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USER'S GUIDE: STEADY-STATE AERODYNAMIC-LOADS PROGRAM FOR SHUTTLE TPS TILES

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LIST OF SYMBOLS

Mathematical Symbols

C_p	specific heat of an ideal diatomic gas measured at a constant pressure, (7/2)R, (ft-lbf)/(lbm-^{0}R)
C_v	specific heat of an ideal diatomic gas measured at a constant volume (5/2)R, (ft-lbf)/(lbm-^{0}R)
g	gravitational constant, 32.2 ft/sec^2
k	nondimensional ratio of C_p/C_v=1.4
P_∞	free stream pressure, lbf/ft^2
R	universal gas constant, 53.3 (ft-lbf)/(lbm-^{0}R)
S	arbitrary function in diffusion equation
T	temperature, ^{0}R
t	time, sec
U_∞	free stream velocity, ft/sec
X_0	distance of leading corner of subject tile from the leading edge of the Shuttle or the edge of the structure simulating the Shuttle
XMACH	mach number
x	x-Cartesian coordinate, in.
y	y-Cartesian coordinate, in.
z	z-Cartesian coordinate, in.
δ_0	boundary layer thickness of turbulent flow over a flat plate, ft
μ_∞	free stream viscosity coefficient, lbm/(ft-sec)
ρ_∞	free stream density, lbm/ft^3

Program Parameter Names

B	24 element array of pressures at the top of the gap between tiles, psi
DELTAX	integration step for the skin friction calculation, usually set at .1 inches
DTILE	depth of tile, inches
FLOSIGN	flag indicating direction of flow parallel to the x-axis
FXTOT	total force on subject tile in the x-direction, lbf
FYTOT	total force on subject tile in the y-direction, lbf
FZTOT	total force on subject tile in the z-direction, lbf
G	24 element array of pressures at the bottom of the gap between tiles, psi
GFX	x-force due to gap pressures, lbf
GFY	y-force due to gap pressures, lbf
GMX	moment about the x-axis due to gap pressures, in.-lbf
GMY	moment about the y-axis due to gap pressures, in.-lbf
GMZ	moment about the z-axis due to gap pressures, in.-lbf
ISTA	x-coordinate of the first point of the pressure profile, in.
IEND	x-coordinate of the last point of the pressure profile, in.
KS	tile roughness parameter
MX	moment about the x-axis due to normal forces, in.-lbf
MXTOT	total moment about the x-axis, in.-lbf
MY	moment about the y-axis due to normal forces, in.-lbf
MYTOT	total moment about the y-axis, in.-lbf
MZTOT	total moment about the z-axis, in.-lbf
NRUN	run number
NTEST	flag indicating presence of shock or no shock condition for model simulation

N1,N2	number of pressure measurements on line 1 and 2, respectively
P	free stream static pressure, lbf/ft^2
PHI	angle of attack of Shuttle or test panel
PRESSURE	pressure measurement, psi
PSUR	6 x 6 subject tile surface pressure array, psi
PTBL	6 x 6 subject tile bondline pressure array, psi
Q	free stream dynamic pressure, lbf/ft^2
RHO	free stream density, lbm/ft^3
SFX	x-force due to skin friction, lbf
SMY	moment about the y-axis due to skin friction, in.-lbf
TITLE	alphanumeric title identifying a pressure profile data set
U	free stream velocity, ft/sec
X	x-coordinate of a pressure measurement, in.
XC	x-coordinate of the leading corner of the subject tile in the coordinate system of the pressure measurements, in.
XMACH	mach number
XMU	free stream viscosity coefficient, lbm/(ft-sec)
XSHOCK	distance of the shock from the edge of the Shuttle in the absolute coordinate system, in.
XZERO	distance of the leading corner of the subject tile from the edge of the Shuttle in the absolute coordinate system, in.
Y	y-coordinate of a pressure measurement, in.
YC	y-coordinate of the leading corner of the subject tile in the coordinate system of the pressure measurements, in.

INTRODUCTION

This report is a user's guide for the computer program that calculates the steady-state aerodynamic loads on the tiles of the Space Shuttle thermal-protection system (TPS). The main element of the program is the Martin Marietta Interactive Thermal Analysis System - Version II (MITAS-II). MITAS-II was designed to solve heat transfer problems using an electrical network analog representation. It can also be used to solve any problem that can be described by diffusion equations of the form $\frac{\partial T}{\partial t} = \nabla^2 T + S$ and that can be solved using lumped parameter techniques.

In the case of the Shuttle TPS tiles, MITAS-II is used to calculate mass flow. The program built around MITAS-II requires input data describing the model network and the pressure profile over the tiles chosen for analysis. The program calculates the mass flow in the tile matrix using finite-difference techniques until a steady state is achieved. The pressures calculated in and around a representative tile are passed to another block of subroutines. These subroutines integrate the pressure to calculate the normal force and the moments about the x, y, and z axes. This information is used in a nonlinear-stress program to determine whether or not the subject tile will fail.

MITAS-II itself is described in detail in the reference manual (ref. 1) provided by Martin Marietta and will not be covered in this report. Only a description of its basic organization will be presented. This information is required to describe the communication of data into and out of the MITAS-II structure. The construction of the model network is discussed in another report (ref. 2).

The user's guide is intended to provide the user with enough information to execute the program. It is divided into four sections. In the first section, the program and data files needed to execute the program will be discussed. In the second section, the techniques used to process the pressure profile data for input to the program will be described. In the third section, the runstream used to execute the program will be discussed step by step. The methods used to modify the input data and program are also presented in this section. In the fourth section, the output from a sample run is explained. In addition, the procedure file used to execute the program, the MITAS-II model input, a surface pressure profile, and the output of a sample run are listed in the appendices.

DESCRIPTION OF SOFTWARE LIBRARIES AND DATA FILES

Several files containing the program software and input data are required for the execution of the loads analysis program. The function of each is briefly described in this section.

MITAS-II is stored on three indirect-access library files: MITABS, ZRJCLIB, ZLIBRY. The MITABS file contains a collection of programs designed to preprocess the model network data to create a FORTRAN source program which performs the flow analysis when executed. The ZRJCLIB file contains the input/output routines used by the preprocessor. These routines are written particularly for the CDC CYBER computers and are not portable to other systems. The ZLIBRY file is a mathematical subroutine library. Routines to manipulate matrices, to interpolate data, and to plot the results are included in this library.

AKCLIB and FTNMLIB are mathematical subroutine libraries. AKCLIB is a special-purpose library containing cubic-spline routines to fit curves and surfaces to data sets requiring interpolation. CURV1, a one-dimensional curve fitting routine, and CURV2, a one-dimensional interpolating routine, (ref. 3) are used from this library to interpolate the pressure data needed to initialize the model. FTNMLIB is the main subroutine library maintained on the computer system and contains routines for a great variety of applications. The bilinear-interpolation routine IBI (ref. 4) from this library is also used in interpolating the surface pressure data.

XEDIT (ref. 5) is one of several text-editor programs maintained at the Langley Research Center and is stored on a direct access file. It provides a convenient way to modify the source program and input data files.

Two data files are required for the loads analysis of the tile system. The file MODEL contains the model representation of the tile matrix to be analyzed. The matrix considered in this report consists of nine 6-inch square tiles arranged in a brick pattern rotated 45^0 counterclockwise as shown in figure 1. The MITAS-II reference manual describes how to develop the lumped-parameter representation of the tiles and how the file should be formatted. The PROFILE file contains the pressure-profile data defining the surface-pressure distribution over the tiles. The structure of this file is given in the second section. Both data files are stored as indirect access files.

Also, both are renamed locally, i.e., TAPE5=PROFILE and A=MODEL. Other data files and model configurations can be easily substituted and used in the program by simply changing the file name in the GET statements.

INPUT DATA

The main forcing function and major input in the model is the pressure distribution existing over the tiles. The model must be initialized with the free-stream steady-state pressures at the tile boundaries. The tile boundaries are defined at the center of the gaps between adjacent tiles. The pressure values are obtained from measurements made in wind-tunnel tests or theoretical models of the flow conditions. The tests and the theoretical models are designed to be representative of actual conditions expected during a Shuttle flight. In both cases, the data is taken or defined on two straight lines parallel to the flow direction on either side of the subject tile (figure 2). The data is then interpolated between the lines to provide the pressures at the boundary points.

The program is designed to accept as many as 50 data points on each line spanning a distance up to 40 inches. The data may be located at unequal increments along the lines. The number of points per line need not be the same. The program fits a cubic spline to each line of data and interpolates the data to provide a value at 1/2-inch increments spanning the range for which data exists on both lines. Outside this range, the data is extrapolated along horizontal straight lines so that the entire 40-inch span of the nine-tile matrix is defined. The new interpolated data forms a regular grid system with dimensions 81 x 2.

The gridded data serves as input to a bilinear-interpolation routine to calculate the pressures at the node points between the data lines. A typical pressure profile is shown in figure 3.

The format of the file TAPE5 containing the pressure measurements is fixed. The first card image or line of the file contains an 80 alphanumeric-character string identifying the profile. The second line contains five parameters describing the test conditions: the run number NRUN, the mach number XMACH, the angle of attack PHI, the free-stream dynamic pressure Q, and the free-stream static pressure P. Both free-stream pressures should be reported in psf. Blanks should be substituted if the value of any or all of these variables is not known or not applicable. The third line contains N1, the number of points to be read for the first line of data. The data set of N1 points follows with one point per line. For each data point the (X,Y) coordinates of the point in inches and its measured value in psi is given. The same format beginning with the number of points in the data set is repeated for the second line of data. The data points must be entered in monotonically increasing order in the x-direction. The y-coordinate of the first data set must be less than the y-coordinate of the second set. The format specifications for the file are given in table 1 and an example of a pressure profile is given in appendix A.

Table 1. Format Specifications for Pressure Profile Data File

Line No.	Variables	Format
1	TITLE	(8A10)
2	NRUN XMACH PHI Q P	(A4,F10.4,F10.2,F10.1,F10.3)
3	N1	(I5)
4	X Y PRESSURE	(2F12.5,F12.3)

The rest of the input is read by the program from the input file through two NAMELIST statements (see the procedure file in appendix A). The first NAMELIST named XYCOOR defines the position of the tile matrix with respect to the pressure profile. The four parameters given are the coordinates (XC,YC) of the leading corner of the subject tile and the x-coordinates of the two endpoints (ISTA,IEND) of the 40-inch span of the tile matrix. These parameters are given in inches and are measured in the same coordinate system as are the pressures. The second NAMELIST named XSHOCK provides additional information about the location of the pressure profile and subject tile relative to the leading edge of the Shuttle structure to be analyzed or the edge of the structure simulating the Shuttle's edge. This information describes the shock wave generated from the leading edges of the Shuttle. It is also used in calculating the loads produced by the drag of skin friction. The parameters listed in XSHOCK are: the free-stream velocity (U), the free-stream density (RHO), viscosity coefficient (XMU), distance of shock from edge of Shuttle (XSHOCK), distance of leading corner of tile from edge of Shuttle (XZERO), tile roughness factor (KS), the integration step for the skin friction calculation (DELTAX) which is usually set at .1 inches, the tile thickness (DTILE), and the flag to indicate the direction of the flow across the test panel (FLOSIGN).

The two coordinate systems mentioned above can be different. The system used to measure the XSHOCK parameters should be thought of as the absolute coordinate system on the Shuttle or in the wind tunnel (figure 4). The other coordinate system used for the pressure profile

can be relative to the edge of the test panel or to the area to be analyzed. All that the program requires is a means to register the position of the test panel with the pressure data. This information is provided in namelist XYCOOR.

The equations to define U, RHO, and XMU are listed in appendix B. The flag FLOSIGN is assigned a value of either +1.0 or -1.0. to indicate the flow direction parallel to the x-axis. It is assigned a value of +1.0 if the flow direction in the model simulation is from left to right across the test panel as indiacted in figure 1, and it is assigned a value of -1.0 if the flow is in the opposite direction from right to left. Also, listed in appendix B is the equation for the boundary layer thickness of turbulent flow over a flat plate, δ_o. This equation can be used when the boundary layer thickness is known to calculate an equivalent value of the distance of the subject tile from the edge of the Shuttle, X_o (figure 4).

EXECUTION PROCEDURES

This section describes the control-card sequence necessary to execute the program. The procedure file is listed in appendix A.

The first step after the usual JOB card and accounting cards is to attach the software libraries. The indirect-access file MODEL containing the model representation is attached next and called A. The data file PROFILE containing the pressure measurements defining the surface-pressure profile is attached and named TAPE5.

Next, modifications to the model input file A are made if needed using the text editor XEDIT. Changes can be made to the local file A without changing the permanent file MODEL. This is especially useful in performing parameter studies where one parameter at a time is changed. In this way, the program sensitivity to particular parameters can be judged.

The general format of the XEDIT statement is: XEDIT, filename.; character string. The filename referenced in the statement must be a local file. The character string is the list of XEDIT commands to be performed separated with semicolons. The prefix "X" is used with the locate (L), change (C), and quit (Q) commands to eliminate unnecessary output from XEDIT. A complete list of XEDIT commands and options can be found in volume IV of the LaRC Computer Programing Manual.

The binary file MITABS is then executed with A as the input file to produce the FORTRAN source file EXFOR. The output of this module is written on a local file named MOUTPUT. The MITAS-II preprocessor echoes all the input data in the output file. Also, it creates and writes out directories to keep track of the storage locations of all the data. For a large model such as this, the output file is very long (on the order of 70 pages). Usually, this file is not needed, so it is stored as a permanent file rather than being sent to the line printer or terminal screen. The permanent file can be easily accessed or routed to a printer when needed. The MITAS-II preprocessor creates the program source file EXFOR from the input file A. It is this file that is actually executed to produce the solution to the problem. This file is

modified with XEDIT to make changes in the subroutines and to extend the file capability of the program. An input file was added to allow direct communication with the program. Specifically, it was added to allow easy entry of data through a NAMELIST statement.

Next the file EXFOR is compiled and loaded. The compilation listing is written on a local file LIST. The LDSET card follows. It defines all the libraries, presets the core to negative infinity, and creates a load map. The load map is written on a local file LMAP. Both LIST and LMAP are usually not needed and are treated as MOUTPUT is treated. These files are useful in the case of errors. They are stored as permanent files and routed to the printer only when the program has an abnormal exit.

The compiled program is then executed using the LGO statement. After normal execution, the dayfile information is written on a local file DAYTEST. This file is then stored as a permanent file with the same name. If a fatal error occurs, execution stops, and control is passed automatically to the EXIT card. The control statements following the EXIT card are then executed. The dayfile is written, stored, and routed to a printer along with the compilation listing LIST and load map LMAP to aid in the debugging process.

The procedure file is organized this way to make it easy for the user to change data files in order to run different cases using different pressure profiles. Also, it was designed to keep all the changes made in one place. Rather than using a separate file for the XEDIT directives with XEDIT to modify the files, the XEDIT commands are

listed in the procedure file. It is then easy to determine what test conditions were changed before execution. Also, since the names of the files containing the data, dayfiles, and listings are easy to change from run to run, it is easy to identify the files belonging to a particular run. It should also be noted that all files not already saved or replaced before the job ends will be destroyed at the end of the run. Files A, TAPE5, EXFOR, and TEMP are local files that are never saved and are lost at the end of the job. LIST and LMAP also fall in this category unless an error occurs in compilation or execution and causes the statements after the EXIT card to be performed.

EXPLANATION OF THE PROGRAM LISTING FROM A SAMPLE RUN

A portion of a sample run of the computer program is given here to aid in the discussion of the program output. A complete list of the procedure file, a model input file, a surface pressure profile data file, and the results of a run for a test tile in the mid-fuselage region of the Shuttle is given in appendix A.

The program output begins with a list of the user-defined constants in the internal flow model. The MITAS-II constants block information with typical input values is shown in figure 5. The constants normally varied in this block to perform parameter studies and to define different cases are constant numbers 100, 102, 103, 106, 109, 110, 115, 117, and NTEST. Constant numbers 109 and 110 should be changed when the SIP thickness is changed. The last number on the right in the equation for constants 109 and 110 is the SIP thickness shown as 0.16 in figure 5. Constant number 117 is the force in pounds required to move a tile

0.05 inches in the plane parallel to the surface of the Shuttle. NTEST is set to either 1 for cases representing conditions for a shock over the subject tile or 0 for cases representing conditions for a raised subject tile with no shock present.

The namelist XYCOOR and the surface pressure data discussed earlier are listed next in the output and are shown in figure 6. Pressures are given along two lines over the surface of the nine-tile array. The x- and y-coordinates are measured in inches, and the pressure is measured in psi.

The next major section of the output is printed by the MITAS-II system as it searches for a steady state solution to the flow problem defined by the user-supplied model. This section consists of three types of information:

1. Convergence information in the form of the maximum changes in pressure from one iteration to the next at the end of each iteration calculating the change in the gap dimensions.
2. Pressures at the model nodes, tile to tile gap deflections, and tile to filler bar clearances calculated by MITAS-II for the last two major iterations that determine the change in gap dimensions. These pressures in units of psi are listed as Txxxx=pressure, where xxxx is the identifying node number. The tile-to-tile gap deflections are listed as two unlabeled numbers. The first one is closure of gap 1-6, and the second

one is closure of gap 7-12. The tile-to-filler bar clearances are labeled as EDGAP(I). The gap deflections and tile to filler bar clearances are given in inches.

3. Mass flow values based on the final pressure solution. The mass-flow rate values in units of lbm/sec are listed as flow between pairs of nodes. The format is: Node-number A, node number B, flow rate, where A and B are the nodes for which the flow is defined. A positive flow rate indicates flow into node-number A.

A sample of the output from this section is shown in figure 7. This particular run was configured so that the strict convergence criterion could not be realistically met. This condition forces the program to iterate the maximum number of times as set by the user. Even though the solution has not "converged" by the set standards, a solution has actually been found. This can be determined by examining the parameters printed out every 600 iterations and noting the small changes from iteration to iteration.

The last section in the output summarizes the loads calculations. The first part of this section is shown in figure 8. The program prints the input data used from the namelist XSHOCK and the pressures calculated by MITAS-II for the subject tile. These pressures are stored in four arrays and are labeled as follows:

B(1-24) = pressure at top of gap, psi

G(1-24) = pressure at bottom of gap, psi

ARRAY PSUR= 6 x 6 subject tile surface-pressure array, entry (1,1) is T61, entry (1,6) is T66, etc., psi

ARRAY PTBL = 6 x 6 subject tile bondline pressure array, entry (1,1) is T25, entry (1,6) is T30, etc., psi

Next, the results of the force and moment calculation using the pressure information in the arrays B, G, PSUR and PTBL are printed to complete the program output. A typical summary is shown in figure 9. Included in the summary are the following forces and moments:

FXTOT = total force in the x-direction, lbf

FYTOT = total force in the y-direction, lbf

FZTOT = total force in the z-direction, lbf

MXTOT = total moment about the x-axis, in.-lbf

MYTOT = total moment about the y-axis, in.-lbf

MZTOT = total moment about the z-axis, in.-lbf

GFX = x-force due to gap pressures, lbf

GFY = y-force due to gap pressures, lbf

GMX = moment about the x-axis due to gap pressures, in.-lbf

GMY = moment about the y-axis due to gap pressures, in.-lbf

GMZ = moment about the z-axis due to gap pressures, in.-lbf

SFX = x-force due to skin friction, lbf

SMY = moment about the y-axis due to skin friction, in.-lbf

MX = moment about the x-axis due to normal forces, in.-lbf

MY = moment about the y-axis due to normal forces, in.-lbf

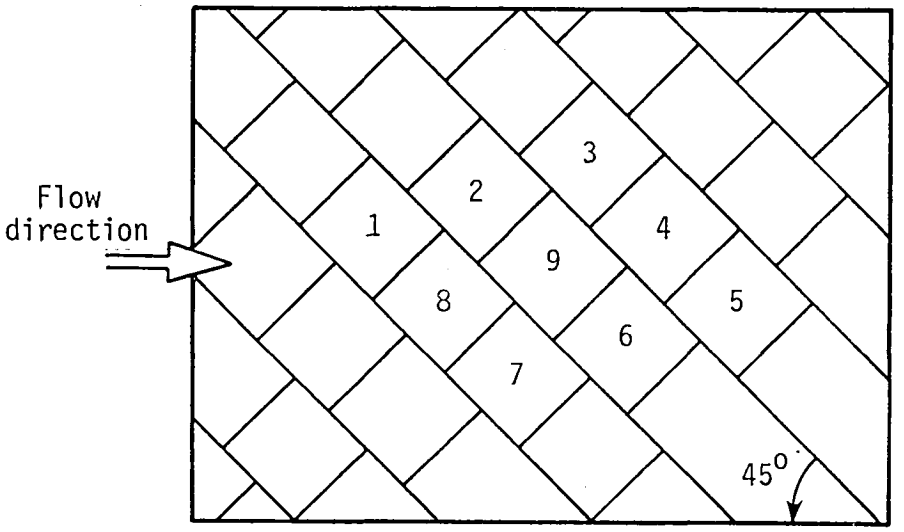

Figure 1. Nine-tile array.

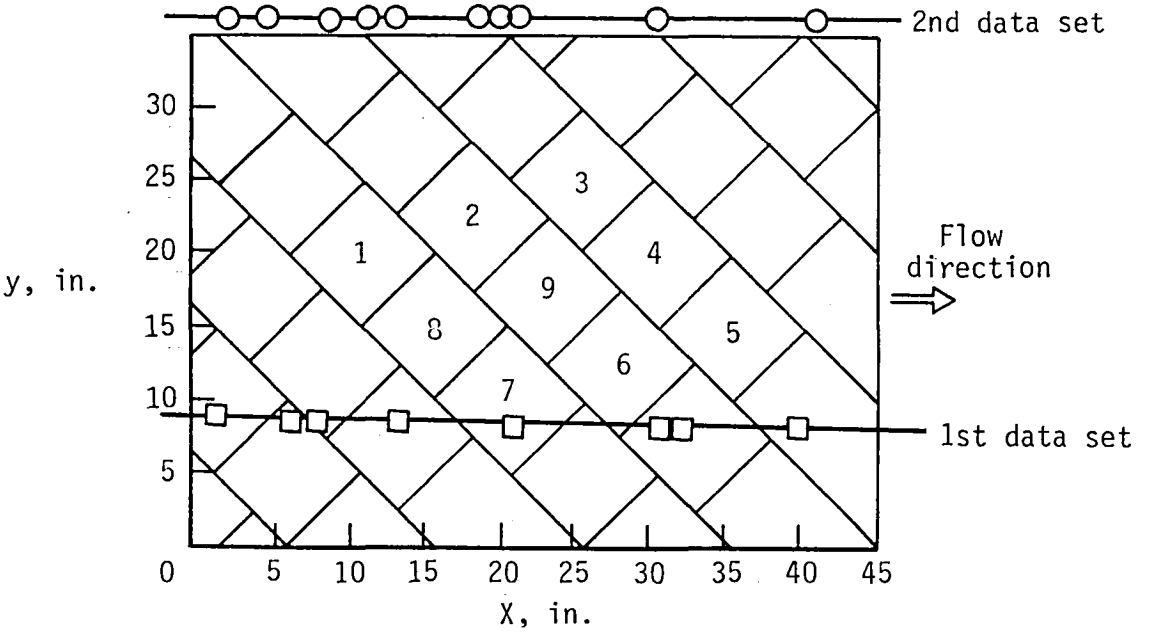

Figure 2. Configuration of text panel used when taking pressure measurements.

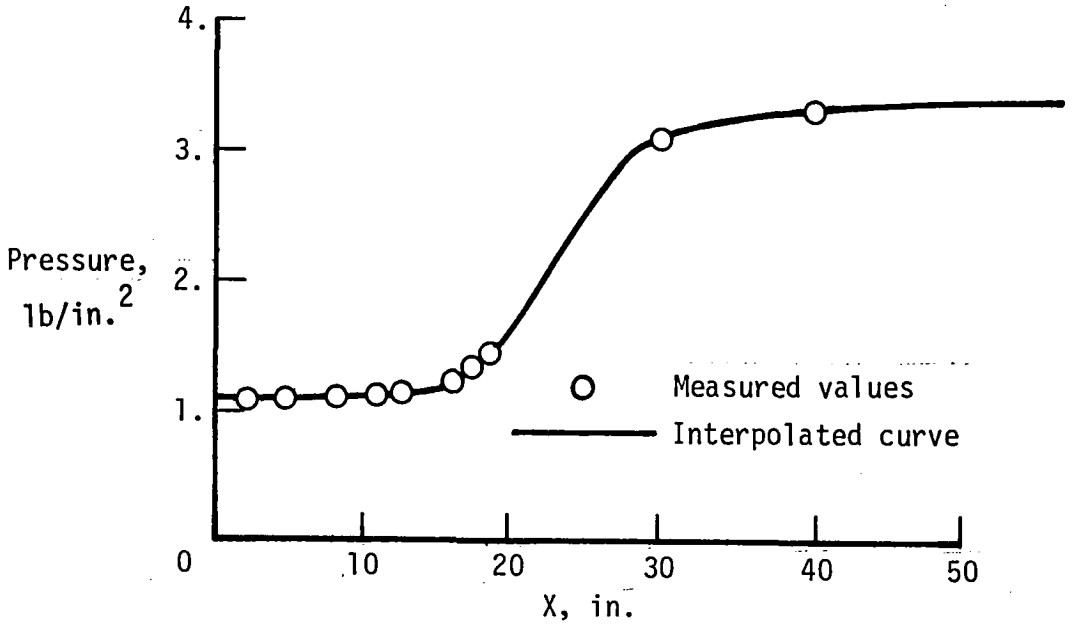

Figure 3. Typical pressure profile.

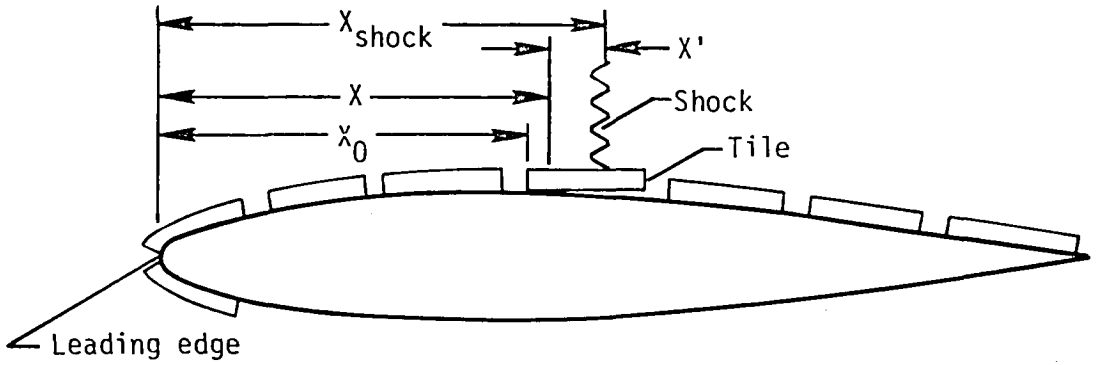

Figure 4. Location of tile and shock from leading edge.

```
BCD $CONSTANTS DATA
NDSTOR=6500,ITERMX=600 ,DRLXCA=1.E-9,ARLXCA=1.E-9
TIMED=0.,TIMEND=32.,TSTEPD=4.
EXTLIM=.5
100=1.47          $TILE THICKNESS (IN)
101=6.0          $TILE SIDE LENGTH (IN)
102=0.16*10.     $SIP THICKNESS (IN)
103=.06          $TERMINATOR GAP (IN)
106=.05          $GAP WIDTH (IN)
107=00.0000      $VISCOSITY (LBM/FT-SEC)
108=0.0000       $DENSITY OF GAS (LB/FT**3)
109=1.0/26.7*.16    $SIP/GAP DP FACTOR (IN/PSI)
110=1.21/26.7*.16   $SIP/SURFACE DP FACTOR (IN/PSI)
111=0.1         $INITIAL EDGE CLEARANCE (IN)
112=0.1          $EDGE CLEARANCE (IN)
113=.5          $SIP/TILE DISCHARGE COEFFICIENT
114=.1           $SIP/FILLER BAR CLEARANCE (IN)
115=115.        $TEMPERATURE (F)
116=0.0         $AVERAGE PRESSURE
117=5.5         $LBF TO MOVE .05 IN LATERALLY
118=0.0         $CLOSURE OF GAP 1
119=0.0         $CLOSURE OF GAP 2
120=.001         $MINIMUM GAP CLEARANCE (IN)
121=1.E-3         $MINIMUM EDGE CLEARANCE (IN)
123=1.0         $PERMEABILITY FACTOR
1,,2,,3,,4,,5,,6,,7,,8,,9,,10,,11,,12,,13,,14,,15=0.
ITEST=0,JTEST=0,KTEST= EDGAP,LTEST=0,MTEST=0
NTEST=0     $ 0= 9 TILE MOVE;  1= 1 TILE MOVES
END
```

Figure 5. MITAS-II output listing of user-supplied constants.

```
$XYCOOR
XC      = .1364E+02,
YC      = 0.0,
ISTA    = 1,
IFIN    = 81,
$END
MF-6 REGION  (REPRESENTATION A)

RUN      MACH      PHI      Q        P
NUMBER             DEG.     PSF      PSIA
****    1.8120    49.51   6560.0     285.

RUN          X             Y          P-LOC
NUMBER                                 PSIA
 MF6       0.00000    -17.00000      3.74000
 MF6      10.00000    -17.00000      3.74000
 MF6      12.00000    -17.00000      3.74000
 MF6      14.00000    -17.00000      3.74000
 MF6      16.00000    -17.00000      3.83000
 MF6      18.00000    -17.00000      3.92000
 MF6      19.00000    -17.00000      3.98000
 MF6      19.50000    -17.00000      4.02500
 MF6      20.00000    -17.00000      4.10000
 MF6      20.50000    -17.00000      4.22000
 MF6      22.00000    -17.00000      4.88000
 MF6      23.00000    -17.00000      5.30000
 MF6      24.00000    -17.00000      5.54000
 MF6      25.00000    -17.00000      5.65000
 MF6      26.00000    -17.00000      5.72000
 MF6      28.00000    -17.00000      5.80000
 MF6      30.00000    -17.00000      5.96000
 MF6      32.00000    -17.00000      6.07000
 MF6      34.00000    -17.00000      6.19000
 MF6      36.00000    -17.00000      6.30000
 MF6      38.00000    -17.00000      6.42000
 MF6      40.00000    -17.00000      6.52000
 MF6       0.00000     17.00000      3.74000
 MF6      10.00000     17.00000      3.74000
 MF6      12.00000     17.00000      3.74000
 MF6      14.00000     17.00000      3.74000
 MF6      16.00000     17.00000      3.83000
 MF6      18.00000     17.00000      3.92000
 MF6      19.00000     17.00000      3.98000
 MF6      19.50000     17.00000      4.02500
 MF6      20.00000     17.00000      4.10000
 MF6      20.50000     17.00000      4.22000
 MF6      22.00000     17.00000      4.88000
 MF6      23.00000     17.00000      5.30000
 MF6      24.00000     17.00000      5.54000
 MF6      25.00000     17.00000      5.65000
 MF6      26.00000     17.00000      5.72000
 MF6      28.00000     17.00000      5.80000
 MF6      30.00000     17.00000      5.96000
 MF6      32.00000     17.00000      6.07000
 MF6      34.00000     17.00000      6.19000
 MF6      36.00000     17.00000      6.30000
 MF6      38.00000     17.00000      6.42000
 MF6      40.00000     17.00000      6.52000
XSTAR1=     0.00000   XSTAR2=      0.00000
XSTOP1=    40.00000   XSTOP2=     40.00000
```

Figure 6. Listing of pressure profile data required for model initialization.

