+01	1.08E+01	2.05E+02	-0.008	3.000	2.010
			5.04E+01	3.10E-01	1.22E+01	3.54E+00	6.35E+01			
			6.62E+02	4.12E+00	1.00E+02	1.44E+01	2.68E+02			
2	CONE	94	1.60E+01	2.28E+00	7.83E+01	7.40E+00	1.47E+02	-0.784	2.896	2.010
			7.00E+01	3.65E-01	1.32E+01	4.57E+00	8.43E+01			
			1.36E+02	2.64E+00	9.15E+01	1.20E+01	2.31E+02			
2	CONE	95	4.28E+01	2.45E+00	6.96E+01	5.35E+00	1.16E+02	-1.507	2.594	2.010
			9.74E+01	5.98E-01	1.27E+01	5.49E+00	1.11E+02			
			1.40E+02	3.05E+00	8.23E+01	1.08E+01	2.28E+02			
2	CONE	96	3.20E+01	2.55E+00	6.14E+01	4.95E+00	9.63E+01	-2.127	2.116	2.010
			1.28E+02	1.02E+00	1.25E+01	6.39E+00	1.41E+02			
			1.60E+02	3.56E+00	7.39E+01	1.13E+01	2.38E+02			
2	CONE	97	2.73E+01	1.60E+00	6.12E+01	5.45E+00	9.03E+01	-2.602	1.493	2.010
			1.45E+02	1.51E+00	1.43E+01	7.82E+00	1.61E+02			
			1.72E+02	3.12E+00	7.55E+01	1.33E+01	2.52E+02			
2	CONE	98	2.64E+01	1.56E+00	6.54E+01	5.75E+00	9.33E+01	-2.900	0.769	2.010
			1.57E+02	1.62E+00	1.53E+01	8.46E+00	1.75E+02			
			1.83E+02	3.19E+00	8.07E+01	1.42E+01	2.68E+02			
2	CONE	99	3.07E+01	1.71E+00	6.78E+01	5.93E+00	1.00E+02	-3.000	-0.008	2.010
			1.64E+02	1.81E+00	1.47E+01	8.31E+00	1.82E+02			
			1.95E+02	3.52E+00	8.25E+01	1.42E+01	2.82E+02			
2	CONE	100	4.07E+01	2.11E+00	6.86E+01	5.78E+00	1.11E+02	-2.896	-0.784	2.010
			1.58E+02	1.99E+00	1.36E+01	7.94E+00	1.75E+02			
			2.00E+02	4.10E+00	8.24E+01	1.37E+01	2.86E+02			
2	CONE	101	5.50E+01	2.55E+00	7.15E+01	6.49E+00	1.27E+02	-2.594	-1.507	2.010
			1.45E+02	1.68E+00	1.43E+01	7.45E+00	1.60E+02			
			2.00E+02	4.23E+00	8.59E+01	1.39E+01	2.87E+02			
2	CONE	102	8.07E+01	3.52E+00	7.68E+01	6.44E+00	1.60E+02	-2.116	-2.127	2.010
			1.24E+02	1.41E+00	1.33E+01	8.39E+00	1.39E+02			
			2.05E+02	4.34E+00	9.01E+01	1.48E+01	2.99E+02			
2	CONE	103	1.32E+02	5.14E+00	8.37E+01	1.15E+01	2.21E+02	-1.493	-2.602	2.010
			1.29E+02	1.29E+00	1.31E+01	5.50E+00	1.16E+02			
			2.34E+02	6.42E+00	9.68E+01	1.70E+01	3.37E+02			
2	CONE	104	2.13E+02	6.32E+00	9.55E+01	1.53E+01	3.16E+02	-0.769	-2.900	2.010
			7.76E+01	9.75E-01	1.26E+01	4.62E+00	9.14E+01			
			2.91E+02	7.29E+00	1.08E+02	1.99E+01	4.07E+02			
2	CONE	105	3.20E+02	7.79E+00	1.05E+02	2.20E+01	4.34E+02	0.008	-3.000	2.010
			5.28E+01	6.68E-01	1.08E+01	3.46E+00	6.42E+01			
			3.73E+02	8.46E+00	1.16E+02	2.55E+01	4.98E+02			
2	CONE	106	4.39E+02	9.35E+00	1.04E+02	2.93E+01	5.53E+02	0.784	-2.896	2.010
			3.28E+01	2.60E-01	9.92E+00	2.34E+00	4.30E+01			
			4.71E+02	9.61E+00	1.14E+02	3.16E+01	5.96E+02			
2	CONE	107	5.54E+02	9.44E+00	1.05E+02	3.62E+01	6.65E+02	1.507	-2.594	2.010
			1.74E+01	9.56E-03	8.84E+00	1.45E+00	2.63E+01			
			9.45E+02	1.14E+02	1.14E+02	3.77E+01	6.92E+02			
2	CONE	108	6.50E+02	1.00E+01	1.10E+02	4.18E+01	7.68E+02	2.127	-2.116	2.010
			6.97E+00	0.00E+00	7.48E+00	8.10E-01	1.45E+01			
			6.57E+02	1.00E+01	1.18E+02	4.26E+01	7.83E+02			
2	CONE	109	7.14E+02	1.06E+01	1.14E+02	4.04E+01	8.37E+02	2.602	-1.493	2.010
			1.24E+00	0.00E+00	6.13E+00	2.92E-01	7.38E+00			
			7.15E+02	1.06E+01	1.20E+02	4.07E+01	8.45E+02			
2	CONE	110	7.28E+02	9.50E+00	1.16E+02	4.14E+01	8.35E+02	2.900	-0.769	2.010
			0.00E+00	0.00E+00	5.47E+00	2.54E-01	5.44E+00			
			7.02E+02	8.50E+00	1.22E+02	4.17E+01	8.61E+02			
2	CONE	111	7.02E+02	8.86E+00	1.18E+02	4.35E+01	8.31E+02	3.000	-0.008	2.010
			0.00E+00	0.00E+00	4.32E+00	2.35E-01	4.33E+00			
			7.02E+02	8.86E+00	1.22E+02	4.38E+01	8.36E+02			

2	CONE	112	7.66E+02	6.31E+00	5.37E+01	4.01E+01	8.28E+02	3.000	0.008	3.010
			0.00E+00	0.00E+00	2.03E+00	1.48E-01	2.04E+00			
2	CONE	113	6.6E+02	6.31E+00	5.58E+01	4.03E+01	8.30E+02	2.896	0.784	3.010
			6.87E+02	6.81E+00	5.12E+01	3.52E+01	7.46E+02			
2	CONE	114	0.00E+00	0.00E+00	1.83E+00	8.66E-02	1.77E+00	2.594	1.507	3.010
			6.87E+02	6.81E+00	5.30E+01	3.52E+01	7.48E+02			
2	CONE	115	5.73E+02	7.10E+00	4.84E+01	2.95E+01	6.27E+02	2.116	2.127	3.010
			5.96E-01	0.00E+00	2.12E+00	6.88E-02	2.73E+00			
2	CONE	116	5.74E+02	7.10E+00	5.05E+01	2.96E+01	6.30E+02	1.493	2.602	3.010
			4.41E+02	6.75E+00	4.73E+01	2.41E+01	4.95E+02			
2	CONE	117	4.4E+02	1.10E-01	2.69E+00	3.27E-01	8.29E+00	0.769	2.900	3.010
			4.47E+02	6.86E+00	4.99E+01	2.45E+01	5.04E+02			
2	CONE	118	3.13E+02	5.55E+00	4.51E+01	1.79E+01	3.65E+02	1.507	2.594	3.010
			2.03E+02	1.89E-01	3.74E+00	1.26E+00	2.41E+01			
2	CONE	119	2.04E+02	3.96E+00	4.88E+01	1.91E+01	3.89E+02	0.769	2.900	3.010
			4.06E+02	6.06E-02	4.08E+01	1.14E+01	2.48E+02			
2	CONE	120	2.44E+02	4.02E+00	4.56E+01	1.36E+01	2.94E+02	-0.008	3.000	3.010
			1.10E+02	2.95E+00	4.09E+01	8.50E+00	1.66E+02			
2	CONE	121	6.15E+01	-6.39E-03	5.29E+00	3.21E+00	6.72E+01	-0.784	2.896	3.010
			1.84E+02	2.94E+00	4.61E+01	1.17E+01	2.33E+02			
2	CONE	122	7.15E+01	2.45E+00	3.85E+01	5.99E+00	1.12E+02	-1.507	2.594	3.010
			8.46E+01	1.28E-02	6.32E+00	4.39E+00	9.12E+01			
2	CONE	123	1.56E+02	2.47E+00	4.48E+01	1.04E+01	2.04E+02	0.769	2.900	3.010
			4.35E+01	2.75E+00	3.48E+01	3.77E+00	8.17E+01			
2	CONE	124	1.10E+02	2.13E-01	5.91E+00	5.68E+00	1.16E+02	-2.127	2.116	3.010
			1.54E+02	2.96E+00	4.07E+01	9.45E+00	1.98E+02			
2	CONE	125	3.18E+01	2.53E+00	3.02E+01	3.27E+00	6.47E+01	-3.000	-0.008	3.010
			1.36E+02	4.82E-01	4.92E+00	6.95E+00	1.42E+02			
2	CONE	126	1.68E+02	3.01E+00	3.51E+01	1.02E+01	2.07E+02	-2.896	0.769	3.010
			2.66E+01	2.28E+00	2.84E+01	2.83E+00	5.75E+01			
2	CONE	127	1.61E+02	6.22E-01	6.23E+00	8.94E+00	1.68E+02	-2.900	-0.784	3.010
			1.88E+02	2.91E+00	3.46E+01	1.18E+01	2.26E+02			
2	CONE	128	2.60E+01	2.18E+00	3.03E+01	3.41E+00	5.87E+01	-3.000	-0.008	3.010
			1.81E+02	7.79E-01	6.79E+00	9.94E+00	1.88E+02			
2	CONE	129	2.07E+02	2.96E+00	3.71E+01	1.33E+01	2.47E+02	-2.896	0.769	3.010
			3.16E+01	2.02E+00	3.21E+01	3.45E+00	6.58E+01			
2	CONE	130	1.85E+02	9.47E-01	5.90E+00	1.00E+01	1.92E+02	-3.000	-0.008	3.010
			2.17E+02	2.97E+00	3.80E+01	1.35E+01	2.58E+02			
2	CONE	131	4.29E+01	1.87E+00	3.34E+01	3.50E+00	7.85E+01	-2.896	0.769	3.010
			1.77E+02	1.01E+00	5.58E+00	8.93E+00	1.83E+02			
2	CONE	132	2.20E+02	2.86E+00	3.90E+01	1.24E+01	2.62E+02	-2.594	-1.507	3.010
			6.70E+01	1.84E+00	3.29E+01	4.35E+00	1.01E+02			
2	CONE	133	1.58E+02	9.09E-01	6.50E+00	7.68E+00	1.66E+02	-2.116	-2.127	3.010
			2.25E+02	2.75E+00	3.94E+01	1.20E+01	2.66E+02			
2	CONE	134	1.08E+02	2.72E+00	3.47E+01	6.46E+00	1.48E+02	-2.116	-2.127	3.010
			1.35E+02	6.05E-01	6.48E+00	6.60E+00	1.43E+02			
2	CONE	135	2.43E+02	3.32E+00	4.12E+01	1.31E+01	2.91E+02	-1.493	-2.602	3.010
			1.75E+02	4.01E+00	4.03E+01	1.15E+01	2.23E+02			
2	CONE	136	1.08E+02	5.63E-01	6.08E+00	5.37E+00	1.15E+02	-0.769	-2.900	3.010
			2.84E+02	4.58E+00	4.63E+01	1.69E+01	3.37E+02			
2	CONE	137	2.74E+02	4.59E+00	4.18E+01	1.55E+01	3.23E+02	0.008	-3.000	3.010
			8.04E+01	6.55E-01	5.99E+00	4.14E+00	8.70E+01			
2	CONE	138	3.54E+02	5.25E+00	4.78E+01	1.96E+01	4.10E+02	0.784	-2.896	3.010
			3.92E+02	5.60E+00	4.43E+01	2.08E+01	4.43E+02			
2	CONE	139	5.13E-01	5.13E+00	5.13E+00	2.67E+00	6.03E+01	-3.000	-3.000	3.010
			4.47E+02	6.13E+00	4.95E+01	2.34E+01	5.03E+02			
2	CONE	140	5.16E+02	6.08E+00	4.77E+01	2.83E+01	5.73E+02	0.784	-2.896	3.010
			3.28E+01	4.74E+00	4.74E+00	1.89E+00	3.78E+01			
2	CONE	141	5.49E+02	6.32E+00	5.24E+01	3.01E+01	6.11E+02	1.507	-2.594	3.010
			6.36E+02	6.25E+00	4.82E+01	3.41E+01	6.93E+02			
2	CONE	142	1.74E+01	1.63E-02	4.69E+00	1.22E+00	2.21E+01	-2.127	-2.116	3.010
			6.53E+02	6.26E+00	5.29E+01	3.54E+01	7.15E+02			
2	CONE	143	7.34E+02	6.23E+00	5.07E+01	4.11E+01	7.93E+02	2.127	-2.116	3.010
			6.97E+00	0.00E+00	3.88E+00	6.13E-01	1.09E+01			
			7.41E+02	6.23E+00	5.45E+01	4.17E+01	8.04E+02			

2	CONE	134	7.95E+02	6.48E+00	5.48E+01	4.37E+01	8.57E+02	2.602	-1.493	3.010
			1.24E+00	0.00E+00	3.07E+00	2.13E-01	4.30E+00			
			7.95E+02	6.48E+00	5.78E+01	4.39E+01	8.61E+00			
2	CONE	135	8.06E+02	6.51E+00	5.80E+01	4.24E+01	8.70E+02	2.900	-0.769	3.010
			0.00E+00	0.00E+00	2.61E+00	1.38E-01	2.62E+00			
			8.06E+02	6.51E+00	6.06E+01	4.25E+01	8.73E+02			
2	CONE	136	7.75E+02	6.29E+00	5.58E+01	4.14E+01	8.38E+02	3.000	-0.008	3.010
			0.00E+00	0.00E+00	2.18E+00	1.83E-01	2.18E+00			
			7.75E+02	6.29E+00	5.80E+01	4.16E+01	8.40E+02			
2	CONE	137	8.13E+02	3.87E+00	2.30E+01	3.87E+01	8.42E+02	3.000	0.008	4.010
			0.00E+00	0.00E+00	6.60E-01	1.18E-01	6.54E-01			
			8.13E+02	3.87E+00	2.36E+01	3.88E+01	8.43E+02			
2	CONE	138	7.33E+02	3.92E+00	2.19E+01	3.64E+01	7.60E+02	2.896	0.784	4.010
			0.00E+00	0.00E+00	9.36E-01	1.20E-01	7.60E+02			
			7.33E+02	3.92E+00	2.28E+01	3.65E+01	7.61E+02			
2	CONE	139	6.14E+02	3.91E+00	2.17E+01	3.35E+01	6.40E+02	2.594	1.507	4.010
			8.12E-01	0.00E+00	1.24E+00	1.17E-01	2.15E+00			
			6.14E+02	3.91E+00	2.30E+01	3.36E+01	6.42E+02			
2	CONE	140	4.77E+02	3.90E+00	2.00E+01	2.63E+01	5.01E+02	2.116	2.127	4.010
			6.86E+00	0.00E+00	1.46E+00	3.94E-01	8.43E+00			
			4.77E+02	3.90E+00	2.15E+01	2.67E+01	5.10E+02			
2	CONE	141	3.42E+02	3.93E+00	1.82E+01	1.77E+01	3.55E+02	1.493	2.602	4.010
			2.09E+01	7.74E-03	1.70E+00	1.27E+00	2.27E+01			
			3.42E+02	3.93E+00	1.99E+01	1.90E+01	3.88E+02			
2	CONE	142	2.22E+02	3.59E+00	1.63E+01	1.28E+01	2.44E+02	0.769	2.900	4.010
			4.06E+01	9.54E-03	1.84E+00	1.90E+00	4.24E+01			
			2.22E+02	3.59E+00	1.81E+01	1.47E+01	2.86E+02			
2	CONE	143	1.34E+02	2.23E+00	1.66E+01	8.68E+00	1.55E+02	-0.008	3.000	4.010
			6.15E+01	-2.83E-04	2.20E+00	2.55E+00	6.16E+01			
			1.34E+02	2.23E+00	1.88E+01	1.12E+01	2.19E+02			
2	CONE	144	7.94E+01	1.72E+00	1.75E+01	4.04E+00	9.96E+01	-0.784	2.896	4.010
			8.49E+01	3.16E-04	2.60E+00	4.29E+00	8.73E+01			
			1.64E+02	1.72E+00	2.01E+01	8.33E+00	1.87E+02			
2	CONE	145	4.80E+01	2.15E+00	1.64E+01	3.00E+00	6.75E+01	-1.507	2.594	4.010
			1.13E+02	1.69E-01	2.53E+00	6.10E+00	1.15E+02			
			4.80E+01	2.15E+00	1.89E+01	9.10E+00	1.83E+02			
2	CONE	146	3.37E+01	2.29E+00	1.40E+01	2.60E+00	5.00E+01	-2.127	2.116	4.010
			1.40E+02	3.53E-01	2.39E+00	7.24E+00	1.43E+02			
			3.37E+01	2.29E+00	1.64E+01	9.84E+00	1.93E+02			
2	CONE	147	2.71E+01	2.13E+00	1.29E+01	1.43E+00	4.20E+01	-2.602	1.493	4.010
			1.65E+02	3.66E-01	2.59E+00	8.96E+00	1.68E+02			
			1.92E+02	2.50E+00	1.55E+01	1.04E+01	2.10E+02			
2	CONE	148	2.62E+01	2.29E+00	1.24E+01	2.52E+00	4.11E+01	-2.900	0.769	4.010
			1.84E+02	4.75E-01	2.57E+00	9.69E+00	1.87E+02			
			2.62E+01	2.29E+00	1.50E+01	1.22E+01	2.28E+02			
2	CONE	149	3.68E+01	1.60E+00	1.36E+01	3.34E+00	5.31E+01	-3.000	-0.008	4.010
			1.89E+02	5.96E-01	2.55E+00	9.86E+00	1.93E+02			
			2.26E+02	2.20E+00	1.62E+01	1.32E+01	2.46E+02			
2	CONE	150	5.56E+01	1.55E+00	1.52E+01	3.95E+00	7.37E+01	-2.896	-0.784	4.010
			1.83E+02	5.37E-01	2.73E+00	9.35E+00	1.86E+02			
			2.38E+02	2.09E+00	1.79E+01	1.33E+01	2.60E+02			
2	CONE	151	8.60E+01	2.22E+00	1.41E+01	5.23E+00	1.03E+02	-2.594	-1.507	4.010
			1.64E+02	3.60E-01	2.67E+00	8.14E+00	1.68E+02			
			2.50E+02	2.58E+00	1.70E+01	1.34E+01	2.71E+02			
2	CONE	152	1.39E+02	3.87E+00	1.63E+01	7.75E+00	1.57E+02	-2.116	-2.127	4.010
			1.40E+02	3.67E-01	2.64E+00	6.79E+00	1.43E+02			
			2.79E+02	2.75E+00	1.90E+01	1.45E+01	3.01E+02			
2	CONE	153	2.20E+02	2.71E+00	1.90E+01	1.25E+01	2.41E+02	-1.493	-2.602	4.010
			1.13E+02	4.13E-01	2.76E+00	5.74E+00	1.16E+02			
			3.33E+02	3.12E+00	2.17E+01	1.82E+01	3.57E+02			
2	CONE	154	3.27E+02	3.45E+00	1.88E+01	1.77E+01	3.48E+02	-0.769	-2.900	4.010
			8.48E+01	4.02E-01	2.76E+00	4.41E+00	8.83E+01			
			4.12E+02	3.86E+00	2.16E+01	2.21E+01	4.36E+02			
2	CONE	155	4.50E+02	4.43E+00	1.78E+01	2.27E+01	4.70E+02	0.008	-3.000	4.010
			5.74E+01	3.57E-01	2.05E+00	2.45E+00	6.01E+01			
			3.08E+02	4.79E+00	1.99E+01	2.51E+01	5.30E+02			

2	CONE	156	5.81E+02	4.14E+00	1.95E+01	2.90E+01	6.03E+02	0.784	-2.896	4.010
			3.29E+01	2.47E-01	1.92E+00	1.47E+00	3.51E+01			
2	CONE	157	6.14E+02	4.39E+00	2.15E+01	3.05E+01	7.33E+02	1.507	-2.594	4.010
			7.05E+02	4.69E+00	2.21E+01	3.58E+01	6.38E+02			
2	CONE	158	1.74E+01	8.52E-02	2.15E+00	9.16E-01	1.96E+01	2.127	-2.116	4.010
			7.23E+02	4.77E+00	2.43E+01	3.67E+01	7.52E+02			
2	CONE	159	7.99E+02	5.18E+00	2.28E+01	4.19E+01	8.27E+02	2.602	-1.493	4.010
			6.97E+00	0.00E+00	1.67E+00	5.44E-01	8.63E+00			
2	CONE	160	8.06E+02	5.18E+00	2.45E+01	4.24E+01	8.36E+02	2.900	-0.769	4.010
			8.51E+02	5.41E+00	2.39E+01	4.60E+01	8.80E+02			
2	CONE	161	1.24E+00	0.00E+00	1.34E+00	1.86E-01	2.60E+00	3.000	-0.008	4.010
			8.52E+02	5.41E+00	2.53E+01	4.62E+01	8.83E+02			
2	CONE	162	8.57E+02	4.76E+00	2.53E+01	4.53E+01	8.87E+02	2.900	-0.769	4.010
			0.00E+00	0.00E+00	1.04E+00	8.84E-02	9.76E-01			
2	CONE	163	8.57E+02	4.76E+00	2.63E+01	4.54E+01	8.88E+02	3.000	-0.008	4.010
			8.23E+02	3.71E+00	2.45E+01	4.20E+01	8.51E+02			
2	CONE	164	0.00E+00	0.00E+00	6.97E-01	1.47E-01	6.97E-01	3.000	0.008	4.990
			8.34E+02	2.55E+00	1.60E+01	3.85E+01	8.53E+02			
2	CONE	165	0.00E+00	0.00E+00	1.83E-01	-1.01E-02	1.75E-01	2.896	0.784	4.990
			0.00E+00	0.00E+00	1.62E+01	3.85E+01	8.53E+02			
2	CONE	166	6.29E+02	3.81E+00	1.66E+01	3.91E+01	7.72E+02	2.594	1.507	4.990
			0.00E+00	0.00E+00	7.10E-01	7.09E-02	5.61E-01			
2	CONE	167	7.53E+02	2.84E+00	1.73E+01	3.92E+01	7.73E+02	2.116	2.127	4.990
			6.28E+02	3.41E+00	1.73E+01	3.92E+01	6.49E+02			
2	CONE	168	8.12E-01	0.00E+00	1.05E+00	1.33E-01	2.03E+00	1.493	2.602	4.990
			4.89E+02	3.88E+00	1.44E+01	2.91E+01	5.08E+02			
2	CONE	169	4.96E+02	3.88E+00	1.19E+00	4.39E-01	8.06E+00	2.900	2.900	4.990
			3.52E+02	3.68E+00	1.22E+01	1.84E+01	3.67E+02			
2	CONE	170	2.09E+01	0.00E+00	1.32E+00	1.27E+00	2.22E+01	0.769	2.900	4.990
			3.73E+02	3.68E+00	1.35E+01	1.85E+01	4.19E+01			
2	CONE	171	2.30E+02	3.12E+00	1.35E+00	1.45E+01	2.45E+02	-0.008	3.000	4.990
			4.06E+01	0.00E+00	1.22E+01	1.63E+01	2.87E+02			
2	CONE	172	7.0E+02	3.12E+00	1.36E+01	1.63E+01	2.87E+02	-0.784	2.896	4.990
			1.41E+02	2.11E+00	1.26E+01	9.11E+00	1.56E+02			
2	CONE	173	6.15E+01	0.00E+00	1.74E+00	2.22E+00	6.32E+01	-1.507	2.594	4.990
			8.43E+01	1.05E+00	1.44E+01	1.13E+01	2.19E+02			
2	CONE	174	8.43E+01	1.05E+00	1.26E+01	3.07E+00	9.78E+01	-2.127	2.116	4.990
			1.69E+02	1.05E+00	1.75E+00	4.35E+00	8.61E+01			
2	CONE	175	5.14E+01	1.73E+00	1.44E+01	7.42E+00	1.84E+02	-2.602	1.493	4.990
			1.13E+02	1.60E-01	1.57E+00	6.44E+00	1.15E+02			
2	CONE	176	1.65E+02	1.89E+00	1.38E+01	9.31E+00	1.81E+02	-2.900	0.769	4.990
			3.53E+01	2.45E+00	1.88E+00	7.20E+00	1.45E+02			
2	CONE	177	1.43E+02	2.58E-01	1.88E+00	7.20E+00	1.45E+02	-3.000	-0.008	4.990
			1.78E+02	2.71E+00	1.18E+01	9.87E+00	1.92E+02			
2	CONE	178	2.77E+01	1.98E+00	1.18E+01	1.11E+00	3.87E+01	-2.602	1.493	4.990
			1.67E+02	3.35E-01	1.85E+00	8.65E+00	1.69E+02			
2	CONE	179	1.94E+02	2.32E+00	1.10E+01	9.77E+00	2.08E+02	-2.900	0.769	4.990
			2.66E+01	1.70E+00	9.33E+00	2.02E+00	3.81E+01			
2	CONE	180	1.84E+02	4.89E-01	1.58E+00	8.93E+00	1.86E+02	-3.000	-0.008	4.990
			2.10E+02	2.19E+00	1.09E+01	1.09E+01	2.24E+02			
2	CONE	181	4.03E+01	1.12E+00	3.56E+00	3.56E+00	5.24E+01	-2.900	-0.008	4.990
			1.89E+02	4.47E-01	2.00E+00	9.24E+00	1.92E+02			
2	CONE	182	3.0E+02	1.57E+00	1.27E+01	1.28E+01	2.44E+02	-2.896	-0.784	4.990
			6.36E+01	2.03E+00	1.29E+01	4.70E+00	7.86E+01			
2	CONE	183	1.83E+02	3.64E-01	2.19E+00	9.21E+00	1.85E+02	-2.594	-1.507	4.990
			2.47E+02	2.40E+00	1.50E+01	5.97E+00	1.08E+02			
2	CONE	184	9.37E+01	2.97E+00	1.12E+01	1.39E+01	2.64E+02	-2.594	-1.507	4.990
			1.64E+02	1.79E-01	2.22E+00	8.01E+00	1.67E+02			
2	CONE	185	2.58E+02	3.15E+00	1.34E+01	1.40E+01	2.75E+02	-2.116	-2.127	4.990
			1.40E+02	2.34E+00	1.31E+01	8.78E+00	1.61E+02			
2	CONE	186	1.46E+02	3.63E-01	1.81E+00	6.75E+00	1.42E+02	-2.116	-2.127	4.990
			2.86E+02	2.71E+00	1.49E+01	1.55E+01	3.03E+02			

2	CONE	178	2.32E+02	2.85E+00	1.41E+01	1.35E+01	2.48E+02	-1.493	-2.602	4.990
			1.15E+02	5.26E-01	1.88E+00	5.95E+00	1.17E+02			
			3.46E+02	3.38E+00	1.60E+01	1.94E+01	3.65E+02			
2	CONE	179	3.41E+02	3.41E+00	1.47E+01	1.91E+01	3.59E+02	-0.769	-2.900	4.990
			8.81E+01	3.49E-01	2.04E+00	4.59E+00	9.06E+01			
			4.29E+02	3.75E+00	1.67E+01	2.36E+01	4.50E+02			
2	CONE	180	4.68E+02	3.70E+00	1.47E+01	2.63E+01	4.85E+02	0.008	-3.000	4.990
			5.26E+01	3.49E-01	1.31E+00	2.64E+00	6.03E+01			
			5.85E+02	4.05E+00	1.60E+01	2.90E+01	5.46E+02			
2	CONE	181	6.00E+02	3.39E+00	1.45E+01	3.21E+01	6.17E+02	0.784	-2.896	4.990
			3.28E+01	3.24E-01	1.16E+00	1.44E+00	3.43E+01			
			6.32E+02	3.71E+00	1.57E+01	3.36E+01	6.51E+02			
2	CONE	182	7.24E+02	3.72E+00	1.59E+01	3.89E+01	7.43E+02	1.507	-2.594	4.990
			1.74E+01	1.25E-01	1.31E+00	7.32E-01	1.88E+01			
			7.41E+02	3.84E+00	1.72E+01	3.96E+01	7.62E+02			
2	CONE	183	8.17E+02	4.59E+00	1.59E+01	4.37E+01	8.37E+02	2.127	-2.116	4.990
			6.97E+00	0.00E+00	1.22E+00	4.46E-01	8.18E+00			
			8.24E+02	4.59E+00	1.71E+01	4.42E+01	8.45E+02			
2	CONE	184	8.68E+02	4.44E+00	1.60E+01	4.50E+01	8.88E+02	2.602	-1.493	4.990
			1.24E+00	0.00E+00	1.12E+00	1.18E-01	2.41E+00			
			8.69E+02	4.44E+00	1.72E+01	4.51E+01	8.91E+02			
2	CONE	185	8.75E+02	3.38E+00	1.66E+01	4.68E+01	8.96E+02	2.900	-0.769	4.990
			0.00E+00	0.00E+00	6.00E-01	8.78E-03	7.06E-01			
			8.75E+02	3.38E+00	1.74E+01	4.68E+01	8.96E+02			
2	CONE	186	8.42E+02	2.49E+00	1.69E+01	4.50E+01	8.61E+02	3.000	-0.008	4.990
			0.00E+00	0.00E+00	2.94E-01	1.29E-02	2.93E-01			
			8.42E+02	2.49E+00	1.72E+01	4.50E+01	8.61E+02			
3	CYLINDER	187	8.16E+02	1.18E+01	1.43E+01	7.90E+01	8.43E+02	2.995	0.008	5.008
			0.00E+00	2.42E-01	5.47E-01	4.00E-02	5.41E-01			
			8.16E+02	1.21E+01	1.49E+01	7.91E+01	8.43E+02			
3	CYLINDER	188	7.44E+02	1.30E+01	1.24E+01	7.51E+01	7.69E+02	2.891	0.783	5.008
			9.28E-01	7.07E-02	4.75E-01	3.16E-01	1.46E+00			
			7.44E+02	1.30E+01	1.28E+01	7.54E+01	7.71E+02			
3	CYLINDER	189	6.49E+02	1.70E+01	1.06E+01	6.70E+01	6.77E+02	2.590	1.504	5.008
			4.56E+00	7.54E-02	3.11E-01	7.57E-01	4.92E+00			
			6.53E+02	1.71E+01	1.09E+01	6.78E+01	6.82E+02			
3	CYLINDER	190	5.38E+02	1.62E+01	1.18E+01	5.67E+01	5.67E+02	2.113	2.124	5.008
			1.05E+01	1.04E-01	4.25E-01	1.39E+00	1.10E+01			
			5.49E+02	1.63E+01	1.22E+01	5.81E+01	5.78E+02			
3	CYLINDER	191	4.20E+02	1.43E+01	9.81E+00	4.45E+01	4.44E+02	1.491	2.598	5.008
			2.05E+01	6.49E-02	1.01E+00	1.69E+00	2.16E+01			
			4.40E+02	1.44E+01	1.08E+01	4.62E+01	4.66E+02			
3	CYLINDER	192	3.10E+02	1.30E+01	7.83E+00	3.27E+01	3.31E+02	0.768	2.895	5.008
			3.75E+01	5.91E-03	1.02E+00	3.54E+00	3.85E+01			
			3.47E+02	1.30E+01	8.85E+00	3.62E+01	3.69E+02			
3	CYLINDER	193	2.23E+02	1.21E+01	6.32E+00	2.55E+01	2.42E+02	-0.008	2.995	5.008
			6.15E+01	8.55E-02	1.11E+00	7.32E+00	6.27E+01			
			2.85E+02	1.22E+01	7.43E+00	3.28E+01	3.04E+02			
3	CYLINDER	194	1.59E+02	1.19E+01	3.91E+00	2.03E+01	1.75E+02	-0.783	2.891	5.008
			8.68E+01	3.15E-01	1.77E+00	9.53E+00	8.99E+01			
			2.46E+02	1.23E+01	5.68E+00	2.98E+01	2.64E+02			
3	CYLINDER	195	1.33E+02	1.46E+01	5.62E+00	1.74E+01	1.53E+02	-1.504	2.590	5.008
			1.10E+02	3.90E-01	2.17E+00	1.06E+01	1.13E+02			
			2.43E+02	1.50E+01	7.79E+00	2.80E+01	2.66E+02			
3	CYLINDER	196	1.15E+02	1.65E+01	5.54E+00	1.67E+01	1.37E+02	-2.124	2.113	5.008
			1.32E+02	2.31E-01	2.58E+00	1.27E+01	1.35E+02			
			2.66E+02	1.68E+01	8.12E+00	2.93E+01	2.71E+02			
3	CYLINDER	197	9.93E+01	1.50E+01	3.38E+00	1.19E+01	1.18E+02	-2.598	1.491	5.008
			1.51E+02	1.77E-01	2.44E+00	1.47E+01	1.54E+02			
			2.50E+02	1.51E+01	5.81E+00	2.66E+01	2.71E+02			
3	CYLINDER	198	1.02E+02	1.27E+01	4.16E+00	1.01E+01	1.18E+02	-2.895	0.768	5.008
			1.65E+02	2.01E-01	1.98E+00	1.51E+01	1.69E+02			
			2.67E+02	1.29E+01	6.14E+00	2.52E+01	2.86E+02			
3	CYLINDER	199	1.14E+02	1.36E+01	5.88E+00	1.08E+01	1.35E+02	-2.995	-0.008	5.008
			1.70E+02	1.00E-01	2.46E+00	1.64E+01	1.73E+02			
			2.85E+02	1.37E+01	8.35E+00	2.72E+01	3.08E+02			



3	CYLINDER	200	1.34E+02	1.69E+01	5.39E+00	1.19E+01	1.57E+02	-2.891	-0.783	5.008
			1.66E+02	9.08E-02	2.72E+00	1.73E+01	1.69E+02			
3	CYLINDER	201	3.00E+02	1.70E+01	8.11E+00	2.93E+01	3.26E+02	-2.590	-1.504	5.008
			1.61E+02	1.46E+01	4.95E+00	1.78E+01	1.81E+02			
			1.54E+02	3.77E-01	2.57E+00	1.50E+01	1.57E+02			
3	CYLINDER	202	3.15E+02	1.49E+01	7.52E+00	3.27E+01	3.38E+02	-2.113	-2.124	5.008
			2.08E+02	1.21E+01	9.80E+00	2.47E+01	1.32E+02			
			1.33E+02	3.05E-01	2.67E+00	1.18E+01	1.36E+02			
3	CYLINDER	203	3.42E+02	1.24E+01	1.25E+01	3.65E+01	3.68E+02	-1.491	-2.598	5.008
			2.73E+02	1.10E+01	1.18E+01	3.02E+01	2.98E+02			
			1.09E+02	3.28E-01	2.26E+00	9.90E+00	1.11E+02			
3	CYLINDER	204	3.61E+02	1.13E+01	1.40E+01	4.01E+01	4.09E+02	-0.768	-2.895	5.008
			3.61E+02	1.17E+01	1.15E+01	4.03E+01	3.85E+02			
			8.48E+01	4.08E-01	1.71E+00	8.78E+00	6.69E+01			
3	CYLINDER	205	4.46E+02	1.21E+01	1.32E+01	4.91E+01	4.72E+02	0.008	-2.995	5.008
			4.79E+02	1.39E+01	1.09E+01	4.97E+01	5.04E+02			
			6.47E+01	1.28E-01	1.17E+00	6.39E+00	6.58E+01			
3	CYLINDER	206	5.44E+02	1.40E+01	1.17E+00	5.61E+01	5.70E+02	0.783	-2.891	5.008
			6.00E+02	1.43E+01	1.23E+01	6.27E+01	6.26E+02			
			4.59E+01	1.08E-01	8.96E-01	4.52E+00	4.67E+01			
3	CYLINDER	207	6.46E+02	1.45E+01	1.32E+01	6.73E+01	6.72E+02	1.504	-2.590	5.008
			7.11E+02	1.22E+01	1.51E+01	7.39E+01	7.39E+02			
			2.79E+01	8.16E-02	1.01E+00	3.21E+00	2.90E+01			
3	CYLINDER	208	7.38E+02	1.23E+01	1.61E+01	7.71E+01	7.68E+02	2.124	-2.113	5.008
			8.00E+02	9.95E+00	1.55E+01	8.24E+01	8.25E+02			
			1.36E+01	8.94E-02	7.75E-01	1.17E+00	1.45E+01			
3	CYLINDER	209	8.14E+02	1.00E+01	1.62E+01	8.36E+01	8.40E+02	2.598	-1.491	5.008
			8.48E+02	1.27E+01	1.54E+01	8.92E+01	8.76E+02			
			5.27E+00	3.40E-01	4.99E-01	3.69E-01	6.08E+00			
3	CYLINDER	210	8.59E+02	1.30E+01	1.59E+01	8.96E+01	8.83E+02	2.895	-0.768	5.008
			9.35E+02	1.59E+01	1.37E+01	8.25E+01	8.85E+02			
			1.13E+00	5.43E-01	4.77E-01	1.65E-01	2.16E+00			
3	CYLINDER	211	8.24E+02	1.65E+01	1.41E+01	8.27E+01	8.87E+02	2.995	-0.008	5.008
			8.56E+02	1.65E+01	1.29E+01	7.78E+01	8.52E+02			
			0.00E+00	4.56E-01	5.82E-01	9.24E-02	7.57E-01			
3	CYLINDER	212	8.24E+02	1.58E+01	1.35E+01	7.79E+01	8.52E+02	2.495	0.007	5.841
			8.11E+02	1.56E+01	1.65E+01	7.98E+01	8.42E+02			
			0.00E+00	1.56E-01	6.18E-01	1.52E-02	5.15E-01			
3	CYLINDER	213	8.11E+02	1.58E+01	1.72E+01	7.96E+01	8.43E+02	2.409	0.652	5.841
			7.42E+02	1.51E+01	1.48E+01	7.32E+01	7.72E+02			
			9.28E-01	2.60E-02	5.58E-01	1.85E-01	1.50E+00			
3	CYLINDER	214	7.43E+02	1.51E+01	1.54E+01	7.34E+01	7.74E+02	2.158	1.253	5.841
			6.42E+02	1.70E+01	1.53E+01	6.59E+01	6.74E+02			
			4.56E+00	5.89E-02	5.56E-01	5.65E-01	5.16E+00			
3	CYLINDER	215	6.46E+02	1.70E+01	1.58E+01	6.65E+01	6.79E+02	1.760	1.769	5.841
			5.25E+02	1.66E+01	1.46E+01	5.93E+01	5.57E+02			
			1.05E+01	8.87E-02	7.61E-01	1.20E+00	1.13E+01			
3	CYLINDER	216	5.35E+02	1.66E+01	1.53E+01	6.05E+01	5.68E+02	1.242	2.164	5.841
			4.10E+02	1.60E+01	9.88E+00	4.44E+01	4.36E+02			
			2.02E+01	1.20E-01	1.07E+00	2.27E+00	2.14E+01			
3	CYLINDER	217	4.31E+02	1.61E+01	1.10E+01	4.67E+01	4.57E+02	0.640	2.412	5.841
			3.05E+02	1.63E+01	8.36E+00	3.06E+01	3.29E+02			
			3.73E+01	6.41E-02	1.10E+00	4.37E+00	3.64E+01			
3	CYLINDER	218	3.42E+02	1.64E+01	9.46E+00	3.50E+01	3.67E+02	-0.007	2.495	5.841
			2.16E+02	1.75E+01	7.02E+00	2.54E+01	2.40E+02			
			6.15E+01	3.36E-02	1.63E+00	6.97E+00	6.32E+01			
3	CYLINDER	219	2.77E+02	1.75E+01	8.64E+00	3.23E+01	3.04E+02	-0.652	2.409	5.841
			1.52E+02	1.70E+01	4.67E+00	1.96E+01	1.74E+02			
			8.68E+01	1.84E-01	2.19E+00	9.11E+00	8.91E+01			
3	CYLINDER	220	2.39E+02	1.72E+01	6.87E+00	2.87E+01	2.63E+02	-1.253	2.158	5.841
			1.17E+02	1.59E+01	6.50E+00	1.53E+01	1.40E+02			
			1.10E+02	2.42E-01	2.24E+00	1.05E+01	1.13E+02			
3	CYLINDER	221	2.28E+02	1.61E+01	6.74E+00	2.58E+01	2.53E+02	-1.769	1.760	5.841
			1.02E+02	1.72E+01	7.48E+00	1.37E+01	1.27E+02			
			1.32E+02	2.09E-01	2.69E+00	1.28E+01	1.35E+02			
			2.34E+02	1.74E+01	1.02E+01	2.65E+01	2.61E+02			

3	CYLINDER	222	9.53E+01	1.64E+01	5.50E+00	1.16E+01	1.16E+02	-2.164	1.242	5.841
			1.51E+02	1.62E-01	3.16E+00	1.50E+01	1.54E+02			
			2.46E+02	1.66E+01	8.66E+00	2.67E+01	2.71E+02			
3	CYLINDER	223	9.66E+01	1.62E+01	4.51E+00	1.06E+01	1.17E+02	-2.412	0.640	5.841
			1.65E+02	1.29E-01	3.11E+00	1.56E+01	1.69E+02			
			2.62E+02	1.63E+01	7.61E+00	2.62E+01	2.85E+02			
3	CYLINDER	224	1.06E+02	1.63E+01	6.36E+00	1.06E+01	1.30E+02	-2.495	-0.007	5.841
			1.70E+02	7.49E-02	3.55E+00	1.71E+01	1.74E+02			
			2.77E+02	1.63E+01	9.90E+00	2.77E+01	3.04E+02			
3	CYLINDER	225	1.28E+02	1.71E+01	7.35E+00	1.32E+01	1.53E+02	-2.409	-0.652	5.841
			1.66E+02	1.77E-01	3.28E+00	1.79E+01	1.70E+02			
			2.94E+02	1.73E+01	1.06E+01	3.12E+01	3.22E+02			
3	CYLINDER	226	1.58E+02	1.67E+01	6.89E+00	1.88E+01	1.81E+02	-2.158	-1.253	5.841
			1.54E+02	3.68E-01	2.95E+00	1.62E+01	1.57E+02			
			3.11E+02	1.70E+01	9.84E+00	3.50E+01	3.38E+02			
3	CYLINDER	227	2.03E+02	1.55E+01	9.69E+00	2.42E+01	2.28E+02	-1.760	-1.769	5.841
			1.33E+02	2.26E-01	2.98E+00	1.35E+01	1.36E+02			
			3.36E+02	1.57E+01	1.27E+01	3.77E+01	3.65E+02			
3	CYLINDER	228	2.67E+02	1.40E+01	1.13E+01	2.88E+01	2.92E+02	-1.242	-2.164	5.841
			1.09E+02	2.42E-01	2.37E+00	1.08E+01	1.11E+02			
			3.76E+02	1.42E+01	1.37E+01	3.96E+01	4.04E+02			
3	CYLINDER	229	3.55E+02	1.41E+01	1.16E+01	3.81E+01	3.80E+02	-0.640	-2.412	5.841
			8.48E+01	3.58E-01	2.09E+00	8.81E+00	8.73E+01			
			4.40E+02	1.45E+01	1.37E+01	4.69E+01	4.68E+02			
3	CYLINDER	230	4.73E+02	1.50E+01	1.31E+01	5.04E+01	5.01E+02	0.007	-2.495	5.841
			6.47E+01	1.92E-01	1.87E+00	6.19E+00	6.66E+01			
			5.38E+02	1.52E+01	1.50E+01	5.66E+01	5.67E+02			
3	CYLINDER	231	5.95E+02	1.42E+01	1.67E+01	6.24E+01	6.25E+02	0.652	-2.409	5.841
			4.59E+01	9.95E-02	1.27E+00	4.35E+00	4.72E+01			
			6.41E+02	1.43E+01	1.80E+01	6.68E+01	6.72E+02			
3	CYLINDER	232	7.06E+02	1.61E+01	1.74E+01	7.35E+01	7.38E+02	1.253	-2.158	5.841
			2.79E+01	9.61E-02	9.98E-01	3.10E+00	2.90E+01			
			7.34E+02	1.42E+01	1.84E+01	7.66E+01	7.67E+02			
3	CYLINDER	233	7.92E+02	1.49E+01	1.71E+01	8.32E+01	8.24E+02	1.769	-1.760	5.841
			1.37E+01	1.93E-01	7.54E-01	1.46E+00	1.47E+01			
			8.06E+02	1.51E+01	1.78E+01	8.47E+01	8.39E+02			
3	CYLINDER	234	8.43E+02	1.50E+01	1.75E+01	8.84E+01	8.75E+02	2.164	-1.242	5.841
			4.58E+00	8.30E-01	6.29E-01	7.20E-01	5.95E+00			
			8.47E+02	1.58E+01	1.82E+01	8.92E+01	8.81E+02			
3	CYLINDER	235	8.50E+02	1.62E+01	1.62E+01	8.56E+01	8.81E+02	2.412	-0.640	5.841
			5.50E-01	8.04E-01	6.40E-01	1.79E-01	1.86E+00			
			8.50E+02	1.70E+01	1.68E+01	8.57E+01	8.83E+02			
3	CYLINDER	236	8.17E+02	1.68E+01	1.55E+01	8.00E+01	8.49E+02	2.495	-0.007	5.841
			0.00E+00	2.76E-01	6.24E-01	4.79E-02	7.41E-01			
			8.17E+02	1.71E+01	1.61E+01	8.01E+01	8.50E+02			
3	CYLINDER	237	7.92E+02	1.71E+01	2.39E+01	8.80E+01	8.41E+02	1.996	0.005	6.674
			0.00E+00	4.17E-02	7.20E-01	1.02E-01	4.61E-01			
			7.92E+02	2.39E+01	2.46E+01	8.81E+01	8.41E+02			
3	CYLINDER	238	7.27E+02	2.28E+01	2.42E+01	7.96E+01	7.74E+02	1.926	0.522	6.674
			9.28E-01	-6.17E-03	7.72E-01	1.21E-01	1.66E+00			
			7.28E+02	2.28E+01	2.50E+01	7.97E+01	7.76E+02			
3	CYLINDER	239	6.22E+02	2.20E+01	2.48E+01	6.83E+01	6.70E+02	1.726	1.002	6.674
			4.56E+00	1.99E-02	1.03E+00	2.25E-01	5.60E+00			
			6.27E+02	2.21E+01	2.58E+01	6.85E+01	6.75E+02			
3	CYLINDER	240	5.02E+02	2.14E+01	1.90E+01	5.93E+01	5.42E+02	1.407	1.415	6.674
			1.05E+01	1.22E-01	1.34E+00	9.29E-01	1.20E+01			
			5.12E+02	2.15E+01	2.03E+01	6.02E+01	5.54E+02			
3	CYLINDER	241	3.88E+02	2.19E+01	1.35E+01	4.13E+01	4.24E+02	0.993	1.731	6.674
			1.99E+01	1.64E-01	1.61E+00	2.64E+00	2.16E+01			
			4.08E+02	2.21E+01	1.51E+01	4.39E+01	4.46E+02			
3	CYLINDER	242	3.83E+02	2.20E+01	1.42E+01	2.75E+01	3.21E+02	0.511	1.929	6.674
			3.61E+01	1.60E-01	2.00E+00	4.32E+00	3.82E+01			
			3.19E+02	2.21E+01	1.62E+01	3.18E+01	3.59E+02			
3	CYLINDER	243	1.94E+02	2.29E+01	1.35E+01	2.40E+01	2.31E+02	-0.005	1.996	6.674
			6.10E+01	1.80E-01	2.52E+00	6.62E+00	6.37E+01			
			2.55E+02	2.31E+01	1.60E+01	3.08E+01	2.94E+02			

3	CYLINDER	244	1.32E+02	2.49E+01	1.14E+01	1.07E+01	1.69E+02	-0.522	1.926	6.674
			8.68E+01	1.08E-01	3.10E+00	9.09E+00	9.01E+01			
			2.19E+02	2.51E+01	1.45E+01	2.78E+01	2.59E+02			
3	CYLINDER	245	9.06E+01	2.09E+01	8.66E+00	1.42E+01	1.22E+02	-1.002	1.726	6.674
			1.10E+02	8.15E-02	3.14E+00	9.83E+00	1.13E+02			
			2.01E+02	2.10E+01	1.20E+01	2.40E+01	2.35E+02			
3	CYLINDER	246	7.32E+01	2.07E+01	9.19E+00	1.20E+01	1.04E+02	-1.415	1.407	6.674
			1.32E+02	1.63E-01	4.00E+00	1.26E+01	1.36E+02			
			2.05E+02	2.08E+01	1.32E+01	2.46E+01	2.40E+02			
3	CYLINDER	247	7.03E+01	2.07E+01	9.04E+00	1.10E+01	1.01E+02	-1.731	0.993	6.674
			1.51E+02	1.12E-01	4.33E+00	1.56E+01	1.55E+02			
			2.21E+02	2.08E+01	1.34E+01	2.66E+01	2.57E+02			
3	CYLINDER	248	7.56E+01	2.00E+01	8.24E+00	1.03E+01	1.05E+02	-1.929	0.511	6.674
			1.65E+02	7.74E-02	4.50E+00	1.65E+01	1.70E+02			
			2.41E+02	2.01E+01	1.27E+01	2.68E+01	2.75E+02			
3	CYLINDER	249	8.62E+01	2.01E+01	8.74E+00	1.02E+01	1.16E+02	-1.996	-0.005	6.674
			1.70E+02	5.23E-02	5.05E+00	1.74E+01	1.76E+02			
			2.57E+02	2.02E+01	1.38E+01	2.76E+01	2.91E+02			
3	CYLINDER	250	1.03E+02	1.95E+01	8.90E+00	1.27E+01	1.32E+02	-1.926	-0.522	6.674
			1.66E+02	1.19E-01	4.55E+00	1.71E+01	1.71E+02			
			2.69E+02	1.96E+01	1.34E+01	2.98E+01	3.03E+02			
3	CYLINDER	251	1.31E+02	2.07E+01	1.03E+01	1.73E+01	1.63E+02	-1.726	-1.002	6.674
			1.54E+02	2.75E-01	4.60E+00	1.62E+01	1.59E+02			
			2.85E+02	2.10E+01	1.49E+01	3.35E+01	3.22E+02			
3	CYLINDER	252	1.80E+02	2.19E+01	1.31E+01	2.09E+01	2.15E+02	-1.407	-1.415	6.674
			1.33E+02	1.76E-01	4.29E+00	1.50E+01	1.37E+02			
			2.21E+02	2.21E+01	1.74E+01	3.59E+01	3.53E+02			
3	CYLINDER	253	1.47E+02	1.99E+01	1.60E+01	2.71E+01	2.82E+02	-0.993	-1.731	6.674
			2.09E+02	1.61E-01	3.46E+00	1.24E+01	1.12E+02			
			3.55E+02	2.01E+01	1.94E+01	3.95E+01	3.94E+02			
3	CYLINDER	254	3.37E+02	1.79E+01	1.85E+01	3.60E+01	3.72E+02	-0.511	-1.929	6.674
			8.48E+01	2.31E-01	3.26E+00	9.84E+00	8.83E+01			
			4.22E+02	1.81E+01	2.18E+01	4.58E+01	4.61E+02			
3	CYLINDER	255	4.53E+02	1.73E+01	2.29E+01	4.95E+01	4.92E+02	0.005	-1.996	6.674
			6.47E+01	2.20E-01	2.65E+00	6.71E+00	6.75E+01			
			5.17E+02	1.75E+01	2.55E+01	5.62E+01	5.60E+02			
3	CYLINDER	256	5.73E+02	1.67E+01	2.75E+01	6.03E+01	6.17E+02	0.522	-1.926	6.674
			4.59E+01	2.68E-01	1.87E+00	4.34E+00	4.81E+01			
			6.19E+02	1.70E+01	2.93E+01	6.46E+01	6.66E+02			
3	CYLINDER	257	6.85E+02	2.14E+01	2.79E+01	7.34E+01	7.33E+02	1.002	-1.726	6.674
			2.81E+01	5.96E-01	1.48E+00	2.91E+00	3.02E+01			
			7.13E+02	2.20E+01	2.93E+01	7.64E+01	7.64E+02			
3	CYLINDER	258	7.70E+02	2.73E+01	2.42E+01	8.45E+01	8.22E+02	1.415	-1.407	6.674
			1.30E+01	1.29E+00	9.64E-01	1.45E+00	1.50E+01			
			7.83E+02	2.86E+01	2.52E+01	8.60E+01	8.37E+02			
3	CYLINDER	259	8.20E+02	2.59E+01	2.35E+01	8.75E+01	8.69E+02	1.731	-0.993	6.674
			2.41E+00	1.53E+00	8.22E-01	5.42E-01	4.63E+00			
			8.22E+02	2.74E+01	2.43E+01	8.80E+01	8.74E+02			
3	CYLINDER	260	8.27E+02	2.28E+01	2.54E+01	8.77E+01	8.75E+02	1.929	-0.511	6.674
			0.00E+00	7.17E-01	6.41E-01	1.29E-01	1.34E+00			
			8.27E+02	2.55E+01	2.62E+01	8.78E+01	8.76E+02			
3	CYLINDER	261	7.97E+02	2.32E+01	2.63E+01	8.42E+01	8.47E+02	1.996	-0.005	6.674
			0.00E+00	4.92E-02	7.52E-01	9.57E-02	7.44E-01			
			7.97E+02	2.32E+01	2.70E+01	8.43E+01	8.47E+02			
3	CYLINDER	262	7.65E+02	2.73E+01	3.65E+01	8.33E+01	8.32E+02	1.496	0.004	7.507
			0.00E+00	3.39E-03	8.97E-01	1.24E-01	6.25E-01			
			7.65E+02	2.73E+01	3.74E+01	8.34E+01	8.32E+02			
3	CYLINDER	263	6.96E+02	2.75E+01	3.92E+01	8.01E+01	7.66E+02	1.444	0.391	7.507
			9.28E-01	-6.09E-05	1.11E+00	1.26E-01	2.02E+00			
			6.99E+02	2.75E+01	4.03E+01	8.03E+01	7.68E+02			
3	CYLINDER	264	5.95E+02	2.57E+01	3.85E+01	6.82E+01	6.60E+02	1.293	0.751	7.507
			4.56E+00	3.08E-03	1.51E+00	3.15E-01	6.06E+00			
			5.99E+02	2.57E+01	4.00E+01	6.85E+01	6.66E+02			
3	CYLINDER	265	4.77E+02	2.43E+01	3.03E+01	5.25E+01	5.32E+02	1.055	1.060	7.507
			1.05E+01	1.44E-01	2.25E+00	1.24E+00	1.29E+01			
			4.87E+02	2.45E+01	3.26E+01	5.38E+01	5.45E+02			

3	CYLINDER	266	3.59E+02	2.36E+01	2.80E+01	3.98E+01	4.13E+02	0.745	1.297	7.507
			2.00E+01	1.99E-01	2.87E+00	2.38E+00	4.32E+01			
			3.79E+02	2.36E+01	3.09E+01	4.22E+01	4.66E+02			
3	CYLINDER	267	3.54E+02	2.12E+01	2.61E+01	2.82E+01	3.02E+02	0.383	1.446	7.507
			3.54E+01	3.16E-01	3.01E+00	3.14E+00	3.85E+01			
			2.89E+02	2.15E+01	2.91E+01	2.07E+01	3.41E+02			
3	CYLINDER	268	2.89E+02	2.13E+01	2.19E+01	2.07E+01	2.13E+02	-0.004	1.496	7.507
			5.85E+01	3.85E-01	3.35E+00	6.78E+00	6.22E+01			
			2.28E+02	2.17E+01	2.53E+01	2.75E+01	2.75E+02			
3	CYLINDER	269	1.11E+02	2.42E+01	1.91E+01	1.73E+01	1.56E+02	-0.391	1.444	7.507
			8.56E+01	1.99E-01	4.70E+00	9.58E+00	9.07E+01			
			1.96E+02	2.44E+01	2.38E+01	2.69E+01	2.47E+02			
3	CYLINDER	270	7.11E+01	2.34E+01	1.54E+01	1.36E+01	1.11E+02	-0.751	1.293	7.507
			1.10E+02	4.01E-01	6.40E+00	9.82E+00	1.18E+02			
			1.82E+02	2.38E+01	2.18E+01	2.34E+01	2.29E+02			
3	CYLINDER	271	4.76E+01	2.12E+01	1.16E+01	9.32E+00	8.21E+01	-1.060	1.055	7.507
			1.32E+02	4.45E-01	6.53E+00	1.28E+01	1.39E+02			
			1.79E+02	2.17E+01	1.81E+01	2.21E+01	2.21E+02			
3	CYLINDER	272	4.26E+01	1.91E+01	1.22E+01	9.03E+00	7.51E+01	-1.297	0.745	7.507
			1.51E+02	3.63E-01	6.00E+00	1.59E+01	1.57E+02			
			1.94E+02	1.94E+01	1.82E+01	2.50E+01	2.33E+02			
3	CYLINDER	273	4.86E+01	1.67E+01	1.27E+01	8.75E+00	7.77E+01	-1.446	0.383	7.507
			1.65E+02	2.78E-01	6.18E+00	1.65E+01	1.72E+02			
			2.14E+02	1.70E+01	1.89E+01	2.53E+01	2.49E+02			
3	CYLINDER	274	5.70E+01	1.57E+01	1.48E+01	8.86E+00	8.87E+01	-1.496	-0.004	7.507
			1.70E+02	5.67E-02	6.89E+00	1.69E+01	1.77E+02			
			2.27E+02	1.58E+01	2.17E+01	2.57E+01	2.66E+02			
3	CYLINDER	275	7.08E+01	1.59E+01	1.30E+01	9.51E+00	1.02E+02	-1.444	-0.391	7.507
			1.66E+02	1.88E-03	6.68E+00	1.67E+01	1.73E+02			
			2.37E+02	1.59E+01	1.97E+01	2.62E+01	2.75E+02			
3	CYLINDER	276	9.59E+01	1.71E+01	1.45E+01	1.23E+01	1.29E+02	-1.293	-0.751	7.507
			1.94E+02	1.47E-01	6.54E+00	1.46E+01	1.61E+02			
			2.50E+02	1.72E+01	2.10E+01	2.69E+01	2.89E+02			
3	CYLINDER	277	1.45E+02	2.04E+01	2.07E+01	1.86E+01	1.85E+02	-1.055	-1.060	7.507
			1.33E+02	2.43E-01	6.46E+00	1.36E+01	1.40E+02			
			2.78E+02	2.07E+01	2.71E+01	3.22E+01	3.25E+02			
3	CYLINDER	278	2.15E+02	2.16E+01	2.54E+01	2.90E+01	2.62E+02	-0.745	-1.297	7.507
			1.09E+02	2.13E-01	6.01E+00	1.27E+01	1.15E+02			
			3.24E+02	2.18E+01	3.14E+01	4.17E+01	3.77E+02			
3	CYLINDER	279	3.09E+02	2.08E+01	2.79E+01	3.97E+01	3.58E+02	-0.383	-1.446	7.507
			8.50E+01	4.52E-01	5.10E+00	1.01E+01	9.09E+01			
			3.94E+02	2.13E+01	3.30E+01	4.98E+01	4.49E+02			
3	CYLINDER	280	4.23E+02	2.03E+01	2.95E+01	4.71E+01	4.71E+02	0.004	-1.496	7.507
			6.17E+01	2.10E+00	3.42E+00	7.03E+00	6.73E+01			
			4.85E+02	2.24E+01	3.29E+01	5.42E+01	5.39E+02			
3	CYLINDER	281	5.40E+02	2.07E+01	3.27E+01	5.67E+01	5.92E+02	0.391	-1.444	7.507
			4.01E+01	3.30E+00	2.85E+00	4.24E+00	4.67E+01			
			5.80E+02	2.40E+01	3.55E+01	6.10E+01	6.38E+02			
3	CYLINDER	282	6.50E+02	2.44E+01	3.87E+01	7.13E+01	7.10E+02	0.751	-1.293	7.507
			2.37E+01	2.75E+00	2.65E+00	3.10E+00	2.94E+01			
			6.74E+02	2.71E+01	4.13E+01	7.44E+01	7.39E+02			
3	CYLINDER	283	7.34E+02	2.87E+01	4.16E+01	8.04E+01	8.05E+02	1.060	-1.055	7.507
			9.57E+00	1.89E+00	2.15E+00	1.44E+00	1.36E+01			
			7.43E+02	3.06E+01	4.37E+01	8.18E+01	8.19E+02			
3	CYLINDER	284	7.83E+02	2.92E+01	3.98E+01	8.59E+01	8.53E+02	1.297	-0.745	7.507
			1.24E+00	9.68E-01	1.87E+00	6.38E-02	4.07E+00			
			7.85E+02	3.02E+01	4.16E+01	8.59E+01	8.57E+02			
3	CYLINDER	285	7.94E+02	2.75E+01	4.11E+01	8.52E+01	8.54E+02	1.446	-0.383	7.507
			0.00E+00	1.58E-01	1.35E+00	7.03E-02	1.52E+00			
			7.94E+02	2.77E+01	4.25E+01	8.53E+01	8.66E+02			
3	CYLINDER	286	7.72E+02	2.73E+01	4.12E+01	8.00E+01	8.42E+02	1.496	-0.004	7.507
			0.00E+00	-5.76E-04	1.05E+00	1.56E-01	1.02E+00			
			7.72E+02	2.73E+01	4.23E+01	8.01E+01	8.43E+02			
3	CYLINDER	287	7.25E+02	1.45E+01	5.80E+01	7.40E+01	7.98E+02	0.996	0.003	8.340
			0.00E+00	1.35E-01	2.10E+00	2.83E-01	1.97E+00			
			7.25E+02	1.46E+01	6.01E+01	7.43E+01	8.00E+02			



3	CYLINDER	310	7.55E+02	1.50E+01	7.06E+01	8.14E+01	8.41E+02	0.963	-0.255	8.340
			0.00E+00	-2.03E-03	1.91E+00	1.12E-01	1.75E+00			
			7.55E+02	1.50E+01	7.25E+01	8.15E+01	8.43E+02			
3	CYLINDER	311	7.32E+02	1.52E+01	6.23E+01	7.33E+01	8.09E+02	0.996	-0.003	8.340
			0.00E+00	5.34E-02	1.71E+00	2.83E-01	1.79E+00			
			7.32E+02	1.53E+01	6.40E+01	7.36E+01	8.10E+02			
3	CYLINDER	312	6.20E+02	4.96E+00	1.20E+02	8.20E+01	7.45E+02	0.497	0.001	9.171
			0.00E+00	1.28E-01	3.68E+00	6.57E-01	3.51E+00			
			6.20E+02	5.09E+00	1.24E+02	8.27E+01	7.48E+02			
3	CYLINDER	313	5.57E+02	5.80E+00	1.26E+02	7.16E+01	6.83E+02	0.480	0.130	9.171
			9.28E-01	1.03E-01	3.85E+00	4.67E-01	5.02E+00			
			5.58E+02	5.90E+00	1.30E+02	7.21E+01	6.88E+02			
3	CYLINDER	314	4.65E+02	7.19E+00	1.35E+02	5.72E+01	6.06E+02	0.430	0.250	9.171
			4.56E+00	1.27E-01	5.00E+00	7.16E-02	9.67E+00			
			4.70E+02	7.32E+00	1.40E+02	5.72E+01	6.15E+02			
3	CYLINDER	315	3.62E+02	7.55E+00	1.22E+02	4.52E+01	4.91E+02	0.351	0.353	9.171
			1.05E+01	3.01E-01	6.57E+00	1.86E-01	1.74E+01			
			3.73E+02	7.85E+00	1.29E+02	4.54E+01	5.09E+02			
3	CYLINDER	316	2.62E+02	1.12E+01	1.01E+02	3.43E+01	3.72E+02	0.248	0.431	9.171
			2.00E+01	5.60E-01	9.36E+00	1.69E+00	3.01E+01			
			2.82E+02	1.18E+01	1.10E+02	3.60E+01	4.02E+02			
3	CYLINDER	317	1.71E+02	1.07E+01	9.33E+01	2.74E+01	2.76E+02	0.128	0.481	9.171
			3.52E+01	1.03E+00	1.26E+01	2.97E+00	4.88E+01			
			2.06E+02	1.18E+01	1.06E+02	3.04E+01	3.25E+02			
3	CYLINDER	318	9.98E+01	8.42E+00	9.24E+01	1.74E+01	2.03E+02	-0.001	0.497	9.171
			5.61E+01	1.09E+00	1.38E+01	3.31E+00	7.11E+01			
			1.56E+02	9.51E+00	1.06E+02	2.07E+01	2.74E+02			
3	CYLINDER	319	5.31E+01	5.94E+00	6.27E+01	6.98E+00	1.23E+02	-0.130	0.480	9.171
			7.80E+01	7.21E-01	1.82E+01	6.52E+00	9.67E+01			
			1.31E+02	6.66E+00	8.09E+01	4.35E+01	2.20E+02			
3	CYLINDER	320	2.70E+01	4.16E+00	4.58E+01	1.11E+00	7.76E+01	-0.250	0.430	9.171
			9.77E+01	1.35E+00	2.17E+01	8.77E+00	1.21E+02			
			1.25E+02	5.51E+00	6.75E+01	1.29E+01	1.99E+02			
3	CYLINDER	321	1.49E+01	4.07E+00	4.94E+01	8.14E+00	6.91E+01	-0.353	0.351	9.171
			1.16E+02	3.01E+00	2.29E+01	4.07E+00	1.40E+02			
			9.11E+00	6.37E+00	7.23E+01	1.22E+01	2.09E+02			
3	CYLINDER	322	9.11E+00	3.23E+00	3.97E+01	4.45E+00	5.23E+01	-0.431	0.248	9.171
			1.35E+02	1.78E+00	2.65E+01	9.19E+00	1.63E+02			
			1.44E+02	5.01E+00	6.62E+01	1.36E+01	2.16E+02			
3	CYLINDER	323	7.09E+00	1.87E+00	4.21E+01	4.30E+00	5.26E+01	-0.481	0.128	9.171
			1.51E+02	1.21E+00	2.66E+01	1.08E+01	1.78E+02			
			1.58E+02	3.08E+00	6.87E+01	1.51E+01	2.31E+02			
3	CYLINDER	324	1.08E+01	1.72E+00	5.54E+01	5.86E+00	6.92E+01	-0.497	-0.001	9.171
			1.54E+02	5.17E-01	2.64E+01	1.03E+01	1.81E+02			
			1.65E+02	2.24E+00	8.18E+01	1.62E+01	2.50E+02			
3	CYLINDER	325	2.35E+01	3.57E+00	6.18E+01	7.54E+00	8.92E+01	-0.480	-0.130	9.171
			1.49E+02	6.70E-01	2.97E+01	1.00E+01	1.79E+02			
			1.73E+02	4.24E+00	9.15E+01	1.76E+01	2.68E+02			
3	CYLINDER	326	4.25E+01	1.86E+00	7.16E+01	8.94E+00	1.16E+02	-0.430	-0.250	9.171
			1.37E+02	1.42E+00	2.77E+01	9.32E+00	1.66E+02			
			1.79E+02	3.28E+00	9.93E+01	1.83E+01	2.82E+02			
3	CYLINDER	327	7.19E+01	7.91E-01	7.33E+01	1.28E+01	1.48E+02	-0.351	-0.353	9.171
			1.17E+02	1.60E+00	2.36E+01	8.02E+00	1.42E+02			
			1.89E+02	2.39E+00	9.69E+01	2.09E+01	2.91E+02			
3	CYLINDER	328	1.27E+02	4.74E+00	7.67E+01	1.88E+01	2.09E+02	-0.248	-0.431	9.171
			8.96E+01	2.54E+00	1.94E+01	7.18E+00	1.12E+02			
			2.16E+02	7.28E+00	9.60E+01	2.59E+01	3.20E+02			
3	CYLINDER	329	2.04E+02	1.13E+01	6.98E+01	2.13E+01	3.06E+02	-0.128	-0.481	9.171
			6.32E+01	3.08E+00	1.56E+01	5.64E+00	8.18E+01			
			2.67E+02	1.44E+01	1.05E+02	2.69E+01	3.87E+02			
3	CYLINDER	330	3.01E+02	1.39E+01	1.12E+02	3.13E+01	4.27E+02	0.001	-0.497	9.171
			4.71E+01	2.77E+00	1.77E+01	4.41E+00	6.76E+01			
			3.49E+02	1.66E+01	1.30E+02	3.57E+01	4.95E+02			
3	CYLINDER	331	4.05E+02	1.42E+01	1.36E+02	5.39E+01	5.55E+02	0.130	-0.480	9.171
			3.17E+01	1.77E+00	1.35E+01	3.83E+00	4.71E+01			
			4.37E+02	1.59E+01	1.49E+02	5.78E+01	6.02E+02			