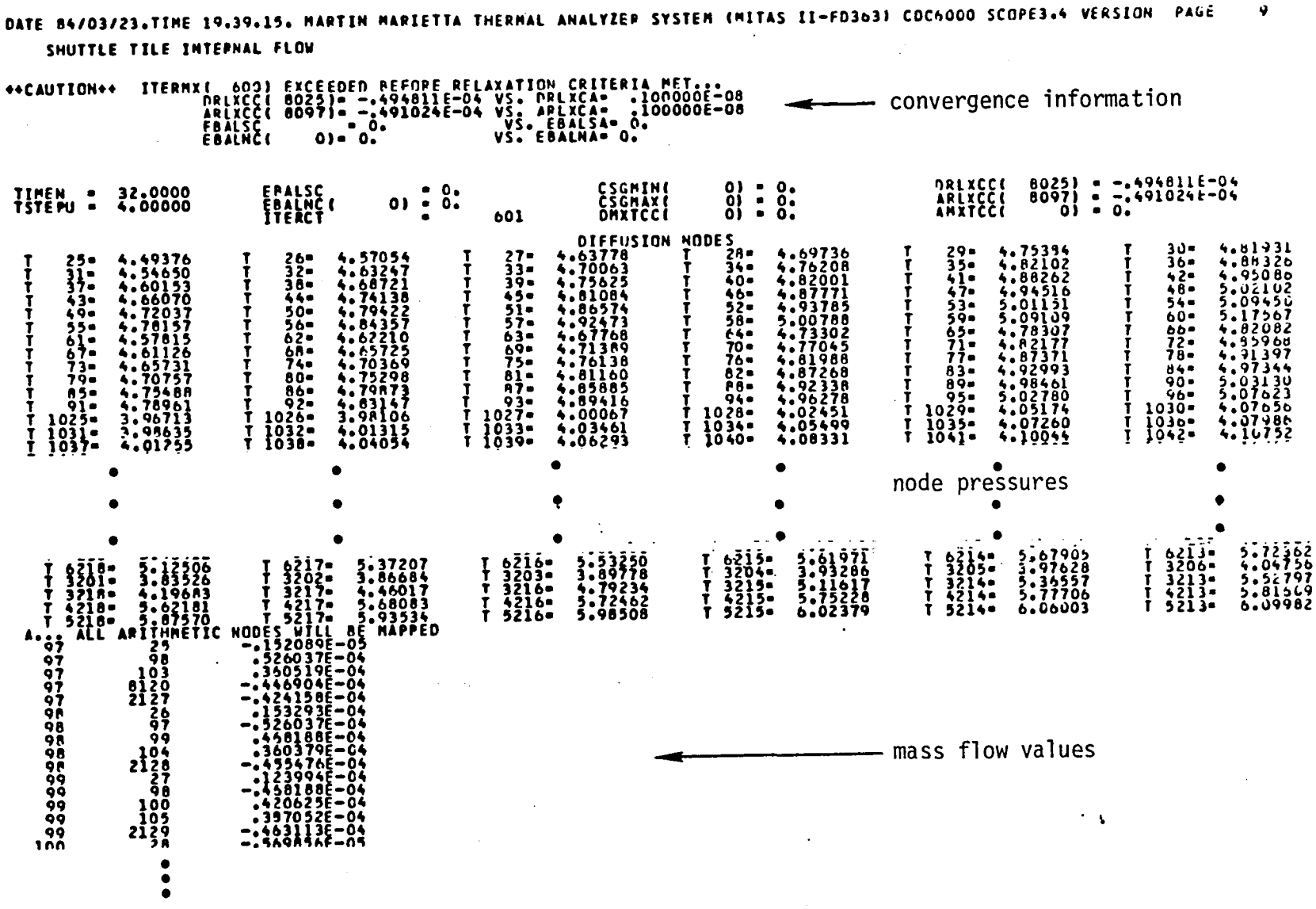

Figure 7. Example of MITAS-II flow related output.

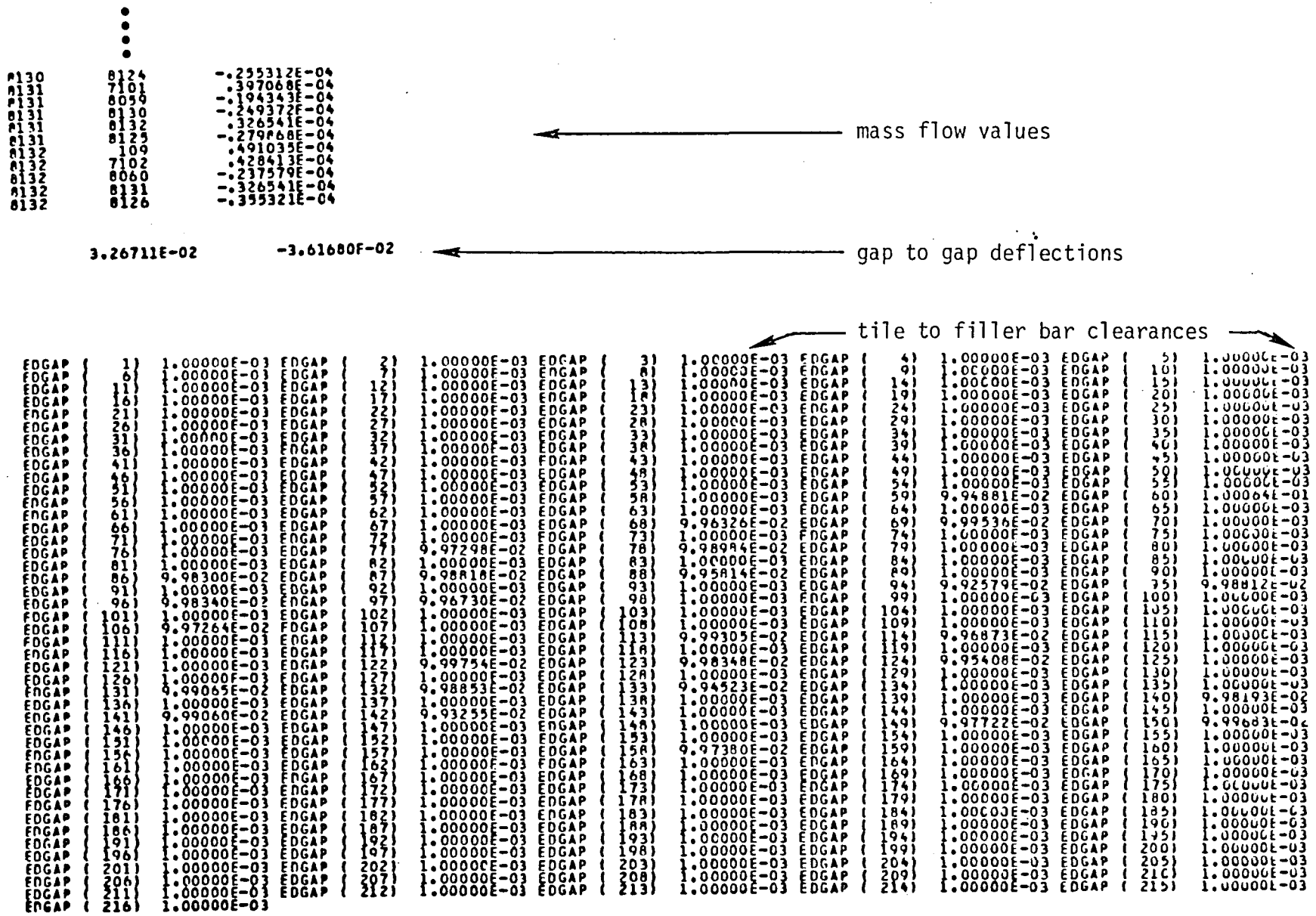

Figure 7 (cont.). Example of MITAS-II flow related output.

```
$SHOCK
U        = .2116F+04,
RHO      = .1E-01,
XMU      = .128E-04,
XSHOCK   = .2902E+03,
XZERO    = .28384E+03,
RS       = .36E-01,
DELTAX   = .1E+00,
DTILE    = .147E+01,
FLOSIGN  = .1E+01,
$END
B(1-24), TOP OF GAP
      3.73963311      3.76463875      3.79899422      3.83420721      3.86584139      3.89669428
      3.93411633      3.97779004      4.05100748      4.19131744      4.44957763      4.78128213
      4.78128734      4.44958204      4.19131943      4.05100853      3.97779042      3.93411658
      3.89777810      3.86683621      3.83525887      3.79782461      3.76358465      3.73934650
G(1-24), BOTTOM OF GAP
      3.76315110      3.78533574      3.81468761      3.84874537      3.88684009      3.93189097
      4.05372077      4.12186446      4.25656631      4.39504862      4.49693957      4.62072920
      4.54209849      4.40979090      4.25904499      4.13961473      4.06116254      4.02126720
      3.95608785      3.89199254      3.83439378      3.80119420      3.77797455      3.75679989
ARRAY PSUR
      3.75144864      3.78217724      3.81799893      3.85144838      3.88222398      3.91446633
      3.78217939      3.81799710      3.85144672      3.88222239      3.91446461      3.95311980
      3.81799527      3.85144506      3.88222080      3.91446290      3.95311742      4.00672179
      3.85144339      3.88221922      3.91446118      3.95311503      4.00671852      4.10095937
      3.88221763      3.91445947      3.95311265      4.00671525      4.10095065      4.29988419
      3.91445775      3.95311027      4.00671198      4.10094193      4.29987044      4.60187724
ARRAY PTBL
      4.49375718      4.57053951      4.63778196      4.69736158      4.75384345      4.81931356
      4.54649757      4.63247456      4.70062859      4.76208033      4.82102465      4.88326212
      4.60153316      4.68720678      4.75624859      4.82001131      4.88261904      4.95086033
      4.66070120      4.74137614      4.81083980      4.87770792      4.94516205      5.02102113
      4.72037471      4.79421891      4.86574390      4.93784914      5.01151309      5.09450125
      4.78157233      4.84356956      4.92472869      5.00787704      5.09108966      5.17566815
```

Figure 8. Listing of data required for force and moment calculations.

TOTAL FORCES AND TOTAL MOMENTS

FXTOT	FYTOT	FZTOT	MXTOT	MYTOT	MZTOT
-.50228019E+01	-.27205698E+00	.30952180E+02	.82696153E+00	-.43210101E+01	-.45789313E-01

GAP FORCES

GFX	GFY
-.53522744E+01	-.27205698E+00

GAP MOMENTS

GMX	GMY	GMZ
.13314665E+00	-.38881844E+01	-.45789313E-01

SKIN FRICTION FORCES AND MOMENTS

SFX	SMY
.32947248E+00	.48432454E+00

NORMAL FORCE FM .30952180E+02

NORMAL FORCE MOMENTS

MX	MY	MZ
.69381489E+00	-.91715027E+00	0.

Figure 9. Force and moment summary.

APPENDIX A

Procedure File for Execution

```
JOB,T000,CM000000
USER,USERNO,PASSWD.
CHARGE,CHARGENO,LRC.
DELIVER.
GET,MITABS,ZRJCLIB,ZLIBRY/UN=691425N.
ATTACH,AKCLIB,FTNMLIB/UN=LIBRARY.
ATTACH,XEDIT/UN=LIBRARY.
GET,A=MODEL.
GET,TAPE5=PROFILE.
XEDIT,A.;XL/EXEC/;XL/2.135/;XC/3.74/;XQ
XEDIT,A.;XL/CONSTANTS/;XL/100=/;XC/1.41./1.47./;XQ
XEDIT,A.;XL/CONSTANTS/;XP30;XQ
MITABS,MOUTPUT,,,,,I=A.
RETURN,MITABS.
REPLACE,MOUTPUT.
XEDIT,EXFOR.;XL/)/;XC/)/,INPUT,TAPE7=INPUT,TAPE5)/;XQ
FTN(I=EXFOR,R=3,L=LIST)
LDSET(LIB=ZRJCLIB/ZLIBRY/AKCLIB/FTNMLIB,PRESETA=NGINF,
      MAP=SBEX/LMAP)
LGO.
DAYFILE,DAYTEST.
REPLACE,DAYTEST.
EXIT.
DAYFILE,DAYTEST.
REPLACE,DAYTEST.
REPLACE,LIST.
REPLACE,LMAP.
COPYSBF,LIST,TEMP.
COPYSBF,LMAP,TEMP.
REWIND,TEMP.
ROUTE,TEMP,DC=PR.
EOR
 $ XYCOOR X=13.64, Y=0.0, ISTA=1, IEND=81$END
 $ XSHOCK U=2116.0, RHO=.01, XMU=.128E-4, XSHOCK=290.2,
   XZERO=283.84, KS=.036, DELTAX=.1, DTILE=1.47, FLOSIGN=1.0$END
EOR
EOF
```

APPENDIX A, CONTINUED

MITAS-II Model Input File

```
NOT RESTART
NGENL=NG
NDIP=NGCA
```

APPENDIX A, CONTINUED

```
BCD 3TITLE DATA
BCD 9SHUTTLE TILE INTERNAL FLOW
END
BCD 3NODE DATA
GEN   97,36,1,0.,-1.
 1024,0.,-1.,    1023,0.,-1.,    1022,0.,-1.,    1021,0.,-1.
 1020,0.,-1.,    1019,0.,-1.,    8024,0.,-1.,    8023,0.,-1.
 8022,0.,-1.,    8021,0.,-1.,    8020,0.,-1.,    8019,0.,-1.
 7024,0.,-1.,    7023,0.,-1.,    7022,0.,-1.,    7021,0.,-1.
 7020,0.,-1.,    7019,0.,-1.,    1007,0.,-1.,    1008,0.,-1.
 1009,0.,-1.,    1010,0.,-1.,    1011,0.,-1.,    1012,0.,-1.
 2021,0.,-1.,    2020,0.,-1.,    2019,0.,-1.,      24,0.,-1.
   23,0.,-1.,      22,0.,-1.,      21,0.,-1.,      20,0.,-1.
   19,0.,-1.,    6024,0.,-1.,    6023,0.,-1.,    6022,0.,-1.
 6021,0.,-1.,    6020,0.,-1.,    6019,0.,-1.,    2007,0.,-1.
 2008,0.,-1.,    2009,0.,-1.,    2010,0.,-1.,    2011,0.,-1.
 2012,0.,-1.,       7,0.,-1.,       8,0.,-1.,       9,0.,-1.
   10,0.,-1.,      11,0.,-1.,      12,0.,-1.,    4021,0.,-1.
 4020,0.,-1.,    4019,0.,-1.,    5024,0.,-1.,    5023,0.,-1.
 5022,0.,-1.,    5021,0.,-1.,    5020,0.,-1.,    5019,0.,-1.
 3007,0.,-1.,    3008,0.,-1.,    3009,0.,-1.,    3010,0.,-1.
 3011,0.,-1.,    3012,0.,-1.,    4007,0.,-1.,    4008,0.,-1.
 4009,0.,-1.,    4010,0.,-1.,    4011,0.,-1.,    4012,0.,-1.
 5007,0.,-1.,    5008,0.,-1.,    5009,0.,-1.,    5010,0.,-1.
 5011,0.,-1.,    5012,0.,-1.,    1001,0.,-1.,    1002,0.,-1.
 1003,0.,-1.,    1004,0.,-1.,    1005,0.,-1.,    1006,0.,-1.
 1018,0.,-1.,    1017,0.,-1.,    1016,0.,-1.,    1015,0.,-1.
 1014,0.,-1.,    1013,0.,-1.,    7001,0.,-1.,    7002,0.,-1.
 7003,0.,-1.,    7004,0.,-1.,    7005,0.,-1.,    7006,0.,-1.
 7018,0.,-1.,    7017,0.,-1.,    7016,0.,-1.,    7015,0.,-1.
 7014,0.,-1.,    7013,0.,-1.,    2001,0.,-1.,    2002,0.,-1.
 2003,0.,-1.,    2004,0.,-1.,    2005,0.,-1.,    2006,0.,-1.
    1,0.,-1.,       2,0.,-1.,       3,0.,-1.,       4,0.,-1.
    5,0.,-1.,       6,0.,-1.,      18,0.,-1.,      17,0.,-1.
   16,0.,-1.,      15,0.,-1.,      14,0.,-1.,      13,0.,-1.
 6018,0.,-1.,    6017,0.,-1.,    6016,0.,-1.,    6015,0.,-1.
 6014,0.,-1.,    6013,0.,-1.,    3001,0.,-1.,    3002,0.,-1.
 3003,0.,-1.,    3004,0.,-1.,    3005,0.,-1.,    3006,0.,-1.
 3018,0.,-1.,    3017,0.,-1.,    3016,0.,-1.,    3015,0.,-1.
 3014,0.,-1.,    3013,0.,-1.,    4018,0.,-1.,    4017,0.,-1.
 4016,0.,-1.,    4015,0.,-1.,    4014,0.,-1.,    4013,0.,-1.
 5018,0.,-1.,    5017,0.,-1.,    5016,0.,-1.,    5015,0.,-1.
 5014,0.,-1.,    5013,0.,-1.
CGS   25,0.,A1,R1,    26,0.,A1,R1,    27,0.,A1,R1,    28,0.,A1,R1
CGS   29,0.,A1,R1,    30,0.,A1,R1,    31,0.,A1,R1,    32,0.,A1,R1
CGS   33,0.,A1,R1,    34,0.,A1,R1,    35,0.,A1,R1,    36,0.,A1,R1
CGS   37,0.,A1,R1,    38,0.,A1,R1,    39,0.,A1,R1,    40,0.,A1,R1
CGS   41,0.,A1,R1,    42,0.,A1,R1,    43,0.,A1,R1,    44,0.,A1,R1
CGS   45,0.,A1,R1,    46,0.,A1,R1,    47,0.,A1,R1,    48,0.,A1,R1
CGS   49,0.,A1,R1,    50,0.,A1,R1,    51,0.,A1,R1,    52,0.,A1,R1
CGS   53,0.,A1,R1,    54,0.,A1,R1,    55,0.,A1,R1,    56,0.,A1,R1
CGS   57,0.,A1,R1,    58,0.,A1,R1,    59,0.,A1,R1,    60,0.,A1,R1
CGS   61,0.,A1,R1,    62,0.,A1,R1,    63,0.,A1,R1,    64,0.,A1,R1
CGS   65,0.,A1,R1,    66,0.,A1,R1,    67,0.,A1,R1,    68,0.,A1,R1
CGS   69,0.,A1,R1,    70,0.,A1,R1,    71,0.,A1,R1,    72,0.,A1,R1
CGS   73,0.,A1,R1,    74,0.,A1,R1,    75,0.,A1,R1,    76,0.,A1,R1
CGS   77,0.,A1,R1,    78,0.,A1,R1,    79,0.,A1,R1,    80,0.,A1,R1
CGS   81,0.,A1,R1,    82,0.,A1,R1,    83,0.,A1,R1,    84,0.,A1,R1
CGS   85,0.,A1,R1,    86,0.,A1,R1,    87,0.,A1,R1,    88,0.,A1,R1
CGS   89,0.,A1,R1,    90,0.,A1,R1,    91,0.,A1,R1,    92,0.,A1,R1
CGS   93,0.,A1,R1,    94,0.,A1,R1,    95,0.,A1,R1,    96,0.,A1,R1
 -1224,       3.740,       0.0
 -1223,       3.740,       0.0
 -1222,       3.740,       0.0
```

APPENDIX A, CONTINUED

```
-1221,      3.740,      0.0
-1220,      3.740,      0.0
-1219,      3.739,      0.0
-8224,      3.739,      0.0
-8223,      3.739,      0.0
-8222,      3.739,      0.0
-8221,      3.740,      0.0
-8220,      3.740,      0.0
-8219,      3.741,      0.0
-7224,      3.740,      0.0
-7223,      3.737,      0.0
-7222,      3.734,      0.0
-7221,      3.739,      0.0
-7220,      3.764,      0.0
-7219,      3.798,      0.0
-1207,      3.739,      0.0
-1208,      3.739,      0.0
-1209,      3.739,      0.0
-1210,      3.740,      0.0
-1211,      3.740,      0.0
-1212,      3.741,      0.0
-2221,      3.740,      0.0
-2220,      3.737,      0.0
-2219,      3.734,      0.0
 -224,      3.739,      0.0
 -223,      3.764,      0.0
 -222,      3.798,      0.0
 -221,      3.835,      0.0
 -220,      3.867,      0.0
 -219,      3.899,      0.0
-6224,      3.933,      0.0
-6223,      3.976,      0.0
-6222,      4.048,      0.0
-6221,      4.197,      0.0
-6220,      4.460,      0.0
-6219,      4.792,      0.0
-2207,      3.740,      0.0
-2208,      3.765,      0.0
-2209,      3.799,      0.0
-2210,      3.834,      0.0
-2211,      3.866,      0.0
-2212,      3.897,      0.0
 -207,      3.934,      0.0
 -208,      3.978,      0.0
 -209,      4.051,      0.0
 -210,      4.191,      0.0
 -211,      4.450,      0.0
 -212,      4.781,      0.0
-4221,      5.125,      0.0
-4220,      5.372,      0.0
-4219,      5.533,      0.0
-5224,      5.620,      0.0
-5223,      5.679,      0.0
-5222,      5.724,      0.0
-5221,      5.753,      0.0
-5220,      5.778,      0.0
-5219,      5.818,      0.0
-3207,      4.197,      0.0
-3208,      4.460,      0.0
-3209,      4.792,      0.0
-3210,      5.116,      0.0
-3211,      5.366,      0.0
-3212,      5.528,      0.0
-4207,      5.622,      0.0
```

APPENDIX A, CONTINUED

```
-4208,      5.681,      0.0
-4209,      5.725,      0.0
-4210,      5.752,      0.0
-4211,      5.777,      0.0
-4212,      5.816,      0.0
-5207,      5.876,      0.0
-5208,      5.935,      0.0
-5209,      5.985,      0.0
-5210,      6.024,      0.0
-5211,      6.060,      0.0
-5212,      6.100,      0.0
-1201,      3.740,      0.0
-1202,      3.740,      0.0
-1203,      3.740,      0.0
-1204,      3.740,      0.0
-1205,      3.740,      0.0
-1206,      3.739,      0.0
-1218,      3.739,      0.0
-1217,      3.739,      0.0
-1216,      3.739,      0.0
-1215,      3.740,      0.0
-1214,      3.740,      0.0
-1213,      3.741,      0.0
-7201,      3.740,      0.0
-7202,      3.737,      0.0
-7203,      3.734,      0.0
-7204,      3.739,      0.0
-7205,      3.764,      0.0
-7206,      3.798,      0.0
-7218,      3.835,      0.0
-7217,      3.867,      0.0
-7216,      3.898,      0.0
-7215,      3.933,      0.0
-7214,      3.976,      0.0
-7213,      4.048,      0.0
-2201,      3.740,      0.0
-2202,      3.740,      0.0
-2203,      3.741,      0.0
-2204,      3.740,      0.0
-2205,      3.737,      0.0
-2206,      3.734,      0.0
 -201,      3.740,      0.0
 -202,      3.765,      0.0
 -203,      3.799,      0.0
 -204,      3.834,      0.0
 -205,      3.866,      0.0
 -206,      3.897,      0.0
 -218,      3.934,      0.0
 -217,      3.979,      0.0
 -216,      4.051,      0.0
 -215,      4.191,      0.0
 -214,      4.450,      0.0
 -213,      4.781,      0.0
-6218,      5.125,      0.0
-6217,      5.372,      0.0
-6216,      5.533,      0.0
-6215,      5.620,      0.0
-6214,      5.679,      0.0
-6213,      5.724,      0.0
-3201,      3.835,      0.0
-3202,      3.867,      0.0
-3203,      3.898,      0.0
-3204,      3.933,      0.0
-3205,      3.976,      0.0
```