3	CYLINDER	332	5.05E+02	1.28E+01	1.52E+02	6.87E+01	6.71E+02	0.250	-0.430	9.171
			1.73E+01	3.87E-01	8.47E+00	2.57E+00	2.64E+01			
			5.22E+02	1.32E+01	1.61E+02	7.12E+01	6.98E+02	0.353	-0.351	9.171
			5.88E+02	1.33E+01	1.46E+02	7.23E+01	7.45E+02			
			6.56E+00	8.20E-02	7.29E+00	1.08E+00	1.43E+01			
			5.94E+02	1.34E+01	1.53E+02	7.94E+01	7.59E+02	0.431	-0.248	9.171
			6.38E+02	1.19E+01	1.46E+02	8.70E+01	7.94E+02			
			1.04E+00	4.64E-03	3.98E+00	2.02E-01	5.00E+00			
			6.39E+02	1.19E+01	1.50E+02	8.72E+01	7.99E+02	0.481	-0.128	9.171
			6.50E+02	5.84E+00	1.63E+02	9.16E+01	8.17E+02			
			0.00E+00	4.34E-03	3.43E+00	3.27E-02	3.28E+00			
			6.50E+02	5.84E+00	1.67E+02	9.16E+01	8.21E+02	0.497	-0.001	9.171
			6.26E+02	4.47E+00	1.54E+02	8.12E+01	7.86E+02			
			0.00E+00	5.06E-02	3.51E+00	3.62E-01	3.58E+00			
			6.26E+02	4.52E+00	1.58E+02	8.16E+01	7.89E+02	0.050	0.000	9.917
			5.50E+02	6.06E+00	1.63E+02	8.69E+01	7.18E+02			
			0.00E+00	0.00E+00	4.14E+00	7.44E-01	3.78E+00			
			5.50E+02	6.06E+00	1.68E+02	8.77E+01	7.21E+02	0.048	0.013	9.917
			4.91E+02	7.01E+00	1.73E+02	7.47E+01	6.67E+02			
			9.28E-01	0.00E+00	5.21E+00	4.76E-01	6.13E+00			
			4.92E+02	7.01E+00	1.78E+02	7.52E+01	6.73E+02	0.043	0.025	9.917
			4.03E+02	7.01E+00	1.87E+02	6.83E+01	5.97E+02			
			4.56E+00	0.00E+00	7.58E+00	-1.37E-02	1.21E+01	0.035	0.035	9.917
			4.08E+02	7.01E+00	1.95E+02	6.83E+01	6.09E+02			
			3.07E+02	5.22E+00	1.75E+02	5.59E+01	4.87E+02			
			1.05E+01	2.36E-01	8.45E+00	1.80E-02	1.93E+01			
			3.17E+02	5.45E+00	1.84E+02	5.59E+01	5.07E+02	0.025	0.043	9.917
			2.11E+02	1.25E+01	1.45E+02	3.60E+01	3.69E+02			
			2.00E+01	9.60E-01	1.23E+01	1.14E+00	3.36E+01	0.013	0.048	9.917
			2.31E+02	1.35E+01	1.57E+02	3.71E+01	4.02E+02			
			1.27E+02	1.20E+01	1.32E+02	2.80E+01	2.73E+02	0.013	0.048	9.917
			3.48E+01	1.74E+00	1.80E+01	2.86E+00	5.48E+01			
			1.62E+02	1.37E+01	1.50E+02	3.09E+01	3.28E+02	-0.000	0.050	9.917
			6.77E+01	7.10E+00	1.37E+02	1.90E+01	2.14E+02			
			5.48E+01	1.46E+00	1.89E+01	2.07E+00	7.52E+01	-0.013	0.048	9.917
			1.22E+02	8.56E+00	1.56E+02	2.11E+01	2.89E+02			
			2.97E+01	5.09E+00	9.39E+01	8.73E+00	1.31E+02	0.048	0.048	9.917
			7.54E+01	9.70E-01	2.27E+01	1.68E+00	9.89E+01			
			1.05E+02	6.06E+00	1.17E+02	1.04E+01	2.30E+02	-0.025	0.043	9.917
			9.87E+00	3.61E+00	6.61E+01	5.22E+00	8.04E+01			
			9.40E+01	2.01E+00	2.85E+01	2.02E+00	1.25E+02	-0.035	0.035	9.917
			1.04E+02	5.62E+00	9.46E+01	7.24E+00	2.05E+02			
			2.76E+00	5.21E+00	7.02E+01	5.31E+00	7.86E+01	0.035	0.035	9.917
			1.14E+02	7.98E+00	3.10E+01	1.52E+00	1.44E+02			
			3.62E-01	3.51E+00	1.01E+02	6.82E+00	2.23E+02	-0.043	0.025	9.917
			1.26E+02	2.65E+00	5.19E+01	7.01E+00	5.62E+01			
			3.71E-01	1.70E+00	8.79E+01	1.10E+01	2.20E+02	-0.048	0.013	9.917
			1.26E+02	6.16E+00	5.32E+01	7.01E+00	5.55E+01			
			1.37E+02	1.34E+00	3.44E+01	4.82E+00	1.72E+02	0.013	0.013	9.917
			1.37E+02	3.04E+00	8.76E+01	1.18E+01	2.27E+02			
			2.58E+00	1.80E+00	7.54E+01	5.21E+00	8.01E+01	-0.050	-0.000	9.917
			1.39E+02	2.96E-01	3.54E+01	3.58E+00	1.74E+02			
			1.42E+02	2.10E+00	1.11E+02	8.59E+00	2.20E+02	-0.048	-0.013	9.917
			7.77E+00	3.61E+00	8.61E+01	5.29E+00	9.80E+01			
			1.33E+02	4.17E-01	4.24E+01	4.21E+00	1.76E+02	0.013	0.013	9.917
			1.41E+02	4.03E+00	1.28E+02	9.50E+00	2.74E+02			
			1.86E+01	1.70E+00	1.02E+02	8.80E+00	1.23E+02	-0.043	-0.025	9.917
			1.21E+02	1.54E+00	3.64E+01	4.10E+00	1.58E+02			
			1.39E+02	3.25E+00	1.39E+02	1.29E+01	2.61E+02	-0.035	-0.035	9.917
			4.10E+01	-6.44E-02	9.78E+01	8.71E+00	1.41E+02			
			1.01E+02	2.30E+00	2.94E+01	3.42E+00	1.33E+02	0.013	0.013	9.917
			1.42E+02	2.24E+00	1.27E+02	1.21E+01	2.74E+02			
			8.55E+01	5.36E+00	9.52E+01	1.24E+01	1.86E+02	-0.025	-0.043	9.917
			7.92E+01	1.93E+00	2.35E+01	4.31E+00	1.05E+02			
			1.66E+02	7.30E+00	1.19E+02	1.67E+01	2.91E+02			

3	CYLINDER	354	1.54E+02	1.59E+01	1.18E+02	1.93E+01	2.90E+02	-0.013	-0.048	9.917
			5.85E+01	1.87E+00	1.77E+01	3.00E+00	7.71E+01			
3	CYLINDER	355	2.13E+02	1.78E+01	1.36E+02	3.00E+00	3.67E+02	0.000	-0.050	9.917
			4.43E+02	1.92E+01	1.53E+02	2.90E+01	4.15E+02			
3	CYLINDER	356	2.86E+02	2.19E+01	1.76E+02	3.10E+01	4.83E+02	0.013	-0.048	9.917
			2.85E+01	1.75E+01	1.89E+02	5.11E+01	5.46E+02			
3	CYLINDER	357	4.34E+02	1.92E+01	2.06E+02	3.33E+00	4.76E+01	0.025	-0.043	9.917
			1.53E+01	2.54E-01	1.04E+01	3.15E+00	2.63E+01			
3	CYLINDER	358	4.9E+02	1.60E+01	2.24E+02	6.46E+01	6.91E+02	0.035	-0.035	9.917
			5.12E+02	1.58E+01	1.96E+02	5.94E+01	7.20E+02			
3	CYLINDER	359	5.18E+02	1.60E+01	9.95E+00	1.75E+00	1.65E+01	0.043	-0.025	9.917
			5.61E+02	1.40E+01	2.05E+02	6.12E+01	7.37E+02			
3	CYLINDER	360	1.06E+00	1.40E+01	1.91E+02	8.67E+01	7.63E+02	0.048	-0.013	9.917
			5.62E+02	1.40E+01	1.97E+02	8.71E+01	7.70E+02			
3	CYLINDER	361	0.00E+00	8.47E-03	4.76E+00	-6.66E-02	4.77E+00	0.050	-0.000	9.917
			5.56E+02	4.65E+00	2.34E+02	1.03E+02	8.15E+02			
4	DISK	362	5.56E+02	4.65E+00	2.26E+02	8.74E+01	7.88E+02	5.993	-0.016	0.000
			5.75E+02	2.92E+01	1.02E+02	3.31E+01	7.06E+02			
4	DISK	363	2.67E+01	3.46E-01	1.46E+00	1.61E+00	2.86E+01	5.785	-1.566	0.000
			6.02E+02	2.96E+01	1.03E+02	3.47E+01	7.35E+02			
4	DISK	364	3.83E+01	1.10E+00	1.08E+02	3.40E+01	7.13E+02	5.182	-3.010	0.000
			5.89E+02	3.47E+01	1.95E+00	2.03E+00	4.05E+01			
4	DISK	365	4.11E+01	3.51E+01	1.10E+02	3.61E+01	7.53E+02	4.227	-4.249	0.000
			5.66E+02	3.57E+01	1.05E+02	3.35E+01	7.06E+02			
4	DISK	366	4.00E+02	3.51E+01	2.08E+00	3.34E+00	4.34E+01	2.983	-5.198	0.000
			5.81E+02	3.68E+01	1.07E+02	3.58E+01	7.50E+02			
4	DISK	367	5.36E+02	3.84E+01	9.21E+01	3.22E+01	6.77E+02	1.536	-5.793	0.000
			4.66E+01	2.48E+00	7.51E+00	2.42E+00	5.68E+01			
4	DISK	368	5.83E+02	4.09E+01	7.72E+01	3.35E+01	7.01E+02	-0.016	-5.993	0.000
			5.34E+02	3.51E+01	6.47E+01	3.07E+01	6.34E+02			
4	DISK	369	5.89E+02	3.80E+01	7.45E+01	3.39E+01	7.02E+02	-1.566	-5.785	0.000
			5.27E+02	3.12E+01	5.36E+01	2.87E+01	6.12E+02			
4	DISK	370	5.97E+01	3.91E+00	1.23E+01	3.46E+00	7.62E+01	-3.010	-5.182	0.000
			5.86E+02	3.51E+01	6.59E+01	3.21E+01	6.88E+02			
4	DISK	371	5.08E+02	2.76E+01	3.99E+01	2.68E+01	5.75E+02	-4.249	-4.227	0.000
			5.97E+01	4.49E+00	1.57E+01	3.48E+00	7.99E+01			
4	DISK	372	4.85E+02	3.21E+01	5.55E+01	3.03E+01	6.55E+02	-5.198	-2.983	0.000
			5.68E+02	2.10E+01	2.80E+01	2.59E+01	5.35E+02			
4	DISK	373	5.97E+01	5.37E+00	1.78E+01	4.25E+00	8.23E+01	-5.793	-1.536	0.000
			4.81E+02	2.13E+01	3.95E+01	2.69E+01	5.42E+02			
4	DISK	374	4.05E+02	1.71E+01	1.86E+01	2.30E+01	4.41E+02	-5.993	0.016	0.000
			5.97E+01	1.56E+00	2.07E+01	4.10E+00	8.40E+01			
4	DISK	375	4.65E+02	2.07E+01	3.93E+01	2.71E+01	5.25E+02	-5.785	1.566	0.000
			5.97E+01	4.21E+00	2.02E+01	2.24E+01	4.19E+02			
			4.47E+02	2.11E+01	3.58E+01	2.70E+01	5.03E+02			



4	DISK	376	4.02E+02	1.37E+01	1.58E+01	2.30E+01	4.32E+02	-5.182	3.010	0.000
			5.97E+01	5.12E+00	1.86E+01	4.87E+00	8.34E+01			
4	DISK	377	4.61E+02	1.89E+01	3.44E+01	2.79E+01	5.15E+02	-4.227	4.249	0.000
			4.27E+02	1.29E+01	1.72E+01	2.39E+01	4.58E+02			
4	DISK	378	5.97E+01	4.99E+00	1.54E+01	4.69E+00	8.02E+01	-2.983	5.198	0.000
			4.87E+02	1.79E+01	3.27E+01	2.86E+01	5.38E+02			
			4.52E+02	1.73E+01	1.97E+01	2.42E+01	4.89E+02			
			5.97E+01	4.61E+00	1.33E+01	3.60E+00	7.77E+01			
4	DISK	379	5.12E+02	2.21E+01	3.30E+01	2.80E+01	5.67E+02	-1.536	5.793	0.000
			4.73E+02	2.26E+00	2.74E+01	2.52E+01	5.23E+02			
4	DISK	380	5.97E+01	3.62E+00	1.15E+01	3.34E+00	7.48E+01	0.016	5.993	0.000
			5.33E+02	2.68E+01	3.89E+01	2.86E+01	5.98E+02			
			4.87E+02	2.62E+01	3.70E+01	2.62E+01	5.51E+02			
			5.97E+01	2.54E+00	9.41E+00	3.27E+00	7.16E+01			
4	DISK	381	5.47E+02	2.93E+01	4.64E+01	2.94E+01	6.23E+02	1.566	5.785	0.000
			5.04E+02	2.68E+01	4.49E+01	2.90E+01	5.77E+02			
4	DISK	382	5.97E+01	2.37E+00	7.08E+00	3.62E+00	6.91E+01	3.010	5.182	0.000
			5.64E+02	2.92E+01	5.20E+01	3.26E+01	6.46E+02			
			5.30E+02	2.40E+01	5.93E+01	3.31E+01	6.13E+02			
			5.21E+01	2.01E+00	5.23E+00	3.07E+00	5.94E+01			
4	DISK	383	5.82E+02	2.60E+01	6.45E+01	3.61E+01	6.73E+02	4.249	4.227	0.000
			5.52E+02	2.62E+01	7.40E+01	3.56E+01	6.53E+02			
			3.26E+01	1.26E+00	3.57E+00	1.84E+00	3.75E+01			
4	DISK	384	5.85E+02	2.75E+01	7.75E+01	3.54E+01	6.90E+02	5.198	2.983	0.000
			5.65E+02	3.16E+01	8.24E+01	3.15E+01	6.79E+02			
			2.21E+01	9.59E-01	2.02E+00	1.29E+00	2.52E+01			
4	DISK	385	5.87E+02	3.26E+01	8.45E+01	3.28E+01	7.04E+02	5.793	1.536	0.000
			5.76E+02	3.48E+01	9.22E+01	3.23E+01	7.03E+02			
			2.11E+01	1.07E+00	1.22E+00	1.10E+00	2.35E+01			
4	DISK	386	5.97E+02	3.58E+01	9.34E+01	3.34E+01	7.26E+02	5.993	0.016	0.000
			5.78E+02	3.28E+01	1.02E+02	3.37E+01	7.11E+02			
			2.30E+01	8.83E-01	1.24E+00	1.39E+00	2.55E+01			
4	DISK	387	5.70E+02	3.28E+01	1.03E+02	3.50E+01	7.37E+02	5.243	-0.014	0.000
			5.70E+02	3.28E+01	1.17E+02	3.36E+01	7.20E+02			
			2.52E+01	2.65E-01	1.02E+00	1.61E+00	2.63E+01			
4	DISK	388	5.95E+02	3.31E+01	1.18E+02	3.52E+01	7.47E+02	5.061	-1.370	0.000
			5.65E+02	3.48E+01	1.16E+02	3.36E+01	7.17E+02			
			3.31E+01	1.37E-01	1.79E+00	1.94E+00	3.50E+01			
4	DISK	389	5.98E+02	3.49E+01	1.18E+02	3.55E+01	7.52E+02	4.534	-2.633	0.000
			5.59E+02	3.95E+01	1.11E+02	3.22E+01	7.11E+02			
			3.67E+01	5.75E-01	2.22E+00	2.10E+00	3.95E+01			
4	DISK	390	5.96E+02	4.01E+01	1.13E+02	3.43E+01	7.50E+02	3.698	-3.717	0.000
			5.48E+02	4.17E+01	1.02E+02	3.31E+01	6.92E+02			
			3.80E+01	1.02E+00	3.49E+00	2.23E+00	4.24E+01			
4	DISK	391	5.86E+02	4.27E+01	1.06E+02	3.54E+01	7.34E+02	2.610	-4.547	0.000
			5.33E+02	4.27E+01	9.19E+01	3.39E+01	6.67E+02			
			4.09E+01	1.91E+00	5.75E+00	2.41E+00	4.84E+01			
4	DISK	392	5.74E+02	4.46E+01	9.76E+01	3.63E+01	7.15E+02	1.344	-5.068	0.000
			5.26E+02	4.32E+01	8.15E+01	3.20E+01	6.50E+02			
			4.67E+01	2.89E+00	8.30E+00	2.71E+00	5.82E+01			
4	DISK	393	5.72E+02	4.61E+01	8.98E+01	3.47E+01	7.08E+02	-0.014	-5.243	0.000
			5.21E+02	4.11E+01	7.21E+01	3.08E+01	6.35E+02			
			5.51E+01	3.48E+00	1.09E+01	3.35E+00	6.98E+01			
4	DISK	394	5.13E+02	4.46E+01	8.30E+01	3.41E+01	7.05E+02	-1.370	-5.061	0.000
			5.36E+02	3.59E+01	6.16E+01	2.95E+01	6.11E+02			
			5.97E+01	4.30E+00	1.34E+01	3.65E+00	7.80E+01			
4	DISK	395	5.73E+02	4.02E+01	7.50E+01	3.34E+01	6.89E+02	-2.633	-4.534	0.000
			4.95E+02	3.01E+01	4.77E+01	2.78E+01	5.72E+02			
			5.97E+01	4.96E+00	1.74E+01	3.91E+00	8.20E+01			
4	DISK	396	5.54E+02	3.50E+01	6.51E+01	3.17E+01	6.54E+02	-3.717	-3.698	0.000
			4.97E+02	2.45E+01	3.35E+01	2.59E+01	5.23E+02			
			5.97E+01	5.63E+00	2.07E+01	4.30E+00	8.62E+01			
4	DISK	397	5.25E+02	3.01E+01	5.42E+01	3.02E+01	6.10E+02	-4.547	-2.610	0.000
			4.32E+02	2.11E+01	2.43E+01	2.42E+01	4.77E+02			
			5.97E+01	6.26E+00	2.15E+01	4.87E+00	8.75E+01			
			4.92E+02	2.73E+01	4.59E+01	2.91E+01	5.65E+02			

4	DISK	398	4.11E+02	1.82E+01	2.02E+01	2.34E+01	4.49E+02	-5.068	-1.344	0.000
			5.97E+01	5.83E+00	2.23E+01	4.66E+00	8.78E+01			
			4.71E+02	2.40E+01	4.25E+01	2.81E+01	5.37E+01			
4	DISK	399	3.92E+02	1.73E+01	1.87E+01	2.29E+01	4.27E+02	-5.243	0.014	0.000
			5.97E+01	4.72E+00	2.28E+01	4.35E+00	8.68E+01			
			4.52E+02	2.18E+01	4.14E+01	2.73E+01	5.14E+02			
4	DISK	400	3.66E+02	1.81E+01	1.70E+01	2.12E+01	4.02E+02	-5.061	1.370	0.000
			5.97E+01	5.17E+00	2.26E+01	4.44E+00	8.75E+01			
			4.26E+02	2.33E+01	2.96E+01	2.57E+01	4.89E+02			
4	DISK	401	3.87E+02	1.53E+01	1.73E+01	2.17E+01	4.20E+02	-4.534	2.633	0.000
			5.97E+01	6.35E+00	2.04E+01	4.64E+00	8.63E+01			
			4.47E+02	2.17E+01	3.77E+01	2.64E+01	5.06E+02			
4	DISK	402	4.16E+02	1.32E+01	2.02E+01	2.26E+01	4.49E+02	-3.698	3.717	0.000
			5.97E+01	5.61E+00	1.78E+01	4.61E+00	8.31E+01			
			4.75E+02	1.88E+01	3.81E+01	2.72E+01	5.32E+02			
4	DISK	403	4.29E+02	1.64E+01	2.34E+01	2.29E+01	4.69E+02	-2.610	4.547	0.000
			5.97E+01	4.87E+00	1.57E+01	3.86E+00	8.01E+01			
			4.89E+02	2.12E+01	3.91E+01	2.68E+01	5.49E+02			
4	DISK	404	4.53E+02	2.20E+01	3.04E+01	2.48E+01	5.06E+02	-1.344	5.068	0.000
			5.97E+01	3.77E+00	1.24E+01	3.43E+00	7.59E+01			
			5.13E+02	2.58E+01	4.29E+01	2.82E+01	5.81E+02			
4	DISK	405	4.81E+02	2.86E+01	3.81E+01	2.68E+01	5.48E+02	0.014	5.243	0.000
			5.97E+01	2.86E+00	9.65E+00	3.40E+00	5.48E+02			
			5.41E+02	3.10E+01	4.77E+01	3.02E+01	7.21E+01			
4	DISK	406	4.96E+02	2.86E+01	4.77E+01	3.02E+01	6.20E+02	1.370	5.061	0.000
			5.97E+01	2.43E+00	7.25E+00	3.67E+00	5.74E+02			
			5.56E+02	3.11E+01	5.49E+01	3.24E+01	6.43E+02			
4	DISK	407	5.19E+02	2.68E+01	5.50E+01	3.17E+01	6.13E+02	2.633	4.534	0.000
			4.93E+01	1.87E+00	5.24E+00	3.03E+00	5.63E+01			
			5.69E+02	2.86E+01	7.02E+01	3.48E+01	6.70E+02			
4	DISK	408	5.48E+02	2.99E+01	7.86E+01	3.32E+01	6.56E+02	3.717	3.698	0.000
			2.92E+01	1.26E+00	3.27E+00	1.70E+00	3.37E+01			
			5.78E+02	3.11E+01	8.18E+01	3.49E+01	6.90E+02			
4	DISK	409	5.58E+02	3.80E+01	8.77E+01	3.29E+01	6.84E+02	4.547	2.610	0.000
			2.21E+01	1.09E+00	2.11E+00	1.30E+00	2.53E+01			
			5.80E+02	3.91E+01	8.98E+01	3.42E+01	7.09E+02			
4	DISK	410	5.67E+02	4.21E+01	1.03E+02	3.33E+01	7.12E+02	5.068	1.344	0.000
			2.00E+01	8.00E-01	1.38E+00	1.16E+00	2.23E+01			
			5.72E+02	4.30E+01	1.04E+02	3.45E+01	7.34E+02			
4	DISK	411	5.72E+02	3.73E+01	1.16E+02	3.35E+01	7.25E+02	5.243	0.014	0.000
			2.06E+01	5.40E-01	1.06E+00	1.36E+00	2.26E+01			
			5.92E+02	3.78E+01	1.17E+02	3.49E+01	7.47E+02			
4	DISK	412	5.53E+02	4.57E+01	1.58E+02	3.62E+01	7.57E+02	4.493	-0.012	0.000
			1.67E+01	1.12E-01	1.58E+02	1.12E+00	1.76E+01			
			5.69E+02	4.59E+01	1.59E+02	3.73E+01	7.75E+02			
4	DISK	413	5.47E+02	4.99E+01	1.55E+02	3.75E+01	7.51E+02	4.337	-1.174	0.000
			1.94E+01	1.56E-01	1.77E+00	1.31E+00	2.13E+01			
			5.67E+02	5.00E+01	1.57E+02	3.88E+01	7.72E+02			
4	DISK	414	5.43E+02	5.35E+01	1.53E+02	3.67E+01	7.49E+02	3.885	-2.257	0.000
			2.93E+01	3.44E-01	2.77E+00	1.87E+00	3.25E+01			
			5.73E+02	5.39E+01	1.56E+02	3.86E+01	7.82E+02			
4	DISK	415	5.36E+02	5.71E+01	1.43E+02	3.56E+01	7.37E+02	3.169	-3.185	0.000
			3.72E+01	7.85E-01	4.60E+00	2.30E+00	4.26E+01			
			5.72E+02	5.79E+01	1.47E+02	3.79E+01	7.80E+02			
4	DISK	416	5.21E+02	5.56E+01	1.26E+02	3.47E+01	7.02E+02	2.236	-3.897	0.000
			3.95E+01	2.19E+00	7.59E+00	2.65E+00	4.92E+01			
			5.60E+02	5.78E+01	1.33E+02	3.73E+01	7.52E+02			
4	DISK	417	5.11E+02	5.10E+01	1.09E+02	3.26E+01	6.69E+02	1.152	-4.343	0.000
			4.38E+01	3.56E+00	1.09E+01	2.97E+00	5.65E+01			
			5.35E+02	5.46E+01	1.20E+02	3.56E+01	7.28E+02			
4	DISK	418	5.03E+02	5.09E+01	9.33E+01	3.26E+01	6.44E+02	-0.012	-4.493	0.000
			5.08E+01	4.52E+00	1.47E+01	3.37E+00	7.06E+01			
			5.53E+02	5.54E+01	1.08E+02	3.60E+01	7.15E+02			
4	DISK	419	4.86E+02	4.51E+01	7.82E+01	3.23E+01	6.09E+02	-1.174	-4.337	0.000
			5.78E+01	4.67E+00	1.81E+01	4.15E+00	8.11E+01			
			5.44E+02	5.00E+01	9.63E+01	3.65E+01	6.90E+02			

4	DISK	420	4.59E+02	3.47E+01	6.29E+01	2.78E+01	5.55E+02	-2.257	-3.885	0.000
			5.97E+01	5.60E+00	2.33E+01	4.68E+00	8.88E+01			
4	DISK	421	5.19E+02	4.03E+01	8.62E+01	3.25E+01	6.44E+02	-3.185	-3.169	0.000
			4.23E+02	2.91E+01	4.76E+01	2.41E+01	4.99E+02			
4	DISK	422	5.97E+01	6.61E+00	7.56E+01	4.63E+00	9.45E+01	-3.897	-2.236	0.000
			4.82E+02	3.57E+01	7.56E+01	2.87E+01	5.94E+02			
4	DISK	423	5.97E+01	7.00E+00	2.92E+01	4.80E+00	9.58E+01	-4.343	-1.152	0.000
			4.55E+02	3.40E+01	6.56E+01	2.78E+01	5.54E+02			
4	DISK	424	3.72E+02	2.12E+01	3.02E+01	2.27E+01	4.20E+02	-4.493	0.012	0.000
			5.97E+01	7.22E+00	3.02E+01	5.28E+00	9.69E+01			
4	DISK	425	4.32E+02	2.84E+01	5.74E+01	2.80E+01	5.17E+02	-4.337	1.174	0.000
			3.42E+02	1.82E+01	2.28E+01	2.06E+01	3.85E+02			
4	DISK	426	5.97E+01	5.77E+00	3.07E+01	5.07E+00	9.60E+01	-3.885	2.257	0.000
			4.01E+02	2.40E+01	5.35E+01	2.57E+01	4.81E+02			
4	DISK	427	3.26E+02	2.23E+01	2.44E+01	1.90E+01	3.74E+02	-3.169	3.165	0.000
			5.97E+01	6.08E+00	3.03E+01	4.56E+00	9.62E+01			
4	DISK	428	3.86E+02	2.83E+01	5.47E+01	2.36E+01	4.70E+02	-2.236	3.897	0.000
			3.42E+02	2.30E+01	2.47E+01	1.90E+01	3.90E+02			
4	DISK	429	5.97E+01	8.04E+00	2.80E+01	4.56E+00	9.58E+01	-1.152	4.343	0.000
			4.02E+02	3.10E+01	5.27E+01	2.36E+01	4.86E+02			
4	DISK	430	5.97E+01	7.21E+00	2.86E+01	2.01E+01	4.19E+02	0.012	4.493	0.000
			5.97E+01	6.68E+01	2.49E+01	2.49E+01	5.11E+02			
4	DISK	431	4.76E+02	3.53E+01	5.34E+01	2.18E+01	4.39E+02	1.174	4.337	0.000
			5.97E+01	5.94E+00	2.14E+01	4.48E+00	8.68E+01			
4	DISK	432	4.76E+02	2.54E+01	5.41E+01	2.63E+01	5.25E+02	2.257	3.885	0.000
			4.11E+02	2.53E+01	3.84E+01	2.45E+01	4.74E+02			
4	DISK	433	5.97E+01	4.71E+00	1.68E+01	3.93E+00	8.10E+01	0.012	4.493	0.000
			4.71E+02	3.00E+01	5.52E+01	2.85E+01	5.55E+02			
4	DISK	434	4.52E+02	3.42E+01	4.59E+01	2.75E+01	5.33E+02	1.174	4.337	0.000
			5.97E+01	3.42E+00	1.22E+01	3.69E+00	7.55E+01			
4	DISK	435	5.12E+02	3.76E+01	5.80E+01	3.11E+01	6.09E+02	2.257	3.885	0.000
			4.76E+02	3.53E+01	6.25E+01	2.93E+01	5.73E+02			
4	DISK	436	5.97E+01	2.58E+00	8.90E+00	3.56E+00	6.84E+01	3.165	3.169	0.000
			5.33E+02	3.79E+01	7.14E+01	3.28E+01	6.41E+02			
4	DISK	437	5.00E+02	3.48E+01	8.71E+01	3.15E+01	6.21E+02	2.257	3.885	0.000
			3.88E+02	1.98E+00	6.04E+00	2.62E+00	4.72E+01			
4	DISK	438	5.30E+02	3.68E+01	9.32E+01	3.41E+01	6.68E+02	3.165	3.169	0.000
			3.0E+02	4.18E+00	1.05E+02	3.38E+01	6.75E+02			
4	DISK	439	5.46E+02	5.22E+01	1.39E+00	1.09E+00	2.86E+01	3.897	2.236	0.000
			5.64E+02	5.28E+01	1.46E+02	3.61E+01	7.63E+02			
4	DISK	440	5.97E+01	4.66E+01	1.58E+02	3.48E+01	7.61E+02	0.012	4.493	0.000
			1.01E+01	1.01E+01	9.40E+01	1.00E+00	1.71E+01			
4	DISK	441	5.66E+02	4.87E+01	1.59E+02	3.58E+01	7.78E+02	3.743	-0.010	0.000
			5.29E+02	6.68E+01	2.95E+02	4.55E+01	8.91E+02			
4	DISK	442	6.08E+00	6.17E-02	2.38E+02	4.01E-01	8.70E+00	3.613	-0.978	0.000
			5.64E+02	5.05E-01	1.39E+00	1.09E+00	2.08E+01			
4	DISK	443	5.28E+02	6.69E+01	2.97E+02	4.59E+01	8.92E+02	3.237	-1.880	0.000
			5.97E+01	6.96E+01	2.95E+02	4.15E+01	8.10E+00			
4	DISK	444	5.33E+02	6.97E+01	2.89E+00	4.53E-01	8.10E+00	2.640	-2.654	0.000
			5.24E+02	7.28E+01	2.97E+02	4.19E+01	9.00E+02			
4	DISK	445	5.40E+02	7.29E+01	2.96E+02	4.32E+01	8.92E+02	1.863	-3.247	0.000
			5.17E+02	7.29E+01	3.00E+02	4.43E+01	9.14E+02			
4	DISK	446	5.47E+02	7.33E+01	2.77E+02	4.48E+01	8.59E+02	2.640	-2.654	0.000
			5.04E+02	6.95E+01	2.30E+02	3.83E+01	8.96E+02			
4	DISK	447	3.74E+01	1.55E+00	1.19E+01	2.56E+00	5.10E+01	1.063	-3.247	0.000
			5.41E+02	7.11E+01	2.42E+02	4.09E+01	8.55E+02			

4	DISK	442	4.94E+02	6.52E+01	2.06E+02	3.72E+01	7.65E+02	0.959	-3.618	0.000
			3.94E+01	3.63E+00	1.91E+01	3.18E+00	6.25E+01			
4	DISK	443	5.33E+02	6.88E+01	2.25E+02	4.03E+01	8.28E+02	-0.010	-3.743	0.000
			4.78E+02	6.25E+01	1.78E+02	3.87E+01	7.18E+01			
4	DISK	444	4.34E+01	5.62E+00	2.75E+01	3.85E+00	7.70E+01	-0.978	-3.613	0.000
			5.21E+02	6.81E+01	2.05E+02	4.25E+01	7.95E+02			
4	DISK	445	4.41E+02	5.44E+01	1.48E+02	3.39E+01	6.39E+02	-1.880	-3.237	0.000
			5.08E+01	6.06E+00	3.50E+01	4.70E+00	9.19E+01			
4	DISK	446	3.99E+02	4.25E+01	1.17E+02	2.86E+01	5.57E+02	-2.654	-2.640	0.000
			5.73E+01	7.12E+00	4.14E+01	6.12E+00	1.06E+02			
4	DISK	447	4.56E+02	4.96E+01	1.58E+02	3.47E+01	6.64E+02	-3.247	-1.863	0.000
			5.97E+01	8.41E+00	4.78E+01	6.49E+00	1.16E+02			
4	DISK	448	3.65E+02	3.57E+01	1.42E+02	3.02E+01	6.12E+02	-0.959	-0.959	0.000
			4.25E+02	4.41E+01	1.42E+02	3.02E+01	6.12E+02			
4	DISK	449	3.37E+02	3.14E+01	7.61E+01	2.17E+01	4.44E+02	0.010	0.010	0.000
			5.97E+01	9.42E+00	5.35E+01	6.10E+00	1.22E+02			
4	DISK	450	3.98E+02	4.09E+01	1.30E+02	2.78E+01	5.66E+02	-3.613	0.978	0.000
			3.06E+02	2.70E+01	6.37E+01	2.15E+01	3.94E+02			
4	DISK	451	5.97E+01	9.52E+00	5.67E+01	6.47E+00	1.26E+02	-3.237	1.880	0.000
			3.65E+02	3.65E+01	1.20E+02	2.80E+01	5.20E+02			
4	DISK	452	2.80E+02	2.55E+01	5.57E+01	1.86E+01	3.60E+02	0.010	0.010	0.000
			5.97E+01	7.90E+00	5.66E+01	6.55E+00	1.24E+02			
4	DISK	453	3.34E+01	1.12E+02	2.52E+01	2.52E+01	4.85E+02	-2.640	2.654	0.000
			2.70E+02	2.66E+01	5.38E+01	1.78E+01	3.51E+02			
4	DISK	454	5.97E+01	8.18E+00	5.33E+01	6.03E+00	1.21E+02	0.010	0.010	0.000
			3.00E+02	3.48E+01	1.07E+02	2.38E+01	4.72E+02			
4	DISK	455	3.29E+02	2.81E+01	4.81E+01	1.79E+01	3.53E+02	-3.618	3.618	0.000
			5.97E+01	7.69E+00	4.81E+01	5.62E+00	1.17E+02			
4	DISK	456	3.88E+02	3.58E+01	1.00E+02	2.35E+01	4.71E+02	0.010	0.010	0.000
			3.52E+02	3.54E+01	8.02E+01	2.53E+01	4.75E+02			
4	DISK	457	5.97E+01	5.88E+00	6.00E+01	1.94E+01	3.84E+02	0.010	0.010	0.000
			4.19E+02	4.13E+01	1.10E+02	3.03E+01	5.71E+02			
4	DISK	458	4.96E+02	4.38E+01	1.00E+02	2.94E+01	5.42E+02	0.978	3.613	0.000
			5.58E+01	4.10E+00	2.32E+01	4.28E+00	8.33E+01			
4	DISK	459	4.36E+02	4.89E+01	1.24E+02	3.36E+01	6.25E+02	1.880	3.237	0.000
			4.21E+01	3.06E+00	1.29E+02	3.34E+01	6.14E+02			
4	DISK	460	4.78E+02	5.19E+01	1.65E+02	3.01E+00	6.17E+01	0.010	0.010	0.000
			4.69E+02	5.27E+01	1.45E+02	3.64E+01	6.76E+02			
4	DISK	461	2.68E+01	2.52E+00	1.08E+01	2.00E+00	4.01E+01	2.654	2.640	0.000
			4.96E+02	5.53E+01	1.71E+02	3.78E+01	7.22E+02			
4	DISK	462	4.90E+02	6.21E+01	1.95E+02	3.66E+01	7.47E+02	0.010	0.010	0.000
			2.15E+01	2.13E+00	6.84E+00	1.57E+00	3.07E+01			
4	DISK	463	5.11E+02	6.42E+01	2.02E+02	3.82E+01	7.78E+02	3.247	1.863	0.000
			5.02E+02	6.90E+01	2.34E+02	3.73E+01	8.06E+02			
4	DISK	464	1.99E+01	1.12E+00	3.81E+00	1.29E+00	2.48E+01	3.618	0.959	0.000
			5.22E+02	7.02E+01	2.38E+02	3.86E+01	8.30E+02			
4	DISK	465	5.15E+02	6.71E+01	2.73E+02	4.13E+01	8.55E+02	3.743	0.010	0.000
			1.57E+01	3.27E+01	2.54E+00	8.56E+01	1.85E+01			
4	DISK	466	5.31E+02	6.74E+01	2.76E+02	4.21E+01	8.73E+02	3.008	-0.008	0.000
			5.27E+02	6.52E+01	2.94E+02	4.57E+01	8.87E+02			
4	DISK	467	9.17E+00	9.69E-02	2.47E+00	5.42E-01	1.17E+01	3.743	0.010	0.000
			5.36E+02	6.53E+01	2.97E+02	4.62E+01	8.99E+02			
4	DISK	468	5.17E+02	7.82E+01	3.98E+02	5.19E+01	9.94E+02	3.008	-0.008	0.000
			2.38E+00	7.30E-02	3.41E+02	2.40E-01	6.10E+00			
4	DISK	469	5.20E+02	7.83E+01	4.01E+02	5.22E+01	1.00E+03	2.904	-0.786	0.000
			5.17E+02	7.94E+01	3.93E+02	4.13E+01	9.89E+02			
			-1.03E-01	-3.62E-03	3.63E+00	1.06E-01	3.39E+00			
			5.17E+02	7.94E+01	3.97E+02	4.14E+01	9.93E+02			

4	DISK	464	5.13E+02	8.25E+01	3.91E+02	4.36E+01	9.87E+02	2.601	-1.511	0.000
			7.52E+00	4.33E-03	6.10E+00	5.12E-01	1.40E+01			
4	DISK	465	5.21E+02	8.25E+01	3.97E+02	4.41E+01	1.00E+03	2.122	-2.133	0.000
			5.05E+02	8.11E+01	3.58E+02	5.02E+01	9.44E+02			
			2.57E+01	1.34E-01	1.00E+01	1.62E+00	3.60E+01			
4	DISK	466	5.31E+02	8.12E+01	3.68E+02	5.18E+01	9.80E+02	1.497	-2.609	0.000
			3.93E+02	7.76E+01	3.09E+02	4.29E+01	8.79E+02			
			3.63E+01	1.05E+00	1.51E+01	2.25E+00	5.28E+01			
4	DISK	467	5.29E+02	7.86E+01	3.24E+02	4.51E+01	9.32E+02	0.771	-2.908	0.000
			4.83E+02	7.56E+01	2.83E+02	4.17E+01	8.42E+02			
			3.85E+01	3.56E+00	2.51E+01	3.39E+00	6.71E+01			
4	DISK	468	5.21E+02	7.92E+01	3.08E+02	4.51E+01	9.09E+02	-0.008	-3.008	0.000
			4.59E+02	6.99E+01	2.44E+02	4.21E+01	7.74E+02			
			4.11E+01	6.20E+00	3.67E+01	4.45E+00	8.41E+01			
4	DISK	469	5.00E+02	7.61E+01	2.81E+02	4.66E+01	8.58E+02	-0.786	-2.904	0.000
			4.11E+02	5.90E+01	1.99E+02	3.39E+01	6.68E+02			
			4.66E+01	7.01E+00	4.71E+01	5.28E+00	1.01E+02			
4	DISK	470	4.57E+02	6.60E+01	2.46E+02	3.92E+01	7.69E+02	-1.511	-2.601	0.000
			3.62E+02	4.79E+01	1.60E+02	3.01E+01	5.70E+02			
			5.51E+01	8.38E+00	5.44E+01	7.15E+00	1.18E+02			
4	DISK	471	4.17E+02	5.63E+01	2.15E+02	3.73E+01	6.88E+02	-2.133	-2.122	0.000
			3.32E+02	4.08E+01	1.30E+02	2.49E+01	5.03E+02			
			5.97E+01	9.92E+00	6.23E+01	7.90E+00	1.32E+02			
4	DISK	472	3.92E+02	5.07E+01	1.93E+02	3.28E+01	6.35E+02	-2.609	-1.497	0.000
			3.00E+02	3.39E+01	1.06E+02	2.14E+01	4.41E+02			
			5.97E+01	1.14E+01	7.20E+01	7.43E+00	1.43E+02			
4	DISK	473	3.60E+02	4.53E+01	1.78E+02	2.88E+01	5.84E+02	-2.908	-0.771	0.000
			2.69E+02	3.18E+01	8.92E+01	2.17E+01	3.89E+02			
			5.97E+01	1.08E+01	7.62E+01	7.38E+00	1.47E+02			
4	DISK	474	3.28E+02	4.26E+01	1.65E+02	2.91E+01	5.36E+02	-3.008	0.008	0.000
			2.49E+02	3.16E+01	7.96E+01	1.88E+01	3.60E+02			
			5.97E+01	9.44E+00	7.51E+01	7.50E+00	1.44E+02			
4	DISK	475	3.09E+02	4.11E+01	1.55E+02	2.63E+01	5.04E+02	-2.904	0.786	0.000
			2.35E+02	2.82E+01	7.44E+01	1.77E+01	3.38E+02			
			5.97E+01	1.02E+01	6.99E+01	6.99E+00	1.40E+02			
4	DISK	476	2.95E+02	3.83E+01	1.44E+02	2.47E+01	4.78E+02	-2.601	1.511	0.000
			2.34E+02	2.92E+01	7.12E+01	1.80E+01	3.34E+02			
			5.97E+01	1.04E+01	6.12E+01	6.31E+00	1.31E+02			
4	DISK	477	2.94E+02	3.96E+01	1.32E+02	2.43E+01	4.65E+02	-2.122	2.133	0.000
			2.53E+02	2.95E+01	8.44E+01	1.97E+01	3.66E+02			
			5.97E+01	9.89E+00	5.07E+01	6.07E+00	1.20E+02			
4	DISK	478	3.13E+02	3.94E+01	1.35E+02	2.58E+01	4.87E+02	-1.497	2.609	0.000
			2.90E+02	3.24E+01	1.02E+02	2.02E+01	4.25E+02			
			5.97E+01	8.43E+00	4.36E+01	5.65E+00	1.12E+02			
4	DISK	479	3.50E+02	4.09E+01	1.45E+02	2.58E+01	5.36E+02	-0.771	2.908	0.000
			3.29E+02	4.08E+01	1.15E+02	2.58E+01	4.86E+02			
			5.97E+01	6.27E+00	3.79E+01	5.64E+00	1.04E+02			
4	DISK	480	3.89E+02	4.70E+01	1.53E+02	3.14E+01	5.91E+02	0.008	3.008	0.000
			2.68E+02	4.89E+01	1.43E+02	3.11E+01	5.59E+02			
			5.21E+01	4.53E+00	3.06E+01	4.69E+00	8.76E+01			
4	DISK	481	4.20E+02	5.34E+01	1.73E+02	3.58E+01	6.47E+02	0.786	2.904	0.000
			4.10E+02	5.71E+01	1.78E+02	3.58E+01	6.45E+02			
			3.26E+01	3.42E+00	2.16E+01	2.70E+00	5.77E+01			
4	DISK	482	4.43E+02	6.05E+01	1.99E+02	3.85E+01	7.03E+02	1.511	2.601	0.000
			4.48E+02	6.47E+01	2.13E+02	3.83E+01	7.25E+02			
			2.21E+01	2.79E+00	1.39E+01	4.00E+01	7.64E+01			
4	DISK	483	4.70E+02	6.75E+01	2.27E+02	4.00E+01	7.64E+02	2.133	2.122	0.000
			4.66E+02	7.36E+01	2.56E+02	3.81E+01	7.97E+02			
			2.13E+01	2.20E+00	9.24E+00	1.66E+00	3.27E+01			
4	DISK	484	4.88E+02	7.58E+01	2.65E+02	3.98E+01	8.29E+02	2.609	1.497	0.000
			4.81E+02	8.12E+01	3.09E+02	3.78E+01	8.72E+02			
			1.85E+01	9.59E-01	5.16E+00	1.38E+00	2.46E+01			
4	DISK	485	5.00E+02	8.22E+01	3.15E+02	3.92E+01	8.96E+02	2.908	0.771	0.000
			4.98E+02	7.82E+01	3.62E+02	4.64E+01	9.38E+02			
			1.30E+01	2.24E-01	3.76E+00	7.90E-01	1.67E+01			
			5.11E+02	7.84E+01	3.66E+02	4.72E+01	9.55E+02			

4	DISK	486	5.14E+02	7.46E+01	3.94E+02	5.36E+01	9.82E+02	3.008	0.008	0.000
			1.27E-01	3.63E+00	4.26E-01	4.26E-01	8.91E+00			
5	SPHERE	487	5.19E+02	7.47E+01	3.98E+02	5.40E+01	9.92E+02	0.204	0.001	14.992
			1.30E+02	3.32E+02	2.96E+02	4.26E+01	4.26E+02			
5	SPHERE	488	0.00E+00	3.95E+00	6.61E+00	3.99E-01	1.08E+01	0.197	0.053	14.992
			1.30E+02	3.36E+02	3.02E+02	4.30E+01	7.70E+02			
5	SPHERE	489	1.14E+02	3.16E+02	2.74E+02	3.64E+01	7.04E+02	0.176	0.102	14.992
			0.00E+00	5.45E+00	9.56E+00	6.62E-01	1.52E+01			
5	SPHERE	490	8.98E+01	2.98E+02	2.83E+02	3.71E+01	7.19E+02	0.144	0.145	14.992
			0.00E+00	8.88E+00	2.67E+02	3.13E+01	6.94E+02			
5	SPHERE	491	0.00E+00	1.19E+01	1.19E+01	1.12E+00	2.09E+01	0.102	0.177	14.992
			6.09E+01	3.07E+02	2.79E+02	3.24E+01	6.75E+02			
5	SPHERE	492	0.00E+00	1.31E+01	1.42E+01	1.46E+00	5.71E+02	0.052	0.197	14.992
			6.09E+01	3.07E+02	2.79E+02	3.24E+01	6.75E+02			
5	SPHERE	493	6.09E+01	3.07E+02	2.79E+02	3.24E+01	6.75E+02	-0.001	0.204	14.992
			0.00E+00	2.16E+02	2.10E+02	2.26E+01	4.62E+02			
5	SPHERE	494	3.53E+01	1.75E+01	1.74E+01	1.86E+00	3.48E+01	-0.053	0.197	14.992
			0.00E+00	1.75E+01	1.74E+01	1.86E+00	3.48E+01			
5	SPHERE	495	1.70E+01	1.71E+02	2.27E+02	2.44E+01	4.97E+02	0.102	0.176	14.992
			3.12E-02	1.93E+02	2.04E+02	2.10E+01	4.14E+02			
5	SPHERE	496	1.70E+01	1.93E+02	2.04E+02	2.10E+01	4.14E+02	-0.102	0.176	14.992
			8.17E-01	3.08E+01	2.79E+01	3.35E+00	5.94E+01			
5	SPHERE	497	5.97E+00	1.61E+02	1.66E+02	2.12E+01	3.51E+02	0.052	0.197	14.992
			4.94E+00	4.00E+01	3.29E+01	4.07E+00	7.77E+01			
5	SPHERE	498	6.54E+00	1.42E+02	1.65E+02	2.01E+01	3.12E+02	-0.102	0.176	14.992
			3.81E-01	9.13E+01	1.13E+02	1.25E+01	2.06E+02			
5	SPHERE	499	1.05E+01	4.82E+01	3.81E+01	5.13E+00	9.67E+01	-0.145	0.144	14.992
			2.72E-02	8.42E+01	1.03E+02	9.96E+00	1.88E+02			
5	SPHERE	500	1.62E+01	5.50E+01	4.21E+01	5.91E+00	1.14E+02	-0.177	0.102	14.992
			0.00E+00	6.96E+01	9.35E+01	6.42E+00	1.64E+02			
5	SPHERE	501	3.56E+01	1.27E+02	1.54E+02	1.50E+01	3.16E+02	-0.197	-0.053	14.992
			0.00E+00	9.20E+01	1.18E+02	9.46E+00	2.10E+02			
5	SPHERE	502	3.86E+01	1.54E+02	1.70E+02	1.72E+01	4.26E+02	-0.102	-0.102	14.992
			1.25E-01	1.37E+02	1.39E+02	1.36E+01	2.94E+02			
5	SPHERE	503	3.93E+01	1.93E+02	1.94E+02	2.10E+01	4.26E+02	-0.144	-0.145	14.992
			2.21E+00	1.63E+02	1.72E+02	1.72E+01	3.58E+02			
5	SPHERE	504	3.75E+01	5.42E+01	4.88E+01	7.47E+00	1.40E+02	-0.102	-0.177	14.992
			7.96E+00	2.13E+02	1.96E+02	1.82E+01	4.18E+02			
5	SPHERE	505	3.40E+01	4.88E+01	4.13E+01	6.82E+00	1.24E+02	-0.052	-0.197	14.992
			1.84E+01	2.27E+02	2.37E+02	2.50E+01	5.42E+02			
5	SPHERE	506	2.90E+01	4.08E+01	3.83E+01	6.06E+00	1.08E+02	0.001	-0.204	14.992
			4.74E+01	2.68E+02	2.50E+02	2.70E+01	5.65E+02			
5	SPHERE	507	2.63E+01	2.56E+02	2.42E+02	2.76E+01	5.37E+02	-0.197	-0.176	14.992
			2.29E+01	3.26E+01	3.59E+01	4.52E+00	9.10E+01			
5	SPHERE	508	5.92E+01	2.89E+02	2.78E+02	3.21E+01	6.28E+02	0.053	-0.197	14.992
			6.25E+01	3.01E+02	2.65E+02	2.77E+01	6.29E+02			
5	SPHERE	509	1.61E+01	2.85E+01	2.90E+01	3.06E+00	7.36E+01	0.102	-0.176	14.992
			7.86E+01	3.29E+02	2.94E+02	3.08E+01	7.02E+02			
5	SPHERE	510	9.45E+00	3.44E+02	2.84E+02	2.75E+01	7.19E+02	-0.102	-0.176	14.992
			9.96E+01	3.66E+02	3.05E+02	2.96E+01	7.72E+02			

5	SPHERE	508	1.14E+02	3.79E+02	2.91E+02	3.38E+01	7.88E+02	0.145	-0.144	14.992
			3.89E+00	1.36E+01	1.38E+01	1.50E+00	3.13E+01			
5	SPHERE	509	1.18E+02	3.92E+02	3.05E+02	3.53E+01	8.20E+02	0.177	-0.102	14.992
			1.30E+02	3.76E+02	2.89E+02	4.22E+01	7.96E+02			
			6.65E-01	7.32E+00	1.12E+01	6.33E-01	1.96E+01			
5	SPHERE	510	1.31E+02	3.84E+02	3.00E+02	4.28E+01	8.15E+02	0.197	-0.052	14.992
			1.35E+02	3.44E+02	3.02E+02	4.39E+01	7.82E+02			
			0.00E+00	4.78E+00	6.59E+00	4.33E-01	1.34E+01			
5	SPHERE	511	1.35E+02	3.49E+02	3.10E+02	4.43E+01	7.95E+02	0.204	-0.001	14.992
			1.31E+02	3.31E+02	3.04E+02	4.23E+01	7.63E+02			
			0.00E+00	4.15E+00	6.41E+00	4.56E-01	1.02E+01			
5	SPHERE	512	1.31E+02	3.35E+02	3.10E+02	4.27E+01	7.73E+02	1.871	0.005	14.158
			1.15E+02	2.55E+02	2.09E+02	4.01E+01	7.78E+02			
			0.00E+00	2.110E+00	5.79E+00	4.05E-01	7.71E+00			
5	SPHERE	513	3.15E+02	2.57E+02	2.15E+02	4.05E+01	7.86E+02	1.806	0.489	14.158
			2.78E+02	2.41E+02	1.97E+02	3.57E+01	7.11E+02			
			0.00E+00	3.29E+00	6.85E+00	4.65E-01	1.03E+01			
5	SPHERE	514	2.19E+02	2.44E+02	2.04E+02	3.61E+01	7.21E+02	1.618	0.940	14.158
			0.00E+00	2.30E+02	1.92E+02	3.05E+01	6.39E+02			
			0.00E+00	6.21E+00	8.68E+00	6.75E-01	1.49E+01			
5	SPHERE	515	1.49E+02	2.13E+02	2.00E+02	3.12E+01	6.54E+02	1.319	1.326	14.158
			1.49E+02	2.13E+02	1.78E+02	2.65E+01	5.40E+02			
			0.00E+00	9.23E+00	1.07E+01	9.60E-01	1.99E+01			
5	SPHERE	516	1.49E+02	2.22E+02	1.88E+02	2.74E+01	5.60E+02	0.931	1.623	14.158
			8.42E+01	1.61E+02	1.57E+02	2.07E+01	4.27E+02			
			4.15E-01	1.23E+01	1.30E+01	1.31E+00	2.57E+01			
5	SPHERE	517	4.08E+01	1.46E+02	1.35E+02	1.50E+01	3.25E+02	0.479	1.808	14.158
			1.25E+01	1.58E+01	1.63E+01	2.65E+00	4.44E+01			
5	SPHERE	518	5.33E+01	1.62E+02	1.51E+02	1.76E+01	3.69E+02	-0.005	1.871	14.158
			1.42E+01	1.13E+02	1.19E+02	1.31E+01	2.48E+02			
			2.89E+01	2.20E+01	1.99E+01	4.04E+00	7.08E+01			
5	SPHERE	519	4.14E+00	1.35E+02	1.38E+02	1.71E+01	3.19E+02	-0.489	1.806	14.158
			4.14E+00	9.13E+01	1.06E+02	1.23E+01	1.99E+02			
			3.08E+01	3.10E+01	2.30E+01	4.35E+00	8.45E+01			
5	SPHERE	520	3.49E+01	1.22E+02	1.29E+02	1.67E+01	2.84E+02	-0.940	1.618	14.158
			1.04E+00	7.68E+01	9.25E+01	1.05E+01	1.70E+02			
			3.21E+01	3.80E+01	2.68E+01	4.78E+00	9.74E+01			
5	SPHERE	521	3.1E+01	1.15E+02	1.19E+02	1.53E+01	2.67E+02	-1.326	1.319	14.158
			1.96E-01	6.93E+01	8.72E+01	8.72E+00	1.55E+02			
			4.24E+01	4.22E+01	2.97E+01	5.75E+00	1.15E+02			
5	SPHERE	522	4.26E+01	1.11E+02	1.17E+02	1.45E+01	2.70E+02	-1.623	0.931	14.158
			2.64E-02	6.33E+01	8.05E+01	6.69E+00	1.43E+02			
			6.14E+01	4.52E+01	3.15E+01	7.19E+00	1.38E+02			
5	SPHERE	523	6.14E+01	1.09E+02	1.12E+02	1.39E+01	2.81E+02	-1.808	0.479	14.158
			1.63E-02	5.40E+01	8.24E+01	6.66E+00	1.34E+02			
			7.81E+01	4.50E+01	3.27E+01	7.55E+00	1.56E+02			
5	SPHERE	524	7.81E+01	9.90E+01	1.15E+02	1.42E+01	2.89E+02	-1.871	-0.005	14.158
			1.47E-02	5.76E+01	8.99E+01	6.73E+00	1.45E+02			
			8.34E+01	4.62E+01	3.33E+01	8.01E+00	1.63E+02			
5	SPHERE	525	8.34E+01	1.04E+02	1.23E+02	1.47E+01	3.07E+02	-1.806	-0.489	14.158
			3.98E-01	8.21E+01	9.98E+01	8.81E+00	1.80E+02			
			8.40E+01	4.52E+01	3.49E+01	8.29E+00	1.63E+02			
5	SPHERE	526	8.40E+01	1.27E+02	1.35E+02	1.71E+01	3.43E+02	-1.618	-0.940	14.158
			2.02E+00	1.13E+02	1.15E+02	1.28E+01	2.30E+02			
			7.41E+01	4.24E+01	3.60E+01	7.48E+00	1.52E+02			
5	SPHERE	527	7.61E+01	1.56E+02	1.51E+02	2.03E+01	3.82E+02	-1.319	-1.326	14.158
			8.45E+00	1.49E+02	1.34E+02	1.45E+01	2.96E+02			
			6.20E+01	3.98E+01	3.33E+01	6.95E+00	1.35E+02			
5	SPHERE	528	7.04E+01	1.69E+02	1.67E+02	2.14E+01	4.31E+02	-0.931	-1.623	14.158
			2.55E+01	1.77E+02	1.48E+02	1.50E+01	3.57E+02			
			5.21E+01	3.51E+01	2.89E+01	6.14E+00	1.16E+02			
5	SPHERE	529	7.75E+01	2.12E+02	1.78E+02	2.11E+01	4.74E+02	-0.479	-1.808	14.158
			5.62E+01	1.94E+02	1.58E+02	1.92E+01	4.12E+02			
			4.07E+01	2.98E+01	2.65E+01	5.11E+00	9.71E+01			
			9.69E+01	2.24E+02	1.84E+02	2.43E+01	5.09E+02			

5	SPHERE	530	9.99E+01	2.20E+02	1.71E+02	2.53E+01	4.97E+02	0.005	-1.871	14.158
			3.00E+01	2.40E+02	2.42E+01	3.53E+00	7.80E+01			
5	SPHERE	531	1.30E+02	2.44E+02	1.95E+02	2.92E+01	5.75E+02	0.489	-1.806	14.158
			1.54E+02	2.63E+02	1.89E+02	2.65E+01	6.08E+02			
			2.07E+01	1.99E+01	2.00E+01	2.98E+00	6.06E+01			
5	SPHERE	532	1.75E+02	2.83E+02	2.09E+02	2.95E+01	6.69E+02	0.940	-1.618	14.158
			2.09E+02	3.01E+02	2.10E+02	2.98E+01	7.18E+02			
			1.22E+01	1.54E+01	1.48E+01	2.15E+00	4.26E+01			
5	SPHERE	533	2.21E+02	3.16E+02	2.25E+02	3.20E+01	7.60E+02	1.326	-1.319	14.158
			2.63E+02	3.22E+02	2.16E+02	3.86E+01	7.97E+02			
			5.03E+00	8.46E+00	1.08E+01	1.14E+00	8.21E+01			
5	SPHERE	534	2.68E+02	3.30E+02	2.27E+02	3.197E+01	8.21E+01	1.623	-0.931	14.158
			3.07E+02	3.07E+02	2.12E+02	4.22E+01	8.25E+02			
			8.68E-01	3.83E+00	8.84E+00	5.39E-01	1.37E+01			
5	SPHERE	535	3.08E+02	3.11E+02	2.21E+02	4.27E+01	8.39E+02	1.808	-0.479	14.158
			3.26E+02	2.76E+02	2.18E+02	4.10E+01	8.20E+02			
			0.00E+00	2.47E+00	6.62E+00	3.44E-01	8.91E+00			
5	SPHERE	536	3.26E+02	2.79E+02	2.25E+02	4.13E+01	8.29E+02	1.871	-0.005	14.158
			3.19E+02	2.56E+02	2.17E+02	4.02E+01	7.93E+02			
			0.00E+00	2.18E+00	5.26E+00	3.50E-01	7.18E+00			
5	SPHERE	537	3.19E+02	2.60E+02	2.23E+02	4.05E+01	8.00E+02	2.360	0.006	13.325
			6.43E+02	1.33E+02	7.39E+01	4.30E+01	8.49E+02			
			0.00E+00	6.85E-02	2.86E+00	3.16E-01	2.59E+00			
5	SPHERE	538	6.43E+02	1.33E+02	7.68E+01	4.34E+01	8.52E+02	2.278	0.617	13.325
			5.74E+02	1.16E+02	7.26E+01	3.57E+01	7.60E+02			
			4.88E-01	4.47E-01	2.68E+00	2.01E-01	3.07E+00			
5	SPHERE	539	5.74E+02	1.17E+02	7.53E+01	3.59E+01	7.63E+02	2.041	1.185	13.325
			4.55E+02	1.10E+02	6.71E+01	1.82E+01	3.96E+02			
			4.55E+02	1.10E+02	6.71E+01	1.82E+01	3.96E+02			
5	SPHERE	540	3.19E+02	1.14E+02	7.03E+01	2.27E+01	5.06E+02	1.664	1.673	13.325
			3.55E+00	2.51E+00	4.10E+00	3.62E-01	1.03E+01			
5	SPHERE	541	3.23E+02	1.16E+02	7.44E+01	2.31E+01	5.16E+02	1.175	2.047	13.325
			2.05E+02	1.07E+02	6.20E+01	1.72E+01	3.76E+02			
			1.12E+01	3.22E+00	5.14E+00	1.03E+00	2.04E+01			
5	SPHERE	542	2.16E+02	1.10E+02	6.71E+01	1.82E+01	3.96E+02	0.605	2.281	13.325
			1.26E+02	8.39E+01	5.09E+01	1.21E+01	2.57E+02			
			3.33E+01	4.09E+00	6.43E+00	2.26E+00	4.36E+01			
5	SPHERE	543	6.66E+01	7.05E+01	4.68E+01	8.38E+00	1.81E+02	-0.006	2.360	13.325
			1.59E+02	8.80E+01	5.73E+01	1.43E+01	3.01E+02			
			5.91E+01	6.13E+00	6.47E+00	3.60E+00	7.23E+01			
5	SPHERE	544	1.26E+02	7.66E+01	5.33E+01	1.20E+01	2.53E+02	-0.617	2.278	13.325
			3.24E+01	5.95E+01	4.69E+01	6.16E+00	1.36E+02			
			7.23E+01	1.16E+01	7.76E+00	4.67E+00	9.03E+01			
5	SPHERE	545	1.05E+02	7.12E+01	5.46E+01	1.08E+01	2.26E+02	-1.185	2.041	13.325
			1.33E+01	4.79E+01	4.63E+01	5.25E+00	1.06E+02			
			8.24E+01	1.55E+01	9.34E+00	5.33E+00	1.08E+02			
5	SPHERE	546	9.57E+01	6.34E+01	5.56E+01	1.06E+01	2.14E+02	-1.673	1.664	13.325
			7.11E+00	4.10E+01	4.54E+01	4.38E+00	9.39E+01			
			1.01E+02	1.76E+01	1.06E+01	6.37E+00	1.31E+02			
5	SPHERE	547	1.08E+02	5.86E+01	5.60E+01	1.07E+01	2.23E+02	-2.047	1.175	13.325
			4.81E+00	3.79E+01	4.13E+01	4.65E+00	8.54E+01			
			1.31E+02	1.86E+01	1.12E+01	8.22E+00	1.60E+02			
5	SPHERE	548	1.36E+02	5.67E+01	5.24E+01	1.29E+01	2.45E+02	-2.281	0.605	13.325
			3.65E+00	3.65E+01	3.89E+01	4.44E+00	7.96E+01			
			1.56E+02	1.79E+01	1.09E+01	9.55E+00	1.85E+02			
5	SPHERE	549	1.60E+02	5.44E+01	4.98E+01	1.40E+01	2.65E+02	-2.360	-0.006	13.325
			4.72E+00	4.43E+01	4.06E+01	4.24E+00	9.03E+01			
			1.61E+02	1.62E+01	1.02E+01	9.79E+00	1.88E+02			
5	SPHERE	550	1.66E+02	6.05E+01	5.08E+01	1.40E+01	2.78E+02	-2.278	-0.617	13.325
			9.47E+00	5.93E+01	4.83E+01	6.23E+00	1.20E+02			
			1.57E+02	1.63E+01	9.79E+00	9.21E+00	1.83E+02			
5	SPHERE	551	1.66E+02	7.57E+01	5.81E+01	1.54E+01	3.03E+02	-2.041	-1.185	13.325
			2.11E+01	7.14E+01	5.60E+01	8.89E+00	1.48E+02			
			1.33E+02	1.84E+01	1.00E+01	7.71E+00	1.61E+02			
			1.54E+02	8.98E+01	6.60E+01	1.66E+01	3.09E+02			