APPENDIX A, CONTINUED

```
 -3206,        4.048,        0.0
 -3218,        4.197,        0.0
 -3217,        4.460,        0.0
 -3216,        4.792,        0.0
 -3215,        5.116,        0.0
 -3214,        5.366,        0.0
 -3213,        5.528,        0.0
 -4218,        5.622,        0.0
 -4217,        5.681,        0.0
 -4216,        5.725,        0.0
 -4215,        5.752,        0.0
 -4214,        5.777,        0.0
 -4213,        5.816,        0.0
 -5218,        5.876,        0.0
 -5217,        5.935,        0.0
 -5216,        5.985,        0.0
 -5215,        6.024,        0.0
 -5214,        6.060,        0.0
 -5213,        6.100,        0.0
GEN 1097,36,1,0.,-1.
CGS 1025,0.,A1,R1, 1026,0.,A1,R1, 1027,0.,A1,R1, 1028,0.,A1,R1
CGS 1029,0.,A1,R1, 1030,0.,A1,R1, 1031,0.,A1,R1, 1032,0.,A1,R1
CGS 1033,0.,A1,R1, 1034,0.,A1,R1, 1035,0.,A1,R1, 1036,0.,A1,R1
CGS 1037,0.,A1,R1, 1038,0.,A1,R1, 1039,0.,A1,R1, 1040,0.,A1,R1
CGS 1041,0.,A1,R1, 1042,0.,A1,R1, 1043,0.,A1,R1, 1044,0.,A1,R1
CGS 1045,0.,A1,R1, 1046,0.,A1,R1, 1047,0.,A1,R1, 1048,0.,A1,R1
CGS 1049,0.,A1,R1, 1050,0.,A1,R1, 1051,0.,A1,R1, 1052,0.,A1,R1
CGS 1053,0.,A1,R1, 1054,0.,A1,R1, 1055,0.,A1,R1, 1056,0.,A1,R1
CGS 1057,0.,A1,R1, 1058,0.,A1,R1, 1059,0.,A1,R1, 1060,0.,A1,R1
CGS 1061,0.,A1,R1, 1062,0.,A1,R1, 1063,0.,A1,R1, 1064,0.,A1,R1
CGS 1065,0.,A1,R1, 1066,0.,A1,R1, 1067,0.,A1,R1, 1068,0.,A1,R1
CGS 1069,0.,A1,R1, 1070,0.,A1,R1, 1071,0.,A1,R1, 1072,0.,A1,R1
CGS 1073,0.,A1,R1, 1074,0.,A1,R1, 1075,0.,A1,R1, 1076,0.,A1,R1
CGS 1077,0.,A1,R1, 1078,0.,A1,R1, 1079,0.,A1,R1, 1080,0.,A1,R1
CGS 1081,0.,A1,R1, 1082,0.,A1,R1, 1083,0.,A1,R1, 1084,0.,A1,R1
CGS 1085,0.,A1,R1, 1086,0.,A1,R1, 1087,0.,A1,R1, 1088,0.,A1,R1
CGS 1089,0.,A1,R1, 1090,0.,A1,R1, 1091,0.,A1,R1, 1092,0.,A1,R1
CGS 1093,0.,A1,R1, 1094,0.,A1,R1, 1095,0.,A1,R1, 1096,0.,A1,R1
GEN 2097,36,1,0.,-1.
CGS 2025,0.,A1,R1, 2026,0.,A1,R1, 2027,0.,A1,R1, 2028,0.,A1,R1
CGS 2029,0.,A1,R1, 2030,0.,A1,R1, 2031,0.,A1,R1, 2032,0.,A1,R1
CGS 2033,0.,A1,R1, 2034,0.,A1,R1, 2035,0.,A1,R1, 2036,0.,A1,R1
CGS 2037,0.,A1,R1, 2038,0.,A1,R1, 2039,0.,A1,R1, 2040,0.,A1,R1
CGS 2041,0.,A1,R1, 2042,0.,A1,R1, 2043,0.,A1,R1, 2044,0.,A1,R1
CGS 2045,0.,A1,R1, 2046,0.,A1,R1, 2047,0.,A1,R1, 2048,0.,A1,R1
CGS 2049,0.,A1,R1, 2050,0.,A1,R1, 2051,0.,A1,R1, 2052,0.,A1,R1
CGS 2053,0.,A1,R1, 2054,0.,A1,R1, 2055,0.,A1,R1, 2056,0.,A1,R1
CGS 2057,0.,A1,R1, 2058,0.,A1,R1, 2059,0.,A1,R1, 2060,0.,A1,R1
CGS 2061,0.,A1,R1, 2062,0.,A1,R1, 2063,0.,A1,R1, 2064,0.,A1,R1
CGS 2065,0.,A1,R1, 2066,0.,A1,R1, 2067,0.,A1,R1, 2068,0.,A1,R1
CGS 2069,0.,A1,R1, 2070,0.,A1,R1, 2071,0.,A1,R1, 2072,0.,A1,R1
CGS 2073,0.,A1,R1, 2074,0.,A1,R1, 2075,0.,A1,R1, 2076,0.,A1,R1
CGS 2077,0.,A1,R1, 2078,0.,A1,R1, 2079,0.,A1,R1, 2080,0.,A1,R1
CGS 2081,0.,A1,R1, 2082,0.,A1,R1, 2083,0.,A1,R1, 2084,0.,A1,R1
CGS 2085,0.,A1,R1, 2086,0.,A1,R1, 2087,0.,A1,R1, 2088,0.,A1,R1
CGS 2089,0.,A1,R1, 2090,0.,A1,R1, 2091,0.,A1,R1, 2092,0.,A1,R1
CGS 2093,0.,A1,R1, 2094,0.,A1,R1, 2095,0.,A1,R1, 2096,0.,A1,R1
GEN 3097,36,1,0.,-1.
CGS 3025,0.,A1,R1, 3026,0.,A1,R1, 3027,0.,A1,R1, 3028,0.,A1,R1
CGS 3029,0.,A1,R1, 3030,0.,A1,R1, 3031,0.,A1,R1, 3032,0.,A1,R1
CGS 3033,0.,A1,R1, 3034,0.,A1,R1, 3035,0.,A1,R1, 3036,0.,A1,R1
CGS 3037,0.,A1,R1, 3038,0.,A1,R1, 3039,0.,A1,R1, 3040,0.,A1,R1
CGS 3041,0.,A1,R1, 3042,0.,A1,R1, 3043,0.,A1,R1, 3044,0.,A1,R1
CGS 3045,0.,A1,R1, 3046,0.,A1,R1, 3047,0.,A1,R1, 3048,0.,A1,R1
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APPENDIX A, CONTINUED

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CGS 3049,0.,A1,R1, 3050,0.,A1,R1, 3051,0.,A1,R1, 3052,0.,A1,R1
CGS 3053,0.,A1,R1, 3054,0.,A1,R1, 3055,0.,A1,R1, 3056,0.,A1,R1
CGS 3057,0.,A1,R1, 3058,0.,A1,R1, 3059,0.,A1,R1, 3060,0.,A1,R1
CGS 3061,0.,A1,R1, 3062,0.,A1,R1, 3063,0.,A1,R1, 3064,0.,A1,R1
CGS 3065,0.,A1,R1, 3066,0.,A1,R1, 3067,0.,A1,R1, 3068,0.,A1,R1
CGS 3069,0.,A1,R1, 3070,0.,A1,R1, 3071,0.,A1,R1, 3072,0.,A1,R1
CGS 3073,0.,A1,R1, 3074,0.,A1,R1, 3075,0.,A1,R1, 3076,0.,A1,R1
CGS 3077,0.,A1,R1, 3078,0.,A1,R1, 3079,0.,A1,R1, 3080,0.,A1,R1
CGS 3081,0.,A1,R1, 3082,0.,A1,R1, 3083,0.,A1,R1, 3084,0.,A1,R1
CGS 3085,0.,A1,R1, 3086,0.,A1,R1, 3087,0.,A1,R1, 3088,0.,A1,R1
CGS 3089,0.,A1,R1, 3090,0.,A1,R1, 3091,0.,A1,R1, 3092,0.,A1,R1
CGS 3093,0.,A1,R1, 3094,0.,A1,R1, 3095,0.,A1,R1, 3096,0.,A1,R1
GEN 4097,36,1,0.,-1.
CGS 4025,0.,A1,R1, 4026,0.,A1,R1, 4027,0.,A1,R1, 4028,0.,A1,R1
CGS 4029,0.,A1,R1, 4030,0.,A1,R1, 4031,0.,A1,R1, 4032,0.,A1,R1
CGS 4033,0.,A1,R1, 4034,0.,A1,R1, 4035,0.,A1,R1, 4036,0.,A1,R1
CGS 4037,0.,A1,R1, 4038,0.,A1,R1, 4039,0.,A1,R1, 4040,0.,A1,R1
CGS 4041,0.,A1,R1, 4042,0.,A1,R1, 4043,0.,A1,R1, 4044,0.,A1,R1
CGS 4045,0.,A1,R1, 4046,0.,A1,R1, 4047,0.,A1,R1, 4048,0.,A1,R1
CGS 4049,0.,A1,R1, 4050,0.,A1,R1, 4051,0.,A1,R1, 4052,0.,A1,R1
CGS 4053,0.,A1,R1, 4054,0.,A1,R1, 4055,0.,A1,R1, 4056,0.,A1,R1
CGS 4057,0.,A1,R1, 4058,0.,A1,R1, 4059,0.,A1,R1, 4060,0.,A1,R1
CGS 4061,0.,A1,R1, 4062,0.,A1,R1, 4063,0.,A1,R1, 4064,0.,A1,R1
CGS 4065,0.,A1,R1, 4066,0.,A1,R1, 4067,0.,A1,R1, 4068,0.,A1,R1
CGS 4069,0.,A1,R1, 4070,0.,A1,R1, 4071,0.,A1,R1, 4072,0.,A1,R1
CGS 4073,0.,A1,R1, 4074,0.,A1,R1, 4075,0.,A1,R1, 4076,0.,A1,R1
CGS 4077,0.,A1,R1, 4078,0.,A1,R1, 4079,0.,A1,R1, 4080,0.,A1,R1
CGS 4081,0.,A1,R1, 4082,0.,A1,R1, 4083,0.,A1,R1, 4084,0.,A1,R1
CGS 4085,0.,A1,R1, 4086,0.,A1,R1, 4087,0.,A1,R1, 4088,0.,A1,R1
CGS 4089,0.,A1,R1, 4090,0.,A1,R1, 4091,0.,A1,R1, 4092,0.,A1,R1
CGS 4093,0.,A1,R1, 4094,0.,A1,R1, 4095,0.,A1,R1, 4096,0.,A1,R1
GEN 5097,36,1,0.,-1.
CGS 5025,0.,A1,R1, 5026,0.,A1,R1, 5027,0.,A1,R1, 5028,0.,A1,R1
CGS 5029,0.,A1,R1, 5030,0.,A1,R1, 5031,0.,A1,R1, 5032,0.,A1,R1
CGS 5033,0.,A1,R1, 5034,0.,A1,R1, 5035,0.,A1,R1, 5036,0.,A1,R1
CGS 5037,0.,A1,R1, 5038,0.,A1,R1, 5039,0.,A1,R1, 5040,0.,A1,R1
CGS 5041,0.,A1,R1, 5042,0.,A1,R1, 5043,0.,A1,R1, 5044,0.,A1,R1
CGS 5045,0.,A1,R1, 5046,0.,A1,R1, 5047,0.,A1,R1, 5048,0.,A1,R1
CGS 5049,0.,A1,R1, 5050,0.,A1,R1, 5051,0.,A1,R1, 5052,0.,A1,R1
CGS 5053,0.,A1,R1, 5054,0.,A1,R1, 5055,0.,A1,R1, 5056,0.,A1,R1
CGS 5057,0.,A1,R1, 5058,0.,A1,R1, 5059,0.,A1,R1, 5060,0.,A1,R1
CGS 5061,0.,A1,R1, 5062,0.,A1,R1, 5063,0.,A1,R1, 5064,0.,A1,R1
CGS 5065,0.,A1,R1, 5066,0.,A1,R1, 5067,0.,A1,R1, 5068,0.,A1,R1
CGS 5069,0.,A1,R1, 5070,0.,A1,R1, 5071,0.,A1,R1, 5072,0.,A1,R1
CGS 5073,0.,A1,R1, 5074,0.,A1,R1, 5075,0.,A1,R1, 5076,0.,A1,R1
CGS 5077,0.,A1,R1, 5078,0.,A1,R1, 5079,0.,A1,R1, 5080,0.,A1,R1
CGS 5081,0.,A1,R1, 5082,0.,A1,R1, 5083,0.,A1,R1, 5084,0.,A1,R1
CGS 5085,0.,A1,R1, 5086,0.,A1,R1, 5087,0.,A1,R1, 5088,0.,A1,R1
CGS 5089,0.,A1,R1, 5090,0.,A1,R1, 5091,0.,A1,R1, 5092,0.,A1,R1
CGS 5093,0.,A1,R1, 5094,0.,A1,R1, 5095,0.,A1,R1, 5096,0.,A1,R1
GEN 6097,36,1,0.,-1.
CGS 6025,0.,A1,R1, 6026,0.,A1,R1, 6027,0.,A1,R1, 6028,0.,A1,R1
CGS 6029,0.,A1,R1, 6030,0.,A1,R1, 6031,0.,A1,R1, 6032,0.,A1,R1
CGS 6033,0.,A1,R1, 6034,0.,A1,R1, 6035,0.,A1,R1, 6036,0.,A1,R1
CGS 6037,0.,A1,R1, 6038,0.,A1,R1, 6039,0.,A1,R1, 6040,0.,A1,R1
CGS 6041,0.,A1,R1, 6042,0.,A1,R1, 6043,0.,A1,R1, 6044,0.,A1,R1
CGS 6045,0.,A1,R1, 6046,0.,A1,R1, 6047,0.,A1,R1, 6048,0.,A1,R1
CGS 6049,0.,A1,R1, 6050,0.,A1,R1, 6051,0.,A1,R1, 6052,0.,A1,R1
CGS 6053,0.,A1,R1, 6054,0.,A1,R1, 6055,0.,A1,R1, 6056,0.,A1,R1
CGS 6057,0.,A1,R1, 6058,0.,A1,R1, 6059,0.,A1,R1, 6060,0.,A1,R1
CGS 6061,0.,A1,R1, 6062,0.,A1,R1, 6063,0.,A1,R1, 6064,0.,A1,R1
CGS 6065,0.,A1,R1, 6066,0.,A1,R1, 6067,0.,A1,R1, 6068,0.,A1,R1
CGS 6069,0.,A1,R1, 6070,0.,A1,R1, 6071,0.,A1,R1, 6072,0.,A1,R1
CGS 6073,0.,A1,R1, 6074,0.,A1,R1, 6075,0.,A1,R1, 6076,0.,A1,R1
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APPENDIX A, CONTINUED

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      CGS 6077,0.,A1,R1, 6078,0.,A1,R1, 6079,0.,A1,R1, 6080,0.,A1,R1
      CGS 6081,0.,A1,R1, 6082,0.,A1,R1, 6083,0.,A1,R1, 6084,0.,A1,R1
      CGS 6085,0.,A1,R1, 6086,0.,A1,R1, 6087,0.,A1,R1, 6088,0.,A1,R1
      CGS 6089,0.,A1,R1, 6090,0.,A1,R1, 6091,0.,A1,R1, 6092,0.,A1,R1
      CGS 6093,0.,A1,R1, 6094,0.,A1,R1, 6095,0.,A1,R1, 6096,0.,A1,R1
      GEN 7097,36,1,0.,-1.
      CGS 7025,0.,A1,R1, 7026,0.,A1,R1, 7027,0.,A1,P1, 7028,0.,A1,R1
      CGS 7029,0.,A1,R1, 7030,0.,A1,R1, 7031,0.,A1,R1, 7032,0.,A1,R1
      CGS 7033,0.,A1,R1, 7034,0.,A1,R1, 7035,0.,A1,R1, 7036,0.,A1,R1
      CGS 7037,0.,A1,R1, 7038,0.,A1,R1, 7039,0.,A1,R1, 7040,0.,A1,R1
      CGS 7041,0.,A1,R1, 7042,0.,A1,R1, 7043,0.,A1,R1, 7044,0.,A1,R1
      CGS 7045,0.,A1,P1, 7046,0.,A1,R1, 7047,0.,A1,R1, 7048,0.,A1,R1
      CGS 7049,0.,A1,R1, 7050,0.,A1,R1, 7051,0.,A1,P1, 7052,0.,A1,P1
      CGS 7053,0.,A1,R1, 7054,0.,A1,R1, 7055,0.,A1,P1, 7056,0.,A1,R1
      CGS 7057,0.,A1,P1, 7058,0.,A1,R1, 7059,0.,A1,R1, 7060,0.,A1,R1
      CGS 7061,0.,A1,P1, 7062,0.,A1,R1, 7063,0.,A1,P1, 7064,0.,A1,R1
      CGS 7065,0.,A1,P1, 7066,0.,A1,R1, 7067,0.,A1,R1, 7068,0.,A1,R1
      CGS 7069,0.,A1,P1, 7070,0.,A1,R1, 7071,0.,A1,P1, 7072,0.,A1,R1
      CGS 7073,0.,A1,P1, 7074,0.,A1,R1, 7075,0.,A1,P1, 7076,0.,A1,R1
      CGS 7077,0.,A1,R1, 7078,0.,A1,R1, 7079,0.,A1,P1, 7080,0.,A1,R1
      CGS 7081,0.,A1,R1, 7082,0.,A1,P1, 7083,0.,A1,R1, 7084,0.,A1,R1
      CGS 7085,0.,A1,R1, 7086,0.,A1,R1, 7087,0.,A1,P1, 7088,0.,A1,R1
      CGS 7089,0.,A1,R1, 7090,0.,A1,R1, 7091,0.,A1,R1, 7092,0.,A1,R1
      CGS 7093,0.,A1,R1, 7094,0.,A1,P1, 7095,0.,A1,R1, 7096,0.,A1,R1
      GEN 8097,36,1,0.,-1.
      CGS 8025,0.,A1,R1, 8026,0.,A1,P1, 8027,0.,A1,P1, 8028,0.,A1,R1
      CGS 8029,0.,A1,R1, 8030,0.,A1,R1, 8031,0.,A1,R1, 8032,0.,A1,R1
      CGS 8033,0.,A1,P1, 8034,0.,A1,R1, 8035,0.,A1,P1, 8036,0.,A1,P1
      CGS 8037,0.,A1,R1, 8038,0.,A1,P1, 8039,0.,A1,R1, 8040,0.,A1,R1
      CGS 8041,0.,A1,P1, 8042,0.,A1,P1, 8043,0.,A1,R1, 8044,0.,A1,R1
      CGS 8045,0.,A1,R1, 8046,0.,A1,R1, 8047,0.,A1,P1, 8048,0.,A1,R1
      CGS 8049,0.,A1,R1, 8050,0.,A1,R1, 8051,0.,A1,R1, 8052,0.,A1,R1
      CGS 8053,0.,A1,R1, 8054,0.,A1,R1, 8055,0.,A1,R1, 8056,0.,A1,R1
      CGS 8057,0.,A1,P1, 8058,0.,A1,R1, 8059,0.,A1,R1, 8060,0.,A1,R1
      CGS 8061,0.,A1,P1, 8062,0.,A1,R1, 8063,0.,A1,P1, 8064,0.,A1,R1
      CGS 8065,0.,A1,P1, 8066,0.,A1,P1, 8067,0.,A1,P1, 8068,0.,A1,R1
      CGS 8069,0.,A1,P1, 8070,0.,A1,R1, 8071,0.,A1,P1, 8072,0.,A1,R1
      CGS 8073,0.,A1,R1, 8074,0.,A1,R1, 8075,0.,A1,R1, 8076,0.,A1,R1
      CGS 8077,0.,A1,P1, 8078,0.,A1,P1, 8079,0.,A1,P1, 8080,0.,A1,R1
      CGS 8081,0.,A1,P1, 8082,0.,A1,R1, 8083,0.,A1,R1, 8084,0.,A1,R1
      CGS 8085,0.,A1,P1, 8086,0.,A1,R1, 8087,0.,A1,R1, 8088,0.,A1,R1
      CGS 8089,0.,A1,P1, 8090,0.,A1,R1, 8091,0.,A1,P1, 8092,0.,A1,P1
      CGS 8093,0.,A1,P1, 8094,0.,A1,R1, 8095,0.,A1,P1, 8096,0.,A1,R1
      END
      BCD 3CONDUCTOR DATA
      GEN    1,24,1. 201,   1,1,1,1.
      GEN   25,23,1,2,1,1,1,1.
      48,24,1,1.
      GEN 53,6,1,1,1,25,1,1.
      GEN 59,6,1,7,1,30,6,1.
      GEN 65,6,1,13,1,60,-1,1.
      GEN 71,6,1,19,1,55,-6,1.
C CONDUCTORS IN TILE
      CGS   77,   1,  25,A2,R2,      78,   2,  26,A2,R2
      CGS   79,   3,  27,A2,R2,      80,   4,  28,A2,R2
      CGS   81,   5,  29,A2,R2,      82,   6,  30,A2,R2
      CGS   83,   7,  30,A2,R2,      84,   8,  36,A2,R2
      CGS   85,   9,  42,A2,R2,      86,  10,  48,A2,R2
      CGS   87,  11,  54,A2,R2,      88,  12,  60,A2,R2
      CGS   89,  13,  60,A2,R2,      90,  14,  59,A2,P2
      CGS   91,  15,  58,A2,R2,      92,  16,  57,A2,R2
      CGS   93,  17,  56,A2,R2,      94,  18,  55,A2,R2
      CGS   95,  19,  55,A2,R2,      96,  20,  49,A2,R2
      CGS   97,  21,  43,A2,R2,      98,  22,  37,A2,R2
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APPENDIX A, CONTINUED

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CGS   99,  23,  31,A2,R2,     100,  24,  25,A2,R2
CGS  101,  25,  26,A3,R3,     102,  26,  27,A3,R3
CGS  103,  27,  28,A3,R3,     104,  28,  29,A3,R3
CGS  105,  29,  30,A3,R3,     106,  31,  32,A3,R3
CGS  107,  32,  33,A3,R3,     108,  33,  34,A3,R3
CGS  109,  34,  35,A3,R3,     110,  35,  36,A3,R3
CGS  111,  37,  38,A3,R3,     112,  38,  39,A3,R3
CGS  113,  39,  40,A3,R3,     114,  40,  41,A3,R3
CGS  115,  41,  42,A3,R3,     116,  43,  44,A3,R3
CGS  117,  44,  45,A3,R3,     118,  45,  46,A3,R3
CGS  119,  46,  47,A3,R3,     120,  47,  48,A3,R3
CGS  121,  49,  50,A3,R3,     122,  50,  51,A3,R3
CGS  123,  51,  52,A3,R3,     124,  52,  53,A3,R3
CGS  125,  53,  54,A3,R3,     126,  55,  56,A3,R3
CGS  127,  56,  57,A3,R3,     128,  57,  58,A3,R3
CGS  129,  58,  59,A3,R3,     130,  59,  60,A3,R3
CGS  131,  25,  31,A3,R3,     132,  31,  37,A3,R3
CGS  133,  37,  43,A3,R3,     134,  43,  49,A3,R3
CGS  135,  49,  55,A3,R3,     136,  26,  32,A3,R3
CGS  137,  32,  38,A3,R3,     138,  38,  44,A3,R3
CGS  139,  44,  50,A3,R3,     140,  50,  56,A3,R3
CGS  141,  27,  33,A3,R3,     142,  33,  39,A3,R3
CGS  143,  39,  45,A3,R3,     144,  45,  51,A3,R3
CGS  145,  51,  57,A3,R3,     146,  28,  34,A3,R3
CGS  147,  34,  40,A3,R3,     148,  40,  46,A3,R3
CGS  149,  46,  52,A3,R3,     150,  52,  58,A3,R3
CGS  151,  29,  35,A3,R3,     152,  35,  41,A3,R3
CGS  153,  41,  47,A3,R3,     154,  47,  53,A3,R3
CGS  155,  53,  59,A3,R3,     156,  30,  36,A3,R3
CGS  157,  36,  42,A3,R3,     158,  42,  48,A3,R3
CGS  159,  48,  54,A3,R3,     160,  54,  60,A3,R3
CGS  161,  61,  62,A3,R3,     162,  62,  63,A3,R3
CGS  163,  63,  64,A3,R3,     164,  64,  65,A3,R3
CGS  165,  65,  66,A3,R3,     166,  67,  68,A3,R3
CGS  167,  68,  69,A3,R3,     168,  69,  70,A3,R3
CGS  169,  70,  71,A3,R3,     170,  71,  72,A3,R3
CGS  171,  73,  74,A3,R3,     172,  74,  75,A3,R3
CGS  173,  75,  76,A3,R3,     174,  76,  77,A3,R3
CGS  175,  77,  78,A3,R3,     176,  79,  80,A3,R3
CGS  177,  80,  81,A3,R3,     178,  81,  82,A3,R3
CGS  179,  82,  83,A3,R3,     180,  83,  84,A3,R3
CGS  181,  85,  86,A3,R3,     182,  86,  87,A3,R3
CGS  183,  87,  88,A3,R3,     184,  88,  89,A3,R3
CGS  185,  89,  90,A3,R3,     186,  91,  92,A3,R3
CGS  187,  92,  93,A3,R3,     188,  93,  94,A3,R3
CGS  189,  94,  95,A3,R3,     190,  95,  96,A3,R3
CGS  191,  61,  67,A3,R3,     192,  67,  73,A3,R3
CGS  193,  73,  79,A3,R3,     194,  79,  85,A3,R3
CGS  195,  85,  91,A3,R3,     196,  62,  68,A3,R3
CGS  197,  68,  74,A3,R3,     198,  74,  80,A3,R3
CGS  199,  80,  86,A3,R3,     200,  86,  92,A3,R3
CGS  201,  63,  69,A3,R3,     202,  69,  75,A3,R3
CGS  203,  75,  81,A3,R3,     204,  81,  87,A3,R3
CGS  205,  87,  93,A3,R3,     206,  64,  70,A3,R3
CGS  207,  70,  76,A3,R3,     208,  76,  82,A3,R3
CGS  209,  82,  88,A3,R3,     210,  88,  94,A3,R3
CGS  211,  65,  71,A3,R3,     212,  71,  77,A3,R3
CGS  213,  77,  83,A3,R3,     214,  83,  89,A3,R3
CGS  215,  89,  95,A3,R3,     216,  66,  72,A3,R3
CGS  217,  72,  78,A3,R3,     218,  78,  84,A3,R3
CGS  219,  84,  90,A3,R3,     220,  90,  96,A3,R3
CGS  221,  25,  61,A3,R4,     222,  26,  62,A3,R4
CGS  223,  27,  63,A3,R4,     224,  28,  64,A3,R4
CGS  225,  29,  65,A3,R4,     226,  30,  66,A3,R4
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APPENDIX A, CONTINUED

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CGS  227,  31,  67,A3,R4,     228,  32,  68,A3,R4
CGS  229,  33,  69,A3,R4,     230,  34,  70,A3,R4
CGS  231,  35,  71,A3,R4,     232,  36,  72,A3,R4
CGS  233,  37,  73,A3,R4,     234,  38,  74,A3,R4
CGS  235,  39,  75,A3,R4,     236,  40,  76,A3,R4
CGS  237,  41,  77,A3,R4,     238,  42,  78,A3,R4
CGS  239,  43,  79,A3,R4,     240,  44,  80,A3,R4
CGS  241,  45,  81,A3,R4,     242,  46,  82,A3,R4
CGS  243,  47,  83,A3,R4,     244,  48,  84,A3,R4
CGS  245,  49,  85,A3,R4,     246,  50,  86,A3,R4
CGS  247,  51,  87,A3,R4,     248,  52,  88,A3,R4
CGS  249,  53,  89,A3,R4,     250,  54,  90,A3,R4
CGS  251,  55,  91,A3,R4,     252,  56,  92,A3,R4
CGS  253,  57,  93,A3,R4,     254,  58,  94,A3,R4
CGS  255,  59,  95,A3,R4,     256,  60,  96,A3,R4
GEN  257,6,1,  25,  1,97,1,1.
GEN  263,4,1,  36, 6,108,6,1.
GEN  267,6,1,  60, -1,132,-1,1.
GEN  273,4,1,  49, -6,121,-6,1.
CGS  277,  97,  98,A4,R5,     278,  98,  99,A4,R5
CGS  279,  99, 100,A4,R5,     280, 100, 101,A4,R5
CGS  281, 101, 102,A4,R5,     282, 103, 104,A4,R5
CGS  283, 104, 105,A4,R5,     284, 105, 106,A4,R5
CGS  285, 106, 107,A4,R5,     286, 107, 108,A4,R5
CGS  287, 109, 110,A4,R5,     288, 110, 111,A4,R5
CGS  289, 111, 112,A4,R5,     290, 112, 113,A4,R5
CGS  291, 113, 114,A4,R5,     292, 115, 116,A4,R5
CGS  293, 116, 117,A4,R5,     294, 117, 118,A4,R5
CGS  295, 118, 119,A4,R5,     296, 119, 120,A4,R5
CGS  297, 121, 122,A4,R5,     298, 122, 123,A4,R5
CGS  299, 123, 124,A4,R5,     300, 124, 125,A4,R5
CGS  301, 125, 126,A4,R5,     302, 127, 128,A4,R5
CGS  303, 128, 129,A4,R5,     304, 129, 130,A4,R5
CGS  305, 130, 131,A4,R5,     306, 131, 132,A4,R5
CGS  307,  97, 103,A4,R5,     308, 103, 109,A4,R5
CGS  309, 109, 115,A4,R5,     310, 115, 121,A4,R5
CGS  311, 121, 127,A4,R5,     312,  98, 104,A4,R5
CGS  313, 104, 110,A4,R5,     314, 110, 116,A4,R5
CGS  315, 116, 122,A4,R5,     316, 122, 128,A4,R5
CGS  317,  99, 105,A4,R5,     318, 105, 111,A4,R5
CGS  319, 111, 117,A4,R5,     320, 117, 123,A4,R5
CGS  321, 123, 129,A4,R5,     322, 100, 106,A4,R5
CGS  323, 106, 112,A4,R5,     324, 112, 118,A4,R5
CGS  325, 118, 124,A4,R5,     326, 124, 130,A4,R5
CGS  327, 101, 107,A4,R5,     328, 107, 113,A4,R5
CGS  329, 113, 119,A4,R5,     330, 119, 125,A4,R5
CGS  331, 125, 131,A4,R5,     332, 102, 108,A4,R5
CGS  333, 108, 114,A4,R5,     334, 114, 120,A4,R5
CGS  335, 120, 126,A4,R5,     336, 126, 132,A4,R5
CGS 500,1120,2097,A5,R6, 501,1126,2103,A5,R6, 502,1132,2109,A5,R6
CGS 503,8102,2115,A5,R6, 504,8108,2121,A5,R6, 505,8114,2127,A5,R6
CGS 506,8120,97,  A5,R6, 507,8126,103, A5,R6, 508,8132,109, A5,R6
CGS 509,7102,115, A5,R6, 510,7108,121, A5,R6, 511,7114,127, A5,R6
CGS 512,7120,6097,A5,R6, 513,7126,6103,A5,R6, 514,7132,6109,A5,R6
CGS 515,2120,3097,A5,R6, 516,2126,3103,A5,R6, 517,2132,3109,A5,R6
CGS 518,102,3115, A5,R6, 519,108,3121, A5,R6, 520,114,3127, A5,R6
CGS 521,120,4097, A5,R6, 522,126,4103, A5,R6, 523,132,4109, A5,R6
CGS 524,6102,4115,A5,R6, 525,6108,4121,A5,R6, 526,6114,4127,A5,R6
CGS 527,6120,5097,A5,R6, 528,6126,5103,A5,R6, 529,6132,5109,A5,R6
CGS 530,1127,8097,A5,R6, 531,1128,8098,A5,R6, 532,1129,8099,A5,R6
CGS 533,1130,8100,A5,R6, 534,1131,8101,A5,R6, 535,1132,8102,A5,R6
CGS 536,2127,97,  A5,R6, 537,2128,98,  A5,R6, 538,2129,99,  A5,R6
CGS 539,2130,100, A5,R6, 540,2131,101, A5,R6, 541,2132,102, A5,R6
CGS 542,3127,4097,A5,R6, 543,3128,4098,A5,R6, 544,3129,4099,A5,R6
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APPENDIX A, CONTINUED

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      CGS 545,3130,4100,A5,R6, 546,3131,4101,A5,R6, 547,3132,4102,A5,R6
      CGS 548,8127,7097,A5,R6, 549,8128,7098,A5,R6, 550,8129,7099,A5,R6
      CGS 551,8130,7100,A5,R6, 552,8131,7101,A5,R6, 553,8132,7102,A5,R6
      CGS 554,127,6097, A5,R6, 555,128,6098, A5,R6, 556,129,6099, A5,R6
      CGS 557,130,6100, A5,R6, 558,131,6101, A5,R6, 559,132,6102, A5,R6
      CGS 560,4127,5097,A5,R6, 561,4128,5098,A5,R6, 562,4129,5099,A5,R6
      CGS 563,4130,5100,A5,R6, 564,4131,5101,A5,R6, 565,4132,5102,A5,R6
      GEN 1001,24,1,1201,1,1001,1,1.
      GEN 1025,23,1,1001,1,1002,1,1.
      1048,1024,1001,1.
      GEN 1053,6,1,1001,1,1025,1,1.
      GEN 1059,6,1,1007,1,1030,6,1.
      GEN 1065,6,1,1013,1,1060,-1,1.
      GEN 1071,6,1,1019,1,1055,-6,1.
C CONDUCTORS IN TILE
      CGS 1077,1001,1025,A2,R2,       1078,1002,1026,A2,R2
      CGS 1079,1003,1027,A2,R2,       1080,1004,1028,A2,R2
      CGS 1081,1005,1029,A2,R2,       1082,1006,1030,A2,R2
      CGS 1083,1007,1030,A2,R2,       1084,1008,1036,A2,R2
      CGS 1085,1009,1042,A2,R2,       1086,1010,1048,A2,R2
      CGS 1087,1011,1054,A2,R2,       1088,1012,1060,A2,R2
      CGS 1089,1013,1060,A2,R2,       1090,1014,1059,A2,R2
      CGS 1091,1015,1058,A2,R2,       1092,1016,1057,A2,R2
      CGS 1093,1017,1056,A2,R2,       1094,1018,1055,A2,R2
      CGS 1095,1019,1055,A2,R2,       1096,1020,1049,A2,R2
      CGS 1097,1021,1043,A2,R2,       1098,1022,1037,A2,R2
      CGS 1099,1023,1031,A2,R2,       1100,1024,1025,A2,R2
      CGS 1101,1025,1026,A3,R3,       1102,1026,1027,A3,R3
      CGS 1103,1027,1028,A3,R3,       1104,1028,1029,A3,R3
      CGS 1105,1029,1030,A3,R3,       1106,1031,1032,A3,R3
      CGS 1107,1032,1033,A3,R3,       1108,1033,1034,A3,R3
      CGS 1109,1034,1035,A3,R3,       1110,1035,1036,A3,R3
      CGS 1111,1037,1038,A3,R3,       1112,1038,1039,A3,R3
      CGS 1113,1039,1040,A3,R3,       1114,1040,1041,A3,R3
      CGS 1115,1041,1042,A3,R3,       1116,1043,1044,A3,R3
      CGS 1117,1044,1045,A3,R3,       1118,1045,1046,A3,R3
      CGS 1119,1046,1047,A3,R3,       1120,1047,1048,A3,R3
      CGS 1121,1049,1050,A3,R3,       1122,1050,1051,A3,R3
      CGS 1123,1051,1052,A3,R3,       1124,1052,1053,A3,R3
      CGS 1125,1053,1054,A3,R3,       1126,1055,1056,A3,R3
      CGS 1127,1056,1057,A3,R3,       1128,1057,1058,A3,R3
      CGS 1129,1058,1059,A3,R3,       1130,1059,1060,A3,R3
      CGS 1131,1025,1031,A3,R3,       1132,1031,1037,A3,R3
      CGS 1133,1037,1043,A3,R3,       1134,1043,1049,A3,R3
      CGS 1135,1049,1055,A3,R3,       1136,1026,1032,A3,R3
      CGS 1137,1032,1038,A3,R3,       1138,1038,1044,A3,R3
      CGS 1139,1044,1050,A3,R3,       1140,1050,1056,A3,R3
      CGS 1141,1027,1033,A3,R3,       1142,1033,1039,A3,R3
      CGS 1143,1039,1045,A3,R3,       1144,1045,1051,A3,R3
      CGS 1145,1051,1057,A3,R3,       1146,1028,1034,A3,R3
      CGS 1147,1034,1040,A3,R3,       1148,1040,1046,A3,R3
      CGS 1149,1046,1052,A3,R3,       1150,1052,1058,A3,R3
      CGS 1151,1029,1035,A3,R3,       1152,1035,1041,A3,R3
      CGS 1153,1041,1047,A3,R3,       1154,1047,1053,A3,R3
      CGS 1155,1053,1059,A3,R3,       1156,1030,1036,A3,R3
      CGS 1157,1036,1042,A3,R3,       1158,1042,1048,A3,R3
      CGS 1159,1048,1054,A3,R3,       1160,1054,1060,A3,R3
      CGS 1161,1061,1062,A3,R3,       1162,1062,1063,A3,R3
      CGS 1163,1063,1064,A3,R3,       1164,1064,1065,A3,R3
      CGS 1165,1065,1066,A3,R3,       1166,1067,1068,A3,R3
      CGS 1167,1068,1069,A3,R3,       1168,1069,1070,A3,R3
      CGS 1169,1070,1071,A3,R3,       1170,1071,1072,A3,R3
      CGS 1171,1073,1074,A3,R3,       1172,1074,1075,A3,R3
      CGS 1173,1075,1076,A3,R3,       1174,1076,1077,A3,R3
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APPENDIX A, CONTINUED

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CGS 1175,1077,1078,A3,R3,       1176,1079,1080,A3,R3
CGS 1177,1080,1081,A3,R3,       1178,1081,1082,A3,R3
CGS 1179,1082,1083,A3,R3,       1180,1083,1084,A3,R3
CGS 1181,1085,1086,A3,R3,       1182,1086,1087,A3,R3
CGS 1183,1087,1088,A3,R3,       1184,1088,1089,A3,R3
CGS 1185,1089,1090,A3,R3,       1186,1091,1092,A3,R3
CGS 1187,1092,1093,A3,R3,       1188,1093,1094,A3,R3
CGS 1189,1094,1095,A3,R3,       1190,1095,1096,A3,R3
CGS 1191,1061,1067,A3,R3,       1192,1067,1073,A3,R3
CGS 1193,1073,1079,A3,R3,       1194,1079,1085,A3,R3
CGS 1195,1085,1091,A3,R3,       1196,1062,1068,A3,R3
CGS 1197,1068,1074,A3,R3,       1198,1074,1080,A3,R3
CGS 1199,1080,1086,A3,R3,       1200,1086,1092,A3,R3
CGS 1201,1063,1069,A3,R3,       1202,1069,1075,A3,R3
CGS 1203,1075,1081,A3,R3,       1204,1081,1087,A3,R3
CGS 1205,1087,1093,A3,R3,       1206,1064,1070,A3,R3
CGS 1207,1070,1076,A3,R3,       1208,1076,1082,A3,R3
CGS 1209,1082,1088,A3,R3,       1210,1088,1094,A3,R3
CGS 1211,1065,1071,A3,R3,       1212,1071,1077,A3,R3
CGS 1213,1077,1083,A3,R3,       1214,1083,1089,A3,R3
CGS 1215,1089,1095,A3,R3,       1216,1066,1072,A3,R3
CGS 1217,1072,1078,A3,R3,       1218,1078,1084,A3,R3
CGS 1219,1084,1090,A3,R3,       1220,1090,1096,A3,R3
CGS 1221,1025,1061,A3,R4,       1222,1026,1062,A3,R4
CGS 1223,1027,1063,A3,R4,       1224,1028,1064,A3,R4
CGS 1225,1029,1065,A3,R4,       1226,1030,1066,A3,R4
CGS 1227,1031,1067,A3,R4,       1228,1032,1068,A3,R4
CGS 1229,1033,1069,A3,R4,       1230,1034,1070,A3,R4
CGS 1231,1035,1071,A3,R4,       1232,1036,1072,A3,R4
CGS 1233,1037,1073,A3,R4,       1234,1038,1074,A3,R4
CGS 1235,1039,1075,A3,R4,       1236,1040,1076,A3,R4
CGS 1237,1041,1077,A3,R4,       1238,1042,1078,A3,R4
CGS 1239,1043,1079,A3,R4,       1240,1044,1080,A3,R4
CGS 1241,1045,1081,A3,R4,       1242,1046,1082,A3,R4
CGS 1243,1047,1083,A3,R4,       1244,1048,1084,A3,R4
CGS 1245,1049,1085,A3,R4,       1246,1050,1086,A3,R4
CGS 1247,1051,1087,A3,R4,       1248,1052,1088,A3,R4
CGS 1249,1053,1089,A3,R4,       1250,1054,1090,A3,R4
CGS 1251,1055,1091,A3,R4,       1252,1056,1092,A3,R4
CGS 1253,1057,1093,A3,R4,       1254,1058,1094,A3,R4
CGS 1255,1059,1095,A3,R4,       1256,1060,1096,A3,R4
GEN 1257,6,1,1025,1,1097,1,1.
GEN 1263,4,1,1036,5,1108,6,1.
GEN 1267,6,1,1060,-1,1132,-1,1.
GEN 1273,4,1,1049, -6,1121,-6,1.
CGS 1277,1097,1098,A4,R5,       1278,1098,1099,A4,R5
CGS 1279,1099,1100,A4,R5,       1280,1100,1101,A4,R5
CGS 1281,1101,1102,A4,R5,       1282,1103,1104,A4,R5
CGS 1283,1104,1105,A4,R5,       1284,1105,1106,A4,R5
CGS 1285,1106,1107,A4,R5,       1286,1107,1108,A4,R5
CGS 1287,1109,1110,A4,R5,       1288,1110,1111,A4,R5
CGS 1289,1111,1112,A4,R5,       1290,1112,1113,A4,R5
CGS 1291,1113,1114,A4,R5,       1292,1115,1116,A4,R5
CGS 1293,1116,1117,A4,R5,       1294,1117,1118,A4,R5
CGS 1295,1118,1119,A4,R5,       1296,1119,1120,A4,R5
CGS 1297,1121,1122,A4,R5,       1298,1122,1123,A4,R5
CGS 1299,1123,1124,A4,R5,       1300,1124,1125,A4,R5
CGS 1301,1125,1126,A4,R5,       1302,1127,1128,A4,R5
CGS 1303,1128,1129,A4,R5,       1304,1129,1130,A4,R5
CGS 1305,1130,1131,A4,R5,       1306,1131,1132,A4,R5
CGS 1307,1097,1103,A4,R5,       1308,1103,1109,A4,R5
CGS 1309,1109,1115,A4,R5,       1310,1115,1121,A4,R5
CGS 1311,1121,1127,A4,R5,       1312,1098,1104,A4,R5
CGS 1313,1104,1110,A4,R5,       1314,1110,1116,A4,R5
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APPENDIX A, CONTINUED

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      CGS 1315,1116,1122,A4,R5,        1316,1122,1128,A4,R5
      CGS 1317,1099,1105,A4,R5,        1318,1105,1111,A4,R5
      CGS 1319,1111,1117,A4,R5,        1320,1117,1123,A4,R5
      CGS 1321,1123,1129,A4,R5,        1322,1100,1106,A4,R5
      CGS 1323,1106,1112,A4,R5,        1324,1112,1118,A4,R5
      CGS 1325,1118,1124,A4,R5,        1326,1124,1130,A4,R5
      CGS 1327,1101,1107,A4,R5,        1328,1107,1113,A4,R5
      CGS 1329,1113,1119,A4,R5,        1330,1119,1125,A4,R5
      CGS 1331,1125,1131,A4,R5,        1332,1102,1108,A4,R5
      CGS 1333,1108,1114,A4,R5,        1334,1114,1120,A4,R5
      CGS 1335,1120,1126,A4,R5,        1336,1126,1132,A4,R5
      GEN 2001,12,1,2201,1,2001,1,1.
      GEN 2019,3,1,2219,1,2019,1,1.
      GEN 2025,11,1,2001,1,2002,1,1.
      2036,2012,6,1.
      2042,1,2019,1.
      GEN 2043,2,1,2019,1,2020,1,1.
      2048,1010,2001,1.
      2045,2021,1012,1.
      GEN 2053,6,1,2001,1,2025,1,1.
      GEN 2059,6,1,2007,1,2030,6,1.
      GEN 2065,6,1,6,-1,2060,-1,1.
      GEN 2071,3,1,2019,1,2055,-6,1.
      GEN 2074,3,1,1012,-1,2037,-6,1.
C CONDUCTORS IN TILE
      CGS 2077,2001,2025,A2,R2,        2078,2002,2026,A2,R2
      CGS 2079,2003,2027,A2,R2,        2080,2004,2028,A2,R2
      CGS 2081,2005,2029,A2,R2,        2082,2006,2030,A2,R2
      CGS 2083,2007,2030,A2,R2,        2084,2008,2036,A2,R2
      CGS 2085,2009,2042,A2,R2,        2086,2010,2048,A2,R2
      CGS 2087,2011,2054,A2,R2,        2088,2012,2060,A2,R2
      CGS 2089,    6,2060,A2,R2,       2090,    5,2059,A2,R2
      CGS 2091,    4,2058,A2,R2,       2092,    3,2057,A2,R2
      CGS 2093,    2,2056,A2,R2,       2094,    1,2055,A2,R2
      CGS 2095,2019,2055,A2,R2,        2096,2020,2049,A2,R2
      CGS 2097,2021,2043,A2,R2,        2098,1012,2037,A2,R2
      CGS 2099,1011,2031,A2,R2,        2100,1010,2025,A2,R2
      CGS 2101,2025,2026,A3,R3,        2102,2026,2027,A3,R3
      CGS 2103,2027,2028,A3,R3,        2104,2028,2029,A3,R3
      CGS 2105,2029,2030,A3,R3,        2106,2031,2032,A3,R3
      CGS 2107,2032,2033,A3,R3,        2108,2033,2034,A3,R3
      CGS 2109,2034,2035,A3,R3,        2110,2035,2036,A3,R3
      CGS 2111,2037,2038,A3,R3,        2112,2038,2039,A3,R3
      CGS 2113,2039,2040,A3,R3,        2114,2040,2041,A3,R3
      CGS 2115,2041,2042,A3,R3,        2116,2043,2044,A3,R3
      CGS 2117,2044,2045,A3,R3,        2118,2045,2046,A3,R3
      CGS 2119,2046,2047,A3,R3,        2120,2047,2048,A3,R3
      CGS 2121,2049,2050,A3,R3,        2122,2050,2051,A3,R3
      CGS 2123,2051,2052,A3,R3,        2124,2052,2053,A3,R3
      CGS 2125,2053,2054,A3,R3,        2126,2055,2056,A3,R3
      CGS 2127,2056,2057,A3,R3,        2128,2057,2058,A3,R3