5	SPHERE	552	5.25E+01	8.31E+01	6.18E+01	9.24E+00	1.96E+02	-1.664	-1.673	13.325
			1.66E+02	1.82E+01	1.05E+01	6.90E+00	1.35E+02			
			1.59E+02	1.01E+02	7.22E+01	1.61E+01	3.31E+02			
5	SPHERE	553	1.10E+02	9.61E+01	6.40E+01	1.08E+01	2.67E+02	-1.175	-2.047	13.325
			8.59E+01	1.71E+01	1.02E+01	5.78E+00	1.14E+02			
			1.96E+02	1.13E+02	7.42E+01	1.56E+01	3.81E+02			
5	SPHERE	554	1.92E+02	1.05E+02	6.24E+01	1.56E+01	3.58E+02	-0.605	-2.281	13.325
			6.33E+01	1.55E+01	8.49E+00	4.39E+00	8.80E+01			
			2.55E+02	1.21E+02	7.09E+01	2.02E+01	4.46E+02			
5	SPHERE	555	2.86E+02	1.18E+02	5.80E+01	2.09E+01	4.66E+02	0.006	-2.360	13.325
			4.19E+01	1.23E+01	7.07E+00	3.45E+00	6.08E+01			
			3.28E+02	1.30E+02	6.50E+01	2.43E+01	5.26E+02			
5	SPHERE	556	3.79E+02	1.44E+02	6.46E+01	2.49E+01	5.90E+02	0.617	-2.278	13.325
			2.71E+01	7.43E+00	6.18E+00	2.63E+00	4.04E+01			
			4.07E+02	1.52E+02	7.07E+01	2.75E+01	6.30E+02			
5	SPHERE	557	4.85E+02	1.66E+02	8.25E+01	3.33E+01	7.19E+02	1.185	-2.041	13.325
			1.50E+01	4.16E+00	6.02E+00	1.46E+00	2.62E+01			
			4.81E+02	1.71E+02	8.85E+01	3.49E+01	7.45E+02			
5	SPHERE	558	5.49E+02	1.77E+02	8.74E+01	4.21E+01	8.17E+02	1.673	-1.664	13.325
			6.61E+00	1.51E+00	5.33E+00	5.08E-01	1.38E+01			
			5.56E+02	1.79E+02	9.27E+01	4.26E+01	8.31E+02			
5	SPHERE	559	6.27E+02	1.72E+02	8.29E+01	4.52E+01	8.80E+02	2.047	-1.175	13.325
			1.17E+00	1.51E-01	4.22E+00	3.14E-01	5.12E+00			
			6.28E+02	1.72E+02	8.71E+01	4.55E+01	8.85E+02			
5	SPHERE	560	6.63E+02	1.53E+02	8.05E+01	4.62E+01	8.93E+02	2.281	-0.605	13.325
			0.00E+00	8.29E-02	3.06E+00	1.29E-01	2.83E+00			
			6.63E+02	1.54E+02	7.36E+01	4.63E+01	8.96E+02			
5	SPHERE	561	6.52E+02	1.36E+02	7.83E+01	4.42E+01	8.65E+02	2.360	-0.006	13.325
			0.00E+00	9.76E-02	2.61E+00	1.98E-01	2.45E+00			
			6.52E+02	1.36E+02	8.09E+01	4.44E+01	8.67E+02			
5	SPHERE	562	8.27E+02	4.83E+01	2.00E+01	4.74E+01	8.93E+02	2.500	0.007	12.492
			0.00E+00	1.09E-02	5.52E-01	1.06E-01	6.03E-01			
			8.27E+02	4.83E+01	2.06E+01	4.75E+01	8.94E+02			
5	SPHERE	563	7.44E+02	3.80E+01	1.87E+01	4.12E+01	7.99E+02	2.413	0.653	12.492
			0.00E+00	2.49E-02	8.60E-01	6.25E-02	6.98E-01			
			7.44E+02	3.80E+01	1.96E+01	4.13E+01	7.99E+02			
5	SPHERE	564	6.06E+02	3.59E+01	2.11E+01	3.20E+01	6.53E+02	2.162	1.256	12.492
			9.63E-01	9.29E-02	8.82E-01	1.70E-01	1.76E+00			
			6.06E+02	3.60E+01	2.21E+01	3.22E+01	6.65E+02			
5	SPHERE	565	4.57E+02	4.38E+01	2.12E+01	2.37E+01	5.22E+02	1.763	1.772	12.492
			6.96E+00	1.68E-02	6.03E-01	4.02E-01	7.67E+00			
			4.64E+02	4.38E+01	2.18E+01	2.41E+01	5.29E+02			
5	SPHERE	566	3.22E+02	4.16E+01	1.42E+01	1.64E+01	3.81E+02	1.244	2.168	12.492
			2.07E+01	4.08E-02	9.64E-01	1.34E+00	2.22E+01			
			3.43E+02	4.16E+01	1.52E+01	1.78E+01	4.04E+02			
5	SPHERE	567	4.05E+01	3.19E-01	1.17E+00	2.00E+00	4.19E+01	0.641	2.416	12.492
			2.53E+02	3.05E+01	1.30E+01	1.38E+01	2.97E+02			
			1.37E+02	2.81E+01	1.09E+01	8.29E+00	1.69E+02			
5	SPHERE	568	6.08E+01	2.00E-01	1.24E+00	2.59E+00	6.20E+01	-0.007	2.500	12.492
			1.93E+02	2.83E+01	1.21E+01	1.09E+01	1.13E+02			
			7.89E+01	2.49E+01	1.02E+01	5.32E+00	8.62E+01			
5	SPHERE	569	8.45E+01	7.28E-01	1.83E+00	4.41E+00	8.62E+01	-0.653	2.413	12.492
			1.63E+02	2.57E+01	1.83E+00	4.41E+00	8.62E+01			
			4.73E+01	2.04E+01	1.21E+01	9.73E+00	2.02E+02			
5	SPHERE	570	1.13E+02	2.04E+01	1.21E+01	3.62E+00	7.97E+01	-1.256	2.162	12.492
			1.60E+02	2.21E+01	1.46E+01	5.77E+00	1.17E+02			
			3.15E+01	1.70E+01	1.17E+01	9.40E+00	1.97E+02			
5	SPHERE	571	4.06E+02	2.89E+00	2.98E+00	7.03E+00	1.46E+02	-1.772	1.763	12.492
			1.71E+02	1.99E+01	1.47E+01	9.52E+00	2.05E+02			
			2.47E+01	1.41E+01	1.05E+01	2.18E+00	4.96E+01			
5	SPHERE	572	1.65E+02	4.03E+00	2.64E+00	8.74E+00	1.72E+02	-2.168	1.244	12.492
			1.89E+02	1.82E+01	1.32E+01	1.09E+01	2.21E+02			
			2.55E+01	1.71E+01	8.36E+00	2.81E+00	4.92E+01			
5	SPHERE	573	1.89E+02	4.10E+00	2.18E+00	1.06E+00	1.92E+02	-2.416	0.641	12.492
			2.11E+02	2.12E+01	1.05E+01	1.34E+01	2.42E+02			



5	SPHERE	596	5.96E+01	5.80E+00	5.40E+00	4.05E+00	6.81E+01	-1.669	1.660	11.658
			1.41E+02	2.02E+00	2.29E+00	7.15E+00	1.45E+02			
			2.00E+02	7.82E+00	7.69E+00	1.12E+01	2.13E+01			
5	SPHERE	597	5.41E+01	4.50E+00	4.83E+00	3.08E+00	6.31E+01	-2.042	1.172	11.658
			1.62E+02	1.94E+00	2.16E+00	8.05E+00	1.67E+02			
			2.17E+02	6.44E+00	7.00E+00	1.11E+01	2.30E+02			
5	SPHERE	598	6.07E+01	2.93E+00	5.17E+00	3.10E+00	6.85E+01	-2.275	0.603	11.658
			1.80E+02	1.24E+00	2.56E+00	9.14E+00	1.84E+02			
			2.41E+02	4.17E+00	7.73E+00	1.22E+01	2.52E+02			
5	SPHERE	599	7.45E+01	3.03E+00	6.02E+00	2.32E+00	8.16E+01	-2.354	-0.006	11.658
			1.87E+02	8.78E-01	3.33E+00	9.42E+00	1.92E+02			
			2.62E+02	3.91E+00	9.34E+00	1.17E+01	2.73E+02			
5	SPHERE	600	9.74E+01	5.55E+00	9.09E+00	4.51E+00	1.11E+02	-2.272	-0.615	11.658
			1.80E+02	1.68E+00	3.30E+00	8.76E+00	1.85E+02			
			2.78E+02	7.23E+00	1.24E+01	1.33E+01	2.97E+02			
5	SPHERE	601	1.34E+02	5.32E+00	1.04E+01	6.85E+00	1.50E+02	-2.036	-1.182	11.658
			1.63E+02	2.50E+00	3.02E+00	7.90E+00	1.69E+02			
			2.96E+02	7.82E+00	1.34E+01	1.48E+01	3.18E+02			
5	SPHERE	602	1.87E+02	5.06E+00	1.00E+01	8.37E+00	2.03E+02	-1.660	-1.669	11.658
			1.40E+02	2.52E+00	2.70E+00	6.11E+00	1.46E+02			
			3.28E+02	7.58E+00	1.27E+01	1.45E+01	3.49E+02			
5	SPHERE	603	2.73E+02	5.80E+00	1.07E+01	1.30E+01	2.92E+02	-1.172	-2.042	11.658
			1.13E+02	2.59E+00	2.10E+00	5.29E+00	1.18E+02			
			3.86E+02	8.39E+00	1.28E+01	1.83E+01	4.10E+02			
5	SPHERE	604	3.84E+02	4.67E+00	1.02E+01	2.28E+01	3.99E+02	-0.603	-2.275	11.658
			8.68E+01	1.96E+00	1.99E+00	4.80E+00	9.08E+01			
			4.71E+02	6.62E+00	1.21E+01	2.76E+01	4.89E+02			
5	SPHERE	605	5.03E+02	5.13E+00	9.51E+00	2.72E+01	5.18E+02	0.006	-2.354	11.658
			6.41E+01	8.43E-01	1.65E+00	3.61E+00	6.65E+01			
			5.67E+02	5.97E+00	1.12E+01	3.08E+01	5.84E+02			
5	SPHERE	606	6.27E+02	7.91E+00	1.13E+01	3.33E+01	6.45E+02	0.615	-2.272	11.658
			4.20E+01	2.12E-01	1.40E+00	2.37E+00	4.42E+01			
			6.69E+02	8.12E+00	1.27E+01	3.57E+01	6.90E+02			
5	SPHERE	607	7.45E+02	1.20E+01	1.53E+01	4.05E+01	7.72E+02	1.182	-2.036	11.658
			2.39E+01	1.59E-01	7.34E-01	1.48E+00	2.45E+01			
			7.69E+02	1.21E+01	1.61E+01	4.20E+01	7.97E+02			
5	SPHERE	608	8.33E+02	1.75E+01	1.79E+01	4.21E+01	8.72E+02	1.669	-1.660	11.658
			9.78E+00	1.08E-01	4.31E-01	8.15E-01	1.02E+01			
			8.43E+02	1.76E+01	1.83E+01	4.29E+01	8.82E+02			
5	SPHERE	609	8.86E+02	1.75E+01	1.65E+01	4.50E+01	9.22E+02	2.042	-1.172	11.658
			2.60E+00	0.00E+00	6.24E-01	3.50E-01	3.15E+00			
			8.89E+02	1.75E+01	1.71E+01	4.54E+01	9.26E+02			
5	SPHERE	610	8.95E+02	9.95E+00	1.55E+01	4.51E+01	9.22E+02	2.275	-0.603	11.658
			3.67E-01	0.00E+00	4.75E-01	1.25E-01	7.80E-01			
			8.96E+02	2.95E+00	1.60E+01	4.52E+01	9.23E+02			
5	SPHERE	611	8.65E+02	5.47E+00	1.50E+01	4.49E+01	8.84E+02	2.354	-0.006	11.658
			0.00E+00	8.67E-03	3.77E-01	-1.55E-02	1.95E-01			
			7.51E+02	1.48E+01	1.54E+01	4.48E+01	8.84E+02			
5	SPHERE	612	7.51E+02	1.48E+01	6.18E+01	4.23E+01	8.29E+02	1.856	0.005	10.825
			1.81E+00	0.00E+00	1.62E+00	8.09E-02	3.29E+00			
			7.53E+02	1.48E+01	6.34E+01	4.24E+01	8.32E+02			
5	SPHERE	613	6.88E+02	2.11E+01	6.08E+01	3.88E+01	7.69E+02	1.791	0.485	10.825
			3.89E+00	5.22E-02	1.97E+00	3.02E-01	5.93E+00			
			6.92E+02	2.11E+01	6.28E+01	3.91E+01	7.75E+02			
5	SPHERE	614	5.93E+02	2.80E+01	5.68E+01	3.37E+01	6.77E+02	1.605	0.932	10.825
			7.98E+00	3.44E-01	2.05E+00	5.56E-01	1.04E+01			
			6.01E+02	2.84E+01	5.88E+01	3.43E+01	6.87E+02			
5	SPHERE	615	4.85E+02	2.24E+01	5.27E+01	2.87E+01	5.61E+02	1.309	1.316	10.825
			1.54E+01	8.54E-01	2.87E+00	9.83E-01	1.91E+01			
			5.01E+02	2.32E+01	5.56E+01	2.97E+01	5.80E+02			
5	SPHERE	616	3.80E+02	1.44E+01	4.66E+01	2.21E+01	4.41E+02	0.924	1.610	10.825
			2.53E+01	1.35E+00	4.16E+00	1.66E+00	3.09E+01			
			4.05E+02	1.58E+01	5.08E+01	2.38E+01	4.72E+02			
5	SPHERE	617	2.87E+02	1.09E+01	3.72E+01	1.74E+01	3.33E+02	0.476	1.794	10.825
			3.85E+01	2.25E+00	5.13E+00	2.11E+00	4.57E+01			
			3.25E+02	1.32E+01	4.23E+01	1.95E+01	3.78E+02			

5	SPHERE	618	2.11E+02	8.86E+00	3.12E+01	1.37E+01	2.51E+02	-0.005	1.856	10.825
			5.92E+01	3.55E+00	6.11E+00	3.16E+00	6.88E+01			
			2.70E+02	1.24E+01	3.73E+01	1.69E+01	3.19E+02			
5	SPHERE	619	1.60E+02	3.74E+00	2.66E+01	9.53E+00	1.93E+02	-0.485	1.791	10.825
			8.18E+01	6.78E+00	7.88E+00	4.60E+00	9.37E+01			
			2.41E+02	1.05E+01	3.45E+01	1.41E+01	2.87E+02			
5	SPHERE	620	1.28E+02	5.05E+00	2.25E+01	8.88E+00	1.56E+02	-0.932	1.605	10.825
			1.01E+02	3.71E+00	9.71E+00	5.90E+00	1.14E+02			
			2.29E+02	8.76E+00	3.22E+01	1.48E+01	2.70E+02			
5	SPHERE	621	1.10E+02	5.44E+00	1.72E+01	7.68E+00	1.32E+02	-1.316	1.309	10.825
			1.18E+02	4.79E+00	9.39E+00	7.08E+00	1.32E+02			
			2.28E+02	1.02E+01	2.66E+01	1.48E+01	2.64E+02			
5	SPHERE	622	1.04E+02	5.24E+00	1.38E+01	6.09E+00	1.24E+02	-1.610	0.924	10.825
			1.33E+02	6.06E+00	1.05E+01	7.15E+00	1.50E+02			
			2.38E+02	1.13E+01	2.43E+01	1.32E+01	2.73E+02			
5	SPHERE	623	1.11E+02	2.98E+00	1.43E+01	6.31E+00	1.28E+02	-1.794	0.476	10.825
			1.45E+02	4.12E+00	1.22E+01	7.07E+00	1.61E+02			
			2.56E+02	7.10E+00	2.65E+01	1.34E+01	2.89E+02			
5	SPHERE	624	1.26E+02	2.50E+00	1.47E+01	6.67E+00	1.43E+02	-1.856	-0.005	10.825
			1.50E+02	2.25E+00	1.18E+01	7.76E+00	1.64E+02			
			2.75E+02	4.76E+00	2.66E+01	1.44E+01	3.06E+02			
5	SPHERE	625	1.55E+02	6.15E+00	1.91E+01	9.21E+00	1.81E+02	-1.791	-0.485	10.825
			1.47E+02	3.23E+00	1.11E+01	7.91E+00	1.61E+02			
			3.02E+02	9.38E+00	3.02E+01	1.71E+01	3.42E+02			
5	SPHERE	626	1.95E+02	9.87E+00	2.62E+01	1.16E+01	2.32E+02	-1.605	-0.932	10.825
			1.38E+02	3.81E+00	1.10E+01	7.33E+00	1.53E+02			
			3.32E+02	1.37E+01	3.73E+01	1.89E+01	3.84E+02			
5	SPHERE	627	2.44E+02	1.29E+01	1.18E+01	1.29E+01	2.89E+02	-1.309	-1.316	10.825
			1.22E+02	1.87E+00	1.03E+01	6.12E+00	1.36E+02			
			3.66E+02	1.68E+01	4.22E+01	1.90E+01	4.25E+02			
5	SPHERE	628	3.15E+02	1.60E+01	3.94E+01	1.77E+01	3.71E+02	-0.924	-1.610	10.825
			1.03E+02	2.74E+00	8.94E+00	5.52E+00	1.15E+02			
			4.18E+02	1.87E+01	4.83E+01	2.33E+01	4.86E+02			
5	SPHERE	629	4.03E+02	1.84E+01	4.21E+01	2.45E+01	4.62E+02	-0.476	-1.794	10.825
			8.31E+01	1.99E+00	8.29E+00	4.77E+00	9.33E+01			
			4.86E+02	2.04E+01	5.04E+01	2.93E+01	5.55E+02			
5	SPHERE	630	4.93E+02	1.94E+01	4.53E+01	2.68E+01	5.59E+02	0.005	-1.856	10.825
			6.45E+01	1.68E+00	6.94E+00	3.75E+00	7.31E+01			
			5.58E+02	2.11E+01	5.22E+01	3.06E+01	6.31E+02			
5	SPHERE	631	5.88E+02	2.41E+01	5.42E+01	3.16E+01	6.66E+02	0.485	-1.791	10.825
			4.82E+01	5.69E-01	5.07E+00	2.68E+00	5.34E+01			
			6.16E+02	2.47E+01	5.93E+01	3.42E+01	7.19E+02			
5	SPHERE	632	6.75E+02	3.02E+01	5.88E+01	3.86E+01	7.64E+02	0.932	-1.605	10.825
			3.24E+01	1.62E-01	4.39E+00	1.64E+00	3.71E+01			
			7.07E+02	3.04E+01	6.32E+01	4.02E+01	8.01E+02			
5	SPHERE	633	7.37E+02	3.27E+01	6.20E+01	4.21E+01	8.32E+02	1.316	-1.309	10.825
			2.01E+01	1.02E-01	3.84E+00	1.18E+00	2.40E+01			
			7.57E+02	3.29E+01	6.58E+01	4.33E+01	8.56E+02			
5	SPHERE	634	7.74E+02	3.71E+01	6.22E+01	4.09E+01	8.73E+02	1.610	-0.924	10.825
			9.70E+00	0.00E+00	2.84E+00	6.16E-01	1.26E+01			
			7.84E+02	3.71E+01	6.50E+01	4.13E+01	8.66E+02			
5	SPHERE	635	7.80E+02	2.87E+01	6.36E+01	4.12E+01	8.73E+02	1.794	-0.476	10.825
			2.46E+00	0.00E+00	1.86E+00	1.61E-01	4.33E+00			
			7.83E+02	2.87E+01	6.54E+01	4.13E+01	8.77E+02			
5	SPHERE	636	7.54E+02	1.59E+01	6.43E+01	4.27E+01	8.33E+02	1.856	-0.005	10.825
			1.49E+00	0.00E+00	1.60E+00	5.50E-02	3.01E+00			
			7.56E+02	1.59E+01	6.59E+01	4.28E+01	8.36E+02			
5	SPHERE	637	6.75E+02	2.38E+01	9.76E+01	3.91E+01	7.98E+02	0.204	0.001	10.008
			3.54E+00	0.00E+00	2.60E+00	1.56E-01	6.13E+00			
			6.79E+02	2.38E+01	1.00E+02	3.92E+01	8.04E+02			
5	SPHERE	638	6.26E+02	3.11E+01	9.36E+01	3.62E+01	7.49E+02	0.197	0.053	10.008
			6.76E+00	1.62E-02	3.38E+00	5.88E-01	1.02E+01			
			6.33E+02	3.11E+01	9.70E+01	3.68E+01	7.59E+02			
5	SPHERE	639	5.51E+02	4.20E+01	8.69E+01	3.47E+01	6.80E+02	0.176	0.102	10.008
			1.13E+01	4.56E-01	3.47E+00	8.77E-01	1.54E+01			
			5.62E+02	4.25E+01	9.04E+01	3.56E+01	6.95E+02			

5	SPHERE	640	4.66E+02	3.39E+01	8.16E+01	3.15E+01	5.83E+02	0.144	0.145	10.008
			2.00E+01	1.19E+00	4.51E+00	1.43E+00	2.57E+01			
			4.86E+02	3.51E+01	6.61E+01	3.30E+01	6.09E+02			
5	SPHERE	641	3.79E+02	2.13E+01	7.00E+01	2.40E+01	4.71E+02	0.102	0.177	10.008
			3.02E+01	1.90E+00	6.44E+00	2.25E+00	3.85E+01			
			4.09E+02	2.32E+01	7.64E+01	2.63E+01	5.10E+02			
5	SPHERE	642	3.95E+02	1.60E+01	5.76E+01	1.96E+01	3.69E+02	0.052	0.197	10.008
			2.96E+01	3.42E+00	8.10E+00	2.25E+00	5.07E+01			
			3.35E+02	1.94E+01	6.57E+01	2.19E+01	4.19E+02			
5	SPHERE	643	2.30E+02	1.26E+01	4.97E+01	1.69E+01	2.93E+02	-0.001	0.204	10.008
			5.66E+01	5.05E+00	9.58E+00	2.70E+00	7.11E+01			
			2.87E+02	1.77E+01	5.93E+01	1.96E+01	3.64E+02			
5	SPHERE	644	1.86E+02	8.74E+00	4.00E+01	1.28E+01	2.34E+02	-0.053	0.197	10.008
			7.61E+01	5.33E+00	1.24E+01	4.42E+00	9.41E+01			
			2.62E+02	1.41E+01	5.24E+01	1.73E+01	3.28E+02			
5	SPHERE	645	1.60E+02	4.61E+00	3.28E+01	1.17E+01	1.97E+02	-0.102	0.176	10.008
			9.03E+01	5.06E+00	1.52E+01	6.23E+00	1.10E+02			
			2.51E+02	9.67E+00	4.80E+01	1.79E+01	3.07E+02			
5	SPHERE	646	1.45E+02	5.79E+00	2.52E+01	1.02E+01	1.75E+02	-0.145	0.144	10.008
			1.03E+02	6.24E+00	1.44E+01	6.86E+00	1.23E+02			
			2.48E+02	1.20E+01	3.96E+01	1.70E+01	2.98E+02			
5	SPHERE	647	1.35E+02	7.31E+00	2.03E+01	7.97E+00	1.63E+02	-0.177	0.102	10.008
			1.14E+02	8.59E+00	1.64E+01	6.78E+00	1.39E+02			
			2.50E+02	1.59E+01	3.67E+01	1.47E+01	3.02E+02			
5	SPHERE	648	1.40E+02	4.67E+00	1.88E+01	6.44E+00	1.65E+02	-0.197	0.052	10.008
			1.23E+02	6.03E+00	1.88E+01	1.57E+01	1.47E+02			
			2.63E+02	1.07E+01	3.97E+01	1.57E+01	3.12E+02			
5	SPHERE	649	1.56E+02	3.78E+00	2.06E+01	6.98E+00	1.80E+02	-0.204	-0.001	10.008
			1.27E+02	3.17E+00	1.72E+01	1.72E+01	1.47E+02			
			2.83E+02	6.95E+00	3.78E+01	1.72E+01	3.28E+02			
5	SPHERE	650	1.88E+02	8.27E+00	2.49E+01	1.19E+01	2.21E+02	-0.197	-0.053	10.008
			1.26E+02	4.95E+00	1.65E+01	7.31E+00	1.47E+02			
			3.14E+02	1.32E+01	4.14E+01	1.92E+01	3.69E+02			
5	SPHERE	651	2.28E+02	1.50E+01	3.59E+01	1.41E+01	2.79E+02	-0.176	-0.102	10.008
			1.20E+02	6.05E+00	1.63E+01	6.76E+00	1.43E+02			
			3.48E+02	2.10E+01	5.22E+01	2.09E+01	4.21E+02			
5	SPHERE	652	2.75E+02	2.12E+01	4.69E+01	1.58E+01	3.42E+02	-0.144	-0.145	10.008
			1.10E+02	5.56E+00	1.53E+01	6.50E+00	1.31E+02			
			3.84E+02	2.67E+01	6.22E+01	2.23E+01	4.73E+02			
5	SPHERE	653	3.35E+02	2.48E+01	5.94E+01	2.24E+01	4.20E+02	-0.102	-0.177	10.008
			9.62E+01	3.71E+00	1.37E+01	5.79E+00	1.13E+02			
			4.31E+02	2.85E+01	7.31E+01	2.82E+01	5.34E+02			
5	SPHERE	654	4.05E+02	2.99E+01	6.33E+01	2.55E+01	4.99E+02	-0.052	-0.197	10.008
			8.02E+01	3.14E+00	1.25E+01	4.53E+00	1.31E+01			
			4.86E+02	3.31E+01	7.58E+01	3.01E+01	5.95E+02			
5	SPHERE	655	4.82E+02	3.25E+01	7.18E+01	2.83E+01	5.86E+02	0.001	-0.204	10.008
			6.36E+01	2.76E+00	1.04E+01	3.62E+00	7.69E+01			
			5.45E+02	3.52E+01	8.23E+01	3.19E+01	6.63E+02			
5	SPHERE	656	4.91E+01	8.74E-01	7.56E+00	2.74E+00	5.74E+01	0.053	-0.197	10.008
			6.04E+02	3.99E+01	9.48E+01	3.52E+01	7.38E+02			
			6.18E+02	4.93E+01	9.03E+01	3.84E+01	7.58E+02			
5	SPHERE	657	3.67E+01	7.86E-02	7.16E+00	1.83E+00	4.41E+01	0.102	-0.176	10.008
			6.55E+02	4.94E+01	9.24E+01	4.02E+01	8.02E+02			
			6.63E+02	5.17E+01	9.24E+01	4.37E+01	8.06E+02			
5	SPHERE	658	2.64E+01	0.00E+00	6.28E+00	1.52E+00	3.27E+01	0.145	-0.144	10.008
			6.89E+02	5.17E+01	9.87E+01	4.52E+01	8.39E+02			
			6.91E+02	5.84E+01	9.32E+01	3.97E+01	8.42E+02			
5	SPHERE	659	1.41E+01	0.00E+00	4.17E+00	8.52E-01	1.64E+01	0.177	-0.102	10.008
			7.05E+02	5.94E+01	9.73E+01	4.06E+01	8.60E+02			
			6.97E+02	4.63E+01	9.78E+01	3.85E+01	8.41E+02			
5	SPHERE	660	3.81E+00	0.00E+00	2.64E+00	1.38E-01	6.49E+00	0.197	-0.052	10.008
			7.01E+02	4.63E+01	1.00E+02	3.86E+01	8.48E+02			
			6.77E+02	2.51E+01	1.01E+02	4.00E+01	8.00E+02			
5	SPHERE	661	2.90E+00	0.00E+00	2.40E+00	1.07E-01	5.33E+00	0.204	-0.001	10.008
			6.80E+02	2.51E+01	1.03E+02	4.01E+01	8.06E+02			

1 TITLE="SOLSHAD sample input with 5 surfaces"

SURFACE	1	NUMBER OF NODES	36	NUMBER OF ELEMENTS	25
CONNECTIVITY MATRIX OF NODE NUMBERS					
1	2	8	7		
2	3	9	8		
3	4	10	9		
4	5	11	10		
5	6	12	11		
6	7	13	12		
7	8	14	13		
8	9	15	14		
9	10	16	15		
10	11	17	16		
11	12	18	17		
12	13	19	18		
13	14	20	19		
14	15	21	20		
15	16	22	21		
16	17	23	22		
17	18	24	23		
18	19	25	24		
19	20	26	25		
20	21	27	26		
21	22	28	27		
22	23	29	28		
23	24	30	29		
24	25	31	30		
25	26	32	31		
26	27	33	32		
27	28	34	33		
28	29	35	34		
29	30	36	35		

SURFACE	2	NUMBER OF NODES	150	NUMBER OF ELEMENTS	125
CONNECTIVITY MATRIX OF NODE NUMBERS					
37	38	63	62		
38	39	64	63		
39	40	65	64		
40	41	66	65		
41	42	67	66		
42	43	68	67		
43	44	69	68		
44	45	70	69		
45	46	71	70		
46	47	72	71		
47	48	73	72		
48	49	74	73		
49	50	75	74		
50	51	76	75		
51	52	77	76		
52	53	78	77		
53	54	79	78		
54	55	80	79		
55	56	81	80		
56	57	82	81		
57	58	83	82		
58	59	84	83		
59	60	85	84		
60	61	86	85		
61	62	87	86		
62	63	88	87		
63	64	89	88		
64	65	90	89		
65	66	91	90		
66	67	92	91		
67	68	93	92		

93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159

69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134

68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134

SURFACE 3		NUMBER OF NODES		NUMBER OF ELEMENTS	
CONNECTIVITY MATRIX OF NODE NUMBERS		175	150		
134	135	160	159		
135	136	161	160		
112	136	161	137		
137	138	163	162		
138	139	164	163		
139	140	165	164		
140	141	166	165		
141	142	167	166		
142	143	168	167		
143	144	169	168		
144	145	170	169		
145	146	171	170		
146	147	172	171		
147	148	173	172		
148	149	174	173		
149	150	175	174		
150	151	176	175		
151	152	177	176		
152	153	178	177		
153	154	179	178		
154	155	180	179		
155	156	181	180		
156	157	182	181		
157	158	183	182		
158	159	184	183		
159	160	185	184		
160	161	186	185		
161	162	186	186		
137	188	213	212		
187	189	214	213		
188	190	215	214		
189	191	216	215		
190	192	217	216		
191	193	218	217		
192	194	219	218		
193	195	220	219		
194	196	221	220		
195	197	222	221		
196	198	223	222		
197	199	224	223		
198	200	225	224		
199	201	226	225		
200	202	227	226		
201	203	228	227		
202	204	229	228		
203	205	230	229		
204	206	231	230		
205	207	232	231		
206	208	233	232		
207	209	234	233		
208	210	235	234		
209	211	236	235		
210	212	237	236		
211	213	238	237		
187	214	239	238		
212	215	240	239		
213	216	241	240		
214	217	242	241		
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216	219	244	243		
217	220	245	244		
218	221	246	245		
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SURFACE		5	NUMBER OF NODES		175	NUMBER OF ELEMENTS		150
CONNECTIVITY MATRIX OF NODE NUMBERS								
440	441	442	443	444	445	446	447	448
449	450	451	452	453	454	455	456	457
458	459	460	461	462	463	464	465	466
467	468	469	470	471	472	473	474	475
476	477	478	479	480	481	482	483	484
485	486	487	488	489	490	491	492	493
494	495	496	497	498	499	500	501	502
503	504	505	506	507	508	509	510	511
512	513	514	515	516	517	518	519	520
521	522	523	524	525	526	527	528	529
530	531	532	533	534	535	536	537	538
539	540	541	542	543	544	545	546	547
548	549	550	551	552	553	554	555	556

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634	659
635	660
636	661
637	661

OTOTAL NUMBER OF NODES 661  
TOTAL NUMBER OF ELEMENTS 550

CPU TIME AT END OF PROGRAM 250.0645 S

### A.4 3D Plotting File

This is the file generated by TECPLOT and stored as TAPE7. It is generally renamed to another file by the run.shadow command. It is then transferred to a PC under a shorter name.

Convex file: solmicro/solshad.tp7\_sample  
Transferred to PC: solsam.tec

TITLE="SOLSHAD sample Input with 5 surfaces"  
VARIABLES=NODE, PRIM, SPEC, DIFF, ABSORPTION, TOTAL, PRIMA, SPECA, DIFFA, ABSA, TOTAL, CRTOTAL, X, Y, Z

ZONE T=SURF 1", I= 661, J= 550 F=FEPOINT

1	483.06	10.89	45.37	0.00	539.32	61.07	3.92	21.00	0.00	86.00	625.31	-3.984	15.100
2	445.93	9.32	46.58	0.00	502.55	61.07	3.70	26.65	0.00	91.42	593.97	-2.384	15.100
3	339.25	7.62	44.24	0.00	391.06	61.07	3.71	35.83	0.00	100.60	491.66	-3.984	15.100
4	288.69	6.87	37.29	0.00	332.08	61.07	3.64	33.29	0.00	100.08	432.16	-0.816	15.100
5	347.86	7.16	31.76	0.00	387.21	61.07	2.67	25.82	0.00	89.57	476.78	-3.984	15.100
6	385.36	7.93	30.57	0.00	423.85	61.07	2.12	20.51	0.00	83.70	507.55	-3.984	15.100
7	475.71	10.22	59.82	0.00	544.98	61.07	2.92	31.10	0.00	85.97	630.95	-2.384	15.100
8	424.43	8.84	65.54	0.00	503.58	61.07	3.02	49.51	0.00	95.18	598.76	-0.784	15.100
9	258.18	6.93	70.66	0.00	340.88	61.07	3.64	49.51	0.00	114.20	455.08	-2.384	15.100
10	192.31	6.02	54.37	0.00	257.75	61.07	3.69	47.85	0.00	112.63	370.38	-2.384	15.100
11	300.04	6.70	37.52	0.00	348.49	61.07	2.79	28.72	0.00	92.55	441.05	2.416	15.100
12	362.29	7.57	34.31	0.00	405.70	61.07	2.36	21.37	0.00	84.81	490.50	-2.384	15.100
13	477.10	11.36	102.78	0.00	594.35	56.01	1.77	21.09	0.00	79.47	673.82	-3.984	15.100
14	400.87	11.24	151.86	0.00	563.53	41.39	2.22	31.94	0.00	91.85	655.38	-0.784	15.100
15	162.25	12.33	222.01	0.00	386.23	41.39	3.45	59.79	0.00	107.18	493.41	-0.784	15.100
16	82.35	10.38	171.73	0.00	254.79	38.63	3.41	56.27	0.00	96.49	331.28	-0.784	15.100
17	251.41	7.75	76.90	0.00	339.25	54.77	2.43	28.43	0.00	86.49	425.73	-0.784	15.100
18	7.88	53.03	0.00	408.29	61.07	2.30	19.54	0.00	83.94	492.23	-0.784	15.100	
19	347.55	14.82	140.62	0.00	666.30	45.83	1.23	13.47	0.00	60.52	726.81	0.816	15.100
20	463.76	16.27	216.51	0.00	685.36	34.61	1.38	19.85	0.00	55.58	740.94	0.816	15.100
21	286.41	19.58	337.90	0.00	637.43	9.62	1.89	31.64	0.00	44.51	681.94	-0.784	15.100
22	227.78	16.44	278.72	0.00	517.64	13.62	1.71	29.07	0.00	43.46	561.10	0.816	15.100
23	352.04	11.06	124.49	0.00	487.75	37.69	1.50	16.19	0.00	56.16	543.31	0.816	15.100
24	407.38	10.53	81.35	0.00	503.17	46.22	1.74	12.56	0.00	60.53	563.70	0.816	15.100
25	556.02	15.97	133.05	0.00	707.55	40.40	0.66	6.49	0.00	47.33	754.88	2.416	15.100
26	548.44	17.74	180.98	0.00	738.41	28.37	0.55	6.28	0.00	36.05	774.46	2.416	15.100
27	494.49	20.51	258.10	0.00	763.15	12.14	0.35	5.38	0.00	18.07	781.22	2.416	15.100
28	472.83	19.18	224.81	0.00	708.49	15.83	0.52	4.96	0.00	22.11	730.60	0.816	15.100
29	502.39	15.24	125.29	0.00	642.24	25.85	0.88	5.65	0.00	32.52	674.76	2.416	15.100
30	508.91	13.75	90.74	0.00	616.88	27.84	1.07	6.12	0.00	34.68	651.56	2.416	15.100
31	576.53	15.50	119.58	0.00	711.61	40.40	0.52	5.14	0.00	46.05	757.66	3.984	15.100
32	565.70	17.51	148.00	0.00	731.17	35.15	0.47	4.46	0.00	40.09	771.26	3.984	15.100
33	553.48	20.50	181.61	0.00	755.97	22.86	0.24	3.14	0.00	26.25	782.22	3.984	15.100
34	543.74	20.70	164.57	0.00	725.51	19.76	0.51	2.91	0.00	23.21	748.72	3.984	15.100
35	549.46	17.53	114.24	0.00	678.61	24.46	0.79	3.63	0.00	29.19	707.80	3.984	15.100
36	561.99	15.33	85.96	0.00	683.28	25.39	0.69	4.29	0.00	30.37	693.65	3.984	15.100
37	531.27	20.25	479.95	50.16	1030.44	0.00	0.00	8.62	0.39	8.61	1039.05	3.000	0.010
38	481.93	19.75	445.02	45.08	950.10	0.00	0.00	10.91	0.44	10.85	960.94	2.896	0.010
39	407.88	15.99	409.88	38.75	833.34	0.38	0.07	13.64	0.85	14.07	847.41	2.594	0.010
40	316.98	12.46	385.02	37.42	714.38	3.36	0.18	17.65	1.36	21.18	735.56	2.116	0.010
41	229.08	9.33	356.57	33.03	596.27	10.32	0.58	24.14	1.56	34.99	631.26	1.493	0.010
42	156.22	6.94	324.80	25.60	487.64	19.98	1.03	33.97	3.18	55.08	542.72	0.769	0.010
43	98.00	5.23	300.54	20.42	406.19	30.66	1.22	44.33	3.80	76.10	482.28	-0.008	0.010
44	61.41	3.24	265.01	17.12	331.66	43.51	1.55	49.46	3.94	94.99	426.65	-0.784	0.010
45	42.82	2.71	225.64	13.89	271.39	60.73	2.30	53.56	5.20	116.71	388.10	-1.507	0.010
46	32.57	2.54	200.35	10.74	235.51	79.55	3.05	55.34	6.97	137.89	373.40	-2.127	0.010
47	27.62	2.28	199.37	9.96	229.74	98.21	3.32	57.51	8.82	158.85	388.59	-2.602	0.010
48	26.75	1.97	197.73	11.67	226.96	114.68	3.52	57.51	8.82	158.85	388.59	-2.602	0.010
49	30.71	1.49	199.33	10.90	230.99	124.77	3.76	65.78	9.15	181.56	408.52	-3.000	0.010
50	40.80	2.87	219.41	10.66	263.49	126.17	3.20	65.78	9.15	194.35	425.34	-3.000	0.010
51	54.46	4.12	237.76	11.79	297.01	119.62	2.71	65.94	9.06	195.41	458.91	-2.896	0.010
52	76.55	6.30	255.53	15.40	337.49	107.51	2.02	57.07	8.30	166.43	503.92	-2.116	0.010
53	117.32	8.00	292.73	20.33	416.70	92.16	1.30	54.73	7.09	147.98	564.68	-1.493	0.010
54	171.32	6.21	350.62	25.63	530.04	73.51	1.14	49.09	5.63	123.55	653.58	-2.900	0.010
55	242.40	9.36	393.58	29.24	645.84	52.88	0.64	40.98	4.73	94.35	740.20	-3.000	0.010
56	327.70	14.20	394.50	31.47	736.40	32.88	0.20	32.46	3.47	65.85	802.25	0.784	0.010
57	414.90	15.69	404.72	42.82	834.56	17.42	0.03	25.30	2.41	42.87	877.42	-2.594	0.010
58	487.87	18.05	437.58	48.91	944.48	6.97	-0.01	19.46	1.34	26.54	971.02	-2.116	0.010
59	536.81	18.43	452.46	49.47	1006.76	1.24	0.04	13.09	0.46	14.36	1021.12	-1.493	0.010
60	553.33	17.55	469.69	49.75	1039.59	0.00	0.04	8.85	0.36	8.63	1048.23	2.900	0.010
61	535.52	18.16	482.13	48.66	1039.70	0.00	0.00	8.16	0.46	8.07	1047.76	3.000	0.010
62	590.12	15.16	323.86	45.30	956.79	0.00	0.00	6.81	0.34	6.91	933.60	3.000	0.010
63	534.99	14.54	307.26	41.46	856.70	0.00	0.00	8.12	0.44	8.05	864.75	2.896	0.010
64	448.42	13.50	279.93	36.32	742.38	0.38	0.06	9.99	0.76	10.31	752.88	2.594	1.010
65	348.21	11.72	260.78	30.89	620.98	3.36	0.25	12.90	1.07	16.48	637.47	2.116	1.010

66	251.56	8.94	241.25	25.31	502.06	10.20	0.59	17.77	1.37	28.51	530.57	1.493	2.602	1.010
67	168.46	6.86	224.49	21.29	400.55	20.86	0.90	24.28	2.63	46.63	447.17	0.769	2.900	1.010
68	101.72	4.70	208.65	16.66	318.39	33.52	0.94	30.55	3.69	66.14	384.52	-0.008	3.000	1.010
69	62.06	2.69	185.62	12.39	252.92	47.97	1.14	33.54	4.21	84.51	337.44	-0.784	2.896	1.010
70	42.76	2.42	159.92	10.16	205.90	73.29	1.67	35.76	5.27	110.85	316.74	-1.507	2.594	1.010
71	32.43	2.32	142.84	8.26	177.52	99.04	2.33	37.29	6.62	138.49	316.02	-2.127	2.116	1.010
72	27.51	1.65	143.46	8.46	172.84	114.21	2.72	38.78	7.97	155.71	328.55	-2.602	1.493	1.010
73	26.64	1.86	143.01	9.73	171.74	125.68	2.81	42.23	8.38	172.45	344.19	-2.900	0.769	1.010
74	30.71	1.50	144.76	9.30	177.12	136.22	3.14	43.55	8.19	183.93	361.05	-3.000	-0.008	1.010
75	40.83	2.14	153.99	8.98	197.46	137.31	3.00	43.26	8.39	183.62	381.08	-2.896	-0.784	1.010
76	54.36	3.47	167.12	9.99	225.52	128.74	2.84	40.86	8.24	171.80	397.32	-2.594	-1.507	1.010
77	76.68	5.19	181.63	12.90	264.34	113.13	1.98	37.18	8.24	152.36	416.70	-2.116	-2.127	1.010
78	118.02	6.30	204.16	15.72	329.45	94.62	1.50	36.74	6.46	133.19	462.64	-1.493	-2.602	1.010
79	177.64	6.48	242.84	20.77	432.35	74.37	1.14	33.17	5.41	108.84	541.20	-0.769	-2.900	1.010
80	258.80	9.52	268.26	25.02	544.46	52.74	0.64	27.82	4.27	81.25	623.70	0.008	-3.000	1.010
81	362.21	13.05	267.15	29.45	644.45	32.86	0.19	23.13	2.93	56.50	700.95	0.784	-2.896	1.010
82	464.91	14.18	276.69	39.65	754.17	17.42	0.02	18.66	1.99	36.23	790.40	1.507	-2.594	1.010
83	546.60	16.07	296.61	44.96	860.18	6.97	0.00	14.54	1.22	21.60	881.78	2.127	-2.116	1.010
84	600.32	17.02	303.36	45.64	920.38	1.24	0.02	10.46	0.45	11.72	932.10	2.602	-1.493	1.010
85	615.51	14.90	311.55	46.17	941.52	0.00	0.02	8.11	0.39	7.98	949.49	2.900	-0.769	1.010
86	594.34	14.20	321.16	45.71	931.02	0.00	0.00	6.84	0.44	6.79	937.80	3.000	-0.008	1.010
87	696.84	8.70	119.71	40.93	826.11	0.00	0.00	3.87	0.15	3.88	829.99	3.000	0.008	2.010
88	627.44	9.00	117.82	37.45	754.81	0.00	0.00	3.75	0.21	3.63	758.45	2.896	0.784	2.010
89	519.71	10.28	108.91	32.84	638.19	0.37	0.03	4.37	0.31	4.80	642.99	2.594	1.507	2.010
90	400.20	10.33	101.03	24.90	511.54	3.46	0.29	5.64	0.54	9.19	520.73	2.116	2.127	2.010
91	285.05	7.61	94.42	18.44	386.83	14.60	0.49	8.16	1.23	23.67	410.51	1.493	2.602	2.010
92	182.16	5.20	81.24	14.48	282.54	31.96	0.41	10.74	2.29	43.62	326.15	0.769	2.900	2.010
93	117.14	3.81	87.94	10.82	204.80	50.36	0.31	12.18	3.54	63.47	268.27	-0.008	3.000	2.010
94	66.00	2.28	78.33	7.40	146.72	69.97	0.36	13.16	4.57	84.25	230.97	-0.784	2.896	2.010
95	42.77	2.45	69.62	5.35	116.22	97.37	0.60	12.70	5.49	111.30	227.52	-2.127	2.116	2.010
96	32.05	2.55	61.40	4.95	96.32	128.26	1.02	12.51	6.39	141.20	237.52	-2.602	2.900	2.010
97	27.33	1.60	61.19	5.45	90.27	145.09	1.51	13.27	7.82	161.49	251.76	-2.900	1.493	2.010
98	26.40	1.56	65.42	5.75	93.35	157.04	1.62	13.27	8.46	174.97	268.32	-2.900	0.769	2.010
99	30.73	1.71	67.78	5.93	100.16	163.99	1.81	14.71	8.31	181.64	281.79	-3.000	-0.008	2.010
100	40.67	2.11	68.61	5.78	110.94	158.98	1.99	13.79	7.94	174.91	285.84	-2.896	-0.784	2.010
101	54.98	2.55	71.55	6.49	127.33	144.75	1.68	14.34	7.45	168.05	287.38	-2.594	-1.507	2.010
102	80.72	3.52	76.75	8.44	160.38	124.13	1.41	13.34	6.39	138.73	299.11	-2.116	2.127	2.010
103	132.25	5.14	83.68	11.47	220.51	101.81	1.29	13.14	5.50	116.42	336.93	-1.493	-2.602	2.010
104	213.44	6.32	95.50	15.31	315.90	77.62	0.97	12.58	4.62	91.39	407.29	-0.769	-2.900	2.010
105	320.39	7.79	104.95	21.99	433.83	52.85	0.67	10.81	3.46	64.16	497.99	0.008	-3.000	2.010
106	438.72	9.35	104.22	29.31	552.53	32.77	0.26	9.92	2.34	43.01	595.54	0.784	-2.896	2.010
107	554.07	10.02	110.25	41.77	768.41	17.42	0.01	8.84	1.45	26.32	691.58	1.507	-2.594	2.010
108	650.00	9.44	104.92	36.23	685.27	17.42	0.00	7.48	0.81	14.49	782.90	2.127	-2.116	2.010
109	713.79	10.62	113.65	40.42	837.16	6.97	0.00	6.13	0.29	7.38	844.53	2.602	-1.493	2.010
110	728.39	9.50	116.12	41.44	855.31	0.00	0.00	5.47	0.25	5.44	860.75	2.900	-0.769	2.010
111	702.34	8.66	117.58	43.52	831.37	0.00	0.00	4.32	0.24	4.33	835.60	3.000	-0.008	2.010
112	765.63	6.31	53.75	40.11	827.31	0.00	0.00	2.03	0.15	2.04	829.55	3.000	0.008	3.010
113	687.33	6.81	51.18	35.15	745.74	0.00	0.00	1.83	0.09	1.77	747.52	2.896	1.784	3.010
114	573.06	7.10	48.36	29.49	627.04	0.60	0.00	2.12	0.07	2.73	629.78	2.594	1.507	3.010
115	441.39	6.75	47.25	24.15	495.41	5.32	0.11	2.69	0.33	8.29	503.69	2.116	2.127	3.010
116	312.78	5.55	45.09	17.86	365.33	20.28	0.19	3.74	1.26	24.14	389.48	2.602	2.602	3.010
117	203.70	3.96	40.78	11.40	248.25	40.57	0.06	4.81	2.23	45.78	294.03	0.769	-2.900	3.010
118	122.76	2.95	40.85	8.50	166.07	61.46	-0.01	5.29	3.21	67.17	233.25	-0.008	3.000	3.010
119	71.49	2.45	38.32	5.99	112.40	84.58	0.01	6.32	4.39	91.18	203.58	-0.784	-2.896	3.010
120	43.52	2.75	34.80	3.77	81.74	110.16	0.21	5.91	5.68	116.44	198.17	-1.507	2.594	3.010
121	31.82	2.53	30.20	3.27	64.72	135.80	0.48	4.92	6.95	141.91	206.52	-2.127	2.116	3.010
122	26.83	2.28	28.36	2.83	57.53	160.96	0.62	6.23	8.94	168.42	225.94	-2.602	1.493	3.010
123	26.01	2.18	30.35	3.41	58.72	180.56	0.78	6.79	9.94	188.14	246.87	-2.900	0.769	3.010
124	31.60	2.02	32.07	3.45	65.82	185.46	0.95	5.90	10.04	192.36	258.18	-3.000	-0.008	3.010
125	42.92	1.87	33.99	3.50	78.53	177.37	1.01	5.58	8.93	183.08	261.60	-2.896	-0.784	3.010
126	66.99	1.84	32.89	4.35	100.60	158.15	0.91	6.50	7.68	163.67	266.27	-2.594	-1.507	3.010
127	108.31	2.72	34.71	6.46	148.28	135.06	0.61	6.48	6.06	142.56	290.84	-2.116	-2.127	3.010
128	175.42	4.01	40.27	11.50	222.94	108.19	0.56	6.06	5.37	114.72	337.26	-1.493	-2.602	3.010
129	273.54	4.59	41.84	15.49	323.12	80.43	0.66	5.13	4.14	86.97	410.09	-0.769	-2.900	3.010
130	391.98	5.60	44.35	20.77	442.98	54.71	0.54	5.99	2.67	60.30	503.28	-3.000	-3.000	3.010
131	516.48	6.08	47.68	28.26	573.39	32.85	0.25	4.74	1.89	37.85	611.24	0.784	-2.896	3.010



132	635.89	48.19	34.14	693.34	17.40	0.02	4.69	1.22	22.10	715.44	1.507	-2.594	3.010
133	734.33	50.65	41.06	792.72	6.97	0.00	3.08	0.61	803.57	861.07	2.127	-2.116	3.010
134	795.15	54.77	43.71	856.77	1.24	0.00	3.07	0.21	4.30	803.57	2.602	-1.493	3.010
135	805.52	57.96	42.38	870.24	0.00	0.00	2.61	0.14	2.62	872.86	2.900	-0.769	3.010
136	774.79	55.80	41.43	838.07	0.00	0.00	2.18	0.18	2.18	840.25	3.000	-0.008	3.010
137	813.46	52.97	38.70	841.92	0.00	0.00	0.66	0.12	0.65	842.58	3.000	0.008	4.010
138	733.34	21.89	36.39	760.12	0.00	0.00	0.12	0.12	0.85	760.98	2.896	0.784	4.010
139	614.20	3.91	21.74	639.60	0.81	0.00	1.24	0.12	2.15	641.42	2.594	1.507	4.010
140	477.19	3.90	26.26	501.47	6.86	0.00	0.39	0.39	6.43	509.90	2.116	2.127	4.010
141	341.87	3.93	17.69	365.11	20.87	0.01	1.70	1.27	22.73	387.84	1.493	2.602	4.010
142	222.15	16.31	12.79	243.73	0.56	0.01	1.84	1.90	42.37	286.11	0.769	2.900	4.010
143	134.49	16.61	8.68	155.30	61.45	0.00	2.20	2.55	63.64	218.94	-0.008	3.000	4.010
144	79.39	1.72	17.49	84.51	0.00	0.00	2.60	4.29	87.31	186.90	-0.784	2.896	4.010
145	48.04	2.15	16.42	3.00	112.65	0.17	2.53	6.10	115.46	182.92	-1.507	2.594	4.010
146	33.73	2.29	14.03	6.46	139.81	0.35	2.39	7.24	142.86	192.81	-2.127	2.116	4.010
147	27.11	2.13	12.88	42.04	164.71	0.37	2.59	8.96	168.02	210.07	-2.602	1.493	4.010
148	26.20	2.29	12.41	41.13	183.74	0.47	2.57	9.69	187.14	228.26	-2.900	0.769	4.010
149	36.84	1.60	13.62	3.34	189.29	0.60	2.55	9.86	192.76	249.90	-3.000	-0.008	4.010
150	55.65	1.55	15.16	3.95	182.87	0.54	2.73	9.35	186.41	260.16	-2.896	-0.784	4.010
151	85.99	2.22	14.08	5.23	164.23	0.36	2.87	8.14	167.86	271.24	-2.594	-1.507	4.010
152	139.19	2.38	16.32	7.75	140.21	0.37	2.64	6.79	143.48	300.64	-2.127	-2.127	4.010
153	220.39	2.71	18.95	157.16	112.62	0.41	2.76	5.74	115.87	357.24	-1.493	-2.602	4.010
154	326.93	3.45	17.68	347.87	84.77	0.40	2.76	4.41	88.31	436.18	-0.769	-2.900	4.010
155	450.24	4.43	22.65	470.56	57.42	0.36	2.95	4.45	60.08	530.44	0.008	-3.000	4.010
156	581.10	4.14	29.00	602.57	32.89	0.25	1.92	1.47	35.08	637.65	0.784	-2.896	4.010
157	709.37	4.69	35.78	732.50	17.39	0.09	2.15	0.92	19.61	752.12	1.507	-2.594	4.010
158	799.13	5.18	41.86	827.03	6.97	0.00	1.67	0.54	8.63	835.66	2.127	-2.116	4.010
159	856.96	5.41	46.01	880.03	1.24	0.00	1.34	0.09	2.60	888.63	2.602	-1.493	4.010
160	856.96	4.76	45.30	887.11	0.00	0.00	1.04	0.15	0.98	888.08	2.900	-0.769	4.010
161	822.90	3.71	42.03	851.37	0.00	0.00	0.70	0.15	0.70	852.07	3.000	-0.008	4.010
162	833.70	2.55	38.50	852.60	0.00	0.00	0.18	-0.01	0.17	852.78	3.000	0.008	4.010
163	752.80	2.84	39.11	772.13	0.00	0.00	0.71	0.07	0.56	772.69	2.896	0.784	4.010
164	628.19	3.41	17.56	649.47	0.81	0.00	1.05	0.13	2.03	651.49	2.594	1.507	4.010
165	489.18	3.88	29.22	507.63	6.86	0.00	1.19	0.44	8.06	515.69	2.116	-2.127	4.010
166	352.14	3.68	14.42	29.08	20.87	0.00	1.32	1.27	22.17	389.56	1.493	2.602	4.010
167	229.83	3.12	18.36	245.15	40.56	0.00	1.35	1.85	41.92	287.07	0.769	2.900	4.010
168	141.05	2.11	14.46	155.83	61.45	0.00	1.74	2.22	63.20	219.03	-0.008	3.000	4.010
169	84.27	1.05	9.11	97.79	84.32	0.00	1.75	4.35	86.07	183.86	-0.784	2.896	4.010
170	51.35	1.73	2.86	65.76	113.37	0.16	1.57	6.44	115.14	180.91	-1.507	2.594	4.010
171	35.34	2.45	2.67	47.27	146.60	0.26	1.88	7.20	144.77	192.04	-2.127	-2.116	4.010
172	27.75	1.98	1.11	38.69	166.65	0.34	1.85	8.65	168.86	207.55	-2.602	1.493	4.010
173	26.62	1.70	2.02	38.06	183.65	0.49	1.58	8.93	185.77	223.83	-2.900	0.769	4.010
174	40.28	1.12	3.56	52.36	189.29	0.45	2.00	9.24	191.77	244.13	-3.000	-0.008	4.010
175	63.65	2.03	4.70	78.60	182.87	0.36	2.22	8.01	185.43	264.03	-2.896	-0.784	4.010
176	93.67	2.97	5.97	108.44	164.23	0.18	2.22	8.01	166.59	275.13	-2.594	-1.507	4.010
177	145.53	2.94	8.78	161.26	140.08	0.36	1.81	6.75	142.07	303.34	-2.116	-2.127	4.010
178	231.63	2.85	13.14	248.44	114.53	0.53	1.88	5.95	116.80	365.24	-1.493	-2.602	4.010
179	340.62	3.41	13.47	359.16	88.06	0.35	2.04	4.59	90.64	449.81	-0.769	-2.900	4.010
180	467.50	3.70	14.70	26.34	58.64	0.35	1.31	2.64	60.34	545.71	0.008	-3.000	4.010
181	598.56	3.39	32.11	616.89	32.82	0.32	1.16	1.44	34.30	651.18	0.784	-2.896	4.010
182	723.60	3.72	38.87	743.35	17.39	0.13	1.31	0.73	18.84	762.19	1.507	-2.594	4.010
183	816.55	4.59	43.72	837.12	6.97	0.00	1.22	0.45	8.18	845.28	2.127	-2.116	4.010
184	867.71	4.44	45.01	888.35	1.24	0.00	1.12	0.12	2.41	890.76	2.602	-1.493	4.010
185	875.30	3.38	46.80	895.74	0.00	0.00	0.80	0.01	0.71	896.45	2.900	-0.769	4.010
186	841.64	2.49	44.96	860.60	0.00	0.00	0.29	0.01	0.29	860.89	3.000	0.008	4.010
187	815.74	11.83	79.01	842.54	0.00	0.24	0.55	0.04	0.54	843.08	2.995	-0.008	5.008
188	744.21	12.96	75.10	769.10	0.93	0.07	0.48	0.32	1.46	770.57	2.891	0.783	5.008
189	648.84	16.99	67.01	676.74	4.56	0.08	0.31	0.76	4.92	681.66	2.590	1.504	5.008
190	538.27	16.19	56.74	566.75	10.49	0.10	0.43	1.39	10.96	577.71	2.113	2.124	5.008
191	419.79	14.34	44.50	443.95	20.49	0.06	1.01	1.69	21.61	465.56	1.491	2.598	5.008
192	309.79	13.03	32.70	330.69	37.53	-0.01	1.02	3.54	38.53	369.22	0.768	2.895	5.008
193	223.05	12.12	25.47	241.60	61.48	0.09	1.11	7.32	62.69	304.29	-0.008	2.995	5.008
194	158.87	11.94	20.29	174.79	86.76	0.31	1.77	9.53	88.87	263.60	-0.783	2.891	5.008
195	132.60	14.99	17.39	152.79	110.26	0.39	2.17	10.64	112.84	265.63	-1.504	2.590	5.008
196	114.50	16.53	16.67	136.57	131.84	0.23	2.58	12.66	134.67	271.24	-2.124	-2.113	5.008
197	99.27	14.97	11.69	117.76	151.02	0.18	2.44	14.69	153.72	271.49	-2.598	1.491	5.008

198	101.78	12.70	4.16	10.06	118.24	165.49	0.20	1.98	15.09	167.70	285.94	-2.895	0.768	5.008
199	114.49	13.61	5.88	10.83	134.60	170.37	0.10	2.46	16.37	173.01	307.61	-2.995	-0.008	5.008
200	133.53	16.90	5.39	11.93	156.55	166.22	0.09	2.72	17.32	169.08	325.63	-2.891	-0.783	5.008
201	161.33	14.57	4.95	17.77	181.49	153.81	0.38	2.67	14.97	156.79	338.28	-2.113	-1.504	5.008
202	208.48	12.12	9.80	24.66	232.18	133.09	0.31	2.57	11.85	136.11	368.28	-2.113	-2.124	5.008
203	272.71	10.95	11.75	30.17	297.58	108.67	0.33	2.26	9.90	111.27	408.84	-1.491	-2.598	5.008
204	360.81	11.69	11.50	40.34	384.86	84.80	0.41	1.71	8.98	86.95	471.81	-0.768	-2.895	5.008
205	479.04	13.86	10.95	49.75	503.84	64.70	0.13	1.17	6.39	65.79	569.64	0.008	-2.995	5.008
206	599.62	14.35	12.34	62.75	625.51	45.91	0.11	0.90	4.52	46.23	672.24	0.783	-2.891	5.008
207	710.56	12.20	15.14	73.94	739.16	27.87	0.08	1.01	3.21	29.02	768.18	1.504	-2.590	5.008
208	800.04	9.95	15.46	82.42	825.15	13.63	0.09	0.77	1.17	14.49	839.64	2.124	-2.113	5.008
209	848.49	12.65	15.45	89.22	876.49	5.27	0.34	0.50	0.37	6.08	882.56	2.598	-1.491	5.008
210	855.35	13.94	13.67	82.53	884.86	1.13	0.54	0.48	0.16	2.16	887.02	2.895	-0.768	5.008
211	823.87	15.31	12.93	77.84	851.72	0.00	0.16	0.58	0.09	0.76	852.47	2.995	-0.008	5.008
212	810.86	15.08	16.54	79.82	842.47	0.00	0.16	0.62	0.02	0.51	842.99	2.495	0.007	5.841
213	742.31	15.08	14.83	73.17	772.09	0.93	0.03	0.56	0.19	1.50	773.59	2.409	0.652	5.841
214	641.82	16.98	15.25	65.89	674.29	4.56	0.06	0.55	0.57	5.16	679.44	2.158	1.253	5.841
215	524.86	16.55	14.57	59.27	556.72	10.50	0.09	0.76	1.20	11.32	568.05	1.769	1.769	5.841
216	410.37	16.02	9.88	44.42	435.86	20.18	0.12	1.07	2.27	21.44	457.30	1.242	2.164	5.841
217	305.08	16.32	8.36	30.59	328.91	37.34	0.06	1.10	4.37	38.41	367.33	0.640	2.412	5.841
218	215.84	17.45	7.02	25.36	240.34	61.48	0.03	1.63	6.97	63.16	303.51	-0.007	2.495	5.841
219	152.07	17.04	4.67	19.62	173.51	86.76	0.18	2.19	9.11	89.14	262.64	-0.652	2.409	5.841
220	117.25	15.89	6.50	15.27	139.83	110.26	0.24	2.24	10.51	112.78	252.60	-1.253	2.158	5.841
221	101.80	17.21	7.48	13.72	126.55	131.84	0.21	2.69	12.78	134.72	261.26	-1.769	1.760	5.841
222	95.26	16.43	5.50	11.65	116.50	151.02	0.16	3.16	15.01	154.40	270.90	-2.164	1.242	5.841
223	96.61	16.21	4.51	10.57	116.73	165.45	0.13	3.11	15.58	168.74	285.48	-2.412	0.640	5.841
224	106.20	16.27	6.36	13.23	129.75	170.37	0.07	3.55	17.10	174.07	303.82	-2.495	-0.007	5.841
225	127.80	17.10	7.35	10.59	152.61	166.22	0.18	3.28	17.94	169.74	322.35	-2.409	-0.652	5.841
226	157.56	16.67	6.89	18.82	180.56	133.81	0.37	2.95	16.21	157.12	337.68	-2.158	-1.253	5.841
227	203.02	15.47	9.69	24.15	228.33	133.09	0.23	2.98	16.50	136.25	364.58	-1.760	-1.769	5.841
228	267.33	13.98	11.31	28.85	292.24	108.67	0.24	2.37	10.79	111.35	403.59	-1.242	-2.164	5.841
229	355.50	14.10	11.62	38.08	380.41	84.80	0.36	2.09	8.81	87.27	463.59	-0.640	-2.412	5.841
230	472.92	15.01	13.09	50.43	500.85	64.70	0.19	1.87	6.19	66.63	567.48	0.007	-2.495	5.841
231	595.08	14.21	15.69	62.41	624.85	45.91	0.10	1.27	4.35	47.20	671.85	0.652	-2.409	5.841
232	706.18	14.11	17.42	73.52	738.26	27.87	0.10	1.00	3.10	28.96	767.22	1.253	-2.158	5.841
233	842.82	14.99	17.07	83.20	823.85	13.72	0.19	0.75	1.46	14.67	838.52	1.769	-0.652	5.841
234	842.82	14.99	17.52	88.44	874.93	4.58	0.83	0.63	0.72	5.95	880.88	2.164	-1.760	5.841
235	849.88	16.24	16.18	85.56	881.33	0.55	0.80	0.64	0.18	1.86	883.18	2.412	-0.640	5.841
236	816.78	16.78	15.52	80.04	849.03	0.00	0.28	0.62	0.05	0.74	843.77	2.495	-0.007	5.841
237	792.07	23.88	23.89	88.03	840.70	0.00	0.04	0.72	0.10	0.48	841.18	1.996	0.005	6.674
238	726.99	22.76	24.20	79.57	774.29	0.93	-0.01	0.77	0.12	1.66	775.95	1.926	0.522	6.674
239	622.46	22.03	24.79	68.27	669.84	4.56	0.02	1.03	0.22	5.60	675.45	1.726	1.002	6.674
240	501.73	21.38	18.95	59.26	542.49	10.51	0.12	1.34	0.93	11.96	554.45	1.407	1.415	6.674
241	387.78	21.94	13.47	41.31	424.28	19.93	0.16	1.61	2.64	21.64	445.92	0.993	1.731	6.674
242	283.10	21.97	14.19	27.45	321.09	36.10	0.16	2.00	4.32	38.20	359.29	0.511	1.929	6.674
243	193.85	22.93	13.50	23.95	230.78	60.97	0.18	2.52	6.82	63.65	294.44	-0.005	1.996	6.674
244	131.89	24.95	11.41	18.70	169.10	86.82	0.11	3.10	9.05	90.08	239.18	-0.522	1.926	6.674
245	90.64	20.93	8.66	14.17	121.77	110.26	0.08	3.14	9.83	113.40	235.17	-1.002	1.726	6.674
246	73.15	20.65	9.13	11.99	103.90	131.84	0.16	4.00	12.63	135.93	239.83	-1.415	1.407	6.674
247	70.28	20.68	9.04	10.97	101.18	151.02	0.11	4.33	15.60	155.47	256.65	-1.731	0.993	6.674
248	75.60	20.01	8.24	10.27	104.79	165.49	0.08	4.50	16.51	169.93	274.72	-1.929	0.511	6.674
249	86.22	20.11	8.74	10.20	115.65	170.37	0.05	4.55	17.38	175.54	291.19	-1.896	-0.005	6.674
250	102.95	19.46	8.90	12.70	132.40	166.22	0.12	4.05	17.14	170.95	303.36	-1.926	-0.522	6.674
251	131.03	20.74	10.32	17.33	163.35	133.09	0.28	4.50	16.16	158.69	322.04	-1.726	-1.002	6.674
252	179.64	21.95	13.10	20.93	215.38	133.09	0.18	4.20	14.96	137.29	352.67	-1.407	-1.415	6.674
253	246.75	19.89	13.97	27.07	281.77	108.67	0.16	3.46	12.44	112.33	394.10	-0.993	-1.731	6.674
254	336.96	17.88	18.53	35.98	372.23	84.80	0.23	3.26	9.84	88.30	460.54	0.005	-1.929	6.674
255	452.92	17.29	22.87	49.53	492.28	64.70	0.22	2.65	6.71	67.46	559.74	0.005	-1.996	6.674
256	572.75	16.69	27.48	60.26	617.48	45.91	0.27	1.87	4.34	48.05	665.53	0.522	-1.926	6.674
257	685.36	21.37	27.06	73.44	733.49	28.08	0.60	1.48	2.91	30.25	763.74	1.002	-1.726	6.674
258	770.31	27.31	24.23	84.55	821.92	13.00	1.29	0.96	1.45	15.02	836.84	1.415	-1.407	6.674
259	819.75	25.90	23.52	87.47	869.12	2.41	1.53	0.82	0.54	4.63	873.75	1.731	-0.993	6.674
260	826.57	22.77	25.38	87.67	874.66	0.00	0.72	0.84	0.13	1.34	876.01	1.929	-0.511	6.674
261	797.35	23.18	26.28	84.19	846.84	0.00	0.05	0.75	0.10	0.62	847.38	1.996	-0.005	6.674
262	765.21	27.30	36.46	83.27	831.06	0.00	0.00	0.90	0.12	0.62	832.48	1.496	0.004	7.507
263	698.20	27.47	39.18	80.14	765.58	0.93	0.00	1.12	0.13	2.02	767.60	1.444	0.391	7.507