      CGS 2129,2058,2059,A3,R3,        2130,2059,2060,A3,R3
      CGS 2131,2025,2031,A3,R3,        2132,2031,2037,A3,R3
      CGS 2133,2037,2043,A3,R3,        2134,2043,2049,A3,R3
      CGS 2135,2049,2055,A3,R3,        2136,2026,2032,A3,R3
      CGS 2137,2032,2038,A3,R3,        2138,2038,2044,A3,R3
      CGS 2139,2044,2050,A3,R3,        2140,2050,2056,A3,R3
      CGS 2141,2027,2033,A3,R3,        2142,2033,2039,A3,R3
      CGS 2143,2039,2045,A3,R3,        2144,2045,2051,A3,R3
      CGS 2145,2051,2057,A3,R3,        2146,2028,2034,A3,R3
      CGS 2147,2034,2040,A3,R3,        2148,2040,2046,A3,R3
      CGS 2149,2046,2052,A3,R3,        2150,2052,2058,A3,R3
      CGS 2151,2029,2035,A3,R3,        2152,2035,2041,A3,R3
      CGS 2153,2041,2047,A3,R3,        2154,2047,2053,A3,R3
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APPENDIX A, CONTINUED

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CGS 2155,2053,2059,A3,R3,       2156,2030,2036,A3,R3
CGS 2157,2036,2042,A3,R3,       2158,2042,2048,A3,R3
CGS 2159,2048,2054,A3,R3,       2160,2054,2060,A3,R3
CGS 2161,2061,2062,A3,R3,       2162,2062,2063,A3,R3
CGS 2163,2063,2064,A3,R3,       2164,2064,2065,A3,R3
CGS 2165,2065,2066,A3,R3,       2166,2067,2068,A3,R3
CGS 2167,2068,2069,A3,R3,       2168,2069,2070,A3,R3
CGS 2169,2070,2071,A3,R3,       2170,2071,2072,A3,R3
CGS 2171,2073,2074,A3,R3,       2172,2074,2075,A3,R3
CGS 2173,2075,2076,A3,R3,       2174,2076,2077,A3,R3
CGS 2175,2077,2078,A3,R3,       2176,2079,2080,A3,R3
CGS 2177,2080,2081,A3,R3,       2178,2081,2082,A3,R3
CGS 2179,2082,2083,A3,R3,       2180,2083,2084,A3,R3
CGS 2181,2085,2086,A3,R3,       2182,2086,2087,A3,R3
CGS 2183,2087,2088,A3,R3,       2184,2088,2089,A3,R3
CGS 2185,2089,2090,A3,R3,       2186,2091,2092,A3,R3
CGS 2187,2092,2093,A3,R3,       2188,2093,2094,A3,R3
CGS 2189,2094,2095,A3,R3,       2190,2095,2096,A3,R3
CGS 2191,2061,2067,A3,R3,       2192,2067,2073,A3,R3
CGS 2193,2073,2079,A3,R3,       2194,2079,2085,A3,R3
CGS 2195,2085,2091,A3,R3,       2196,2062,2068,A3,R3
CGS 2197,2068,2074,A3,R3,       2198,2074,2080,A3,R3
CGS 2199,2080,2086,A3,R3,       2200,2086,2092,A3,R3
CGS 2201,2063,2069,A3,R3,       2202,2069,2075,A3,R3
CGS 2203,2075,2081,A3,R3,       2204,2081,2087,A3,R3
CGS 2205,2087,2093,A3,R3,       2206,2064,2070,A3,R3
CGS 2207,2070,2076,A3,R3,       2208,2076,2082,A3,R3
CGS 2209,2082,2088,A3,R3,       2210,2088,2094,A3,R3
CGS 2211,2065,2071,A3,R3,       2212,2071,2077,A3,R3
CGS 2213,2077,2083,A3,R3,       2214,2083,2089,A3,R3
CGS 2215,2089,2095,A3,R3,       2216,2066,2072,A3,R3
CGS 2217,2072,2078,A3,R3,       2218,2078,2084,A3,R3
CGS 2219,2084,2090,A3,R3,       2220,2090,2096,A3,R3
CGS 2221,2025,2061,A3,R4,       2222,2026,2062,A3,R4
CGS 2223,2027,2063,A3,R4,       2224,2028,2064,A3,R4
CGS 2225,2029,2065,A3,R4,       2226,2030,2066,A3,R4
CGS 2227,2031,2067,A3,R4,       2228,2032,2068,A3,R4
CGS 2229,2033,2069,A3,R4,       2230,2034,2070,A3,R4
CGS 2231,2035,2071,A3,R4,       2232,2036,2072,A3,R4
CGS 2233,2037,2073,A3,R4,       2234,2038,2074,A3,R4
CGS 2235,2039,2075,A3,R4,       2236,2040,2076,A3,R4
CGS 2237,2041,2077,A3,R4,       2238,2042,2078,A3,R4
CGS 2239,2043,2079,A3,R4,       2240,2044,2080,A3,R4
CGS 2241,2045,2081,A3,R4,       2242,2046,2082,A3,R4
CGS 2243,2047,2083,A3,R4,       2244,2048,2084,A3,R4
CGS 2245,2049,2085,A3,R4,       2246,2050,2086,A3,R4
CGS 2247,2051,2087,A3,R4,       2248,2052,2088,A3,R4
CGS 2249,2053,2089,A3,R4,       2250,2054,2090,A3,R4
CGS 2251,2055,2091,A3,R4,       2252,2056,2092,A3,R4
CGS 2253,2057,2093,A3,R4,       2254,2058,2094,A3,R4
CGS 2255,2059,2095,A3,R4,       2256,2060,2096,A3,R4
GEN 2257,6,1,2025,1,2097,1,1.
GEN 2263,4,1,2036,5,2108,6,1.
GEN 2267,6,1,2060,-1,2132,-1,1.
GEN 2273,4,1,2049,-6,2121,-6,1.
CGS 2277,2097,2098,A4,R5,       2278,2098,2099,A4,R5
CGS 2279,2099,2100,A4,R5,       2280,2100,2101,A4,R5
CGS 2281,2101,2102,A4,R5,       2282,2103,2104,A4,R5
CGS 2283,2104,2105,A4,R5,       2284,2105,2106,A4,R5
CGS 2285,2106,2107,A4,R5,       2286,2107,2108,A4,R5
CGS 2287,2109,2110,A4,R5,       2288,2110,2111,A4,R5
CGS 2289,2111,2112,A4,R5,       2290,2112,2113,A4,R5
CGS 2291,2113,2114,A4,R5,       2292,2115,2116,A4,R5
CGS 2293,2116,2117,A4,R5,       2294,2117,2118,A4,R5
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APPENDIX A, CONTINUED

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      CGS 2295,2118,2119,A4,R5,        2296,2119,2120,A4,R5
      CGS 2297,2121,2122,A4,R5,        2298,2122,2123,A4,R5
      CGS 2299,2123,2124,A4,R5,        2300,2124,2125,A4,R5
      CGS 2301,2125,2126,A4,R5,        2302,2127,2128,A4,R5
      CGS 2303,2128,2129,A4,R5,        2304,2129,2130,A4,R5
      CGS 2305,2130,2131,A4,R5,        2306,2131,2132,A4,R5
      CGS 2307,2097,2103,A4,R5,        2308,2103,2109,A4,R5
      CGS 2309,2109,2115,A4,R5,        2310,2115,2121,A4,R5
      CGS 2311,2121,2127,A4,R5,        2312,2098,2104,A4,R5
      CGS 2313,2104,2110,A4,R5,        2314,2110,2116,A4,R5
      CGS 2315,2116,2122,A4,R5,        2316,2122,2128,A4,R5
      CGS 2317,2099,2105,A4,R5,        2318,2105,2111,A4,R5
      CGS 2319,2111,2117,A4,R5,        2320,2117,2123,A4,R5
      CGS 2321,2123,2129,A4,R5,        2322,2100,2106,A4,R5
      CGS 2323,2106,2112,A4,R5,        2324,2112,2118,A4,R5
      CGS 2325,2118,2124,A4,R5,        2326,2124,2130,A4,R5
      CGS 2327,2101,2107,A4,R5,        2328,2107,2113,A4,R5
      CGS 2329,2113,2119,A4,R5,        2330,2119,2125,A4,R5
      CGS 2331,2125,2131,A4,R5,        2332,2102,2108,A4,R5
      CGS 2333,2108,2114,A4,R5,        2334,2114,2120,A4,R5
      CGS 2335,2120,2126,A4,R5,        2336,2126,2132,A4,R5
      GEN 3001,18,1,3201,1,3001,1,1.
      GEN 3025,17,1,3001,1,3002,1,1.
      3042,3018,9,1.
      3045,7,2012,1.
      3048,2010,3001,1.
      GEN 3053,6,1,3001,1,3025,1,1.
      GEN 3059,6,1,3007,1,3030,6,1.
      GEN 3065,6,1,3013,1,3060,-1,1.
      GEN 3071,3,1,9,-1,3055,-6,1.
      GEN 3074,3,1,2012,-1,3037,-6,1.
C CONDUCTORS IN TILE
      CGS 3077,3001,3025,A2,R2,        3078,3002,3026,A2,R2
      CGS 3079,3003,3027,A2,R2,        3080,3004,3028,A2,R2
      CGS 3081,3005,3029,A2,R2,        3082,3006,3030,A2,R2
      CGS 3083,3007,3030,A2,R2,        3084,3008,3036,A2,R2
      CGS 3085,3009,3042,A2,R2,        3086,3010,3048,A2,R2
      CGS 3087,3011,3054,A2,R2,        3088,3012,3060,A2,R2
      CGS 3089,3013,3060,A2,R2,        3090,3014,3059,A2,R2
      CGS 3091,3015,3058,A2,R2,        3092,3016,3057,A2,R2
      CGS 3093,3017,3056,A2,R2,        3094,3018,3055,A2,R2
      CGS 3095,    9,3055,A2,R2,       3096,    8,3049,A2,R2
      CGS 3097,    7,3043,A2,R2,       3098,2012,3037,A2,R2
      CGS 3099,2011,3031,A2,R2,        3100,2010,3025,A2,R2
      CGS 3101,3025,3026,A3,R3,        3102,3026,3027,A3,R3
      CGS 3103,3027,3028,A3,R3,        3104,3028,3029,A3,R3
      CGS 3105,3029,3030,A3,R3,        3106,3031,3032,A3,R3
      CGS 3107,3032,3033,A3,R3,        3108,3033,3034,A3,R3
      CGS 3109,3034,3035,A3,R3,        3110,3035,3036,A3,R3
      CGS 3111,3037,3038,A3,R3,        3112,3038,3039,A3,R3
      CGS 3113,3039,3040,A3,R3,        3114,3040,3041,A3,R3
      CGS 3115,3041,3042,A3,R3,        3116,3043,3044,A3,R3
      CGS 3117,3044,3045,A3,R3,        3118,3045,3046,A3,R3
      CGS 3119,3046,3047,A3,R3,        3120,3047,3048,A3,R3
      CGS 3121,3049,3050,A3,R3,        3122,3050,3051,A3,R3
      CGS 3123,3051,3052,A3,R3,        3124,3052,3053,A3,R3
      CGS 3125,3053,3054,A3,R3,        3126,3055,3056,A3,R3
      CGS 3127,3056,3057,A3,R3,        3128,3057,3058,A3,R3
      CGS 3129,3058,3059,A3,R3,        3130,3059,3060,A3,R3
      CGS 3131,3025,3031,A3,R3,        3132,3031,3037,A3,R3
      CGS 3133,3037,3043,A3,R3,        3134,3043,3049,A3,R3
      CGS 3135,3049,3055,A3,R3,        3136,3026,3032,A3,R3
      CGS 3137,3032,3038,A3,R3,        3138,3038,3044,A3,R3
      CGS 3139,3044,3050,A3,R3,        3140,3050,3056,A3,R3
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APPENDIX A, CONTINUED

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CGS 3141,3027,3033,A3,R3,       3142,3033,3039,A3,R3
CGS 3143,3039,3045,A3,R3,       3144,3045,3051,A3,R3
CGS 3145,3051,3057,A3,R3,       3146,3028,3034,A3,R3
CGS 3147,3034,3040,A3,R3,       3148,3040,3046,A3,R3
CGS 3149,3046,3052,A3,R3,       3150,3052,3058,A3,R3
CGS 3151,3029,3035,A3,R3,       3152,3035,3041,A3,R3
CGS 3153,3041,3047,A3,R3,       3154,3047,3053,A3,R3
CGS 3155,3053,3059,A3,R3,       3156,3030,3036,A3,R3
CGS 3157,3036,3042,A3,R3,       3158,3042,3048,A3,R3
CGS 3159,3048,3054,A3,R3,       3160,3054,3060,A3,R3
CGS 3161,3061,3062,A3,R3,       3162,3062,3063,A3,R3
CGS 3163,3063,3064,A3,R3,       3164,3064,3065,A3,R3
CGS 3165,3065,3066,A3,R3,       3166,3067,3068,A3,R3
CGS 3167,3068,3069,A3,R3,       3168,3069,3070,A3,R3
CGS 3169,3070,3071,A3,R3,       3170,3071,3072,A3,R3
CGS 3171,3073,3074,A3,R3,       3172,3074,3075,A3,R3
CGS 3173,3075,3076,A3,R3,       3174,3076,3077,A3,R3
CGS 3175,3077,3078,A3,R3,       3176,3079,3080,A3,R3
CGS 3177,3080,3081,A3,R3,       3178,3081,3082,A3,R3
CGS 3179,3082,3083,A3,R3,       3180,3083,3084,A3,R3
CGS 3181,3085,3086,A3,R3,       3182,3086,3087,A3,R3
CGS 3183,3087,3088,A3,R3,       3184,3088,3089,A3,R3
CGS 3185,3089,3090,A3,R3,       3186,3091,3092,A3,R3
CGS 3187,3092,3093,A3,R3,       3188,3093,3094,A3,R3
CGS 3189,3094,3095,A3,R3,       3190,3095,3096,A3,R3
CGS 3191,3061,3067,A3,R3,       3192,3067,3073,A3,R3
CGS 3193,3073,3079,A3,R3,       3194,3079,3085,A3,R3
CGS 3195,3085,3091,A3,R3,       3196,3062,3068,A3,R3
CGS 3197,3068,3074,A3,R3,       3198,3074,3080,A3,R3
CGS 3199,3080,3086,A3,R3,       3200,3086,3092,A3,R3
CGS 3201,3063,3069,A3,R3,       3202,3069,3075,A3,R3
CGS 3203,3075,3081,A3,R3,       3204,3081,3087,A3,R3
CGS 3205,3087,3093,A3,R3,       3206,3064,3070,A3,R3
CGS 3207,3070,3076,A3,R3,       3208,3076,3082,A3,R3
CGS 3209,3082,3088,A3,R3,       3210,3088,3094,A3,R3
CGS 3211,3065,3071,A3,R3,       3212,3071,3077,A3,R3
CGS 3213,3077,3083,A3,R3,       3214,3083,3089,A3,R3
CGS 3215,3089,3095,A3,R3,       3216,3066,3072,A3,R3
CGS 3217,3072,3078,A3,R3,       3218,3078,3084,A3,R3
CGS 3219,3084,3090,A3,R3,       3220,3090,3096,A3,R3
CGS 3221,3025,3061,A3,R4,       3222,3026,3062,A3,R4
CGS 3223,3027,3063,A3,R4,       3224,3028,3064,A3,R4
CGS 3225,3029,3065,A3,R4,       3226,3030,3066,A3,R4
CGS 3227,3031,3067,A3,R4,       3228,3032,3068,A3,R4
CGS 3229,3033,3069,A3,R4,       3230,3034,3070,A3,R4
CGS 3231,3035,3071,A3,R4,       3232,3036,3072,A3,R4
CGS 3233,3037,3073,A3,R4,       3234,3038,3074,A3,R4
CGS 3235,3039,3075,A3,R4,       3236,3040,3076,A3,R4
CGS 3237,3041,3077,A3,R4,       3238,3042,3078,A3,R4
CGS 3239,3043,3079,A3,R4,       3240,3044,3080,A3,R4
CGS 3241,3045,3081,A3,R4,       3242,3046,3082,A3,R4
CGS 3243,3047,3083,A3,R4,       3244,3048,3084,A3,R4
CGS 3245,3049,3085,A3,R4,       3246,3050,3086,A3,R4
CGS 3247,3051,3087,A3,R4,       3248,3052,3088,A3,R4
CGS 3249,3053,3089,A3,R4,       3250,3054,3090,A3,R4
CGS 3251,3055,3091,A3,R4,       3252,3056,3092,A3,R4
CGS 3253,3057,3093,A3,R4,       3254,3058,3094,A3,R4
CGS 3255,3059,3095,A3,R4,       3256,3060,3096,A3,R4
GEN 3257,6,1,3025,1,3097,1,1.
GEN 3263,4,1,3036,6,3108,6,1.
GEN 3267,6,1,3060,-1,3132,-1,1.
GEN 3273,4,1,3049,-6,3121,-6,1.
CGS 3277,3097,3098,A4,R5,       3278,3098,3099,A4,R5
CGS 3279,3099,3100,A4,R5,       3280,3100,3101,A4,R5
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APPENDIX A, CONTINUED

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      CGS 3281,3101,3102,A4,R5,        3282,3103,3104,A4,R5
      CGS 3283,3104,3105,A4,R5,        3284,3105,3106,A4,R5
      CGS 3285,3106,3107,A4,R5,        3286,3107,3108,A4,R5
      CGS 3287,3109,3110,A4,R5,        3288,3110,3111,A4,R5
      CGS 3289,3111,3112,A4,R5,        3290,3112,3113,A4,R5
      CGS 3291,3113,3114,A4,R5,        3292,3115,3116,A4,R5
      CGS 3293,3116,3117,A4,R5,        3294,3117,3118,A4,R5
      CGS 3295,3118,3119,A4,R5,        3296,3119,3120,A4,R5
      CGS 3297,3121,3122,A4,R5,        3298,3122,3123,A4,R5
      CGS 3299,3123,3124,A4,R5,        3300,3124,3125,A4,R5
      CGS 3301,3125,3126,A4,R5,        3302,3127,3128,A4,R5
      CGS 3303,3128,3129,A4,R5,        3304,3129,3130,A4,R5
      CGS 3305,3130,3131,A4,R5,        3306,3131,3132,A4,R5
      CGS 3307,3097,3103,A4,R5,        3308,3103,3109,A4,R5
      CGS 3309,3109,3115,A4,R5,        3310,3115,3121,A4,R5
      CGS 3311,3121,3127,A4,R5,        3312,3098,3104,A4,R5
      CGS 3313,3104,3110,A4,R5,        3314,3110,3116,A4,R5
      CGS 3315,3116,3122,A4,R5,        3316,3122,3128,A4,R5
      CGS 3317,3099,3105,A4,R5,        3318,3105,3111,A4,R5
      CGS 3319,3111,3117,A4,R5,        3320,3117,3123,A4,R5
      CGS 3321,3123,3129,A4,R5,        3322,3100,3106,A4,R5
      CGS 3323,3106,3112,A4,R5,        3324,3112,3118,A4,R5
      CGS 3325,3118,3124,A4,R5,        3326,3124,3130,A4,R5
      CGS 3327,3101,3107,A4,R5,        3328,3107,3113,A4,R5
      CGS 3329,3113,3119,A4,R5,        3330,3119,3125,A4,R5
      CGS 3331,3125,3131,A4,R5,        3332,3102,3108,A4,R5
      CGS 3333,3108,3114,A4,R5,        3334,3114,3120,A4,R5
      CGS 3335,3120,3126,A4,R5,        3336,3126,3132,A4,R5
      GEN 4007,15,1,4207,1,4007,1,1.
      4030,3013.4007,1.
      GEN 4031,14,1,4007,1,4008,1,1.
      4045,4021,12,1.
      4048,10,3018,1.
      GEN 4053,6,1,3018,-1,4025,1,1.
      GEN 4059,6,1,4007,1,4030,6,1.
      GEN 4065,6,1,4013,1,4060,-1,1.
      GEN 4071,3,1,4019,1,4055,-6,1.
      GEN 4074,3,1,12,-1,4037,-6,1.
C CONDUCTORS IN TILE
      CGS 4077,3018,4025,A2,R2,        4078,3017,4026,A2,R2
      CGS 4079,3016,4027,A2,R2,        4080,3015,4028,A2,R2
      CGS 4081,3014,4029,A2,R2,        4082,3013,4030,A2,R2
      CGS 4083,4007,4030,A2,R2,        4084,4008,4036,A2,R2
      CGS 4085,4009,4042,A2,R2,        4086,4010,4048,A2,R2
      CGS 4087,4011,4054,A2,R2,        4088,4012,4060,A2,R2
      CGS 4089,4013,4060,A2,R2,        4090,4014,4059,A2,R2
      CGS 4091,4015,4058,A2,R2,        4092,4016,4057,A2,R2
      CGS 4093,4017,4056,A2,R2,        4094,4018,4055,A2,R2
      CGS 4095,4019,4055,A2,R2,        4096,4020,4049,A2,R2
      CGS 4097,4021,4043,A2,R2,        4098,  12,4037,A2,R2
      CGS 4099,  11,4031,A2,R2,        4100,  10,4025,A2,R2
      CGS 4101,4025,4026,A3,R3,        4102,4026,4027,A3,R3
      CGS 4103,4027,4028,A3,R3,        4104,4028,4029,A3,R3
      CGS 4105,4029,4030,A3,R3,        4106,4031,4032,A3,R3
      CGS 4107,4032,4033,A3,R3,        4108,4033,4034,A3,R3
      CGS 4109,4034,4035,A3,R3,        4110,4035,4036,A3,R3
      CGS 4111,4037,4038,A3,R3,        4112,4038,4039,A3,R3
      CGS 4113,4039,4040,A3,R3,        4114,4040,4041,A3,R3
      CGS 4115,4041,4042,A3,R3,        4116,4043,4044,A3,R3
      CGS 4117,4044,4045,A3,R3,        4118,4045,4046,A3,R3
      CGS 4119,4046,4047,A3,R3,        4120,4047,4048,A3,R3
      CGS 4121,4049,4050,A3,R3,        4122,4050,4051,A3,R3
      CGS 4123,4051,4052,A3,R3,        4124,4052,4053,A3,R3
      CGS 4125,4053,4054,A3,R3,        4126,4055,4056,A3,R3
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APPENDIX A, CONTINUED

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CGS 4127,4056,4057,A3,R3,      4128,4057,4058,A3,R3
CGS 4129,4058,4059,A3,R3,      4130,4059,4060,A3,R3
CGS 4131,4025,4031,A3,R3,      4132,4031,4037,A3,R3
CGS 4133,4037,4043,A3,R3,      4134,4043,4049,A3,R3
CGS 4135,4049,4055,A3,R3,      4136,4026,4032,A3,R3
CGS 4137,4032,4038,A3,R3,      4138,4038,4044,A3,R3
CGS 4139,4044,4050,A3,R3,      4140,4050,4056,A3,R3
CGS 4141,4027,4033,A3,R3,      4142,4033,4039,A3,R3
CGS 4143,4039,4045,A3,R3,      4144,4045,4051,A3,R3
CGS 4145,4051,4057,A3,R3,      4146,4028,4034,A3,R3
CGS 4147,4034,4040,A3,R3,      4148,4040,4046,A3,R3
CGS 4149,4046,4052,A3,R3,      4150,4052,4058,A3,R3
CGS 4151,4029,4035,A3,R3,      4152,4035,4041,A3,R3
CGS 4153,4041,4047,A3,R3,      4154,4047,4053,A3,R3
CGS 4155,4053,4059,A3,R3,      4156,4030,4036,A3,R3
CGS 4157,4036,4042,A3,R3,      4158,4042,4048,A3,R3
CGS 4159,4048,4054,A3,R3,      4160,4054,4060,A3,R3
CGS 4161,4061,4062,A3,R3,      4162,4062,4063,A3,R3
CGS 4163,4063,4064,A3,R3,      4164,4064,4065,A3,R3
CGS 4165,4065,4066,A3,R3,      4166,4067,4068,A3,R3
CGS 4167,4068,4069,A3,R3,      4168,4069,4070,A3,R3
CGS 4169,4070,4071,A3,R3,      4170,4071,4072,A3,R3
CGS 4171,4073,4074,A3,R3,      4172,4074,4075,A3,R3
CGS 4173,4075,4076,A3,R3,      4174,4076,4077,A3,R3
CGS 4175,4077,4078,A3,R3,      4176,4079,4080,A3,R3
CGS 4177,4080,4081,A3,R3,      4178,4081,4082,A3,R3
CGS 4179,4082,4083,A3,R3,      4180,4083,4084,A3,R3
CGS 4181,4085,4086,A3,R3,      4182,4086,4087,A3,R3
CGS 4183,4087,4088,A3,R3,      4184,4088,4089,A3,R3
CGS 4185,4089,4090,A3,R3,      4186,4091,4092,A3,R3
CGS 4187,4092,4093,A3,R3,      4188,4093,4094,A3,R3
CGS 4189,4094,4095,A3,R3,      4190,4095,4096,A3,R3
CGS 4191,4061,4067,A3,R3,      4192,4067,4073,A3,R3
CGS 4193,4073,4079,A3,R3,      4194,4079,4085,A3,R3
CGS 4195,4085,4091,A3,R3,      4196,4062,4068,A3,R3
CGS 4197,4068,4074,A3,R3,      4198,4074,4080,A3,R3
CGS 4199,4080,4086,A3,R3,      4200,4086,4092,A3,R3
CGS 4201,4063,4069,A3,R3,      4202,4069,4075,A3,R3
CGS 4203,4075,4081,A3,R3,      4204,4081,4087,A3,R3
CGS 4205,4087,4093,A3,R3,      4206,4064,4070,A3,R3
CGS 4207,4070,4076,A3,R3,      4208,4076,4082,A3,R3
CGS 4209,4082,4088,A3,R3,      4210,4088,4094,A3,R3
CGS 4211,4065,4071,A3,R3,      4212,4071,4077,A3,R3
CGS 4213,4077,4083,A3,R3,      4214,4083,4089,A3,R3
CGS 4215,4089,4095,A3,R3,      4216,4066,4072,A3,R3
CGS 4217,4072,4078,A3,R3,      4218,4078,4084,A3,R3
CGS 4219,4084,4090,A3,R3,      4220,4090,4096,A3,R3
CGS 4221,4025,4061,A3,R4,      4222,4026,4062,A3,R4
CGS 4223,4027,4063,A3,R4,      4224,4028,4064,A3,R4
CGS 4225,4029,4065,A3,R4,      4226,4030,4066,A3,R4
CGS 4227,4031,4067,A3,R4,      4228,4032,4068,A3,R4
CGS 4229,4033,4069,A3,R4,      4230,4034,4070,A3,R4
CGS 4231,4035,4071,A3,R4,      4232,4036,4072,A3,R4
CGS 4233,4037,4073,A3,R4,      4234,4038,4074,A3,R4
CGS 4235,4039,4075,A3,R4,      4236,4040,4076,A3,R4
CGS 4237,4041,4077,A3,R4,      4238,4042,4078,A3,R4
CGS 4239,4043,4079,A3,R4,      4240,4044,4080,A3,R4
CGS 4241,4045,4081,A3,R4,      4242,4046,4082,A3,R4
CGS 4243,4047,4083,A3,R4,      4244,4048,4084,A3,R4
CGS 4245,4049,4085,A3,R4,      4246,4050,4086,A3,R4
CGS 4247,4051,4087,A3,R4,      4248,4052,4088,A3,R4
CGS 4249,4053,4089,A3,R4,      4250,4054,4090,A3,R4
CGS 4251,4055,4091,A3,R4,      4252,4056,4092,A3,R4
CGS 4253,4057,4093,A3,R4,      4254,4058,4094,A3,R4
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APPENDIX A, CONTINUED

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      CGS 4255,4059,4095,A3,R4,        4256,4060,4096,A3,R4
      GEN 4257,6,1,4025,1,4097,1,1.
      GEN 4263,4,1,4036,6,4108,6,1.
      GEN 4267,6,1,4060,-1,4132,-1,1.
      GEN 4273,4,1,4049,-6,4121,-6,1.
      CGS 4277,4097,4098,A4,R5,        4278,4098,4099,A4,R5
      CGS 4279,4099,4100,A4,R5,        4280,4100,4101,A4,R5
      CGS 4281,4101,4102,A4,R5,        4282,4103,4104,A4,R5
      CGS 4283,4104,4105,A4,R5,        4284,4105,4106,A4,R5
      CGS 4285,4106,4107,A4,R5,        4286,4107,4108,A4,R5
      CGS 4287,4109,4110,A4,R5,        4288,4110,4111,A4,R5
      CGS 4289,4111,4112,A4,R5,        4290,4112,4113,A4,R5
      CGS 4291,4113,4114,A4,R5,        4292,4115,4116,A4,R5
      CGS 4293,4116,4117,A4,R5,        4294,4117,4118,A4,R5
      CGS 4295,4118,4119,A4,R5,        4296,4119,4120,A4,R5
      CGS 4297,4121,4122,A4,R5,        4298,4122,4123,A4,R5
      CGS 4299,4123,4124,A4,R5,        4300,4124,4125,A4,R5
      CGS 4301,4125,4126,A4,R5,        4302,4127,4128,A4,R5
      CGS 4303,4128,4129,A4,R5,        4304,4129,4130,A4,R5
      CGS 4305,4130,4131,A4,R5,        4306,4131,4132,A4,R5
      CGS 4307,4097,4103,A4,R5,        4308,4103,4109,A4,R5
      CGS 4309,4109,4115,A4,R5,        4310,4115,4121,A4,R5
      CGS 4311,4121,4127,A4,R5,        4312,4098,4104,A4,R5
      CGS 4313,4104,4110,A4,R5,        4314,4110,4116,A4,R5
      CGS 4315,4116,4122,A4,R5,        4316,4122,4128,A4,R5
      CGS 4317,4099,4105,A4,R5,        4318,4105,4111,A4,R5
      CGS 4319,4111,4117,A4,R5,        4320,4117,4123,A4,R5
      CGS 4321,4123,4129,A4,R5,        4322,4100,4106,A4,R5
      CGS 4323,4106,4112,A4,R5,        4324,4112,4118,A4,R5
      CGS 4325,4118,4124,A4,R5,        4326,4124,4130,A4,R5
      CGS 4327,4101,4107,A4,R5,        4328,4107,4113,A4,R5
      CGS 4329,4113,4119,A4,R5,        4330,4119,4125,A4,R5
      CGS 4331,4125,4131,A4,R5,        4332,4102,4108,A4,R5
      CGS 4333,4108,4114,A4,R5,        4334,4114,4120,A4,R5
      CGS 4335,4120,4126,A4,R5,        4336,4126,4132,A4,R5
      GEN 5007,18,1,5207,1,5007,1,1.
      5030,4013,5007,1.
      GEN 5031,17,1,5007,1,5008,1,1.
      5048,5024,4018,1.
      GEN 5053,6,1,4018,-1,5025,1,1.
      GEN 5059,6,1,5007,1,5030,6,1.
      GEN 5065,6,1,5013,1,5060,-1,1.
      GEN 5071,6,1,5019,1,5055,-6,1.
C CONDUCTORS IN TILE
      CGS 5077,4018,5025,A2,R2,        5078,4017,5026,A2,R2
      CGS 5079,4016,5027,A2,R2,        5080,4015,5028,A2,R2
      CGS 5081,4014,5029,A2,R2,        5082,4013,5030,A2,R2
      CGS 5083,5007,5030,A2,R2,        5084,5008,5036,A2,R2
      CGS 5085,5009,5042,A2,R2,        5086,5010,5048,A2,R2
      CGS 5087,5011,5054,A2,R2,        5088,5012,5060,A2,R2
      CGS 5089,5013,5060,A2,R2,        5090,5014,5059,A2,R2
      CGS 5091,5015,5058,A2,R2,        5092,5016,5057,A2,R2
      CGS 5093,5017,5056,A2,R2,        5094,5018,5055,A2,R2
      CGS 5095,5019,5055,A2,R2,        5096,5020,5049,A2,R2
      CGS 5097,5021,5043,A2,R2,        5098,5022,5037,A2,R2
      CGS 5099,5023,5031,A2,R2,        5100,5024,5025,A2,R2
      CGS 5101,5025,5026,A3,R3,        5102,5026,5027,A3,R3
      CGS 5103,5027,5028,A3,R3,        5104,5028,5029,A3,R3
      CGS 5105,5029,5030,A3,R3,        5106,5031,5032,A3,R3
      CGS 5107,5032,5033,A3,R3,        5108,5033,5034,A3,R3
      CGS 5109,5034,5035,A3,R3,        5110,5035,5036,A3,R3
      CGS 5111,5037,5038,A3,R3,        5112,5038,5039,A3,R3
      CGS 5113,5039,5040,A3,R3,        5114,5040,5041,A3,R3
      CGS 5115,5041,5042,A3,R3,        5116,5043,5044,A3,R3
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APPENDIX A, CONTINUED

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CGS 5117,5044,5045,A3,R3,       5118,5045,5046,A3,R3
CGS 5119,5046,5047,A3,R3,       5120,5047,5048,A3,R3
CGS 5121,5049,5050,A3,R3,       5122,5050,5051,A3,R3
CGS 5123,5051,5052,A3,R3,       5124,5052,5053,A3,R3
CGS 5125,5053,5054,A3,R3,       5126,5055,5056,A3,R3
CGS 5127,5056,5057,A3,R3,       5128,5057,5058,A3,R3
CGS 5129,5058,5059,A3,R3,       5130,5059,5060,A3,R3
CGS 5131,5025,5031,A3,R3,       5132,5031,5037,A3,R3
CGS 5133,5037,5043,A3,R3,       5134,5043,5049,A3,R3
CGS 5135,5049,5055,A3,R3,       5136,5026,5032,A3,R3
CGS 5137,5032,5038,A3,R3,       5138,5038,5044,A3,R3
CGS 5139,5044,5050,A3,R3,       5140,5050,5056,A3,R3
CGS 5141,5027,5033,A3,R3,       5142,5033,5039,A3,R3
CGS 5143,5039,5045,A3,R3,       5144,5045,5051,A3,R3
CGS 5145,5051,5057,A3,R3,       5146,5028,5034,A3,R3
CGS 5147,5034,5040,A3,R3,       5148,5040,5046,A3,R3
CGS 5149,5046,5052,A3,R3,       5150,5052,5058,A3,R3
CGS 5151,5029,5035,A3,R3,       5152,5035,5041,A3,R3
CGS 5153,5041,5047,A3,R3,       5154,5047,5053,A3,R3
CGS 5155,5053,5059,A3,R3,       5156,5030,5036,A3,R3
CGS 5157,5036,5042,A3,R3,       5158,5042,5048,A3,R3
CGS 5159,5048,5054,A3,R3,       5160,5054,5060,A3,R3
CGS 5161,5061,5062,A3,R3,       5162,5062,5063,A3,R3
CGS 5163,5063,5064,A3,R3,       5164,5064,5065,A3,R3
CGS 5165,5065,5066,A3,R3,       5166,5067,5068,A3,R3
CGS 5167,5068,5069,A3,R3,       5168,5069,5070,A3,R3
CGS 5169,5070,5071,A3,R3,       5170,5071,5072,A3,R3
CGS 5171,5073,5074,A3,R3,       5172,5074,5075,A3,R3
CGS 5173,5075,5076,A3,R3,       5174,5076,5077,A3,R3
CGS 5175,5077,5078,A3,R3,       5176,5079,5080,A3,R3
CGS 5177,5080,5081,A3,R3,       5178,5081,5082,A3,R3
CGS 5179,5082,5083,A3,R3,       5180,5083,5084,A3,R3
CGS 5181,5085,5086,A3,R3,       5182,5086,5087,A3,R3
CGS 5183,5087,5088,A3,R3,       5184,5088,5089,A3,R3
CGS 5185,5089,5090,A3,R3,       5186,5091,5092,A3,R3
CGS 5187,5092,5093,A3,R3,       5188,5093,5094,A3,R3
CGS 5189,5094,5095,A3,R3,       5190,5095,5096,A3,R3
CGS 5191,5061,5067,A3,R3,       5192,5067,5073,A3,R3
CGS 5193,5073,5079,A3,R3,       5194,5079,5085,A3,R3
CGS 5195,5085,5091,A3,R3,       5196,5062,5068,A3,R3
CGS 5197,5068,5074,A3,R3,       5198,5074,5080,A3,R3
CGS 5199,5080,5086,A3,R3,       5200,5086,5092,A3,R3
CGS 5201,5063,5069,A3,R3,       5202,5069,5075,A3,R3
CGS 5203,5075,5081,A3,R3,       5204,5081,5087,A3,R3
CGS 5205,5087,5093,A3,R3,       5206,5064,5070,A3,R3
CGS 5207,5070,5076,A3,R3,       5208,5076,5082,A3,R3
CGS 5209,5082,5088,A3,R3,       5210,5088,5094,A3,R3
CGS 5211,5065,5071,A3,R3,       5212,5071,5077,A3,R3
CGS 5213,5077,5083,A3,R3,       5214,5083,5089,A3,R3
CGS 5215,5089,5095,A3,R3,       5216,5066,5072,A3,R3
CGS 5217,5072,5078,A3,R3,       5218,5078,5084,A3,R3
CGS 5219,5084,5090,A3,R3,       5220,5090,5096,A3,R3
CGS 5221,5025,5061,A3,R4,       5222,5026,5062,A3,R4
CGS 5223,5027,5063,A3,R4,       5224,5028,5064,A3,R4
CGS 5225,5029,5065,A3,R4,       5226,5030,5066,A3,R4
CGS 5227,5031,5067,A3,R4,       5228,5032,5068,A3,R4
CGS 5229,5033,5069,A3,R4,       5230,5034,5070,A3,R4
CGS 5231,5035,5071,A3,R4,       5232,5036,5072,A3,R4
CGS 5233,5037,5073,A3,R4,       5234,5038,5074,A3,R4
CGS 5235,5039,5075,A3,R4,       5236,5040,5076,A3,R4
CGS 5237,5041,5077,A3,R4,       5238,5042,5078,A3,R4
CGS 5239,5043,5079,A3,R4,       5240,5044,5080,A3,R4
CGS 5241,5045,5081,A3,R4,       5242,5046,5082,A3,R4
CGS 5243,5047,5083,A3,R4,       5244,5048,5084,A3,R4
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APPENDIX A, CONTINUED

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      CGS 5245,5049,5085,A3,R4,        5246,5050,5086,A3,R4
      CGS 5247,5051,5087,A3,R4,        5248,5052,5088,A3,R4
      CGS 5249,5053,5089,A3,R4,        5250,5054,5090,A3,R4
      CGS 5251,5055,5091,A3,R4,        5252,5056,5092,A3,P4
      CGS 5253,5057,5093,A3,R4,        5254,5058,5094,A3,R4
      CGS 5255,5059,5095,A3,R4,        5256,5060,5096,A3,R4
      GEN 5257,6,1,5025,1,5097,1,1.
      GEN 5263,4,1,5036,6,5108,6,1.
      GEN 5267,6,1,5060,-1,5132,-1,1.
      GEN 5273,4,1,5049,-6,5121,-6,1.
      CGS 5277,5097,5098,A4,R5,        5278,5098,5099,A4,R5
      CGS 5279,5099,5100,A4,R5,        5280,5100,5101,A4,R5
      CGS 5281,5101,5102,A4,R5,        5282,5103,5104,A4,R5
      CGS 5283,5104,5105,A4,R5,        5284,5105,5106,A4,R5
      CGS 5285,5106,5107,A4,R5,        5286,5107,5108,A4,P5
      CGS 5287,5109,5110,A4,R5,        5288,5110,5111,A4,R5
      CGS 5289,5111,5112,A4,P5,        5290,5112,5113,A4,R5
      CGS 5291,5113,5114,A4,R5,        5292,5115,5116,A4,R5
      CGS 5293,5116,5117,A4,R5,        5294,5117,5118,A4,P5
      CGS 5295,5118,5119,A4,R5,        5296,5119,5120,A4,R5
      CGS 5297,5121,5122,A4,R5,        5298,5122,5123,A4,R5
      CGS 5299,5123,5124,A4,R5,        5300,5124,5125,A4,R5
      CGS 5301,5125,5126,A4,R5,        5302,5127,5128,A4,P5
      CGS 5303,5128,5129,A4,R5,        5304,5129,5130,A4,R5
      CGS 5305,5130,5131,A4,R5,        5306,5131,5132,A4,P5
      CGS 5307,5097,5103,A4,R5,        5308,5103,5109,A4,P5
      CGS 5309,5109,5115,A4,R5,        5310,5115,5121,A4,P5
      CGS 5311,5121,5127,A4,P5,        5312,5098,5104,A4,R5
      CGS 5313,5104,5110,A4,R5,        5314,5110,5116,A4,R5
      CGS 5315,5116,5122,A4,R5,        5316,5122,5128,A4,R5
      CGS 5317,5099,5105,A4,R5,        5318,5105,5111,A4,P5
      CGS 5319,5111,5117,A4,R5,        5320,5117,5123,A4,P5
      CGS 5321,5123,5129,A4,R5,        5322,5100,5106,A4,R5
      CGS 5323,5106,5112,A4,R5,        5324,5112,5118,A4,R5
      CGS 5325,5118,5124,A4,R5,        5326,5124,5130,A4,R5
      CGS 5327,5101,5107,A4,R5,        5328,5107,5113,A4,R5
      CGS 5329,5113,5119,A4,P5,        5330,5119,5125,A4,R5
      CGS 5331,5125,5131,A4,R5,        5332,5102,5108,A4,R5
      CGS 5333,5108,5114,A4,R5,        5334,5114,5120,A4,R5
      CGS 5335,5120,5126,A4,R5,        5336,5126,5132,A4,R5
      GEN 6013,12,1,6213,1,6013,1,1.
      6030,13,4021,1.
      6033,4019,5024,1.
      6036,6013,5022,1.
      GEN 6037,11,1,6013,1,6014,1,1.