264	594.61	25.69	38.46	68.19	659.61	4.56	0.00	1.51	0.31	6.06	665.67	1.293	0.751	7.507
265	476.97	24.34	30.33	52.54	531.95	10.51	0.14	2.25	1.24	12.89	544.84	1.055	1.060	7.507
266	359.44	23.64	27.98	39.81	412.57	19.96	0.20	2.87	1.24	23.22	435.79	0.745	1.297	7.507
267	253.71	21.17	26.12	28.23	302.28	35.40	0.32	3.01	3.14	38.54	340.82	0.383	1.446	7.507
268	169.59	21.31	21.91	20.72	212.53	58.47	0.38	3.35	6.78	62.25	274.78	-0.004	1.496	7.507
269	110.82	24.17	19.08	17.34	156.39	85.64	0.20	4.70	9.58	90.70	247.08	-0.391	1.444	7.507
270	71.29	23.45	15.44	13.62	111.32	110.34	0.40	6.40	9.82	117.51	228.83	-0.751	1.293	7.507
271	47.58	21.21	11.61	9.32	82.14	131.84	0.45	6.53	12.80	138.81	220.90	-1.060	1.055	7.507
272	42.57	19.06	12.18	8.05	75.12	151.02	0.36	6.00	16.53	157.43	232.56	-1.297	0.745	7.507
273	48.60	16.72	12.73	8.75	77.71	165.49	0.28	6.10	16.53	171.65	249.36	-1.446	0.383	7.507
274	56.96	15.74	14.78	8.86	88.74	170.37	0.06	6.98	16.86	177.35	266.10	-1.446	-0.004	7.507
275	70.81	15.89	12.99	9.51	101.91	166.22	0.00	6.99	16.65	172.95	274.86	-0.391	-0.391	7.507
276	95.85	17.09	14.46	12.28	128.73	153.81	0.15	6.94	14.64	160.52	289.25	-1.293	-0.751	7.507
277	144.65	20.43	20.69	18.57	185.49	133.09	0.24	6.46	13.65	139.70	325.19	-1.055	-1.060	7.507
278	214.96	21.58	25.38	29.04	261.81	108.67	0.21	6.01	12.65	115.11	376.91	-1.297	-1.297	7.507
279	309.25	20.83	27.86	39.67	357.69	84.99	0.45	5.10	10.11	90.93	448.63	-0.383	-1.446	7.507
280	422.89	20.27	29.49	47.14	471.46	61.74	2.10	3.42	7.03	67.26	538.72	0.004	-1.496	7.507
281	539.87	20.38	32.68	56.73	591.78	40.14	3.30	2.85	4.24	46.68	638.46	0.391	-1.444	7.507
282	648.82	24.38	38.57	71.26	709.96	23.74	2.75	2.85	3.10	29.38	739.34	0.751	-1.293	7.507
283	733.70	28.72	41.56	80.36	805.30	9.57	1.89	2.15	1.44	13.56	818.86	1.060	-1.055	7.507
284	783.39	29.19	39.76	85.88	853.11	1.24	0.97	1.87	0.06	4.07	857.18	1.297	-0.745	7.507
285	794.36	27.51	41.15	85.19	864.42	0.00	0.16	1.35	0.07	4.52	865.94	1.446	-0.383	7.507
286	771.76	27.30	41.20	79.97	842.40	0.00	0.00	1.05	0.16	1.02	843.42	1.496	-0.004	7.507
287	725.46	14.50	57.96	74.03	798.27	0.00	0.13	2.10	0.28	1.97	800.24	0.996	0.003	8.340
288	656.99	15.44	61.23	69.73	729.69	0.93	0.11	1.83	0.26	3.00	732.69	0.962	0.260	8.340
289	555.56	15.43	62.84	53.82	633.03	4.56	0.15	2.02	0.34	6.66	639.69	0.861	0.500	8.340
290	441.96	16.69	53.14	40.93	511.06	10.51	0.25	3.75	0.98	14.50	525.55	0.703	0.706	8.340
291	329.37	15.21	45.52	36.61	390.36	19.96	0.19	4.85	2.29	25.30	415.66	0.496	0.864	8.340
292	228.12	13.57	41.92	27.98	284.35	35.55	0.36	4.70	3.02	40.52	324.87	0.255	0.963	8.340
293	145.46	14.85	33.50	17.22	195.61	57.27	0.52	5.76	5.57	63.64	259.25	-0.003	0.996	8.340
294	89.86	13.60	25.29	10.14	129.29	82.55	0.33	9.72	10.72	92.55	221.85	-0.260	0.962	8.340
295	53.65	13.48	22.30	6.94	90.49	106.07	0.65	11.51	13.39	118.50	208.59	-0.500	0.861	8.340
296	32.23	10.76	20.49	3.79	64.97	126.23	0.97	10.74	14.23	137.96	202.93	-0.706	0.703	8.340
297	25.77	8.52	19.35	4.34	53.10	148.83	0.74	11.31	15.42	160.37	213.68	-0.864	0.496	8.340
298	24.60	7.50	21.58	4.65	53.69	165.59	0.74	12.74	16.71	179.96	233.65	-0.963	0.255	8.340
299	29.54	6.26	26.07	7.12	61.62	170.37	0.41	12.33	17.34	183.53	245.15	-0.996	-0.003	8.340
300	47.31	6.59	26.60	9.19	80.03	166.22	0.54	11.91	17.91	178.91	258.95	-0.962	-0.260	8.340
301	74.63	6.69	26.65	9.40	107.35	153.81	0.66	12.30	14.71	167.64	274.99	-0.861	-0.500	8.340
302	115.24	8.63	34.24	17.92	160.90	133.54	0.51	12.41	12.87	147.15	308.06	-0.703	-0.706	8.340
303	183.18	11.56	42.21	28.93	239.55	105.75	1.77	11.26	11.24	118.06	357.60	-0.496	-0.664	8.340
304	275.51	14.16	42.93	33.39	334.67	77.24	2.67	9.76	8.97	90.31	424.98	-0.255	-0.963	8.340
305	385.48	14.89	46.17	40.49	448.40	55.27	3.45	8.12	6.79	67.09	515.49	0.003	-0.996	8.340
306	499.89	15.84	51.78	55.94	569.34	34.94	3.83	6.44	4.19	45.80	615.14	0.260	-0.962	8.340
307	605.77	15.78	61.28	72.79	685.00	19.45	2.35	6.85	2.61	26.89	711.90	0.500	-0.861	8.340
308	689.11	16.77	72.19	81.15	780.26	7.40	0.72	3.71	1.01	11.57	791.83	0.706	-0.703	8.340
309	741.29	16.81	74.59	86.04	834.64	1.13	0.12	2.63	0.05	3.96	838.60	0.864	-0.496	8.340
310	755.22	15.01	70.58	81.38	841.30	0.00	0.00	1.91	0.11	1.75	843.05	0.963	-0.255	8.340
311	732.06	15.21	62.27	73.32	807.92	0.00	0.05	1.71	0.28	1.79	809.61	0.996	-0.003	8.340
312	619.94	4.96	119.86	82.03	744.59	0.00	0.13	3.68	0.66	3.51	748.10	0.497	0.001	9.171
313	556.84	5.80	125.94	71.64	682.98	0.93	0.10	3.85	0.47	5.02	687.99	0.480	0.130	9.171
314	465.14	7.19	134.93	57.15	605.76	4.56	0.13	5.00	0.07	9.67	615.43	0.430	0.250	9.171
315	362.29	7.55	122.35	45.19	491.07	10.51	0.30	6.57	0.19	17.45	508.52	0.351	0.353	9.171
316	261.69	11.22	100.51	34.27	372.09	20.00	0.56	9.36	1.69	30.11	402.20	0.248	0.431	9.171
317	171.01	10.74	93.34	27.40	275.94	35.17	1.03	12.59	2.97	48.79	324.72	0.128	0.481	9.171
318	99.77	8.42	92.41	17.37	203.03	56.14	1.09	13.85	3.31	71.13	274.17	-0.001	0.497	9.171
319	53.10	5.94	62.71	6.98	122.90	78.01	0.72	18.22	6.52	96.73	219.62	-0.130	0.480	9.171
320	27.05	4.16	45.76	4.11	77.62	97.72	1.35	21.72	8.77	120.92	198.54	-0.250	0.430	9.171
321	14.88	4.37	49.40	4.14	69.11	115.51	2.01	22.91	8.07	140.15	209.26	-0.353	0.351	9.171
322	9.11	3.23	39.67	4.45	52.32	134.99	1.78	26.50	9.19	163.22	215.55	-0.431	0.248	9.171
323	7.09	1.87	42.12	4.30	52.57	150.73	1.21	26.57	10.84	178.31	230.88	-0.481	0.128	9.171
324	10.83	1.72	55.42	5.86	69.24	154.27	0.52	28.37	10.34	180.58	249.82	-0.497	-0.001	9.171
325	23.48	3.57	61.83	7.54	89.18	149.35	0.67	29.66	10.03	179.29	268.47	-0.480	-0.130	9.171
326	42.46	1.86	71.62	8.94	116.33	136.82	1.42	27.67	9.32	165.59	281.92	-0.430	-0.250	9.171
327	71.89	0.79	73.32	12.83	148.38	117.05	1.60	23.61	8.02	142.32	290.70	-0.351	-0.353	9.171
328	126.68	4.74	76.67	18.75	208.52	89.64	2.54	19.37	7.18	111.57	320.09	-0.248	-0.431	9.171
329	204.12	11.33	89.82	21.29	305.64	63.20	3.08	15.60	5.64	81.80	387.44	-0.128	-0.481	9.171

330	301.43	13.85	112.06	31.26	427.41	47.10	2.77	17.69	4.41	67.61	495.02	0.001	-0.497	9.171
331	405.23	14.17	135.67	53.93	554.60	31.73	1.77	13.51	3.83	47.07	601.67	0.130	-0.480	9.171
332	505.16	12.85	152.06	68.66	671.25	17.33	0.39	8.47	2.57	26.43	697.62	0.250	-0.430	9.171
333	587.66	13.31	145.58	72.28	744.89	6.58	0.88	7.29	1.08	14.33	759.22	0.353	-0.351	9.171
334	637.97	11.92	146.03	87.03	794.49	1.04	0.00	3.98	0.20	5.00	799.46	0.431	-0.248	9.171
335	650.00	5.84	163.39	91.56	817.37	0.00	0.00	3.43	0.03	3.58	820.65	0.481	-0.128	9.171
336	626.46	4.47	154.32	81.19	785.85	0.00	0.05	3.51	0.36	3.58	789.43	0.497	-0.001	9.171
337	549.93	6.06	163.45	86.94	717.34	0.00	0.00	4.14	0.74	3.78	721.32	0.500	0.000	9.171
338	490.89	7.01	172.55	74.72	667.34	0.93	0.00	5.21	0.48	6.13	673.47	0.048	0.013	9.171
339	403.19	7.01	187.19	68.32	597.06	4.56	0.00	7.58	-0.01	12.12	609.18	0.043	0.025	9.171
340	306.83	5.22	175.27	55.85	487.37	10.51	0.24	8.45	0.12	19.33	506.70	0.035	0.035	9.171
341	211.05	12.94	144.55	35.95	368.90	20.03	0.96	12.31	1.14	33.59	402.49	0.025	0.043	9.171
342	126.82	12.00	131.89	28.05	273.45	34.85	1.74	18.04	2.86	54.81	328.26	0.013	0.048	9.171
343	67.71	7.10	136.90	19.03	213.54	54.78	1.46	18.94	2.07	75.17	288.71	-0.000	0.050	9.171
344	29.74	5.09	93.90	8.73	130.87	75.43	0.97	22.68	1.68	98.86	229.73	-0.013	0.048	9.171
345	9.87	3.61	66.09	5.22	80.38	94.02	2.21	28.49	2.02	124.73	205.11	-0.025	0.043	9.171
346	2.76	5.21	70.19	8.73	78.64	110.83	2.77	31.00	1.52	144.34	222.97	-0.035	0.035	9.171
347	0.36	3.51	51.94	7.01	56.15	125.68	2.65	35.99	4.01	163.90	220.06	-0.043	0.025	9.171
348	0.37	1.70	53.19	7.01	55.50	136.56	1.34	34.44	4.82	171.65	227.15	-0.048	0.013	9.171
349	2.58	3.60	75.38	5.21	80.07	139.02	0.30	35.40	3.38	174.11	254.18	-0.050	-0.048	9.171
350	7.77	3.61	86.07	5.29	97.99	133.39	0.42	42.40	4.21	176.18	274.17	-0.048	-0.013	9.171
351	18.58	1.70	102.46	8.80	123.30	120.75	1.54	36.39	4.10	157.99	281.29	-0.043	-0.025	9.171
352	41.05	-0.06	97.82	8.71	141.31	101.04	2.30	29.45	3.42	132.78	274.09	-0.035	-0.035	9.171
353	86.53	5.36	95.21	12.41	186.46	79.15	1.83	23.53	4.31	104.62	291.08	-0.025	-0.043	9.171
354	154.43	15.88	118.23	19.31	289.31	58.49	1.87	17.68	3.00	77.09	366.60	-0.013	-0.048	9.171
355	243.12	19.23	152.89	28.97	415.41	42.60	2.62	22.82	2.07	68.04	483.45	0.000	-0.050	9.171
356	340.06	17.53	188.97	51.11	546.07	28.46	1.72	17.44	3.33	47.64	593.70	0.013	-0.048	9.171
357	433.93	15.72	213.59	61.30	664.95	15.32	0.25	10.35	3.15	26.32	691.28	0.025	-0.043	9.171
358	511.94	15.82	195.52	59.44	720.39	5.94	0.16	9.95	1.75	16.54	736.93	0.035	-0.035	9.171
359	561.22	13.95	191.43	86.69	763.31	1.06	0.01	5.42	0.76	6.46	769.76	0.043	-0.025	9.171
360	575.02	6.94	228.92	103.21	809.99	0.00	0.00	4.76	-0.07	4.77	814.76	0.048	-0.013	9.171
361	556.15	4.65	225.87	87.44	788.08	0.00	0.00	4.76	0.30	4.70	792.78	0.050	-0.000	9.171
362	574.84	29.22	101.87	33.13	788.16	26.70	0.35	1.46	1.61	28.60	734.76	5.993	-0.016	0.000
363	574.48	31.29	107.56	34.05	712.71	38.62	0.11	1.95	2.03	40.39	753.20	5.785	-1.566	0.000
364	566.47	35.70	104.57	33.46	706.48	40.69	0.62	2.34	2.34	43.99	749.87	5.182	-3.010	0.000
365	551.21	33.65	92.11	33.24	677.28	38.26	1.10	2.90	2.90	42.09	719.36	4.227	-4.249	0.000
366	540.09	35.13	78.39	31.81	652.36	41.13	1.68	4.76	2.47	47.51	699.87	2.983	-5.198	0.000
367	536.17	38.39	69.72	30.73	644.03	46.61	2.48	7.51	2.42	56.80	700.83	1.536	-5.793	0.000
368	534.08	35.06	64.66	30.73	633.89	55.09	2.82	9.84	3.16	67.84	701.74	-0.016	-5.993	0.000
369	526.74	31.17	53.56	28.66	612.14	59.66	3.91	12.31	3.46	79.81	688.38	-1.566	-5.785	0.000
370	507.87	27.38	39.89	26.80	575.11	59.66	4.49	15.65	3.48	79.81	654.92	-3.010	-5.182	0.000
371	485.30	21.01	28.03	25.86	534.80	59.66	4.82	17.83	4.25	82.26	617.06	-4.249	-4.227	0.000
372	449.96	16.80	20.05	24.36	487.48	59.66	5.87	18.54	4.83	84.18	571.66	-5.198	-2.983	0.000
373	421.07	15.89	19.44	22.61	456.45	59.66	5.37	20.07	4.25	85.27	541.72	-5.793	-1.536	0.000
374	405.11	17.10	18.61	22.96	400.83	59.66	3.56	20.68	4.10	83.97	524.80	-5.993	0.016	0.000
375	387.27	16.82	15.58	22.39	419.36	59.66	4.21	20.23	4.57	84.09	503.45	-5.785	1.566	0.000
376	401.81	13.75	15.79	23.05	431.52	59.66	5.12	18.60	4.87	83.37	514.89	-5.182	3.010	0.000
377	427.25	12.94	17.24	23.91	457.86	59.66	4.99	15.44	4.69	80.19	538.05	-4.227	4.249	0.000
378	452.08	17.33	19.69	24.24	489.31	59.66	4.81	13.30	3.80	77.72	567.03	-2.983	5.198	0.000
379	473.35	22.55	27.38	25.24	523.28	59.66	3.52	11.50	3.27	74.77	598.05	0.016	5.793	0.000
380	487.03	26.79	37.01	26.18	551.09	59.66	2.54	9.41	3.24	71.61	622.70	0.016	5.993	0.000
381	504.44	26.79	44.91	29.01	576.61	59.66	2.01	7.08	3.62	69.12	645.73	1.566	5.785	0.000
382	529.95	23.95	59.28	33.07	613.43	52.10	2.01	5.25	3.07	59.42	672.85	3.010	5.182	0.000
383	552.46	26.25	73.97	33.59	652.69	32.62	1.26	3.25	3.84	37.48	690.17	4.249	4.227	0.000
384	564.95	31.65	82.44	31.49	679.24	22.14	0.96	2.22	1.29	25.23	704.46	5.198	2.983	0.000
385	575.61	34.76	92.17	32.35	702.71	21.09	1.07	1.22	1.10	23.47	726.18	5.793	1.536	0.000
386	577.80	32.83	101.77	33.65	713.18	23.04	0.88	1.24	1.39	25.49	736.67	5.993	0.016	0.000
387	569.84	32.79	116.85	33.61	720.28	25.24	0.26	1.02	1.61	26.29	746.57	5.243	-0.014	0.000
388	565.01	34.80	116.00	33.58	717.12	33.14	0.14	1.79	1.94	34.97	752.09	5.061	-1.370	0.000
389	559.17	39.52	111.25	32.18	710.89	36.72	0.57	2.22	2.10	39.54	750.43	4.534	-2.633	0.000
390	547.72	41.73	102.36	33.12	691.70	38.03	1.02	3.49	2.23	42.36	734.06	3.698	-3.717	0.000
391	532.80	42.72	91.87	33.93	666.70	40.87	1.91	5.75	2.41	48.37	715.07	2.610	-4.547	0.000
392	525.82	43.19	81.50	31.96	649.80	46.67	2.89	8.30	2.71	58.16	707.96	1.344	-5.068	0.000
393	520.81	41.14	72.11	30.78	634.81	55.09	3.48	10.89	3.35	69.78	704.60	-0.014	-5.243	0.000
394	513.00	35.90	61.57	29.52	611.09	59.66	4.30	13.42	3.85	78.05	689.14	-1.370	-4.061	0.000
395	494.65	30.05	47.74	27.81	571.80	59.66	4.96	17.40	3.91	81.96	653.77	-2.633	-4.534	0.000

396	465.23	24.49	33.50	25.88	523.45	59.66	20.67	4.30	86.18	609.63	-3.717	-3.698	0.000
397	432.25	21.05	24.32	24.21	477.50	59.66	21.54	4.87	87.49	564.99	-4.547	-2.610	0.000
398	410.91	18.21	20.18	23.44	448.97	59.66	22.29	4.66	87.84	536.82	-5.068	-1.344	0.000
399	391.93	17.34	18.69	22.95	427.41	59.66	22.75	4.35	86.77	514.18	-5.061	0.014	0.000
400	366.37	15.13	16.97	21.23	401.76	59.66	22.61	4.44	87.50	489.26	-5.061	1.370	0.000
401	387.37	18.33	17.28	21.74	419.80	59.66	20.43	4.64	86.33	506.13	-2.633	0.000	0.000
402	415.61	13.17	20.24	22.63	448.58	59.66	17.82	4.61	83.11	531.70	-3.698	3.717	0.000
403	429.01	16.35	23.42	22.91	469.21	59.66	15.73	3.86	80.08	549.29	-2.610	4.547	0.000
404	452.94	22.04	30.44	24.79	505.61	59.66	12.45	3.43	75.86	581.47	-1.344	5.068	0.000
405	481.49	28.14	38.08	26.80	548.09	59.66	9.65	3.40	72.07	620.15	0.014	5.243	0.000
406	496.20	28.64	47.68	28.70	573.67	59.66	7.25	3.67	69.47	643.14	1.370	5.061	0.000
407	519.26	26.75	64.98	31.73	613.30	49.33	5.24	3.03	56.25	669.56	2.633	3.698	0.000
408	548.48	29.87	78.56	33.20	656.12	29.21	3.27	1.70	33.72	689.84	3.717	3.698	0.000
409	566.69	42.06	87.69	32.92	683.55	22.10	2.11	1.30	25.32	708.87	4.547	2.610	0.000
410	566.69	42.06	103.09	33.29	711.75	20.02	1.38	1.36	22.60	747.14	5.068	1.344	0.000
411	571.92	37.30	115.62	33.54	724.54	20.56	1.06	1.31	21.34	775.05	5.243	0.014	0.000
412	552.55	45.74	158.45	36.22	757.43	16.71	0.77	1.12	17.62	775.05	4.493	-0.012	0.000
413	547.28	49.88	155.48	37.51	750.63	19.41	1.77	1.31	21.34	771.97	4.337	-1.174	0.000
414	543.30	53.55	153.25	36.70	749.20	29.25	2.77	1.87	32.46	781.66	3.885	-2.257	0.000
415	536.25	57.07	142.70	35.59	737.14	37.18	4.60	2.30	42.62	779.75	3.169	-3.185	0.000
416	520.89	55.63	125.57	34.68	702.37	39.53	7.59	2.65	49.18	751.54	2.236	-3.897	0.000
417	510.81	51.00	108.90	32.60	669.19	43.85	10.86	2.97	58.49	727.68	1.152	-4.343	0.000
418	502.58	50.87	93.27	32.60	644.46	50.75	14.67	3.37	70.55	715.01	-0.012	-4.493	0.000
419	486.07	45.12	78.19	32.34	609.32	57.82	18.14	4.15	81.12	690.44	-1.174	-4.337	0.000
420	459.40	34.70	62.92	27.85	555.03	59.66	23.31	4.68	88.81	643.83	-2.257	-3.885	0.000
421	422.81	29.06	47.63	24.12	499.43	59.66	27.94	4.83	94.46	593.89	-3.185	-3.169	0.000
422	394.97	27.03	36.11	23.00	458.03	59.66	30.71	5.28	96.89	516.80	-2.236	-3.897	0.000
423	372.28	21.15	27.22	22.75	419.91	59.66	30.71	5.07	96.04	480.72	-4.493	-1.152	0.000
424	341.54	18.21	22.76	20.60	384.68	59.66	30.27	4.56	96.19	470.47	-4.337	1.174	0.000
425	325.55	22.25	19.02	19.02	374.28	59.66	30.27	4.56	95.80	486.07	-3.885	2.257	0.000
426	342.35	22.99	24.67	19.04	390.26	59.66	28.02	4.71	91.68	510.73	-3.169	3.185	0.000
427	373.38	19.59	28.56	20.14	419.05	59.66	24.89	4.71	86.76	525.28	-2.236	3.897	0.000
428	387.57	19.50	32.62	21.78	438.52	59.66	21.44	4.48	80.97	554.99	-1.152	4.343	0.000
429	411.40	25.29	38.38	24.53	474.02	59.66	16.77	3.93	75.55	608.59	0.012	4.493	0.000
430	452.41	34.20	45.86	27.46	533.04	59.66	12.17	3.69	68.39	641.47	1.174	4.337	0.000
431	475.82	35.31	62.46	29.29	573.08	56.74	8.90	3.56	68.39	641.47	1.174	4.337	0.000
432	500.06	34.78	87.15	31.46	621.17	38.82	6.04	2.62	47.21	668.38	2.257	3.885	0.000
433	529.96	41.81	104.98	33.80	675.13	23.66	3.36	1.49	28.61	703.74	3.185	3.169	0.000
434	536.20	50.30	121.18	35.54	709.19	21.73	2.30	1.24	25.19	734.38	3.897	2.236	0.000
435	545.57	52.22	144.99	35.01	742.66	18.77	1.39	1.09	20.77	763.43	4.343	1.152	0.000
436	552.59	48.59	158.45	34.81	761.10	15.74	0.94	1.00	17.12	778.22	4.493	0.012	0.000
437	529.34	66.79	294.75	45.52	890.51	6.08	2.38	0.40	8.70	899.22	3.743	-0.010	0.000
438	527.62	69.63	294.56	41.46	891.70	5.51	2.89	0.45	8.10	899.80	3.613	-0.978	0.000
439	523.71	72.77	295.57	43.18	892.42	16.60	4.70	1.16	21.40	913.83	3.237	-1.680	0.000
440	516.57	72.91	269.05	44.85	859.24	30.92	7.64	2.13	39.02	898.25	2.640	-2.654	0.000
441	504.09	69.51	229.72	44.85	803.62	37.41	11.85	2.58	51.02	854.65	1.863	-3.247	0.000
442	493.90	65.16	205.77	38.32	765.37	39.43	19.09	3.18	62.47	827.84	0.959	-3.618	0.000
443	477.65	62.48	177.72	37.17	717.99	43.35	27.46	3.85	77.00	795.00	-0.010	-3.743	0.000
444	441.00	54.40	144.26	33.92	639.48	50.75	35.03	4.70	91.91	731.38	-3.743	3.613	0.000
445	398.84	42.52	116.50	28.59	557.42	57.31	41.43	6.12	106.12	663.54	-1.880	-3.237	0.000
446	365.49	35.67	94.46	23.71	495.65	59.66	47.77	6.49	115.88	611.53	-2.654	-2.640	0.000
447	336.88	31.45	76.13	23.66	443.70	59.66	53.50	6.10	122.44	566.14	-3.247	-1.863	0.000
448	305.65	26.96	63.65	21.52	393.91	59.66	56.75	6.47	125.81	519.71	-3.618	-0.959	0.000
449	279.58	25.46	55.73	18.60	360.48	59.66	9.52	6.55	124.04	484.52	-3.743	0.010	0.000
450	269.94	26.63	55.84	17.79	350.90	59.66	8.18	6.55	124.04	484.52	-3.743	0.010	0.000
451	272.46	28.80	52.07	17.85	353.20	59.66	9.49	5.62	117.30	470.50	-3.237	1.880	0.000
452	296.98	28.00	59.95	19.35	383.91	59.66	40.50	5.55	109.13	493.04	-2.640	2.654	0.000
453	328.62	28.14	70.88	21.00	426.71	59.66	34.42	5.36	101.72	528.43	-1.863	3.247	0.000
454	359.15	35.42	80.20	25.33	475.29	59.66	29.51	5.02	93.27	570.56	-0.959	3.618	0.000
455	397.54	43.85	100.50	29.35	541.76	55.78	23.19	4.28	83.32	625.08	0.010	3.743	0.000
456	436.23	48.88	128.97	33.38	613.81	42.11	16.47	3.01	61.71	675.53	3.613	3.613	0.000
457	469.20	52.74	160.62	35.77	682.22	26.84	10.79	2.00	40.05	722.28	1.880	3.237	0.000
458	489.91	62.08	195.11	36.60	747.07	21.52	6.84	1.57	30.67	777.74	2.654	2.654	0.000
459	502.49	69.04	234.28	37.34	805.67	19.86	3.81	1.29	24.77	830.44	3.247	1.863	0.000
460	515.12	67.07	273.01	41.26	854.75	15.72	3.81	0.86	18.45	873.20	3.618	0.959	0.000
461	526.96	65.17	294.30	45.66	886.97	9.17	2.47	0.54	11.66	898.63	3.743	0.010	0.000

462	517.48	397.80	51.92	994.00	2.38	0.07	3.43	6.10	1000.10	3.008	-0.008	0.000
463	516.75	393.03	41.27	989.15	-0.10	0.00	0.11	3.39	992.54	2.904	-0.786	0.000
464	513.05	390.94	43.63	986.51	7.92	0.00	0.51	13.97	1000.48	2.601	-1.511	0.000
465	505.31	357.56	50.19	943.95	25.69	0.13	6.10	35.97	979.92	1.422	-2.133	0.000
466	492.63	308.82	42.87	879.04	36.30	1.05	10.03	35.97	931.82	1.497	-2.609	0.000
467	482.53	282.51	41.69	842.01	38.47	3.56	15.09	67.09	909.10	0.771	-2.908	0.000
468	459.12	243.98	42.14	774.01	41.13	6.20	35.70	3.45	858.09	-0.008	-0.008	0.000
469	410.64	198.69	30.92	668.33	46.61	7.01	47.11	100.92	769.25	-0.786	-2.904	0.000
470	362.12	160.36	30.11	569.65	55.09	8.38	54.36	7.15	687.51	-1.511	-2.601	0.000
471	332.03	130.42	24.92	503.39	59.66	9.92	62.27	117.86	635.46	-2.133	-2.122	0.000
472	300.18	106.01	21.39	441.13	59.66	11.39	72.04	132.06	635.46	-2.133	-2.122	0.000
473	268.69	89.23	21.69	389.21	59.66	10.84	76.17	142.86	583.98	-2.609	-1.497	0.000
474	249.07	79.60	18.80	360.25	59.66	9.44	75.10	146.52	535.73	-2.908	-0.771	0.000
475	235.38	74.39	17.68	336.34	59.66	10.15	69.88	143.97	504.23	-3.008	0.008	0.000
476	233.88	71.16	17.99	333.77	59.66	10.40	69.88	139.74	478.09	-2.904	0.786	0.000
477	253.32	29.52	84.41	366.47	59.66	9.89	63.19	131.27	465.04	-2.601	1.511	0.000
478	290.24	32.45	101.87	424.54	59.66	8.43	50.75	120.25	486.72	-2.122	2.133	0.000
479	329.37	40.76	115.04	486.12	59.66	8.43	43.60	111.69	486.72	-1.497	2.609	0.000
480	367.59	48.91	142.85	558.94	59.66	6.27	37.94	104.49	590.60	-0.771	2.908	0.000
481	410.21	57.08	177.63	644.90	52.10	4.53	30.56	87.62	646.56	0.008	3.008	0.000
482	448.02	64.70	212.75	725.08	32.62	3.42	21.59	57.67	702.57	0.786	2.904	0.000
483	466.44	73.57	255.74	796.71	22.14	2.79	13.91	38.90	763.98	1.511	2.601	0.000
484	481.10	81.19	309.44	871.65	18.53	2.20	9.24	32.72	829.42	2.133	2.122	0.000
485	497.55	78.20	362.42	938.12	13.04	0.22	3.76	24.57	896.22	2.609	1.497	0.000
486	513.83	74.61	394.20	983.32	5.15	0.13	3.63	16.72	954.83	2.908	0.771	0.000
487	123.90	332.20	295.74	759.01	0.00	0.13	0.43	8.91	992.24	3.008	0.008	0.000
488	136.47	273.73	363.39	703.92	0.00	3.95	6.61	10.81	769.83	0.204	0.001	14.992
489	89.79	266.77	31.30	654.10	0.00	5.45	9.56	15.16	719.09	0.197	0.053	14.992
490	60.86	243.62	28.52	571.50	0.00	8.88	11.93	20.90	674.99	0.176	0.102	14.992
491	35.33	209.72	22.56	461.83	0.00	13.12	14.21	20.90	598.83	0.144	0.145	14.992
492	16.99	182.12	18.26	370.30	0.03	17.47	17.36	27.33	496.65	0.102	0.177	14.992
493	5.16	157.86	17.82	291.88	0.82	22.58	21.66	2.73	414.37	0.052	0.197	14.992
494	1.59	131.97	16.06	234.73	0.82	30.81	27.93	3.35	351.27	-0.001	0.204	14.992
495	0.38	91.32	13.43	205.62	10.49	39.97	32.86	4.07	312.42	-0.053	0.197	14.992
496	0.03	84.15	103.39	187.63	16.20	55.03	42.14	5.91	301.22	-0.102	0.176	14.992
497	0.00	69.82	93.52	163.89	22.96	59.65	44.23	6.79	290.78	-0.145	0.144	14.992
498	0.00	60.53	96.75	157.25	29.93	60.71	46.43	126.88	290.78	-0.177	0.102	14.992
499	0.00	62.94	105.54	167.68	35.58	64.77	48.56	136.95	294.21	-0.197	0.052	14.992
500	0.00	92.05	117.64	210.24	38.63	61.80	52.33	148.61	316.29	-0.204	-0.001	14.992
501	0.13	137.25	139.21	277.38	39.22	55.43	58.46	152.33	362.74	-0.197	-0.053	14.992
502	2.21	183.21	172.05	357.90	37.52	54.24	58.46	148.66	426.24	-0.176	-0.102	14.992
503	7.98	213.41	195.72	417.62	33.96	48.76	41.27	140.41	498.31	-0.144	-0.145	14.992
504	18.39	227.24	211.65	456.90	28.99	48.76	38.32	124.05	541.67	-0.102	-0.177	14.992
505	36.35	256.30	241.83	536.65	22.88	32.59	35.91	107.99	564.89	-0.052	-0.197	14.992
506	62.49	300.62	265.38	628.57	16.13	28.46	28.96	91.02	627.67	0.001	-0.204	14.992
507	90.20	344.49	284.46	719.07	9.45	23.20	3.06	73.56	702.12	0.053	-0.197	14.992
508	114.48	378.84	291.49	788.22	3.89	13.62	2.30	53.24	772.31	0.102	-0.176	14.992
509	130.27	376.48	289.20	795.68	0.67	7.32	1.50	619.53	819.53	0.145	-0.144	14.992
510	135.40	344.19	301.85	781.82	0.00	4.78	0.59	13.36	795.18	0.177	-0.102	14.992
511	130.83	330.63	42.26	762.67	0.00	4.15	6.41	10.23	772.90	0.197	-0.052	14.992
512	315.23	255.01	209.12	778.31	0.00	2.10	5.79	7.71	786.02	0.204	-0.001	14.992
513	278.34	240.83	35.68	710.94	0.00	3.29	6.85	10.28	721.22	1.871	0.005	14.992
514	218.63	229.61	30.52	639.44	0.00	6.21	8.69	14.94	654.38	1.806	0.489	14.992
515	149.29	212.87	26.47	539.78	0.00	9.23	10.68	19.88	559.66	1.319	1.326	14.992
516	84.16	180.93	20.70	426.91	0.41	12.27	12.97	14.94	452.65	1.319	1.326	14.992
517	40.82	146.23	14.99	324.82	12.46	15.79	13.31	44.38	369.20	0.931	1.623	14.992
518	14.17	112.75	13.07	247.98	28.90	21.96	2.65	25.74	318.81	0.479	1.808	14.992
519	4.14	91.33	105.65	199.22	30.80	31.01	23.03	4.04	70.83	-0.005	1.871	14.992
520	1.04	76.85	92.53	169.76	32.08	38.04	4.35	84.48	263.71	-0.489	1.806	14.992
521	0.20	69.38	87.24	155.19	42.38	38.04	4.78	97.39	267.15	-0.940	1.618	14.992
522	0.03	63.34	80.49	142.82	42.38	42.18	5.75	114.96	270.15	-1.326	1.319	14.992
523	-0.02	54.03	82.41	133.63	61.39	45.19	7.55	137.99	280.62	-1.623	0.931	14.992
524	0.01	57.57	89.93	144.69	83.41	46.18	7.55	155.51	289.14	-1.808	0.479	14.992
525	0.40	82.11	99.76	179.71	83.58	45.17	8.01	162.76	307.45	-1.871	-0.005	14.992
526	2.02	113.27	115.04	230.37	74.08	42.36	8.29	163.47	343.18	-1.806	-0.489	14.992
527	8.45	148.83	134.17	295.80	62.00	39.83	6.95	135.04	430.84	-1.319	-1.326	14.992

528	25.47	177.15	149.46	15.01	357.45	52.05	35.11	28.93	6.14	116.23	473.69	-0.931	-1.623	14.158
529	56.21	193.76	157.64	19.16	412.04	40.72	29.84	26.52	5.11	97.12	509.17	-0.479	-1.808	14.158
530	99.90	220.01	171.00	25.26	496.51	29.95	24.01	24.24	3.93	78.04	578.55	0.005	-1.871	14.158
531	153.84	263.34	189.10	26.52	608.07	20.68	19.90	19.98	2.98	60.59	668.66	0.489	-1.806	14.158
532	208.92	301.08	210.21	29.81	717.80	12.20	15.39	14.78	2.15	42.56	760.37	0.940	-1.618	14.158
533	262.87	321.56	216.46	38.60	797.09	5.03	8.46	10.77	1.14	24.26	821.35	1.326	-1.319	14.158
534	306.69	306.77	212.47	42.16	825.37	0.87	3.83	8.84	0.54	13.70	839.06	1.623	-0.931	14.158
535	325.89	276.32	217.95	40.99	819.80	0.00	2.47	6.82	0.34	8.91	828.71	1.808	-0.479	14.158
536	318.81	258.23	217.47	40.18	793.10	0.00	2.18	5.26	0.35	7.18	800.28	1.871	-0.005	14.158
537	643.04	133.13	73.95	43.05	849.10	0.00	0.07	2.96	0.32	2.59	851.69	2.360	0.006	13.325
538	574.04	116.39	72.58	35.70	760.07	0.00	0.45	2.68	0.20	3.07	763.14	2.278	0.617	13.325
539	454.81	108.48	72.95	28.93	639.62	0.49	1.75	3.31	0.23	5.61	645.23	2.041	1.185	13.325
540	319.21	113.89	70.27	22.71	505.73	3.55	2.51	5.14	0.36	10.31	516.04	1.664	1.673	13.325
541	205.24	107.27	61.97	17.20	376.02	11.24	3.22	5.14	1.03	20.40	396.42	1.175	2.047	13.325
542	124.98	83.91	50.91	12.07	256.98	33.58	4.09	6.43	2.26	43.63	300.61	0.605	2.281	13.325
543	66.58	70.49	46.82	8.38	180.71	59.08	6.13	6.47	3.60	72.29	253.00	-0.006	-0.617	13.325
544	32.30	59.46	46.87	6.16	135.66	72.30	11.76	7.76	4.67	90.33	225.99	-0.617	2.278	13.325
545	13.30	47.94	46.29	5.25	106.36	82.37	15.45	9.34	5.33	108.08	214.44	-1.185	2.041	13.325
546	7.11	41.04	45.38	4.38	93.95	101.29	17.55	10.65	6.37	130.91	224.86	-1.673	1.664	13.325
547	4.81	37.92	41.27	4.65	85.45	130.92	18.82	11.15	8.22	159.92	245.37	-2.047	1.175	13.325
548	3.65	36.46	38.91	4.44	79.58	156.16	17.92	10.86	9.55	184.96	264.54	-2.281	0.605	13.325
549	4.72	44.30	40.56	4.24	90.26	161.29	16.18	10.22	9.79	187.66	277.92	-2.360	-0.006	13.325
550	9.47	59.35	48.34	6.23	120.11	156.73	16.34	9.79	9.21	182.55	302.66	-2.278	-0.617	13.325
551	21.13	71.36	55.97	8.89	148.47	133.34	18.41	10.05	7.71	160.89	309.36	-2.041	-1.185	13.325
552	52.45	83.13	61.75	9.24	195.81	106.38	18.19	10.48	6.90	135.44	331.25	-1.664	-1.673	13.325
553	110.43	96.14	64.01	10.76	267.13	85.91	17.11	10.16	5.78	113.79	380.92	-1.175	-2.047	13.325
554	191.95	105.16	62.38	15.82	358.28	63.26	15.52	8.49	4.39	88.02	446.29	-0.605	-2.281	13.325
555	285.79	118.15	57.97	20.89	485.53	41.94	12.27	7.07	3.45	60.81	526.34	0.006	-2.360	13.325
556	379.48	144.12	64.56	24.88	589.98	27.12	7.43	6.18	2.63	40.39	630.37	0.617	-2.278	13.325
557	465.44	166.36	82.47	33.29	719.11	15.77	4.16	6.02	1.46	26.20	745.31	-2.041	-2.041	13.325
558	549.46	177.09	87.39	42.07	817.49	6.61	1.51	5.22	0.31	13.60	831.29	1.673	-1.664	13.325
559	626.57	153.43	80.51	46.19	892.98	0.00	0.08	3.06	0.13	5.12	885.02	2.047	-1.175	13.325
560	652.57	135.74	78.32	44.25	864.54	0.00	0.10	2.61	0.20	2.83	895.81	2.281	-0.605	13.325
561	826.91	149.32	20.05	47.42	893.19	0.00	0.01	0.55	0.11	0.60	893.79	2.360	-0.006	13.325
562	743.84	38.02	10.73	41.20	798.51	0.00	0.02	0.86	0.06	0.70	799.21	2.500	0.007	12.492
563	605.51	35.94	21.21	32.01	663.33	0.96	0.09	0.88	0.17	1.76	665.08	2.162	1.256	12.492
564	456.89	43.82	21.17	23.72	521.74	6.96	0.02	0.60	0.40	7.67	529.42	1.763	1.772	12.492
565	322.40	41.61	14.21	16.45	381.48	20.71	-0.04	0.96	1.34	22.25	403.73	1.244	2.168	12.492
566	212.48	30.23	11.65	11.75	254.99	40.45	0.32	1.17	2.00	41.87	296.86	0.641	2.500	12.492
567	132.08	28.05	10.85	8.29	168.80	60.75	0.20	1.24	2.59	62.01	230.82	-0.007	-0.007	12.492
568	78.87	24.92	10.23	5.32	113.35	84.53	0.73	1.83	4.41	88.19	201.54	-0.653	2.413	12.492
569	47.31	20.43	12.12	3.62	79.65	113.18	1.72	2.43	5.77	116.97	196.62	-1.256	2.162	12.492
570	31.48	16.97	11.71	2.48	58.78	139.90	2.89	2.98	7.03	146.20	204.98	-1.772	1.763	12.492
571	24.65	14.12	10.53	2.18	49.55	164.53	4.03	2.64	8.74	171.79	221.34	-2.168	1.244	12.492
572	25.47	17.08	8.36	2.81	49.18	185.21	4.10	2.18	10.62	192.33	241.51	-2.416	0.641	12.492
573	34.33	21.70	7.50	2.39	60.41	192.89	3.37	2.39	10.61	199.57	259.98	-2.500	-0.007	12.492
574	49.29	28.98	11.11	3.72	86.61	184.74	4.21	2.56	9.22	191.90	278.51	-2.413	-0.653	12.492
575	75.06	31.94	13.46	5.24	118.46	161.45	6.32	2.43	7.98	169.78	288.25	-2.162	-1.256	12.492
576	124.78	29.61	16.03	6.97	172.05	135.16	7.53	2.53	6.90	144.94	316.99	-1.763	-1.772	12.492
577	212.34	28.50	15.86	11.90	256.74	108.52	8.39	2.69	5.75	119.59	376.33	-1.244	-2.168	12.492
578	325.44	29.00	13.73	18.46	366.11	80.80	7.96	1.94	4.56	90.19	456.30	-0.641	-2.416	12.492
579	448.30	32.08	13.50	24.42	493.00	54.01	5.42	1.44	3.42	61.49	554.49	0.007	-2.500	12.492
580	568.39	39.72	15.23	30.90	620.77	33.42	2.00	1.43	2.25	36.63	657.40	0.653	-2.413	12.492
581	678.47	50.23	21.65	38.35	747.93	18.08	0.58	1.77	1.30	20.56	768.49	1.256	-2.162	12.492
582	770.73	60.16	23.97	42.46	852.68	7.21	0.08	1.55	0.57	8.93	861.62	1.772	-1.763	12.492
583	834.79	63.33	21.21	48.27	919.03	1.20	0.00	0.79	0.82	0.63	934.16	2.168	-1.244	12.492
584	857.23	56.39	20.54	49.88	933.54	0.00	0.00	0.72	0.03	0.60	902.57	2.500	-0.007	12.492
585	835.96	47.09	20.40	46.92	901.97	0.00	0.02	0.56	-0.02	0.16	878.05	2.354	0.006	11.658
586	857.77	4.92	14.17	46.20	877.90	0.00	0.02	0.29	-0.02	0.65	797.00	2.272	0.615	11.658
587	775.60	7.69	14.44	43.52	796.45	0.26	0.06	0.20	-0.03	0.55	797.00	2.036	1.182	11.658
588	647.22	11.71	14.77	34.09	672.19	2.33	0.12	0.30	0.15	2.63	674.82	1.660	1.669	11.658
589	509.04	12.13	13.77	25.80	535.05	8.24	0.22	0.51	0.49	8.87	543.92	1.660	2.042	11.658
590	375.15	10.11	12.10	18.72	401.24	20.38	0.34	0.76	1.21	21.19	422.43	1.172	2.275	11.658
591	260.34	8.07	9.25	13.08	279.55	38.60	0.65	0.98	1.97	40.70	320.24	0.603	2.275	11.658
592	173.92	5.59	8.10	9.06	188.12	61.45	1.06	1.30	3.26	64.36	252.48	-0.006	2.354	11.658

594	117.26	5.50	8.27	6.06	131.40	86.64	1.01	1.60	4.52	89.98	221.37	-0.615	2.272	11.658
595	80.64	7.21	7.22	5.34	93.41	114.81	1.30	2.09	5.41	117.45	210.86	-1.182	2.036	11.658
596	59.58	5.80	5.40	4.05	68.14	140.72	2.02	2.29	7.15	144.89	213.03	-1.669	1.660	11.658
597	54.10	4.50	4.83	3.08	63.14	162.46	1.94	2.16	8.05	166.65	229.79	-2.042	1.172	11.658
598	60.74	2.93	5.17	3.10	68.52	179.79	1.24	2.56	9.14	183.82	252.35	-2.275	0.603	11.658
599	74.51	3.03	6.02	2.32	81.63	187.14	0.88	3.30	9.42	191.66	273.29	-2.354	-0.006	11.658
600	97.42	5.55	9.09	4.51	111.26	180.10	1.68	3.30	8.76	185.49	296.75	-2.272	-0.615	11.658
601	133.66	5.32	10.37	6.85	149.61	162.81	2.50	3.02	7.90	168.58	318.20	-2.036	-1.182	11.658
602	187.46	5.06	10.01	8.37	203.39	140.31	2.52	2.70	6.11	145.82	349.21	-1.660	-1.669	11.658
603	273.32	5.80	10.67	13.02	292.19	113.17	2.59	2.10	5.29	117.62	409.62	-1.172	-2.042	11.658
604	364.11	4.67	10.15	22.84	398.59	86.77	1.96	1.99	4.80	90.79	489.39	-0.603	-2.275	11.658
605	502.85	5.13	9.51	27.18	518.00	64.05	0.84	1.65	3.61	66.48	584.48	0.006	-2.354	11.658
606	627.36	7.91	11.31	33.34	645.36	42.04	0.21	1.40	2.37	44.16	689.52	0.615	-2.272	11.658
607	744.79	11.96	15.33	40.47	772.01	23.88	0.16	1.48	2.54	24.54	796.54	1.182	-2.036	11.658
608	833.28	17.45	17.90	42.10	872.10	9.78	0.11	0.43	0.81	10.24	882.34	1.669	-1.660	11.658
609	885.97	17.47	16.48	45.05	922.46	2.60	0.00	0.62	0.35	3.15	925.61	2.042	-1.172	11.658
610	895.22	9.95	15.49	45.11	922.22	0.37	0.00	0.48	0.13	0.78	923.00	2.275	-0.603	11.658
611	864.63	5.47	15.00	44.86	884.27	0.00	0.01	0.38	-0.02	0.19	884.47	2.354	-0.006	11.658
612	750.79	14.79	61.80	42.31	828.83	1.81	0.00	1.62	0.08	3.29	832.13	1.856	0.005	10.825
613	688.37	21.08	60.82	38.80	769.08	3.89	0.05	1.97	0.30	5.93	775.01	1.791	0.485	10.825
614	592.56	28.01	56.80	33.70	676.93	7.98	0.34	2.05	0.56	10.41	687.34	1.605	0.932	10.825
615	485.47	22.38	52.74	28.70	560.76	15.37	0.85	2.87	0.98	19.06	579.82	1.309	1.316	10.825
616	379.74	14.40	46.60	22.14	441.05	25.28	1.35	4.16	1.68	30.86	471.91	0.924	1.610	10.825
617	286.50	10.91	37.18	17.40	332.63	38.48	2.25	5.13	2.11	45.66	378.30	0.476	1.794	10.825
618	210.52	8.86	31.16	13.72	250.60	59.23	3.55	6.11	3.18	68.82	319.42	-0.005	1.856	10.825
619	159.53	6.78	26.59	9.53	192.87	81.76	3.74	7.88	4.60	93.67	286.54	-0.485	1.791	10.825
620	128.30	5.05	22.49	8.88	155.82	100.76	3.71	9.71	5.90	113.94	269.76	-0.932	1.605	10.825
621	109.74	5.44	17.23	7.68	132.20	117.98	4.79	9.39	7.08	132.05	264.25	-1.316	1.309	10.825
622	104.39	5.24	13.80	6.09	123.56	133.23	6.06	10.23	7.17	149.52	273.08	-1.610	0.924	10.825
623	111.20	2.98	14.29	6.31	128.27	144.94	4.12	12.43	7.07	161.01	289.28	-1.794	0.476	10.825
624	125.60	2.50	14.75	6.67	142.74	149.69	2.25	11.84	7.76	163.56	306.30	-1.856	-0.005	10.825
625	154.51	6.15	18.10	9.21	180.56	147.17	3.23	11.12	7.91	161.42	341.97	-1.791	-0.485	10.825
626	194.73	9.67	26.24	11.55	231.51	137.65	3.61	11.01	7.33	152.52	384.03	-1.605	-0.932	10.825
627	244.16	12.94	31.81	12.91	288.78	122.02	3.87	10.34	6.12	136.40	425.18	-1.309	-1.316	10.825
628	314.93	16.00	39.35	17.74	371.40	103.08	2.74	8.94	5.52	114.54	485.94	-0.924	-1.610	10.825
629	402.50	18.41	42.09	24.53	461.60	83.07	1.99	8.29	7.33	55.13	555.13	-0.476	-1.794	10.825
630	493.29	19.40	45.30	26.80	557.59	64.52	1.68	6.94	3.75	73.10	630.70	0.005	-1.856	10.825
631	587.88	20.12	54.19	31.56	665.76	48.17	0.57	5.07	2.68	53.42	713.18	0.485	-1.791	10.825
632	674.57	34.19	58.83	38.56	763.98	32.42	0.16	4.39	1.64	37.06	801.04	0.932	-1.605	10.825
633	737.22	32.75	62.00	42.14	831.75	20.11	0.10	3.84	1.18	24.04	855.79	1.316	-1.309	10.825
634	774.22	37.12	62.21	40.92	873.00	9.70	0.00	2.84	0.62	12.56	885.56	1.610	-0.924	10.825
635	780.46	28.71	63.56	41.17	872.76	2.46	0.00	1.86	0.16	4.33	877.09	1.794	-0.476	10.825
636	754.31	15.94	64.30	42.71	833.02	3.54	0.00	1.60	0.05	3.01	836.03	1.856	-0.005	10.825
637	675.15	23.76	97.60	39.09	797.82	3.54	0.00	2.60	0.16	6.13	803.95	0.204	0.001	10.008
638	626.15	31.09	93.61	36.23	748.78	6.76	0.02	3.38	0.59	10.21	758.99	0.197	0.053	10.008
639	550.82	42.03	86.92	34.74	679.75	11.35	0.46	3.48	0.88	15.39	695.14	0.176	0.145	10.008
640	466.35	33.94	81.58	31.53	583.31	20.05	1.19	4.31	1.43	25.75	609.06	0.144	0.177	10.008
641	379.17	21.52	69.99	24.02	471.18	30.16	1.90	6.44	2.25	38.51	509.70	0.102	0.177	10.008
642	295.39	16.02	57.63	19.62	368.66	39.55	3.42	8.10	2.25	50.73	419.39	0.052	0.197	10.008
643	230.45	12.64	49.71	16.91	293.11	56.59	5.05	9.58	2.70	71.08	364.19	-0.001	0.204	10.008
644	185.69	8.74	40.00	12.85	234.09	76.11	5.33	12.38	4.42	94.06	328.15	-0.053	0.197	10.008
645	160.44	4.61	32.83	11.66	196.99	90.32	5.06	15.16	6.23	110.38	307.37	-0.102	0.176	10.008
646	144.75	5.79	25.17	10.18	175.00	102.98	6.24	14.42	6.86	123.44	298.44	-0.144	0.144	10.008
647	135.45	7.31	20.34	7.97	163.40	114.13	8.59	16.40	6.78	138.69	302.09	-0.177	0.102	10.008
648	139.98	4.67	20.87	9.24	165.34	122.85	6.03	18.79	6.44	147.09	312.43	-0.197	0.052	10.008
649	155.78	3.78	20.61	10.21	180.37	127.18	3.17	17.23	6.98	147.24	327.60	-0.204	-0.001	10.008
650	187.98	8.27	24.95	11.91	221.17	126.23	4.95	16.46	7.31	147.40	368.57	-0.197	-0.053	10.008
651	228.19	14.99	35.88	14.10	278.78	120.30	6.05	16.31	6.76	142.66	421.44	-0.176	-0.102	10.008
652	274.50	21.15	46.91	15.85	342.33	109.97	5.56	15.29	6.50	130.88	473.21	-0.144	-0.145	10.008
653	334.75	24.75	59.43	22.39	420.17	96.25	3.71	13.68	5.79	113.39	533.55	-0.102	-0.177	10.008
654	405.48	29.93	63.27	25.52	499.13	80.19	3.14	12.94	4.53	95.87	595.00	-0.052	-0.197	10.008
655	481.85	32.45	71.83	28.31	586.10	63.65	2.76	10.43	3.62	76.92	663.02	0.001	-0.204	10.008
656	555.18	39.02	87.24	32.51	680.73	49.06	0.87	7.56	2.74	57.36	738.09	0.053	-0.197	10.008
657	617.84	90.34	98.34	38.37	758.16	36.70	0.08	7.16	1.83	44.05	802.21	0.102	-0.176	10.008
658	662.72	51.71	92.42	43.65	806.09	26.42	0.00	6.28	1.52	32.69	838.78	0.145	-0.144	10.008
659	690.87	58.41	93.17	39.74	841.62	14.15	0.00	4.17	0.85	18.37	860.00	0.177	-0.102	10.008



660	697.48	46.32	97.85	38.50	841.45	3.81	0.00	2.64	0.14	6.49	847.94	0.197	-0.052	10.008
661	677.10	25.14	101.01	39.98	800.48	2.90	0.00	2.40	0.11	5.33	805.81	0.204	-0.001	10.008
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 624 649  
 625 650  
 626 651  
 627 652  
 628 653  
 629 654  
 630 655  
 631 656  
 632 657  
 633 658  
 634 659  
 635 660  
 612 636 661 637

### A.5 TECPLOT Output Graphs

Figure A2 is a black and white plot of the display of CESH from the SOLSHAD sample run contained in sample.tec. The colors of the actual TECPLOT display are labeled on figure A2, and the structure has been rotated so that it can be viewed more clearly. The numbers along the color scale on the figure are grand total exposure in CESH. Examination of the figure shows that the highest flux is along the space-facing edge (the right side) and lowest along the earth-facing side (the left side). On the top square, one can see the effects of the shadowing of the sphere (the blue area), as well as the effects of reflection from the sphere (lighter green area).

Figure A3 is a graph that has been extracted from the plot shown in figure A2. A line has been drawn diagonally along the surface of the square from the upper right corner to the lower left corner, and the graph generated shows the solar exposure along the line as a function of distance along the line. (TECPLOT will plot the values extracted along a line as a function of other values. For figure A3, we chose the distance along the line to be on the x-axis of the 2D plot, and the total exposure, GRTOTAL, to be on the y-axis.) Note the valley that corresponds to blue spot caused by the sphere shadowing, and the peak that corresponds to the lighter green area caused by the sphere reflection.

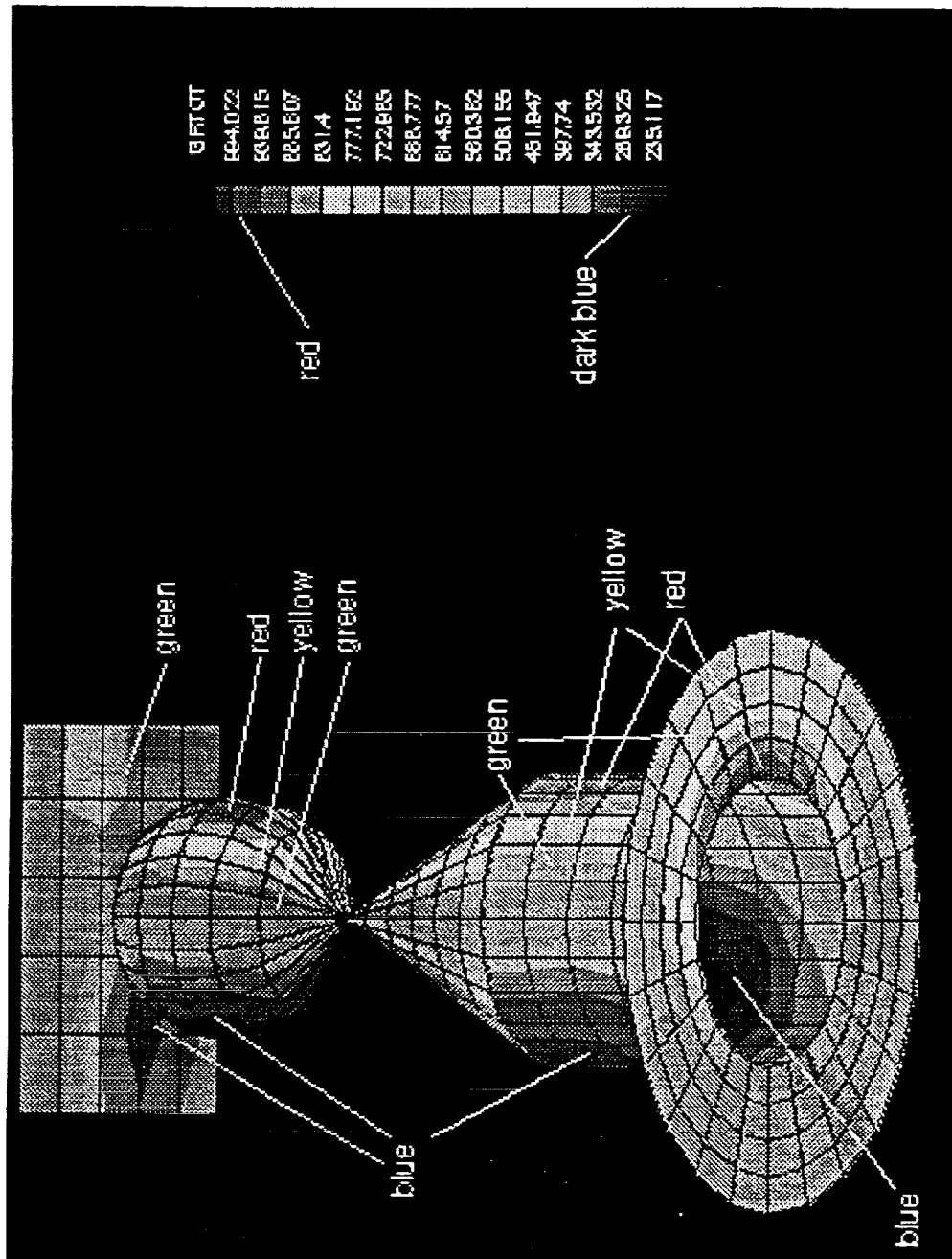


Figure A2. Black and White Plot of the Sample TECPLOT File Generated by SOLSHAD.

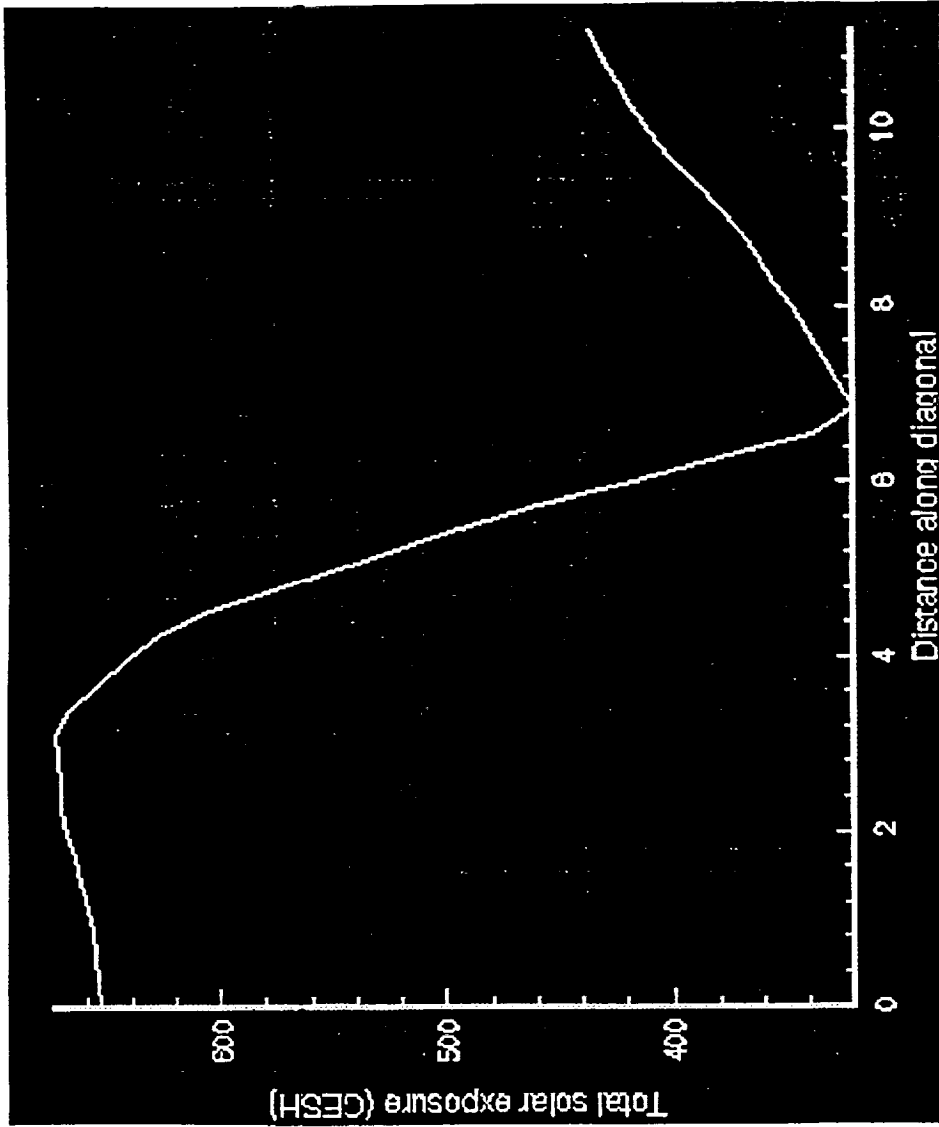


Figure A3. An X-Y Graph of the Solar Exposure as a Function of Distance Along the Diagonal Line of the Square Shown in Figure A2.



## APPENDIX B:      FORMAT OF OUTPUT FILES FOR TECPLOT

### B.1    TECPLOT Output File From SOLSHAD

SOLSHAD produces an ASCII file of the nodes, solar exposures, and connectivity matrix formatted for processing by PREPLOT to create a binary input file for TECPLOT. TECPLOT displays this file as a plot of the object with the fluxes color coded on the surfaces. This file is named TAPE7 and is opened in SOLSHAD (subroutine CONNEC) as STATUS = 'UNKNOWN', FORM = 'FORMATTED'. STATUS = 'UNKNOWN' causes any existing version of TAPE7 to be overwritten. The last line of the batch file `run.shadow` gives the file TAPE7 a new name. Therefore, users should take care to change the name of the file in `run.shadow` if they wish to preserve results of previous SOLSHAD runs.

#### Record E1 Format (1X,'TITLE="',A,'"')

Entry	Columns	Type	Variable
Description of geometry from record B1	9-69	character	HEADER

#### Record E2 Format (' VARIABLES=NODE,PRIM,SPEC,DIFF,ABSORPTION, TOTAL,PRIMA,SPECA,DIFFA,ABSA,TOTAL,GRTOTAL,X,Y,Z')

This record provides variable names for the columns of data in record E4.

#### Record E3 Format (' ZONE T="SURF 1",I=',I4,',J=',I4,',F=FEPOINT')

Entry	Columns	Type	Variable
Number of nodes (points) on the surfaces of the structure.	20-23	integer	NODETOT
Number of elements in the connectivity matrix.	27-30	integer	NCON

#### Record E4 Format (I6,11F10.2,3F10.3)

This record is repeated NODETOT times, once for the data at each node.

Entry	Columns	Type	Variable
Node number.	1-6	integer	L
Direct solar exposure (CESH) at node.	7-16	real	FLUX(1,L)
Solar exposure due to specular reflection of direct solar radiation (CESH) at node.	17-26	real	FLUX(2,L)
Solar exposure due to diffuse reflection of direct solar radiation (CESH) at node.	27-36	real	FLUX(3,L)
Solar exposure due to absorption of direct solar radiation (CESH) at node.	37-46	real	FLUX(4,L)
Total solar exposure due to direct solar exposure + specular reflection of direct solar radiation + diffuse reflection of direct solar radiation (CESH) at node.	47-56	real	FLUX(5,L)
Earth-reflected solar exposure (CESH) at node.	57-66	real	FLUXA(1,L)
Solar exposure due to specular reflection of Earth-reflected solar radiation (CESH) at node.	67-76	real	FLUXA(2,L)
Solar exposure due to diffuse reflection of Earth-reflected solar radiation (CESH) at node.	77-86	real	FLUXA(3,L)

Solar exposure due to absorption of Earth-reflected solar radiation (CESH) at node.	87-96	real	FLUXA(4,L)
Total solar exposure due to Earth-reflected solar exposure + specular reflection of Earth-reflected solar radiation + diffuse reflection of Earth-reflected solar radiation (CESH) at node.	97-106	real	FLUXA(5,L)
Grand total solar exposure (CESH) at node = FLUX(5,L) +FLUXA(5,L)	107-116	real	FLUXT(L)
X coordinate of node	117-126	real	CSAV(1,L)
Y coordinate of node	127-136	real	CSAV(2,L)
Z coordinate of node	137-146	real	CSAV(3,L)

### Record E5 Format (4I10)

This record is repeated NCON times, once for each element of the connectivity matrix.

Entry	Columns	Type	Variable
The indices of the four nodes defining an element of the connectivity matrix. When the four nodes are connected in order, they form a quadrilateral (or a triangle if two adjacent points are identical).	1-10, 11-20, 21-30, 31-40	integer	ICONEC

### B.2 TECPLOT Output Files from MDDB

**TECPLOT Binary Output File From MDDB.** MDDB produces a binary TECPLOT file whenever a TECPLOT display of the object is selected. This file is readable directly by the PC version of TECPLOT 5.0x without need for preprocessing by PREPLOT. The binary file is named MDDB.PLT and is opened in subroutine GENSURF with a FORTRAN open statement as unit 9, STATUS = 'UNKNOWN', FORM = 'BINARY'. STATUS = 'UNKNOWN' causes any existing version of MDDB.PLT to be overwritten. The new version of the file is written in subroutine CONNECM. Because the file is binary, its format is described by contents of individual words rather than by record content. Each word is considered to be a 32-bit real or integer value. When specific values are given in the table below, they are written to the binary file.

Number of words	Type	Contents
1	real	Version number of the input file = 5.0.
80	real	Description of geometry read in record B1 of section 2.2.1 blank padded to 80 characters. Each character is written to MDDB.PLT as the real value of its integer ASCII value.
1	real	Number of variables = 5.0 for which data is written to MDDB.PLT.
25	real	The 5-character names of the variables: 'NODE', 'COLOR', 'X', 'Y', 'Z'. Each character is written to MDDB.PLT as the real value of its integer ASCII value.
1	real	Zone marker = 299.0.
10	real	Ten character zone name: 'SURFACES'. Each character is written to MDDB.PLT as the real value of its integer ASCII value.
1	real	Format of data = 3.0, which indicates FEPOINT.
1	real	Z plane value = 0.0.
1	real	Number of nodes NODETV.
1	real	Number of elements in connectivity matrix NCONV.
1	real	End of header marker = 357.0.
1	real	Zone marker = 299.0.
1	real	Number of repeat variables = 0.0.
5.0*NODETV	real	One word of data for each of five variable values for the NODETV nodes. Data are written in order as NODE1, COLOR1, X1, Y1, Z1 NODE2, COLOR2, X2, Y2, Z2 etc.
4.0*NCONV	integer	One word of data for each of the indices of the four points of the connectivity matrix for the NCONV elements. When the four nodes are connected in order, they form a quadrilateral (or a triangle if two adjacent points are identical).

**TECPLOT ASCII Output File from MDDB.** MDDB also produces an ASCII TECPLOT file whenever a TECPLOT display of the object is selected. This file is readable by PREPLOT which creates a binary file used by TECPLOT. The ASCII file is named MDDB.PRE and is opened in subroutine GENSURF with a FORTRAN open statement as unit 7, STATUS = 'UNKNOWN', FORM = 'FORMATTED'. STATUS = 'UNKNOWN' causes any existing version of MDDB.PRE to be overwritten. The new version of the file is written in subroutine CONNECM. The format of this file is described below. When specific values are given, they are written to the file.

**Record F1 Format (1X,'TITLE="'A,'"')**

Entry	Columns	Type	Variable
Description of geometry from record B1	9-69	character	HEADER

**Record F2 Format (' VARIABLES=NODE,COLOR,X,Y,Z')**

This record provides variable names for the columns of data in record F4.

**Record F3 Format (' ZONE T="SURF 1",I=',I4,',J=',I4,'F=FEPOINT')**

Entry	Columns	Type	Variable
Number of nodes (points) on the surfaces of the structure plus the surface normal direction arrows.	20-23	integer	NODETV
Number of elements in the connectivity matrix.	27-30	integer	NCONV

**Record F4 Format (I6,F10.4,3F10.3)I6,F10.4,3F10.3) L,COLOR,PT**

This record is repeated NODETV times to generate all of the surfaces and surface normal direction arrows.

Entry	Columns	Type	Variable
Node number.	1-6	integer	L
Color of node.	7-16	real	COLOR
X coordinate of node	17-26	real	PT(1) or ARROW(1,J)
Y coordinate of node	27-36	real	PT(2) or ARROW(2,J)
Z coordinate of node	37-46	real	PT(3) or ARROW(3,J)

**Record F5 Format (4I10)**

This record is repeated NCONV times, once for each element of the connectivity matrix.

Entry	Columns	Type	Variable
The indices of the four nodes defining an element of the connectivity matrix. When the four nodes are connected in order, they form a quadrilateral (or a triangle if two adjacent points are identical).	1-10, 11-20, 21-30, 31-40	integer	ICONEC



# REPORT DOCUMENTATION PAGE

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