      6048,6024,18,1.
      GEN 6053,6,1,18,-1,6025,1,1.
      GEN 6059,3,1,4021,-1,6030,6,1.
      GEN 6062,3,1,5024,-1,6048,6,1.
      GEN 6065,6,1,6013,1,6060,-1,1.
      GEN 6071,6,1,6019,1,6055,-6,1.
C CONDUCTORS IN TILE
      CGS 6077,18,6025,A2,P2,        6078,17,6026,A2,P2
      CGS 6079,16,6027,A2,P2,        6080,15,6028,A2,P2
      CGS 6081,14,6029,A2,P2,        6082,13,6030,A2,P2
      CGS 6083,4021,6030,A2,P2,        6084,4020,6036,A2,P2
      CGS 6085,4019,6042,A2,P2,        6086,5024,6048,A2,P2
      CGS 6087,5023,6054,A2,R2,        6088,5022,6060,A2,R2
      CGS 6089,6013,6060,A2,R2,        6090,6014,6059,A2,R2
      CGS 6091,6015,6058,A2,R2,        6092,6016,6057,A2,R2
      CGS 6093,6017,6056,A2,R2,        6094,6018,6055,A2,P2
      CGS 6095,6019,6055,A2,R2,        6096,6020,6049,A2,R2
      CGS 6097,6021,6043,A2,R2,        6098,6022,6037,A2,P2
      CGS 6099,6023,6031,A2,P2,        6100,6024,6025,A2,P2
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APPENDIX A, CONTINUED

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CGS 6101,6025,6026,A3,R3,      6102,6026,6027,A3,R3
CGS 6103,6027,6028,A3,R3,      6104,6028,6029,A3,R3
CGS 6105,6029,6030,A3,R3,      6106,6031,6032,A3,R3
CGS 6107,6032,6033,A3,R3,      6108,6033,6034,A3,R3
CGS 6109,6034,6035,A3,R3,      6110,6035,6036,A3,R3
CGS 6111,6037,6038,A3,R3,      6112,6038,6039,A3,R3
CGS 6113,6039,6040,A3,R3,      6114,6040,6041,A3,R3
CGS 6115,6041,6042,A3,R3,      6116,6043,6044,A3,R3
CGS 6117,6044,6045,A3,R3,      6118,6045,6046,A3,R3
CGS 6119,6046,6047,A3,R3,      6120,6047,6048,A3,R3
CGS 6121,6049,6050,A3,R3,      6122,6050,6051,A3,R3
CGS 6123,6051,6052,A3,R3,      6124,6052,6053,A3,R3
CGS 6125,6053,6054,A3,R3,      6126,6055,6056,A3,R3
CGS 6127,6056,6057,A3,R3,      6128,6057,6058,A3,R3
CGS 6129,6058,6059,A3,R3,      6130,6059,6060,A3,R3
CGS 6131,6025,6031,A3,R3,      6132,6031,6037,A3,R3
CGS 6133,6037,6043,A3,R3,      6134,6043,6049,A3,R3
CGS 6135,6049,6055,A3,R3,      6136,6026,6032,A3,R3
CGS 6137,6032,6038,A3,R3,      6138,6038,6044,A3,R3
CGS 6139,6044,6050,A3,R3,      6140,605C,6056,A3,R3
CGS 6141,6027,6033,A3,R3,      6142,6033,6039,A3,R3
CGS 6143,6039,6045,A3,R3,      6144,6045,6051,A3,R3
CGS 6145,6051,6057,A3,R3,      6146,6028,6034,A3,R3
CGS 6147,6034,6040,A3,R3,      6148,6040,6046,A3,R3
CGS 6149,6046,6052,A3,R3,      6150,6052,6058,A3,R3
CGS 6151,6029,6035,A3,R3,      6152,6035,6041,A3,R3
CGS 6153,6041,6047,A3,R3,      6154,6047,6053,A3,R3
CGS 6155,6053,6059,A3,R3,      6156,6030,6036,A3,R3
CGS 6157,6036,6042,A3,R3,      6158,6042,6048,A3,R3
CGS 6159,6048,6054,A3,R3,      6160,6054,6060,A3,R3
CGS 6161,6061,6062,A3,R3,      6162,6062,6063,A3,R3
CGS 6163,6063,6064,A3,R3,      6164,6064,6065,A3,R3
CGS 6165,6065,6066,A3,R3,      6166,6067,6068,A3,R3
CGS 6167,6068,6069,A3,R3,      6168,6069,6070,A3,R3
CGS 6169,6070,6071,A3,R3,      6170,6071,6072,A3,R3
CGS 6171,6073,6074,A3,R3,      6172,6074,6075,A3,R3
CGS 6173,6075,6076,A3,R3,      6174,6076,6077,A3,R3
CGS 6175,6077,6078,A3,R3,      6176,6079,6080,A3,R3
CGS 6177,6080,6081,A3,R3,      6178,6081,6082,A3,R3
CGS 6179,6082,6083,A3,R3,      6180,6083,6084,A3,R3
CGS 6181,6085,6086,A3,R3,      6182,6086,6087,A3,R3
CGS 6183,6087,6088,A3,R3,      6184,6088,6089,A3,R3
CGS 6185,6089,6090,A3,R3,      6186,6091,6092,A3,R3
CGS 6187,6092,6093,A3,R3,      6188,6093,6094,A3,R3
CGS 6189,6094,6095,A3,R3,      6190,6095,6096,A3,R3
CGS 6191,6061,6067,A3,R3,      6192,6067,6073,A3,R3
CGS 6193,6073,6079,A3,R3,      6194,6079,6085,A3,R3
CGS 6195,6085,6091,A3,R3,      6196,6062,6068,A3,R3
CGS 6197,6068,6074,A3,R3,      6198,6074,6080,A3,R3
CGS 6199,6080,6086,A3,R3,      6200,6086,6092,A3,R3
CGS 6201,6063,6069,A3,R3,      6202,6069,6075,A3,R3
CGS 6203,6075,6081,A3,R3,      6204,6081,6087,A3,R3
CGS 6205,6087,6093,A3,R3,      6206,6064,6070,A3,R3
CGS 6207,6070,6076,A3,R3,      6208,6076,6082,A3,R3
CGS 6209,6082,6088,A3,R3,      6210,6088,6094,A3,R3
CGS 6211,6065,6071,A3,R3,      6212,6071,6077,A3,R3
CGS 6213,6077,6083,A3,R3,      6214,6083,6089,A3,R3
CGS 6215,6089,6095,A3,R3,      6216,6066,6072,A3,R3
CGS 6217,6072,6078,A3,R3,      6218,6078,6084,A3,R3
CGS 6219,6084,6090,A3,R3,      6220,6090,6096,A3,R3
CGS 6221,6025,6061,A3,R4,      6222,6026,6062,A3,R4
CGS 6223,6027,6063,A3,R4,      6224,6028,6064,A3,R4
CGS 6225,6029,6065,A3,R4,      6226,6030,6066,A3,R4
CGS 6227,6031,6067,A3,R4,      6228,6032,6068,A3,R4
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APPENDIX A, CONTINUED

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      CGS 6229,6033,6069,A3,R4,        6230,6034,6070,A3,R4
      CGS 6231,6035,6071,A3,R4,        6232,6036,6072,A3,R4
      CGS 6233,6037,6073,A3,R4,        6234,6038,6074,A3,R4
      CGS 6235,6039,6075,A3,R4,        6236,6040,6076,A3,R4
      CGS 6237,6041,6077,A3,R4,        6238,6042,6078,A3,R4
      CGS 6239,6043,6079,A3,R4,        6240,6044,6080,A3,R4
      CGS 6241,6045,6081,A3,R4,        6242,6046,6082,A3,R4
      CGS 6243,6047,6083,A3,R4,        6244,6048,6084,A3,R4
      CGS 6245,6049,6085,A3,R4,        6246,6050,6086,A3,R4
      CGS 6247,6051,6087,A3,R4,        6248,6052,6088,A3,R4
      CGS 6249,6053,6089,A3,R4,        6250,6054,6090,A3,R4
      CGS 6251,6055,6091,A3,R4,        6252,6056,6092,A3,R4
      CGS 6253,6057,6093,A3,R4,        6254,6058,6094,A3,R4
      CGS 6255,6059,6095,A3,R4,        6256,6060,6096,A3,R4
      GEN 6257,6,1,6025,1,6097,1,1.
      GEN 6263,4,1,6036,6,6108,6,1.
      GEN 6267,6,1,6060,-1,6132,-1,1.
      GEN 6273,4,1,6049,-6,6121,-6,1.
      CGS 6277,6097,6098,A4,R5,        6278,6098,6099,A4,R5
      CGS 6279,6099,6100,A4,R5,        6280,6100,6101,A4,R5
      CGS 6281,6101,6102,A4,R5,        6282,6103,6104,A4,R5
      CGS 6283,6104,6105,A4,R5,        6284,6105,6106,A4,R5
      CGS 6285,6106,6107,A4,R5,        6286,6107,6108,A4,R5
      CGS 6287,6109,6110,A4,R5,        6288,6110,6111,A4,R5
      CGS 6289,6111,6112,A4,R5,        6290,6112,6113,A4,R5
      CGS 6291,6113,6114,A4,R5,        6292,6115,6116,A4,R5
      CGS 6293,6116,6117,A4,R5,        6294,6117,6118,A4,R5
      CGS 6295,6118,6119,A4,R5,        6296,6119,6120,A4,R5
      CGS 6297,6121,6122,A4,R5,        6298,6122,6123,A4,R5
      CGS 6299,6123,6124,A4,R5,        6300,6124,6125,A4,R5
      CGS 6301,6125,6126,A4,R5,        6302,6127,6128,A4,R5
      CGS 6303,6128,6129,A4,R5,        6304,6129,6130,A4,R5
      CGS 6305,6130,6131,A4,R5,        6306,6131,6132,A4,R5
      CGS 6307,6097,6103,A4,R5,        6308,6103,6109,A4,R5
      CGS 6309,6109,6115,A4,R5,        6310,6115,6121,A4,R5
      CGS 6311,6121,6127,A4,R5,        6312,3098,6104,A4,R5
      CGS 6313,6104,6110,A4,R5,        6314,6110,6116,A4,R5
      CGS 6315,6116,6122,A4,R5,        6316,6122,6128,A4,R5
      CGS 6317,6099,6105,A4,R5,        6318,6105,6111,A4,R5
      CGS 6319,6111,6117,A4,R5,        6320,6117,6123,A4,R5
      CGS 6321,6123,6129,A4,R5,        6322,6100,6106,A4,R5
      CGS 6323,6106,6112,A4,R5,        6324,6112,6118,A4,R5
      CGS 6325,6118,6124,A4,R5,        6326,6124,6130,A4,R5
      CGS 6327,6101,6107,A4,R5,        6328,6107,6113,A4,R5
      CGS 6329,6113,6119,A4,R5,        6330,6119,6125,A4,R5
      CGS 6331,6125,6131,A4,R5,        6332,6102,6108,A4,R5
      CGS 6333,6108,6114,A4,R5,        6334,6114,6120,A4,R5
      CGS 6335,6120,6126,A4,R5,        6336,6126,6132,A4,R5
      GEN 7001,6,1,7201,1,7001,1,1.
      GEN 7013,12,1,7213,1,7013,1,1.
      GEN 7025,5,1,7001,1,7002,1,1.
      7030,7006,21,1.
      7033,19,6024,1.
      7036,6022,7013,1.
      GEN 7037,11,1,7013,1,7014,1,1.
      7048,7024,7001,1.
      GEN 7053,6,1,7001,1,7025,1,1.
      GEN 7059,3,1,21,-1,7030,6,1.
      GEN 7062,3,1,6024,-1,7048,6,1.
      GEN 7065,6,1,7013,1,7060,-1,1.
      GEN 7071,6,1,7019,1,7055,-6,1.
C CONDUCTORS IN TILE
      CGS 7077,7001,7025,A2,R2,        7078,7002,7026,A2,R2
      CGS 7079,7003,7027,A2,R2,        7080,7004,7028,A2,R2
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APPENDIX A, CONTINUED

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CGS 7081,7005,7029,A2,R2,       7082,7006,7030,A2,R2
CGS 7083,  21,7030,A2,R2,       7084,  20,7036,A2,R2
CGS 7085,  19,7042,A2,R2,       7086,6024,7048,A2,R2
CGS 7087,6023,7054,A2,R2,       7088,6022,7060,A2,R2
CGS 7089,7013,7060,A2,R2,       7090,7014,7059,A2,R2
CGS 7091,7015,7058,A2,R2,       7092,7016,7057,A2,R2
CGS 7093,7017,7056,A2,R2,       7094,7018,7055,A2,R2
CGS 7095,7019,7055,A2,R2,       7096,7020,7049,A2,R2
CGS 7097,7021,7043,A2,R2,       7098,7022,7037,A2,R2
CGS 7099,7023,7031,A2,R2,       7100,7024,7025,A2,R2
CGS 7101,7025,7026,A3,R3,       7102,7026,7027,A3,R3
CGS 7103,7027,7028,A3,R3,       7104,7028,7029,A3,R3
CGS 7105,7029,7030,A3,R3,       7106,7031,7032,A3,R3
CGS 7107,7032,7033,A3,R3,       7108,7033,7034,A3,R3
CGS 7109,7034,7035,A3,R3,       7110,7035,7036,A3,R3
CGS 7111,7037,7038,A3,R3,       7112,7038,7039,A3,R3
CGS 7113,7039,7040,A3,R3,       7114,7040,7041,A3,R3
CGS 7115,7041,7042,A3,R3,       7116,7043,7044,A3,R3
CGS 7117,7044,7045,A3,R3,       7118,7045,7046,A3,R3
CGS 7119,7046,7047,A3,R3,       7120,7047,7048,A3,R3
CGS 7121,7049,7050,A3,R3,       7122,7050,7051,A3,R3
CGS 7123,7051,7052,A3,R3,       7124,7052,7053,A3,R3
CGS 7125,7053,7054,A3,R3,       7126,7055,7056,A3,R3
CGS 7127,7056,7057,A3,R3,       7128,7057,7058,A3,R3
CGS 7129,7058,7059,A3,R3,       7130,7059,7060,A3,R3
CGS 7131,7025,7031,A3,R3,       7132,7031,7037,A3,R3
CGS 7133,7027,7043,A3,R3,       7134,7043,7049,A3,R3
CGS 7135,7049,7055,A3,R3,       7136,7026,7032,A3,R3
CGS 7137,7032,7038,A3,R3,       7138,7038,7044,A3,R3
CGS 7139,7044,7050,A3,R3,       7140,7050,7056,A3,R3
CGS 7141,7027,7033,A3,R3,       7142,7033,7039,A3,R3
CGS 7143,7039,7045,A3,R3,       7144,7045,7051,A3,R3
CGS 7145,7051,7057,A3,R3,       7146,7028,7034,A3,R3
CGS 7147,7034,7040,A3,R3,       7148,7040,7046,A3,R3
CGS 7149,7046,7052,A3,R3,       7150,7052,7058,A3,R3
CGS 7151,7029,7035,A3,R3,       7152,7035,7041,A3,R3
CGS 7153,7041,7047,A3,R3,       7154,7047,7053,A3,R3
CGS 7155,7053,7059,A3,R3,       7156,7030,7036,A3,R3
CGS 7157,7036,7042,A3,R3,       7158,7042,7048,A3,R3
CGS 7159,7048,7054,A3,R3,       7160,7054,7060,A3,R3
CGS 7161,7061,7062,A3,R3,       7162,7062,7063,A3,R3
CGS 7163,7063,7064,A3,R3,       7164,7064,7065,A3,R3
CGS 7165,7065,7066,A3,R3,       7166,7067,7068,A3,R3
CGS 7167,7068,7069,A3,R3,       7168,7069,7070,A3,R3
CGS 7169,7070,7071,A3,R3,       7170,7071,7072,A3,R3
CGS 7171,7073,7074,A3,R3,       7172,7074,7075,A3,R3
CGS 7173,7075,7076,A3,R3,       7174,7076,7077,A3,R3
CGS 7175,7077,7078,A3,R3,       7176,7079,7080,A3,R3
CGS 7177,7080,7081,A3,R3,       7178,7081,7082,A3,R3
CGS 7179,7082,7083,A3,R3,       7180,7083,7084,A3,R3
CGS 7181,7085,7086,A3,R3,       7182,7086,7087,A3,R3
CGS 7183,7087,7088,A3,R3,       7184,7088,7089,A3,R3
CGS 7185,7089,7090,A3,R3,       7186,7091,7092,A3,R3
CGS 7187,7092,7093,A3,R3,       7188,7093,7094,A3,R3
CGS 7189,7094,7095,A3,R3,       7190,7095,7096,A3,R3
CGS 7191,7061,7067,A3,R3,       7192,7067,7073,A3,R3
CGS 7193,7073,7079,A3,R3,       7194,7079,7085,A3,R3
CGS 7195,7085,7091,A3,R3,       7196,7062,7068,A3,R3
CGS 7197,7068,7074,A3,R3,       7198,7074,7080,A3,R3
CGS 7199,7080,7086,A3,R3,       7200,7086,7092,A3,R3
CGS 7201,7063,7069,A3,R3,       7202,7069,7075,A3,R3
CGS 7203,7075,7081,A3,R3,       7204,7081,7087,A3,R3
CGS 7205,7087,7093,A3,R3,       7206,7064,7070,A3,R3
CGS 7207,7070,7076,A3,R3,       7208,7076,7082,A3,R3
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APPENDIX A, CONTINUED

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CGS 7209,7082,7088,A3,R3,      7210,7088,7094,A3,R3
CGS 7211,7065,7071,A3,R3,      7212,7071,7077,A3,R3
CGS 7213,7077,7083,A3,R3,      7214,7083,7089,A3,R3
CGS 7215,7089,7095,A3,R3,      7216,7066,7072,A3,R3
CGS 7217,7072,7078,A3,R3,      7218,7078,7084,A3,R3
CGS 7219,7084,7090,A3,R3,      7220,7090,7096,A3,R3
CGS 7221,7025,7061,A3,R4,      7222,7026,7062,A3,R4
CGS 7223,7027,7063,A3,R4,      7224,7028,7064,A3,R4
CGS 7225,7029,7065,A3,R4,      7226,7030,7066,A3,R4
CGS 7227,7031,7067,A3,R4,      7228,7032,7068,A3,R4
CGS 7229,7033,7069,A3,R4,      7230,7034,7070,A3,R4
CGS 7231,7035,7071,A3,R4,      7232,7036,7072,A3,R4
CGS 7233,7037,7073,A3,R4,      7234,7038,7074,A3,R4
CGS 7235,7039,7075,A3,R4,      7236,7040,7076,A3,R4
CGS 7237,7041,7077,A3,R4,      7238,7042,7078,A3,R4
CGS 7239,7043,7079,A3,R4,      7240,7044,7080,A3,R4
CGS 7241,7045,7081,A3,R4,      7242,7046,7082,A3,R4
CGS 7243,7047,7083,A3,R4,      7244,7048,7084,A3,R4
CGS 7245,7049,7085,A3,R4,      7246,7050,7086,A3,R4
CGS 7247,7051,7087,A3,R4,      7248,7052,7088,A3,R4
CGS 7249,7053,7089,A3,R4,      7250,7054,7090,A3,R4
CGS 7251,7055,7091,A3,R4,      7252,7056,7092,A3,R4
CGS 7253,7057,7093,A3,R4,      7254,7058,7094,A3,R4
CGS 7255,7059,7095,A3,R4,      7256,7060,7096,A3,R4
GEN 7257,6,1,7025,1,7097,1,1.
GEN 7263,4,1,7036,6,7108,6,1.
GEN 7267,6,1,7060,-1,7132,-1,1.
GEN 7273,4,1,7049,-6,7121,-6,1.
CGS 7277,7097,7098,A4,R5,      7278,7098,7099,A4,R5
CGS 7279,7099,7100,A4,R5,      7280,7100,7101,A4,R5
CGS 7281,7101,7102,A4,R5,      7282,7103,7104,A4,R5
CGS 7283,7104,7105,A4,R5,      7284,7105,7106,A4,R5
CGS 7285,7106,7107,A4,R5,      7286,7107,7108,A4,R5
CGS 7287,7109,7110,A4,R5,      7288,7110,7111,A4,R5
CGS 7289,7111,7112,A4,R5,      7290,7112,7113,A4,R5
CGS 7291,7113,7114,A4,R5,      7292,7115,7116,A4,R5
CGS 7293,7116,7117,A4,R5,      7294,7117,7118,A4,R5
CGS 7295,7118,7119,A4,R5,      7296,7119,7120,A4,R5
CGS 7297,7121,7122,A4,R5,      7298,7122,7123,A4,R5
CGS 7299,7123,7124,A4,R5,      7300,7124,7125,A4,R5
CGS 7301,7125,7126,A4,R5,      7302,7127,7128,A4,R5
CGS 7303,7128,7129,A4,R5,      7304,7129,7130,A4,R5
CGS 7305,7130,7131,A4,R5,      7306,7131,7132,A4,R5
CGS 7307,7097,7103,A4,R5,      7308,7103,7109,A4,R5
CGS 7309,7109,7115,A4,R5,      7310,7115,7121,A4,R5
CGS 7311,7121,7127,A4,R5,      7312,7098,7104,A4,R5
CGS 7313,7104,7110,A4,R5,      7314,7110,7116,A4,R5
CGS 7315,7116,7122,A4,R5,      7316,7122,7128,A4,R5
CGS 7317,7099,7105,A4,R5,      7318,7105,7111,A4,R5
CGS 7319,7111,7117,A4,R5,      7320,7117,7123,A4,R5
CGS 7321,7123,7129,A4,R5,      7322,7100,7106,A4,R5
CGS 7323,7106,7112,A4,R5,      7324,7112,7118,A4,R5
CGS 7325,7118,7124,A4,R5,      7326,7124,7130,A4,R5
CGS 7327,7101,7107,A4,R5,      7328,7107,7113,A4,R5
CGS 7329,7113,7119,A4,R5,      7330,7119,7125,A4,R5
CGS 7331,7125,7131,A4,R5,      7332,7102,7108,A4,R5
CGS 7333,7108,7114,A4,R5,      7334,7114,7120,A4,R5
CGS 7335,7120,7126,A4,R5,      7336,7126,7132,A4,R5
GEN 8019,6,1,8219,1,8019,1,1.
8030,1013,2021,1.
8033,2019,24,1.
8036,22,7006,1.
8042,7001,8019,1.
GEN 8043,5,1,8019,1,8020,1,1.
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APPENDIX A, CONTINUED

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      8048,8024,1018,1.
      GEN 8053,6,1,1018,-1,8025,1,1.
      GEN 8059,3,1,2021,-1,8030,6,1.
      GEN 8062,3,1,24,-1,8048,6,1.
      GEN 8065,6,1,7006,-1,8060,-1,1.
      GEN 8071,6,1,8019,1,8055,-6,1.
C CONDUCTORS IN TILE
      CGS 8077,1018,8025,A2,R2,        8078,1017,8026,A2,R2
      CGS 8079,1016,8027,A2,R2,        8080,1015,8028,A2,R2
      CGS 8081,1014,8029,A2,R2,        8082,1013,8030,A2,R2
      CGS 8083,2021,8030,A2,R2,        8084,2020,8036,A2,R2
      CGS 8085,2019,8042,A2,R2,        8086,  24,8048,A2,R2
      CGS 8087,  23,8054,A2,R2,        8088,  22,8060,A2,R2
      CGS 8089,7006,8060,A2,R2,        8090,7005,8059,A2,R2
      CGS 8091,7004,8058,A2,R2,        8092,7003,8057,A2,R2
      CGS 8093,7002,8056,A2,R2,        8094,7001,8055,A2,R2
      CGS 8095,8019,8055,A2,R2,        8096,8020,8049,A2,R2
      CGS 8097,8021,8043,A2,R2,        8098,8022,8037,A2,R2
      CGS 8099,8023,8031,A2,R2,        8100,8024,8025,A2,R2
      CGS 8101,8025,8026,A3,R3,        8102,8026,8027,A3,R3
      CGS 8103,8027,8028,A3,R3,        8104,8028,8029,A3,R3
      CGS 8105,8029,8030,A3,R3,        8106,8031,8032,A3,R3
      CGS 8107,8032,8033,A3,R3,        8108,8033,8034,A3,R3
      CGS 8109,8034,8035,A3,R3,        8110,8035,8036,A3,R3
      CGS 8111,8037,8038,A3,R3,        8112,8038,8039,A3,R3
      CGS 8113,8039,8040,A3,R3,        8114,8040,8041,A3,R3
      CGS 8115,8041,8042,A3,R3,        8116,8043,8044,A3,R3
      CGS 8117,8044,8045,A3,R3,        8118,8045,8046,A3,R3
      CGS 8119,8046,8047,A3,R3,        8120,8047,8048,A3,R3
      CGS 8121,8049,8050,A3,R3,        8122,8050,8051,A3,R3
      CGS 8123,8051,8052,A3,R3,        8124,8052,8053,A3,R3
      CGS 8125,8053,8054,A3,R3,        8126,8055,8056,A3,R3
      CGS 8127,8056,8057,A3,R3,        8128,8057,8058,A3,R3
      CGS 8129,8058,8059,A3,R3,        8130,8059,8060,A3,R3
      CGS 8131,8025,8031,A3,R3,        8132,8031,8037,A3,R3
      CGS 8133,8037,8043,A3,R3,        8134,8043,8049,A3,R3
      CGS 8135,8049,8055,A3,R3,        8136,8026,8032,A3,R3
      CGS 8137,8032,8038,A3,R3,        8138,8038,8044,A3,R3
      CGS 8139,8044,8050,A3,R3,        8140,8050,8056,A3,R3
      CGS 8141,8027,8033,A3,R3,        8142,8033,8039,A3,R3
      CGS 8143,8039,8045,A3,R3,        8144,8045,8051,A3,R3
      CGS 8145,8051,8057,A3,R3,        8146,8028,8034,A3,R3
      CGS 8147,8034,8040,A3,R3,        8148,8040,8046,A3,R3
      CGS 8149,8046,8052,A3,R3,        8150,8052,8058,A3,R3
      CGS 8151,8029,8035,A3,R3,        8152,8035,8041,A3,R3
      CGS 8153,8041,8047,A3,R3,        8154,8047,8053,A3,R3
      CGS 8155,8053,8059,A3,R3,        8156,8030,8036,A3,R3
      CGS 8157,8036,8042,A3,R3,        8158,8042,8048,A3,R3
      CGS 8159,8048,8054,A3,R3,        8160,8054,8060,A3,R3
      CGS 8161,8061,8062,A3,R3,        8162,8062,8063,A3,R3
      CGS 8163,8063,8064,A3,R3,        8164,8064,8065,A3,R3
      CGS 8165,8065,8066,A3,R3,        8166,8067,8068,A3,R3
      CGS 8167,8068,8069,A3,R3,        8168,8069,8070,A3,R3
      CGS 8169,8070,8071,A3,R3,        8170,8071,8072,A3,R3
      CGS 8171,8073,8074,A3,R3,        8172,8074,8075,A3,R3
      CGS 8173,8075,8076,A3,R3,        8174,8076,8077,A3,R3
      CGS 8175,8077,8078,A3,R3,        8176,8079,8080,A3,R3
      CGS 8177,8080,8081,A3,R3,        8178,8081,8082,A3,R3
      CGS 8179,8082,8083,A3,R3,        8180,8083,8084,A3,R3
      CGS 8181,8085,8086,A3,R3,        8182,8086,8087,A3,R3
      CGS 8183,8087,8088,A3,R3,        8184,8088,8089,A3,R3
      CGS 8185,8089,8090,A3,R3,        8186,8091,8092,A3,R3
      CGS 8187,8092,8093,A3,R3,        8188,8093,8094,A3,R3
      CGS 8189,8094,8095,A3,R3,        8190,8095,8096,A3,R3
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APPENDIX A, CONTINUED

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CGS 8191,8061,8067,A3,R3,       8192,8067,8073,A3,R3
CGS 8193,8073,8079,A3,R3,       8194,8079,8085,A3,R3
CGS 8195,8085,8091,A3,R3,       8196,8062,8068,A3,R3
CGS 8197,8068,8074,A3,R3,       8198,8074,8080,A3,R3
CGS 8199,8080,8086,A3,R3,       8200,8086,8092,A3,R3
CGS 8201,8063,8069,A3,R3,       8202,8069,8075,A3,R3
CGS 8203,8075,8081,A3,R3,       8204,8081,8087,A3,R3
CGS 8205,8087,8093,A3,R3,       8206,8064,8070,A3,R3
CGS 8207,8070,8076,A3,R3,       8208,8076,8082,A3,R3
CGS 8209,8082,8088,A3,R3,       8210,8088,8094,A3,R3
CGS 8211,8065,8071,A3,R3,       8212,8071,8077,A3,R3
CGS 8213,8077,8083,A3,R3,       8214,8083,8089,A3,R3
CGS 8215,8089,8095,A3,R3,       8216,8066,8072,A3,R3
CGS 8217,8072,8078,A3,R3,       8218,8078,8084,A3,R3
CGS 8219,8084,8090,A3,R3,       8220,8090,8096,A3,R3
CGS 8221,8025,8061,A3,R4,       8222,8026,8062,A3,R4
CGS 8223,8027,8063,A3,R4,       8224,8028,8064,A3,R4
CGS 8225,8029,8065,A3,R4,       8226,8030,8066,A3,R4
CGS 8227,8031,8067,A3,R4,       8228,8032,8068,A3,R4
CGS 8229,8033,8069,A3,R4,       8230,8034,8070,A3,R4
CGS 8231,8035,8071,A3,R4,       8232,8036,8072,A3,R4
CGS 8233,8037,8073,A3,R4,       8234,8038,8074,A3,R4
CGS 8235,8039,8075,A3,R4,       8236,8040,8076,A3,R4
CGS 8237,8041,8077,A3,R4,       8238,8042,8078,A3,R4
CGS 8239,8043,8079,A3,R4,       8240,8044,8080,A3,R4
CGS 8241,8045,8081,A3,R4,       8242,8046,8082,A3,R4
CGS 8243,8047,8083,A3,R4,       8244,8048,8084,A3,R4
CGS 8245,8049,8085,A3,R4,       8246,8050,8086,A3,R4
CGS 8247,8051,8087,A3,R4,       8248,8052,8088,A3,R4
CGS 8249,8053,8089,A3,R4,       8250,8054,8090,A3,R4
CGS 8251,8055,8091,A3,R4,       8252,8056,8092,A3,R4
CGS 8253,8057,8093,A3,R4,       8254,8058,8094,A3,R4
CGS 8255,8059,8095,A3,R4,       8256,8060,8096,A3,R4
GEN 8257,6,1,8025,1,8097,1,1.
GEN 8263,4,1,8036,6,8108,6,1.
GEN 8267,6,1,8060,-1,8132,-1,1.
GEN 8273,4,1,8049,-6,8121,-6,1.
CGS 8277,8097,8098,A4,R5,       8278,8098,8099,A4,R5
CGS 8279,8099,8100,A4,R5,       8280,8100,8101,A4,R5
CGS 8281,8101,8102,A4,R5,       8282,8103,8104,A4,R5
CGS 8283,8104,8105,A4,R5,       8284,8105,8106,A4,R5
CGS 8285,8106,8107,A4,R5,       8286,8107,8108,A4,R5
CGS 8287,8109,8110,A4,R5,       8288,8110,8111,A4,R5
CGS 8289,8111,8112,A4,R5,       8290,8112,8113,A4,R5
CGS 8291,8113,8114,A4,R5,       8292,8115,8116,A4,R5
CGS 8293,8116,8117,A4,R5,       8294,8117,8118,A4,R5
CGS 8295,8118,8119,A4,R5,       8296,8119,8120,A4,R5
CGS 8297,8121,8122,A4,R5,       8298,8122,8123,A4,R5
CGS 8299,8123,8124,A4,R5,       8300,8124,8125,A4,R5
CGS 8301,8125,8126,A4,R5,       8302,8127,8128,A4,R5
CGS 8303,8128,8129,A4,R5,       8304,8129,8130,A4,R5
CGS 8305,8130,8131,A4,R5,       8306,8131,8132,A4,R5
CGS 8307,8097,8103,A4,R5,       8308,8103,8109,A4,R5
CGS 8309,8109,8115,A4,R5,       8310,8115,8121,A4,R5
CGS 8311,8121,8127,A4,R5,       8312,8098,8104,A4,R5
CGS 8313,8104,8110,A4,R5,       8314,8110,8116,A4,R5
CGS 8315,8116,8122,A4,R5,       8316,8122,8128,A4,R5
CGS 8317,8099,8105,A4,R5,       8318,8105,8111,A4,R5
CGS 8319,8111,8117,A4,R5,       8320,8117,8123,A4,R5
CGS 8321,8123,8129,A4,R5,       8322,8100,8106,A4,R5
CGS 8323,8106,8112,A4,R5,       8324,8112,8118,A4,R5
CGS 8325,8118,8124,A4,R5,       8326,8124,8130,A4,R5
CGS 8327,8101,8107,A4,R5,       8328,8107,8113,A4,R5
CGS 8329,8113,8119,A4,R5,       8330,8119,8125,A4,R5
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APPENDIX A, CONTINUED

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CGS 8331,8125,8131,A4,R5,        8332,8102,8108,A4,P5
CGS 8333,8108,8114,A4,R5,        8334,8114,8120,A4,P5
CGS 8335,8120,8126,A4,R5,        8336,8126,8132,A4,P5
END
BCD 3CONSTANTS DATA
NDSTOR=6500,ITERMX=600 ,DRLXCA=1.E-9,ARLXCA=1.E-9
TIMED=0.,TIMEND=32.,TSTEPD=4.
EXTLIM=.5
100=1.41          $TILE THICKNESS (IN)
101=6.0          $TILE SIDE LENGTH (IN)
102=0.16*10.     $SIP THICKNESS (IN)
103=.06          $TERMINATOR GAP (IN)
106=.05          $GAP WIDTH (IN)
107=00.0000      $VISCOSITY (LBM/FT-SEC)
108=0.0000       $DENSITY OF GAS (LB/FT**3)
109=1.0/26.7*.16    $SIP/GAP DP FACTOR (IN/PSI)
110=1.21/26.7*.16   $SIP/SURFACE DP FACTOR (IN/PSI)
111=0.1         $INITIAL EDGE CLEARANCE (IN)
112=0.1           $EDGE CLEARANCE (IN)
113=.5           $SIP/TILE DISCHARGE COEFFICIENT
114=.1           $SIP/FILLER BAR CLEARANCE (IN)
115=115.         $TEMPERATURE (F)
116=0.0          $AVERAGE PRESSURE
117=5.5          $LBF TO MOVE .05 IN LATERALLY
118=0.0          $CLOSURE OF GAP 1
119=0.0          $CLOSURE OF GAP 2
120=.001          $MINIMUM GAP CLEARANCE (IN)
121=1.E-3          $MINIMUM EDGE CLEARANCE (IN)
123=1.0          $PERMEABILITY FACTOR
1,,2,,3,,4,,5,,6,,7,,8,,9,,10,,11,,12,,13,,14,,15=0.
ITEST=0,JTEST=0,KTEST= EDGAP,LTEST=0,MTEST=0
NTEST=1     $ 0= 3 TILE MOVE;  1= 1 TILE MOVES
END
BCD 3ARRAY DATA     $VALUES SPECIFIED AT T=560R, LI900
 1,0.,2.652E-6,1.E8,2.652E-6,END                    $LBM/IN-LBF,TILE
 2,2.5,1.274E-4,10.,5.097E-4,15.,7.646E-4,END       $LBM-IN/LBF-SEC,TILE
 3,2.5,1.274E-4,10.,5.097E-4,15.,7.646E-4,END       $LBM-IN/LBF-SEC,TILE
 4,2.5,8.011E-4,10.,3.204E-3,15.,4.807E-3,END       $LBM-IN/LBF-SEC,SIP
 5,2.5,8.011E-4,10.,3.204E-3,15.,4.807E-3,END       $LBM-IN/LBF-SEC,FILL BAR
 6,-200.0,6.6E-6,100.,12.75E-6,END                    $VISCOSITY (LBM/SEC-FT
 7,SPACE,216,END                  $EDGE CLEARANCE STORAGE
 10,SPACE,24,END
 11,SPACE,24,END
 12,SPACE,24,END
 13,SPACE,20,END
 14,SPACE,20,END
 20,SPACE,24,END
 21,SPACE,24,END
 22,SPACE,24,END
 23,SPACE,20,END
 24,SPACE,20,END
 30,SPACE,24,END
 31,SPACE,24,END
 32,SPACE,24,END
 33,SPACE,20,END
 34,SPACE,20,END
 40,SPACE,24,END
 41,SPACE,24,END
 42,SPACE,24,END
 43,SPACE,20,END
 44,SPACE,20,END
 50,SPACE,24,END
 51,SPACE,24,END
 52,SPACE,24,END
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APPENDIX A, CONTINUED

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        53,SPACE,20,END
        54,SPACE,20,END
        60,SPACE,24,END
        61,SPACE,24,END
        62,SPACE,24,END
        63,SPACE,20,END
        64,SPACE,20,END
        70,SPACE,24,END
        71,SPACE,24,END
        72,SPACE,24,END
        73,SPACE,20,END
        74,SPACE,20,END
        80,SPACE,24,END
        81,SPACE,24,END
        82,SPACE,24,END
        83,SPACE,20,END
        84,SPACE,20,END
        90,SPACE,24,END   $SURFACE NODES
        91,SPACE,24,END   $GAP NODES
        92,SPACE,24,END   $SIP NODES
        93,SPACE,20,END   $TILE BOND NODES
        94,SPACE,20,END   $SIP NODES
        15,SPACE,24,END  $TILE  NODES
        25,SPACE,24,END
        35,SPACE,24,END
        45,SPACE,24,END
        55,SPACE,24,END
        65,SPACE,24,END
        75,SPACE,24,END
        85,SPACE,24,END
        95,SPACE,24,END
        96,SPACE,10,END
       END
       BCD 3FXECUTION
F      DIMENSION PLOCIN(81,2), XT(81), YT(2)
F      DIMENSION XNODES(150),YNODES(150)
F      DIMENSION XLINC(16),YLINC(16)
F      NAMELIST/XYCOOR/XC,YC,ISTA,IFIN
F      READ(7,XYCOOR)
F      WRITE(6,XYCOOR)
F      CALL PNTERP(PLOCIN,XT,YT,ISTA,IFIN)
F      XC = XC-.0325*SQRT(2.)
F      CALL GENPT(XC,YC,6.065,XLINC,YLINC,16)
F      NHOLD = 0
F      DS = 1.0
F      DO = .5325
F      XLENGTH = 6.065
F      ANGLE = -45.0
F      DO 86 J = 1,4
F      NNODES = 18
F      IF(J .EQ. 2 .OR. J .EQ. 3)  NNODES = 21
F      CALL LONG(XLINC(J),YLINC(J),ANGLE,XLENGTH,DS,DO,XNODES,YNODES
F     1                            ,NNODES,6)
F      DO 85 I=1,NNODES
F      XN = XNODES(I)
F      YN =  YNODES(I)
F      CALL PRESND(81,XT,2,YT,81,PLOCIN,XN,YN,PRES)
F      T(NHOLD+I+1122) = PRES
F   85 CONTINUE
F      NHOLD = NHOLD + NNODES
F   86 CONTINUE
F      NNODES = 6
F      DO 88 J = 1,12
F      CALL SHORT(XLINC(J+4),YLINC(J+4),ANGLE,XLENGTH,DS,DO,
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APPENDIX A, CONTINUED

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F     1            XNODES,YNODES,NNODES,6)
F      DO 87 I=1,NNODES
F      XN = XNODES(I)
F      YN = YNODES(I)
F      CALL PRESND(81,XT,2,YT,81,PLOCIN,XN,YN,PRES)
F      T(NHOLD+I+1122) = PRES
F   87 CONTINUE
F      NHOLD = NHOLD + NNODES
F   88 CONTINUE
C
F      NNC=NNA+NND
F      DO 15 J=1,NNC
F   15 T(J)=2.135
       SPLIT(3,A2+1,A96+1,A96+4)
       APYMPY(3,A96+4,R123,A96+4)
       JOIN(3,A96+1,A96+4,A2+1)
       SPLIT(3,A3+1,A96+1,A96+4)
       APYMPY(3,A96+4,P123,A96+4)
       JOIN(3,A96+1,A96+4,A3+1)
       SPLIT(3,A4+1,A96+1,A96+4)
       APYMPY(3,A96+4,P123,A96+4)
       JOIN(3,A96+1,A96+4,A4+1)
       SPLIT(3,A5+1,A96+1,A96+4)
       APYMPY(3,A96+4,P123,A96+4)
       JOIN(3,A96+1,A96+4,A5+1)
       P109 = -P109
       P110 = -P110
       R116 = 0.0
       DO 5 ITEST=1,150
       R116 = R116 +T1224 + ITEST - 1
     5 CONTINUE
       R116 = R116/150.
       R108=R116*144.0/(53.3*(R115+460.))
       DIDEG1(R115,A6,P107)
       R9=12.8E-6/R107/.071*R108
       R1=((P101/6.)**2*R100/2.)*560.0/(R115+460.0)
       R2=R103*P9
       R3=(P101/6.*R100/2./(P101/6.))*R9
       R4=((P101/6.)**2/P100)*P9
       R5=(P101/6.*R102/(P101/6.))*R9
       R6=(P102)*R9
       STOSTL
F      CALL CNTRL(PLOCIN,XT,YT,XC,YC,ISTA,IFIN)
       WRITE(NUSER1,100)
F  100 FORMAT("UNDENSIFIED LI900 TPS TILE 6X6X1.3253"
F     1       /"                    "
F     2       /"MACH NO.=0.950"
F     3       /"                    "
F     4       /"                    "
F     5       /"TILE ARRAY MODEL"
F     6      /"LARC    MAR. 23, 1981    MF6TPP5" )
       DO 1 ITEST=1,6
       WRITE(NUSER1,*) T1+ITEST-1
     1 CONTINUE
       DO 2 ITEST=1,6
       WRITE(NUSER1,*) T7+ITEST-1
     2 CONTINUE
       DO 3 ITEST=1,6
       WRITE(NUSER1,*) T13-ITEST+1
     3 CONTINUE
       DO 4 ITEST=1,6
       WRITE(NUSER1,*) T19-ITEST+1
     4 CONTINUE
       DO 11 ITEST=1,72
```

APPENDIX A, CONTINUED

```
      WRITE(NUSER1,*) T25+ITEST-1
   11 CONTINUE
      DO 12 ITEST=1,36
      WRITE(NUSER1,*) T97+ITEST-1
   12 CONTINUE
      DO 21 ITEST=1,6
      WRITE(NUSER1,*) T201+ITEST-1
   21 CONTINUE
      DO 22 ITEST=1,6
      WRITE(NUSER1,*) T207+ITEST-1
   22 CONTINUE
      DO 23 ITEST=1,6
      WRITE(NUSER1,*) T213-ITEST+1
   23 CONTINUE
      DO 24 ITEST=1,6
      WRITE(NUSER1,*) T219-ITEST+1
   24 CONTINUE
      WRITE(NUSER1,*)  T1115, T1122, T1129, T8100, T8107, T8114
      WRITE(NUSER1,*)    T97,  T104,  T111,  T118,  T125,  T132
      WRITE(NUSER1,*)  T4115, T4122, T4129, T5100, T5107, T5114
      WRITE(NUSER1,*)  T7130, T7125, T7120,  T127,  T122,  T117
      WRITE(NUSER1,*)   T112,  T107,  T102, T3109, T3104, T3099
      END
      BCD 3VARIABLES 1
       IF(ITERCT.GT.400)ITERXT=1000
      IF(ITERCT .LE. 10) ITERXT=4
      VARGS
      VAPCS
      BLDARY(A12+1,T1097,T1098,T1099,T1100,T1101,T1102,T1102,T1108,$SIP NODES
     AT1114,T1120,T1126,T1132,T1132,T1131,T1130,T1129,T1128,T1127,
     BT1127,T1121,T1115,T1109,T1103,T1097)
      BLDARY(A13+1,T1025,T1026,T1027,T1028,T1029,T1030,T1036,T1042,$TILE B NODES
     AT1048,T1054,T1060,T1059,T1058,T1057,T1056,T1055,T1049,T1043,
     BT1037,T1031)
      BLDARY(A14+1,T1097,T1098,T1099,T1100,T1101,T1102,T1108,T1114,$SIP NODES
     AT1120,T1126,T1132,T1131,T1130,T1129,T1128,T1127,T1121,T1115,
     BT1109,T1103)
      BLDARY(A22+1,T2097,T2098,T2099,T2100,T2101,T2102,T2102,T2108,$SIP NODES
     AT2114,T2120,T2126,T2132,T2132,T2131,T2130,T2129,T2128,T2127,
     BT2127,T2121,T2115,T2109,T2103,T2097)
      BLDARY(A23+1,T2025,T2026,T2027,T2028,T2029,T2030,T2036,T2042,$TILE B NODES
     AT2048,T2054,T2060,T2059,T2058,T2057,T2056,T2055,T2049,T2043,
     BT2037,T2031)
      BLDARY(A24+1,T2097,T2098,T2099,T2100,T2101,T2102,T2108,T2114,$SIP NODES
     AT2120,T2126,T2132,T2131,T2130,T2129,T2128,T2127,T2121,T2115,
     BT2109,T2103)
      BLDARY(A32+1,T3097,T3098,T3099,T3100,T3101,T3102,T3102,T3108,$SIP NODES
     AT3114,T3120,T3126,T3132,T3132,T3131,T3130,T3129,T3128,T3127,
     BT3127,T3121,T3115,T3109,T3103,T3097)
      BLDARY(A33+1,T3025,T3026,T3027,T3028,T3029,T3030,T3036,T3042,$TILE B NODES
     AT3048,T3054,T3060,T3059,T3058,T3057,T3056,T3055,T3049,T3043,
     BT3037,T3031)
      BLDARY(A34+1,T3097,T3098,T3099,T3100,T3101,T3102,T3108,T3114,$SIP NODES
     AT3120,T3126,T3132,T3131,T3130,T3129,T3128,T3127,T3121,T3115,
     BT3109,T3103)
      BLDARY(A42+1,T4097,T4098,T4099,T4100,T4101,T4102,T4102,T4108,$SIP NODES
     AT4114,T4120,T4126,T4132,T4132,T4131,T4130,T4129,T4128,T4127,
     BT4127,T4121,T4115,T4109,T4103,T4097)
      BLDARY(A43+1,T4025,T4026,T4027,T4028,T4029,T4030,T4036,T4042,$TILE B NODES
     AT4048,T4054,T4060,T4059,T4058,T4057,T4056,T4055,T4049,T4043,
     BT4037,T4031)
      BLDARY(A44+1,T4097,T4098,T4099,T4100,T4101,T4102,T4108,T4114,$SIP NODES
     AT4120,T4126,T4132,T4131,T4130,T4129,T4128,T4127,T4121,T4115,
     BT4109,T4103)
```

APPENDIX A, CONTINUED

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      BLDARY(A52+1,T5097,T5098,T5099,T5100,T5101,T5102,T5102,T5108,$SIP NODES
     AT5114,T5120,T5126,T5132,T5132,T5131,T5130,T5129,T5128,T5127,
     BT5127,T5121,T5115,T5109,T5103,T5097)
      BLDARY(A53+1,T5025,T5026,T5027,T5028,T5029,T5030,T5036,T5042,$TILE B NODES
     AT5048,T5054,T5060,T5059,T5058,T5057,T5056,T5055,T5049,T5043,
     BT5037,T5031)
      BLDARY(A54+1,T5097,T5098,T5099,T5100,T5101,T5102,T5108,T5114,$SIP NODES
     AT5120,T5126,T5132,T5131,T5130,T5129,T5128,T5127,T5121,T5115,
     BT5109,T5103)
      BLDARY(A62+1,T6097,T6098,T6099,T6100,T6101,T6102,T6102,T6108,$SIP NODES
     AT6114,T6120,T6126,T6132,T6132,T6131,T6130,T6129,T6128,T6127,
     BT6127,T6121,T6115,T6109,T6103,T6097)
      BLDARY(A63+1,T6025,T6026,T6027,T6028,T6029,T6030,T6036,T6042,$TILE B NODES
     AT6048,T6054,T6060,T6059,T6058,T6057,T6056,T6055,T6049,T6043,
     BT6037,T6031)
      BLDARY(A64+1,T6097,T6098,T6099,T6100,T6101,T6102,T6108,T6114,$SIP NODES
     AT6120,T6126,T6132,T6131,T6130,T6129,T6128,T6127,T6121,T6115,
     BT6109,T6103)
      BLDARY(A72+1,T7097,T7098,T7099,T7100,T7101,T7102,T7102,T7108,$SIP NODES
     AT7114,T7120,T7126,T7132,T7132,T7131,T7130,T7129,T7128,T7127,
     BT7127,T7121,T7115,T7109,T7103,T7097)
      BLDARY(A73+1,T7025,T7026,T7027,T7028,T7029,T7030,T7036,T7042,$TILE B NODES
     AT7048,T7054,T7060,T7059,T7058,T7057,T7056,T7055,T7049,T7043,
     BT7037,T7031)
      BLDARY(A74+1,T7097,T7098,T7099,T7100,T7101,T7102,T7108,T7114,$SIP NODES
     AT7120,T7126,T7132,T7131,T7130,T7129,T7128,T7127,T7121,T7115,
     BT7109,T7103)
      BLDARY(A82+1,T8097,T8098,T8099,T8100,T8101,T8102,T8102,T8108,$SIP NODES
     AT8114,T8120,T8126,T8132,T8132,T8131,T8130,T8129,T8128,T8127,
     BT8127,T8121,T8115,T8109,T8103,T8097)
      BLDARY(A83+1,T8025,T8026,T8027,T8028,T8029,T8030,T8036,T8042,$TILE B NODES
     AT8048,T8054,T8060,T8059,T8058,T8057,T8056,T8055,T8049,T8043,
     BT8037,T8031)
      BLDARY(A84+1,T8097,T8098,T8099,T8100,T8101,T8102,T8108,T8114,$SIP NODES
     AT8120,T8126,T8132,T8131,T8130,T8129,T8128,T8127,T8121,T8115,
     BT8109,T8103)
      BLDARY(A92+1,T  97,T  98,T  99,T 100,T 101,T 102,T 102,T 108,$SIP NODES
     AT 114,T 120,T 126,T 132,T 132,T 131,T 130,T 129,T 128,T 127,
     BT 127,T 121,T 115,T 109,T 103,T  97)
      BLDARY(A93+1,T  25,T  26,T  27,T  28,T  29,T  30,T  36,T  42,$TILE B NODES
     AT  48,T  54,T  60,T  59,T  58,T  57,T  56,T  55,T  49,T  43,
     BT  37,T  31)
      BLDARY(A94+1,T  97,T  98,T  99,T 100,T 101,T 102,T 108,T 114,$SIP NODES
     AT 120,T 126,T 132,T 131,T 130,T 129,T 128,T 127,T 121,T 115,
     BT 109,T 103)
C     CALCULATION OF GAP DEFLECTIONS
      IF(ITERCT .NE. 1)  GO TO 35
      BLDARY(A10+1,T1201,T1202,T1203,T1204,T1205,T1206,T1207,T1208,$SURFACE NODE
     AT1209,T1210,T1211,T1212,T1213,T1214,T1215,T1216,T1217,T1218,
     BT1219,T1220,T1221,T1222,T1223,T1224)
      BLDARY(A11+1,T1001,T1002,T1003,T1004,T1005,T1006,T1007,T1008,$GAP NODES
     AT1009,T1010,T1011,T1012,T1013,T1014,T1015,T1016,T1017,T1018,
     BT1019,T1020,T1021,T1022,T1023,T1024)
      BLDARY(A20+1,T2201,T2202,T2203,T2204,T2205,T2206,T2207,T2208,$SURFACE NODE
     AT2209,T2210,T2211,T2212,T 206,T 205,T 204,T 203,T 202,T 201,
     BT2219,T2220,T2221,T1212,T1211,T1210)
      BLDARY(A21+1,T2001,T2002,T2003,T2004,T2005,T2006,T2007,T2008,$GAP NODES
     AT2009,T2010,T2011,T2012,T   6,T   5,T   4,T   3,T   2,T   1,
     BT2019,T2020,T2021,T1012,T1011,T1010)
      BLDARY(A30+1,T3201,T3202,T3203,T3204,T3205,T3206,T3207,T3208,$SURFACE NODE
     AT3209,T3210,T3211,T3212,T3213,T3214,T3215,T3216,T3217,T3218,
     BT 209,T 208,T 207,T2212,T2211,T2210)
      BLDARY(A31+1,T3001,T3002,T3003,T3004,T3005,T3006,T3007,T3008,$GAP NODES
     AT3009,T3010,T3011,T3012,T3013,T3014,T3015,T3016,T3017,T3018,
```

APPENDIX A, CONTINUED

```
     BT   9,T   8,T   7,T2012,T2011,T2010)
      BLDARY(A40+1,T3218,T3217,T3216,T3215,T3214,T3213,T4207,T4208,$SURFACE NODE
     AT4209,T4210,T4211,T4212,T4213,T4214,T4215,T4216,T4217,T4218,
     BT4219,T4220,T4221,T 212,T 211,T 210)
      BLDARY(A41+1,T3018,T3017,T3016,T3015,T3014,T3013,T4007,T4008,$GAP NODES
     AT4009,T4010,T4011,T4012,T4013,T4014,T4015,T4016,T4017,T4018,
     BT4019,T4020,T4021,T  12,T  11,T  10)
      BLDARY(A50+1,T4218,T4217,T4216,T4215,T4214,T4213,T5207,T5208,$SURFACE NODE
     AT5209,T5210,T5211,T5212,T5213,T5214,T5215,T5216,T5217,T5218,
     BT5219,T5220,T5221,T5222,T5223,T5224)
      BLDARY(A51+1,T4018,T4017,T4016,T4015,T4014,T4013,T5007,T5008,$GAP NODES
     AT5009,T5010,T5011,T5012,T5013,T5014,T5015,T5016,T5017,T5018,
     BT5019,T5020,T5021,T5022,T5023,T5024)
      BLDARY(A60+1,T 218,T 217,T 216,T 215,T 214,T 213,T4221,T4220,$SURFACE NODE
     AT4219,T5224,T5223,T5222,T6213,T6214,T6215,T6216,T6217,T6218,
     BT6219,T6220,T6221,T6222,T6223,T6224)
      BLDARY(A61+1,T  18,T  17,T  16,T  15,T  14,T  13,T4021,T4020,$GAP NODES
     AT4019,T5024,T5023,T5022,T6013,T6014,T6015,T6016,T6017,T6018,
     BT6019,T6020,T6021,T6022,T6023,T6024)
      BLDARY(A70+1,T7201,T7202,T7203,T7204,T7205,T7206,T 221,T 220,$SURFACE NODE
     AT 219,T6224,T6223,T6222,T7213,T7214,T7215,T7216,T7217,T7218,
     BT7219,T7220,T7221,T7222,T7223,T7224)
      BLDARY(A71+1,T7001,T7002,T7003,T7004,T7005,T7006,T  21,T  20,$GAP NODES
     AT  19,T6024,T6023,T6022,T7013,T7014,T7015,T7016,T7017,T7018,
     BT7019,T7020,T7021,T7022,T7023,T7024)
      BLDARY(A80+1,T1218,T1217,T1216,T1215,T1214,T1213,T2221,T2220,$SURFACE NODE
     AT2219,T 224,T 223,T 222,T7206,T7205,T7204,T7203,T7202,T7201,
     BT8219,T8220,T8221,T8222,T8223,T8224)
      BLDARY(A81+1,T1018,T1017,T1016,T1015,T1014,T1013,T2021,T2020,$GAP NODES
     AT2019,T  24,T  23,T  22,T7006,T7005,T7004,T7003,T7002,T7001,
     BT8019,T8020,T8021,T8022,T8023,T8024)
      BLDARY(A90+1,T 201,T 202,T 203,T 204,T 205,T 206,T 207,T 208,$SURFACE NODE
     AT 209,T 210,T 211,T 212,T 213,T 214,T 215,T 216,T 217,T 218,
     BT 219,T 220,T 221,T 222,T 223,T 224)
      BLDARY(A91+1,T   1,T   2,T   3,T   4,T   5,T   6,T   7,T   8,$GAP NODES
     AT   9,T  10,T  11,T  12,T  13,T  14,T  15,T  16,T  17,T  18,
     BT  19,T  20,T  21,T  22,T  23,T  24)
C GAP CONDUCTORS (NORMAL)
      LTEST = 0
      DO 5 ITEST=1,24
      IF(ITEST .EQ. 7 .OR. ITEST .EQ. 13)   LTEST = LTEST+1
      IF(ITEST .EQ. 19) LTEST = LTEST + 1
      IF(ITEST .EQ. 24) LTEST= 23
      A95+ITEST = A93 +ITEST - LTEST
      A85+ITEST = A83 +ITEST - LTEST
      A75+ITEST = A73 +ITEST - LTEST
      A65+ITEST = A63 +ITEST - LTEST
      A55+ITEST = A53 +ITEST - LTEST
      A45+ITEST = A43 +ITEST - LTEST
      A35+ITEST = A33 +ITEST - LTEST
      A25+ITEST = A23 +ITEST - LTEST
      A15+ITEST = A13 +ITEST - LTEST
    5 CONTINUE
      G1=(P108*P106**3*P101/6.*32.2/(144.*P107*R100))
      R13=G1/P106**3
      DO 10 ITEST=1,24
      G1+ITEST-1=G1
      G1001+ITEST-1=G1
      IF(ITEST.LE.12)G2001+ITEST-1=G1
      IF(ITEST .GT. 18 .AND. ITEST .LT. 22) G2019+ITEST-19=G1
      IF(ITEST .LT. 19)  G3001+ITEST-1=G1
      IF(ITEST .GE. 7 .AND. ITEST .LT.22)  G4007+ITEST-7=G1
      IF(ITEST .GT.6)  G5007+ITEST-7=G1
      IF(ITEST .GT.12)  G6013+ITEST-13=G1
```

APPENDIX A, CONTINUED

```
      IF(ITEST .LT. 7 )  G7001+ITEST-1=G1
      IF(ITEST .GT. 12) G7013+ITEST-13=G1
      IF(ITEST .GT. 18)  G8019+ITEST-19=G1
   10 CONTINUE
C GAP CONDUCTORS (TANGENTIAL)
      G25=(R108*R106**3*R100*32.2/(144.*R107*R101/6.))
      R14=G25/R106**3
      DO 20 ITEST=1,24
      G24+ITEST=G25
      G1024+ITEST=G25
      IF(ITEST.LT.13)G2025+ITEST-1=G25
      IF(ITEST .GT. 17 .AND. ITEST .LT. 22) G2042+ITEST-18=G25
      IF(ITEST .EQ. 24)  G2048=G25
      IF(ITEST .LT. 19)  G3025+ITEST-1=G25
      IF(ITEST .EQ. 21) G3045=G25
      IF(ITEST .EQ. 24) G3048 = G25
      IF(ITEST .GT. 5 .AND. ITEST .LT. 22)  G4030+ITEST-6=G25
      IF(ITEST .GT. 5)  G5030+ITEST-6=G25
      IF(ITEST .EQ. 9) G6033=G25
      IF(ITEST .GT. 11)   G6036+ITEST-12=G25
      IF(ITEST .LT. 7)  G7024+ITEST=G25
      IF(ITEST .EQ.9) G7033=G25
      IF(ITEST .GT. 11)  G7036+ITEST-12=G25
      IF(ITEST .EQ. 9) G8033=G25
      IF(ITEST .GT. 17)  G8042+ITEST-18=G25
   20 CONTINUE
      G30 = G25/2.0
      G36 = G30
      G42 = G30
      G48 = G30
      G1030 = G30
      G1036 = G30
      G1042 = G30
      G1048 = G30
      G2030 =G30
      G2036 = G30
      G2042 = G30
      G2048 = G30
      G3030 = G30
      G3036 = G30
      G3042 = G30
      G3048 = G30
      G4030 = G30
      G4036 = G30
      G4042 = G30
      G4048=G30
      G5030 = G30
      G5036 = G30
      G5042 = G30
      G5048 = G30
      G6030=G30
      G6036 = G30
      G6042 = G30
      G6048 = G30
      G7030 = G30
      G7036 = G30
      G7042 = G30
      G7048 = G30
      G8030=G30
      G8036=G30
      G8042 = G30
      G8048 = G30
      R118=0.0
      R119=0.0
```

APPENDIX A, CONTINUED

```
      DO 22 ITEST=1,6
      R118=R118+T18+ITEST-1+T218+ITEST-1-T1+ITEST-1-T201+ITEST-1
      R119=R119+T24+ITEST-1+T224+ITEST-1-T7+ITEST-1-T207+ITEST-1
   22 CONTINUE
      R118 = R118/2.*R100/R117*.05
      R119 = R119/2.*R100/R117*.05
      IF(TIMEN .LT. 2.0)  R118=R106-.005
      IF(TIMEN .LT. 2.0)  R119=.005-R106
      IF(R118 .GE. (R106-R120)) R118=R106-R120
      IF(R119 .GE. (R106-R120)) R119=R106-R120
      R106 = -1.*R106
      IF(R118 .LE. (R106+R120)) R118 = (R106+R120)
      IF(R119 .LE. (R106+R120)) R119 = (R106+R120)
      R106 = -1.0*R106
      DO 23 ITEST=1,6
      G1+ITEST-1=G1+ITEST-1*(R106-R118)**3/R106**3
      G7+ITEST-1=G7+ITEST-1*(R106-R119)**3/R106**3
      G13+ITEST-1=G13+ITEST-1*(R106+R118)**3/R106**3
      G19+ITEST-1=G19+ITEST-1*(R106+R119)**3/R106**3
   23 CONTINUE
      DO 24 ITEST=1,5
      G24+ITEST = G24+ITEST*(R106-R118)**3/R106**3
      G30+ITEST = G30+ITEST*(R106-R119)**3/R106**3
      G36+ITEST = G36+ITEST*(R106+R118)**3/R106**3
      G42+ITEST = G42+ITEST*(R106+R119)**3/R106**3
   24 CONTINUE
      G30=G30*(R106-R118/2.-R119/2.-ABS(R119-R118)/2.)
     1   **3/(2.*R106**3)
      G36=G36*(R106+R118/2.-R119/2.-ABS(R119+R118)/2.)
     1   **3/(2.*R106**3)
      G42=G42*(R106+R118/2.+R119/2.-ABS(R119-R118)/2.)
     1   **3/(2.*R106**3)
      G48=G48*(R106-R118/2.+R119/2.-ABS(R119+R118)/2.)
     1   **3/(2.*R106**3)
C EDGE CONDUCTORS
      R7=(R108/(R107*.5*144.)*32.2)
      DO 30 ITEST=1,24
      JTEST = (ITEST-1)*9
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A92+ITEST-A91+ITEST)-R110*(A92+ITEST-A90+ITEST)
     1         +R111+R10*A7+JTEST+1)/(R10+1.)
      IF(A91+ITEST .LT. A95+ITEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+1 - R121) .LE. 1.E-10)  R112=R121
      A7 + JTEST + 1 = R112
      G53+ITEST-1=R7*R112**3
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A12+ITEST-A11+ITEST)-R110*(A12+ITEST-A10+ITEST)
     1         +R111+R10*A7+JTEST+2)/(R10+1.)
      IF(A11+ITEST .LT. A15+JTEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+2 - R121) .LE. 1.E-10)  R112=R121
      A7 + JTEST + 2 = R112
      G1053+ITEST-1=R7*R112**3
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A22+ITEST-A21+ITEST)-R110*(A22+ITEST-A20+ITEST)
     1         +R111+R10*A7+JTEST+3)/(R10+1.)
      IF(A21+ITEST .LT. A25+ITEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+3 - R121) .LE. 1.E-10)  R112=R121
      A7+JTEST+3 = R112
      G2053+ITEST-1=R7*R112**3
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A32+ITEST-A31+ITEST)-R110*(A32+ITEST-A30+ITEST)
```

APPENDIX A, CONTINUED

```
     1        +R111+R10*A7+JTEST+4)/(R10+1.)
      IF(A31+ITEST .LT. A35+ITEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+4 - R121) .LE. 1.E-10)  R112=R121
      A7+JTEST+4 = R112
      G3053+ITEST-1=R7*R112**3
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A42+ITEST-A41+ITEST)-R110*(A42+ITEST-A40+ITEST)
     1        +R111+R10*A7+JTEST+5)/(R10+1.)
      IF(A41+ITEST .LT. A45+ITEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+5 - R121) .LE. 1.E-10)  R112=R121
      A7+JTEST+5 = R112
      G4053+ITEST-1=R7*R112**3
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A52+ITEST-A51+ITEST)-R110*(A52+ITEST-A50+ITEST)
     1        +R111+R10*A7+JTEST+6)/(R10+1.)
      IF(A51+ITEST .LT. A55+ITEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+6 - R121) .LE. 1.E-10)  R112=R121
      A7+JTEST+6 = R112
      G5053+ITEST-1=R7*R112**3
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A62+ITEST-A61+ITEST)-R110*(A62+ITEST-A60+ITEST)
     1        +R111+R10*A7+JTEST+7)/(R10+1.)
      IF(A61+ITEST .LT. A65+ITEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+7 - R121) .LE. 1.E-10)  R112=R121
      A7+JTEST+7 = R112
      G6053+ITEST-1=R7*R112**3
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A72+ITEST-A71+ITEST)-R110*(A72+ITEST-A70+ITEST)
     1        +R111+R10*A7+JTEST+8)/(R10+1.)
      IF(A71+ITEST .LT. A75+ITEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+8 - R121) .LE. 1.E-10)  R112=R121
      A7 + JTEST + 8 = R112
      G7053+ITEST-1=R7*R112**3
      IF(TIMEN .GE. 2.0)
     1R112=(R109*(A82+ITEST-A81+ITEST)-R110*(A82+ITEST-A80+ITEST)
     1        +R111+R10*A7+JTEST+9)/(R10+1.)
      IF(A81+ITEST .LT. A85+ITEST)  R112=R121*.9999
      IF(R112 .LE. R121)  R112 =  R121
      IF(ABS(A7+JTEST+9 - R121) .LE. 1.E-10)  R112=R121
      A7+JTEST+9 = R112
      G8053+ITEST-1=R7*R112**3
   30 CONTINUE
C     GLOBAL GAP DEFLECTIONS
C     GAP CONDUCTORS(NORMAL)
      IF(ITEST.EQ.0) 31,165
   31 CONTINUE
      G7 = R13*R106**3
      G8 = G7
      G9 = G7
      DO 161 ITEST = 1,3
      G2010+ITEST-1 = G24
  161 CONTINUE
      DO 162 ITEST = 1,6
      G3001+ITEST-1 = G1
      G3007+ITEST-1 = G7+ITEST-1
      G3013+ITEST-1 = G13
      G7013+ITEST-1 = G1
  162 CONTINUE
C     GAP CONDUCTORS(TANGENTIAL)
```

APPENDIX A, CONTINUED

```
      G31 = R14*P106**3
      G32 = G31
      G33 = (G31+G34-ABS(G31-G34))/2.
  165 CONTINUE
      G8033=(G47+G2043-ABS(G47-G2043))/2.
      G2042=(G25+G1034-ABS(G25-G1034))/4.
      G2036=(G47+G25-ABS(G47-G25))/4.
      G3045=(G31+G2035-ABS(G31-G2035))/2.
      G3042=(G37+G31-ABS(G37-G31))/4.
      G4048=(G37+G34-ABS(G37-G34))/4.
      G4045=(G4044+G35-ABS(G4044-G35))/2.
      G6030=(G29+G4044-ABS(G29-G4044))/4.
      G6048=(G6047+G41-ABS(G6047-G41))/4.
      G7033=(G43+G6047-ABS(G43-G6047))/2.
      G7030=(G1034+G46-ABS(G1034-G46))/4.
      G8036=(G46+G7029-ABS(G46-G7029))/4.
      IF(NTEST.EQ.0) 34,35
   34 CONTINUE
      G2033 = (G1034+G47-ABS(G1034-G47))/2.
      G3025 = G25
      G3026 = G25
      G3027 = G25
      G3028 = G25
      G3029 = G25
      G3030 = G30
      G3031 = G35
      G3032 = G35
      G3033 = G35
      G3034 = G35
      G3035 = G35
      G3036 = G36
      DO 163 ITEST = 1,5
      G3037+ITEST-1 = G37
      G7037+ITEST-1 = G25
  163 CONTINUE
        G3048 = G48
        G7036 = (G31+G25-ABS(G31-G25))/4.
        G7042 = (G25+G1034-ABS(G25-G1034))/4.
      G6033=(G4043+G5047-ABS(G4043-G5047))/2.
   35 CONTINUE
C SIP TO TILE CONDUCTORS
      R8=(R113*R114*(.4472*P108)**.5)
      DO 40 ITEST=1,20
      R15=0.0
      IF(ITEST .LE. 5) R15=(-R118)
      IF(ITEST .GE. 6 .AND. ITEST .LE. 10)  R15=(-R119)
      IF(ITEST .GE. 11 .AND. ITEST .LE. 15) R15=R118
      IF(ITEST .GE. 16) R15 = R119
      G256+ITEST=R8*(ABS(A94+ITEST-A93+ITEST)+1.E-8)**(-.5)/
     1                              R114*(R114+R15)
      G1256+ITEST=R8*(ABS(A14+ITEST-A13+ITEST)+1.E-8)**(-.5)
      G2256+ITEST=R8*(ABS(A24+ITEST-A23+ITEST)+1.E-8)**(-.5)
      G3256+ITEST=R8*(ABS(A34+ITEST-A33+ITEST)+1.E-8)**(-.5)/
     1                    R114*(R114+R15)
      G4256+ITEST=R8*(ABS(A44+ITEST-A43+ITEST)+1.E-8)**(-.5)
      G5256+ITEST=R8*(ABS(A54+ITEST-A53+ITEST)+1.E-8)**(-.5)
      G6256+ITEST=R8*(ABS(A64+ITEST-A63+ITEST)+1.E-8)**(-.5)
      G7256+ITEST=R8*(ABS(A74+ITEST-A73+ITEST)+1.E-8)**(-.5)
      G8256+ITEST=R8*(ABS(A84+ITEST-A83+ITEST)+1.E-8)**(-.5)
   40 CONTINUE
      END
      BCD 30UTPUT CALLS
      IF(TIMEN .LT. TIMEND-.01) GO TO 30
      TPRINT
```

APPENDIX A, CONTINUED

```
      IF(MTEST.EQ.0) GO TO 40
      QMAP(1HA)
   40 MTEST=MTEST+1
      PRINT (R118, R119)
      PRINTA(KTEST,A7+1,216,1)
      DO 1 ITEST=1,6
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T1+ITEST-1)
    1 CONTINUE
      DO 2 ITEST=1,6
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T7+ITEST-1)
    2 CONTINUE
      DO 3 ITEST=1,6
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T13-ITEST+1)
    3 CONTINUE
      DO 4 ITEST=1,6
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T19-ITEST+1)
    4 CONTINUE
      DO 11 ITEST=1,72
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T25+ITEST-1)
   11 CONTINUE
      DO 12 ITEST=1,36
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T97+ITEST-1)
   12 CONTINUE
      DO 21 ITEST=1,6
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T201+ITEST-1)
   21 CONTINUE
      DO 22 ITEST=1,6
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T207+ITEST-1)
   22 CONTINUE
      DO 23 ITEST=1,6
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T213-ITEST+1)
   23 CONTINUE
      DO 24 ITEST=1,6
C     IF(TIMEN .GT. 7.0 .AND. TIMEN .LT. 9.0)
C    1QMAP(3HDAR,T219-ITEST+1)
   24 CONTINUE
   30 CONTINUE
      END
      BCD 3SUBROUTINES
F     SUBROUTINE PMITAS(THOLD,GAPS,BOUNDS)
C
FCALL COMMON
C
F     DIMENSION THOLD(108), GAPS(24), BOUNDS(24)
C
F     DO 10 I=1,6
F     GAPS(I)=T(792+I)
F     GAPS(6+I)=T(729+I)
F     GAPS(12+I) = T(805-I)
F     GAPS(18+I) = T(718-I)
F     BOUNDS(I) =T(1230+I)
F     BOUNDS(6+I)=T(1167+I)
F     BOUNDS(12+I) = T(1243-I)
F     BOUNDS(18+I) = T(1156-I)
F 10  CONTINUE
```

APPENDIX A, CONTINUED

```
C
F     DO 20 I=1,72
F     THOLD(I) = T(I)
F  20 CONTINUE
C
F     DO 30 I=73,108
F     THOLD(I) = T(649+I-73)
F  30 CONTINUE
F     RETURN
F     END
FSTART
      SUBROUTINE OMAP (A1 ,A2 ,A3 ,A4 ,A5 ,A6 ,A7 ,A8 ,A9 ,A10,
     1                 A11,A12,A13,A14,A15,A16,A17,A18,A19,A20,
     2                 A21,A22,A23,A24,A25,A26,A27,A28,A29,A30,
     3                 A31,A32,A33,A34,A35,A36,A37,A38,A39,A40,
     4                 A41,A42,A43,A44,A45,A46,A47,A48,A49,A50,
     5                 A51,A52,A53,A54,A55,A56,A57,A58,A59,A60)
C
C*********************************************************************
C
C       THIS SUBROUTINE COMPUTES A TOTAL NODAL/SYSTEM HEAT BALANCE.
C
C       THE CALLING SEQUENCE IS...
C           CALL OMAP(ARG)    -OR-
C           CALL OMAP(ARG,T1,T2,...)  -OR-
C           CALL OMAP(T1,T2,...)
C
C           ARG - ANY COMBINATION OF THE HOLLORITH LETTERS
C                 ( O, D, A, H, P )
C                 O... REQUEST A ONET
C                 D... MAP ALL DIFFUSION NODES
C                 A... MAP ALL ARITHMETIC NODES
C                 H... MAP ALL HEATER NODES
C                 P... MAP ALL BOUNDARY NODES
C           T1,T2,...  ANY NODE TEMPERATURE THAT A MAP IS DESIRED.
C           THE TOTAL NUMBER OF ARGUMENTS CANNOT EXCEED 60.
C           THIS SUBROUTINE USES THE FOLLOWING FILES...
C             PCS   - CONTAINS THE PSEUDO COMPUTE SEQUENCE.
C             GDRCT - CONTIANS THE CONDUCTOR DIRECTORY.
C             ONETF - CONTAINS THE NODE TOTALS FOR ONET IF A ONET IS
C                     REQUESTED.
C
C*********************************************************************
C
      COMMON / CNTRL /   TIMEN   , TIMEO   , TIMEM   , TIMEND  ,
     1                   TSTEPU  , TSTEPI  , TSTEPL  , TSTEPH  ,
     2                   TSTEPO  , DMXTCA  , DMXTCC  , NDMXTC  ,
     3                   AMXTCA  , AMXTCC  , NAMXTC  , DRLXCA  ,
     4                   DRLXCC  , NDRLXC  , ARLXCA  , ARLXCC  ,
     5                   NARLXC  , EBALSA  , EBALSC  , EBALNA  ,
     6                   EBALNC  , NEBALN  , ITERMX  , ITERCT  ,
     7                   ITEPXT  , EXTLIM  , RLXFAC  , DQRLCA  ,
     8                   DQRLCC  , NDQRLC  , AQRLCA  , AQRLCC  ,
     9                   NAQRLC  , PERIOD  , NPRDMX  , NPRDCT  ,
     10                  CSGFAC  , CSGMIN  , NCSGMN  , CSGMAX  ,
     11                  NCSGMX  , ARSZRO  , SBCNST  , ITEROT  ,
     12                  BACKUP  , DATE    , TIMDY   , NLINE   ,
     13                  NPAGE   , NDSTOR  , CCDUMMY(46)
      COMMON /COMREC/    NAKREC  , NDIR1   , NDIR2   , NDIR3
     1                 , NDATT   , NDATC   , GDIR1   , GDIR2
     2                 , GDATA   , PCS     , PCSB    , UKDIR
     3                 , CKDATA  , UKDATA  , ADIR1   , ADIR2
     4                 , ADATA   , VCCD    , VGCD    , DDX3
      COMMON /DIMENS/    NND     , NNA     , NNH     , NNT     ,
```

APPENDIX A, CONTINUED

```
     1                    NGT     , NCON     , NARYP    , NSEQ     ,
     2                    NSEQB   , NVC      , NVG
       COMMON /NDICT /    ND(1)
       COMMON /TEMP  /    T(1)
       COMMON /CAP   /    C(1)
       COMMON /SOURCE/    Q(1)
       COMMON /COND  /    G(1)
       COMMON /PCS   /    ISEQ(1)
       COMMON /UNPACK/    IPKWRD  , LGLT     , LG(15)   , LT(15)   ,
     1                    INFOGT(15)
       COMMON /TAPE  /    OUTPUT  , NUSER1   , NUSER2   , NRSO(10)
     1                  , PLOT(10), NEXCD(10)          , NRIO(10)
       INTEGER            OUTPUT  , PLOT
       COMMON             NDIM    , NTH      , EXTRA(1)
       COMMON / COMAP/    ITRAN   , ITNTH    , IDIM     , ITH
C
       INTEGER            ONETF(10)
       INTEGER            OPTIONS , OPT      , ARGEND
C
       DIMENSION     IX(1)     , ONETD(9)     , SONETD(6)
C
       EQUIVALENCE  (ONETD,NODE), (ONETD(2),NODEQ), (ONETD(3),TYPE),
      *             (ONETD(4),QDSL), (ONETD(5),QDSL1), (ONETD(6),QDSR),
      *             (ONETD(7),QDS), (ONETD(8),CIENR), (ONETD(9),ONETT),
      *             (SONETD,SQDSL), (SONETD(2),SQDSL1), (IX,EXTRA),
      *             (SONETD(3),SQDSR), (SONETD(4),SQDS),
      *             (SONETD(5),SCIENR), (SONETD(6),ONETOTL)
C
       DATA    ONETF(1) /5LONETF/
C      DATA ALL     /3HALL/
C      DATA ONET    /4HONET/
C      DATA QMAPSP /6HQMAPSP/
       DATA DIFF    /6HDIFF  /
       DATA REG     /6HLINEAR/
       DATA ARTH    /6HARITH /
       DATA HEAT    /6HHEATEP/
       DATA BOUN    /6HBOUND /
       DATA REG1W   /10HLIN 1-WAY /
       DATA RAD     /10HRADIATION /
       DATA RAD1W   /10HRAD 1-WAY /
C
       CALL GETCNT (KOUNT)
       NDPA         = NND + NNA
       NDAH         = NDPA + NNH
       DO 100 I     = 1, NDPA
  100  Q(I)         = 0.0
       CALL VARRL1
       CALL NAJFLD (LOCF(EXTRA(NTH+KOUNT+NGT)),5)
C
C********************
C      BRING IN THE CONDUCTOR DIRECTORY
C
       IGDPCT       = ITH + KOUNT + 1
       CALL READAK (NRIO(1),EXTRA(IGDPCT),NGT,GDIP1)
       CALL OPENSQ (ONETF(1),1)
       IGDPCT       = IGDPCT - 1
C
C X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X
C
C      THIS SECTION FINDS THE RELATIVE NODE NUMBERS OF THE NODES TO
C         WHICH A HEAT BALANCE IS TO BE PREFORMED ON. SINCE THE USER
C         SPECIFIED THE NODE TEMP. IN THE ARGUMENT LIST, THE RELATIVE
C         NODE NUMBER EQUALS....
C
```

APPENDIX A, CONTINUED

```
C            ABS. ADDRESS OF A1,A2..,AN - ABS. ADDRESS OF T(1) + 1
C
C       THIS SECTION ALSO NUMERICALLY ORDERS THE NODES BY RELATIVE
C          NODE NUMBERS
C
        OPTIONS      = 0
        IPKWRD       = 1
        LGLT         = 15
        ICHAR        = 0
        IF( ( A1 .AND. 7777777777B ) .EQ. 5555555555B )  ICHAR = 77B
C
C*******************
C       CHECK TO SEE IF THE FIRST ARGUMENT IS -CHARACTER DATA-
C
        IF( ICHAR .EQ. 0 )               GO TO 1200
C
C*******************
C       INTERROGATE THE FIRST ARGUMENT FOR OPTIONS
C
        DO  1000  I = 6,30,6
        NA           = SHIFT(A1, I).AND. 77B
        IF( NA .EQ. 1R  )                GO TO 1100
        IF( NA .EQ. 1RD )                OPTIONS = OPTIONS .OR. 1B
        IF( NA .EQ. 1RA )                OPTIONS = OPTIONS .OR. 2B
        IF( NA .EQ. 1RH )                OPTIONS = OPTIONS .OR. 4B
        IF( NA .EQ. 1RB )                OPTIONS = OPTIONS .OR. 10B
        IF( NA .EQ. 1RO )                OPTIONS = OPTIONS .OR. 20B
 1000   CONTINUE
 1100   CONTINUE
        IF( KOUNT .GT. 1 )               GO TO 1200
        KOUNT        = KOUNT - 1
                                         GO TO 2000
 1200   LOCT1        = LOCF( T(1) ) - 1
C
        GO TO (1360,1359,1358,1357,1356,1355,1354,1353,1352,1351,
     1         1350,1349,1348,1347,1346,1345,1344,1343,1342,1341,
     2         1340,1339,1338,1337,1336,1335,1334,1333,1332,1331,
     3         1330,1329,1328,1327,1326,1325,1324,1323,1322,1321,
     4         1320,1319,1318,1317,1316,1315,1314,1313,1312,1311,
     5         1310,1309,1308,1307,1306,1305,1304,1303,1302,1301), KOUNT
C
 1301   IX(ITH+60)   = LOCF(A60)-LOCT1
 1302   IX(ITH+59)   = LOCF(A59)-LOCT1
 1303   IX(ITH+58)   = LOCF(A58)-LOCT1
 1304   IX(ITH+57)   = LOCF(A57)-LOCT1
 1305   IX(ITH+56)   = LOCF(A56)-LOCT1
 1306   IX(ITH+55)   = LOCF(A55)-LOCT1
 1307   IX(ITH+54)   = LOCF(A54)-LOCT1
 1308   IX(ITH+53)   = LOCF(A53)-LOCT1
 1309   IX(ITH+52)   = LOCF(A52)-LOCT1
 1310   IX(ITH+51)   = LOCF(A51)-LOCT1
 1311   IX(ITH+50)   = LOCF(A50)-LOCT1
 1312   IX(ITH+49)   = LOCF(A49)-LOCT1
 1313   IX(ITH+48)   = LOCF(A48)-LOCT1
 1314   IX(ITH+47)   = LOCF(A47)-LOCT1
 1315   IX(ITH+46)   = LOCF(A46)-LOCT1
 1316   IX(ITH+45)   = LOCF(A45)-LOCT1
 1317   IX(ITH+44)   = LOCF(A44)-LOCT1
 1318   IX(ITH+43)   = LOCF(A43)-LOCT1
 1319   IX(ITH+42)   = LOCF(A42)-LOCT1
 1320   IX(ITH+41)   = LOCF(A41)-LOCT1
 1321   IX(ITH+40)   = LOCF(A40)-LOCT1
 1322   IX(ITH+39)   = LOCF(A39)-LOCT1
 1323   IX(ITH+38)   = LOCF(A38)-LOCT1
```

APPENDIX A, CONTINUED

```
 1324   IX(ITH+37)   = LOCF(A37)-LOCT1
 1325   IX(ITH+36)   = LOCF(A36)-LOCT1
 1326   IX(ITH+35)   = LOCF(A35)-LOCT1
 1327   IX(ITH+34)   = LOCF(A34)-LOCT1
 1328   IX(ITH+33)   = LOCF(A33)-LOCT1
 1329   IX(ITH+32)   = LOCF(A32)-LOCT1
 1330   IX(ITH+31)   = LOCF(A31)-LOCT1
 1331   IX(ITH+30)   = LOCF(A30)-LOCT1
 1332   IX(ITH+29)   = LOCF(A29)-LOCT1
 1333   IX(ITH+28)   = LOCF(A28)-LOCT1
 1334   IX(ITH+27)   = LOCF(A27)-LOCT1
 1335   IX(ITH+26)   = LOCF(A26)-LOCT1
 1336   IX(ITH+25)   = LOCF(A25)-LOCT1
 1337   IX(ITH+24)   = LOCF(A24)-LOCT1
 1338   IX(ITH+23)   = LOCF(A23)-LOCT1
 1339   IX(ITH+22)   = LOCF(A22)-LOCT1
 1340   IX(ITH+21)   = LOCF(A21)-LOCT1
 1341   IX(ITH+20)   = LOCF(A20)-LOCT1
 1342   IX(ITH+19)   = LOCF(A19)-LOCT1
 1343   IX(ITH+18)   = LOCF(A18)-LOCT1
 1344   IX(ITH+17)   = LOCF(A17)-LOCT1
 1345   IX(ITH+16)   = LOCF(A16)-LOCT1
 1346   IX(ITH+15)   = LOCF(A15)-LOCT1
 1347   IX(ITH+14)   = LOCF(A14)-LOCT1
 1348   IX(ITH+13)   = LOCF(A13)-LOCT1
 1349   IX(ITH+12)   = LOCF(A12)-LOCT1
 1350   IX(ITH+11)   = LOCF(A11)-LOCT1
 1351   IX(ITH+10)   = LOCF(A10)-LOCT1
 1352   IX(ITH+9)    = LOCF(A9) -LOCT1
 1353   IX(ITH+8)    = LOCF(A8) -LOCT1
 1354   IX(ITH+7)    = LOCF(A7) -LOCT1
 1355   IX(ITH+6)    = LOCF(A6) -LOCT1
 1356   IX(ITH+5)    = LOCF(A5) -LOCT1
 1357   IX(ITH+4)    = LOCF(A4) -LOCT1
 1358   IX(ITH+3)    = LOCF(A3) -LOCT1
 1359   IX(ITH+2)    = LOCF(A2) -LOCT1
 1360   IX(ITH+1)    = LOCF(A1) -LOCT1
C
        LTH          = ITH
        IF(ICHAR .EQ. 0)                GO TO 1400
        LTH          = ITH+1
        KOUNT        = KOUNT-1
 1400   APGEND       = LTH+KOUNT
C
C*******************
C       CHECKING USERS INPUT TO OMAP.
C
        IERROR       = 0
        LTH          = LTH+1
        DO 1600 I    = LTH,APGEND
        NA           = IX(I)
        IF((NA.GE.1) .AND. (NA.LE.NNT))  GO TO 1600
        NLINE        = NLINE + 1
C      IF (NLINE.GE.47)   CALL TOPLIN                                    CSC
        IERROR       = 1
        K            = I-LTH+1
        IF(ICHAR .NE. 0 )                K = K+1
        WRITE (OUTPUT,1501)  K
 1501   FORMAT(*0++CAUTION++ ERROR IN ARGUMENT *,I2,* OF OMAP CALL.* )
 1600   CONTINUE
        IF(IERROR.EQ.0)                 GO TO 1740
        WRITE (OUTPUT,1701)
 1701   FORMAT(*0++CAUTION++ DUE TO ERRORS IN THE ARGUMENTS TO OMAP, *
     *         *A OMAP WILL NOT BE GIVEN.*)
```

APPENDIX A, CONTINUED

```
                                        GO TO 9999
C
C      ORDERING THE RELATIVE NODE NUMBERS
C
 1740  CONTINUE
C
C*******************
C      SORT THE NODE NUMBERS INTO ASSENDING ORDER
C
       CALL SORT( IX(LTH), KOUNT )
C
C X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X
C
C      IF AT THIS POINT -OPTIONS- HAS THE FOLLOWING BITS SET THEN ...
C
C                                  OPTIONS
C         0 0 ... 0 0 1 1 1 1 1
C                     ? ? ? ? ?
C                     ? ? ? ? --- ALL DIFFUSION NODES WILL BE MAPPED.
C                     ? ? ? ?
C                     ? ? ? --- ALL ARITHMETIC NODES WILL BE MAPPED.
C                     ? ? ?
C                     ? ? --- ALL HEATER NODES WILL BE MAPPED.
C                     ? ?
C                     ? --- ALL BOUNDARY NODES WILL BE MAPPED.
C                     ?
C                     --- A ONET PRINT WILL BE DONE.
C
C      THE NEW TEMPERATURES OF THE NODES ARE STORED IN THE -T- ARRAY
C      THE OLD TEMPERATURES OF THE NODES ARE STORED IN THE -X- ARRAY
C         STARTING AT LOCATION - ITNTH-. IF -ITPAN=0, A STEADY STATE
C         EXECUTION ROUTINE IS BEING USE AND NO PREVIOUS TEMP ARE
C         AVAILABLE.
C         IF ITPAN=2, TRANSIENT PROBLEM AND OLD TEMP. ARE IN ABSOLUTE.
C      IDIM - THE AMOUNT OF SPACE LEFT IN EXTRA BEYOND THE OLD TEMP.
C      ITH  - THE LAST CELL USED IN EXTRA.
C
 2000  CONTINUE
C
C*******************
C      PRINT OUT THE REQUESTED OPTIONS
C
C      CALL TOPLIN                                                      CSC
       IF( ICHAR .EQ. 0 )              GO TO 2010
       IF((OPTIONS.AND.1B) .EQ. 1) WRITE(OUTPUT,2001)
 2001  FORMAT(* D... ALL DIFFUSION NODES WILL BE MAPPED*)
       IF((OPTIONS.AND.2B) .GT. 0) WRITE(OUTPUT,2002)
 2002  FORMAT(* A... ALL ARITHMETIC NODES WILL BE MAPPED*)
       IF((OPTIONS.AND.4B) .GT. 0) WRITE(OUTPUT,2003)
 2003  FORMAT(* H... ALL HEATER NODES WILL BE MAPPED*)
       IF((OPTIONS.AND.10B) .GT. 0) WRITE(OUTPUT,2004)
 2004  FORMAT(* B... ALL BOUNDARY NODES WILL BE MAPPED*)
       IF(OPTIONS .GT. 17B) WRITE(OUTPUT,2005)
 2005  FORMAT(* O... A ONET WILL BE PRINTED*)
       NLINE        = NLINE + ICNT( OPTIONS )
 2010  CONTINUE
       IF( KOUNT .EQ. 0 )              GO TO 2030
       DO 2020 LOP = LTH, ARGEND
       NT          = IX( LOP )
C     IF (NLINE.GE.46)  CALL TOPLIN                                     CSC
       NLINE       = NLINE + 1
       WRITE( OUTPUT,2011 ) ND(NT)
 2011  FORMAT(* NODE *,I6,* WILL BE MAPPED.*)
 2020  CONTINUE
```

APPENDIX A, CONTINUED

```
 2030  CONTINUE
       CALL RWIND (ONETF(1))
       NODE0        = 0
       NODE1        = 7777777777B
       IEND         = 0
       IF( KOUNT .GT. 0 )              NODE1 = IX( LTH )
       IF( NND .EQ. 0 )                GO TO 2100
C
C*******************
C      SET UP FOR THE DIFFUSION NODE PASS
C
       MASK0        = 21B
       MASK1        = 1B
       ISTART       = 1
       IEND         = NND
       TYPE         = DIFF
       ASSIGN 2100 TO NRET
                                       GO TO 4000
 2100  CONTINUE
       IF( NNA .EQ. 0 )                GO TO 2200
C
C*******************
C      SET UP FOR THE ARITHMETIC NODE PASS
C
       MASK0        = 22B
       MASK1        = 2B
       ISTART       = IEND + 1
       IEND         = NDPA
       TYPE         = ARTH
       ASSIGN 2200 TO NRET
                                       GO TO 4000
 2200  CONTINUE
       IF( NNH .EQ. 0 )                GO TO 2300
C
C*******************
C      SET UP FOR THE HEATER NODE PASS
C
       MASK0        = 24B
       MASK1        = 4B
       ISTART       = IEND + 1
       IEND         = NDAH
       TYPE         = HEAT
       ASSIGN 2300 TO NRET
                                       GO TO 4000
 2300  CONTINUE
       IF( NSEQB .EQ. 0 )              GO TO 2900
       IF((OPTIONS .AND. 10B) .GT. 0 ) GO TO 2400
       IF( LTH .GT. ARGEND )           GO TO 2900
       IF( NODE1 .LE. NDAH )           GO TO 2900
 2400  CONTINUE
C
C*******************
C      BRING IN THE BOUNDARY NODE -PCS-
C
       IF( NSEQ.GE.NSEQB )             GO TO 2420
C     IF (NLINE.GE.43)  CALL TOPLIN                                    CSC
       NLINE        = NLINE+4
       WRITE( OUTPUT,2411 )
 2411  FORMAT( *0++CAUTION++  -OMAP-  INSUFFICIENT AREA IN -ISEQ-(PCS)*
     1         * ARRAY TO ALLOW A BOUNDARY NODE MAP.* / 14X
     2         * A -ONET- PREFORMED ON THIS NETWORK WILL THUS BE IN*
     3         * ERROR.* )
                                       GO TO 2900
 2420  CONTINUE
```

APPENDIX A, CONTINUED

```
      CALL READAK (NRIO(1),ISEQ(1),NSEQB,PCSB)
      IPKWPD      = 1
      LGLT        = 15
C
C*******************
C     SET UP FOR THE BOUNDARY NODE PASS
C
      MASKO       = 308
      MASK1       = 108
      ISTART      = IEND + 1
      IEND        = NNT
      TYPE        = BOUN
      ASSIGN 2810 TO NRET
                                        GO TO 4000
 2810 CONTINUE
C
C*******************
C     RESTORE THE NORMAL -PCS-
C
      CALL READAK (NRIO(1),ISEQ(1),NSEQ,PCS)
 2900 CONTINUE
C
C*******************
C     ALL CALCULATIONS FOR OMAP HAVE BEEN PREFORMED.   CHECK FOR A
C     -ONET- PRINT REQUEST.
C
      IF((OPTIONS .AND. 2OP) .EQ. 0 ) GO TO 9999
C     CALL TOPLIN                                                    CSC
      WRITE( OUTPUT,3001 ) NNT, TIMEN
 3001 FORMAT(*-*,32X,*A ONET ON A *,I6,* NODE PROBLEM AT *,G13.6,
     *        * (TIME UNITS).*,//,18X,
     *        *THE TOTALS OF THE VARIOUS HEAT TRANSFER MODES (ENERGY *,
     *        *UNITS/TIME UNIT) ON EACH NODE ARE...* )
      WRITE( OUTPUT,3002 )
 3002 FORMAT(*0INPUT (INTERNAL)*,12X,*LINEAR*,8X,*LIN 1-WAY*,6X,
     *        *RADIATION*,8X,*HEAT*,7X,*NEGATIVE INTERNAL*,3X,
     *        *BALANCE ON*,/,7X,*NODE*,8X,*TYPE*,4X,3(* TRANSFER*,6X),
     *        *SOURCE/SINK*,5X,*ENERGY CHANGE*,8X,*NODE*,/,
     *        1X16(*-*),1X6(*-*),2X4(*-------------  *),
     *        17(*-*),2X,13(*-*) )
      NLINE       = NLINE + 9
      SODSL       = 0.0
      SODSL1      = 0.0
      SODSP       = 0.0
      SODS        = 0.0
      SCIENP      = 0.0
      ONETOTL     = 0.0
      IHAR        = 0
      CALL WEOF (ONETF(1),1)
      CALL RWIND (ONETF(1))
C
C*******************
C     PRINT THE ONET FOR DIFFUSION AND ARITHMETIC NODES.
C
 3100 CONTINUE
      CALL READSQ (ONETF(1),ONETD(1),9,LNG,JEOF)
      IF(JEOF.GT.0)                     GO TO 3400
      IF( NODEO .GT. NDPA )             GO TO 3500
      IF (NLINE.LT.47)  GO TO 3300
C     CALL TOPLIN                                                    CSC
      WRITE( OUTPUT,3002 )
      NLINE       = NLINE + 4
 3300 CONTINUE
      CIENP       = -CIENP
```

APPENDIX A, CONTINUED

```
      NLINE       = NLINE + 1
      WRITE( OUTPUT,3301 ) ONETD
 3301 FORMAT(1X16,* (*I6,*)  *A8,4(G13.6,2X),2XG13.6,4XG13.6)
      SODSL       = SODSL + ODSL
      SODSL1      = SODSL1 + ODSL1
      SODSP       = SODSP + ODSP
      SODS        = SODS + ODS
      SCIENP      = SCIENP + CIENP
      ONETOTL     = ONETOTL + ONETT
                                        GO TO 3100
 3400 CONTINUE
C
C*******************
C     END OF FILE ON ONETF
C
      IHAB        = 1
C
C
 3500 CONTINUE
C     IF (NLINE.GE.41)  CALL TOPLIN                                    CSC
      WRITE( OUTPUT,3501 )  SONETD
 3501 FORMAT(//,10X,*TOTALS OF DIFF  *,4(*-------------  *),
     *       17(*-*),2X,13(*-*),/,10X,*AND ARITH NODES *,
     *       4(G13.6,2X),2X,G13.6,4X,G13.6,// )
      NLINE       = NLINE + 4
      IF( IHAB .EQ. 1 )                 GO TO 9999
      SODSL       = 0.0
      SODSP       = 0.0
      SODSL1      = 0.0
      SCIENP      = 0.0
      SODS        = 0.0
      ONETOTL     = 0.0
                                        GO TO 3700
 3600 CONTINUE
C
C*******************
C     PRINT THE ONET FOR THE HEATER AND BOUNDARY NODES
C
      CALL READSO (ONETF(1),ONETD(1),9,LNG,JEOF)
      IF(JEOF.GT.0)                     GO TO 3900
 3700 CONTINUE
      IF (NLINE.LT.47)  GO TO 3300                                     CSC
C     CALL TOPLIN
      WRITE( OUTPUT,3002 )
      NLINE       = NLINE + 4
 3800 CONTINUE
      NLINE       = NLINE + 1
      WRITE( OUTPUT,3301 ) ONETD
      SODSL       = SODSL + ODSL
      SODSL1      = SODSL1 + ODSL1
      SODSP       = SODSP + ODSP
      SODS        = SODS + ODS
      SCIENP      = SCIENP + CIENP
      ONETOTL     = ONETOTL + ONETT
                                        GO TO 3600
 3900 CONTINUE
C
C*******************
C     END OF FILE ON -ONETF-
C
C     IF (NLINE.GE.45)  CALL TOPLIN                                    CSC
      WRITE( OUTPUT,3901 ) SONETD
 3901 FORMAT(//,9X,*TOTALS OF HEATER *,4(*-------------  *),
     *       17(*-*),2X,13(*-*),/,9X,*AND BOUND NODES  *,
```

APPENDIX A, CONTINUED

```
     *        4(G13.6,2X),2X,G13.6,4X,G13.6 )
                                        GO TO 9999
 4000  CONTINUE
C
C      ********************************************************************
C      *                                                                  *
C      *       LOGIC FOR THE OMAP CALCULATIONS AND ONET DATA TAPE         *
C      *                                                                  *
C      ********************************************************************
C
       OPT           = OPTIONS .AND. MASK0
       IOPSN         = 0
       IF((OPT .EQ. 208) .AND. (KOUNT .GT. 0))  IOPSN = 1
       DO 7000 LOP = ISTART,IEND
       NODE0         = NODE0 + 1
       PRINT         = OPT .AND. MASK1
 4100  CONTINUE
       IF( OPT .GT. 0 )                 GO TO 4600
 4200  CONTINUE
       IF( NODE0 .LT. NODE1 )           GO TO 4400
       IF( NODE0 .GT. NODE1 )           GO TO 4300
       PRINT         = 1
                                        GO TO 4600
 4300  CONTINUE
       LTH           = LTH + 1
       IF( LTH .GT. ARGEND )            GO TO 7100
       NODE1         = IX(LTH)
                                        GO TO 4200
 4400  CONTINUE
       IF( LGLT .LT. 15 )               GO TO 4500
       CALL UNPACK
       LGLT          = 0
 4500  CONTINUE
       LGLT          = LGLT + 1
       INFO          = INFOGT( LGLT )
       IF((INFO .AND. 18) .EQ. 1 )      GO TO 7000
                                        GO TO 4400
 4600  CONTINUE
C
C******************
C      SAVE THE INITIAL IPKWRD AND LGLT FOR THIS NODE
C
       IPKWRDS       = IPKWRD-7
       LGLTS         = LGLT
       NODE          = ND( NODE0 )
       IF( IOPSN .EQ. 0 )               GO TO 4900
 4700  CONTINUE
       IF( NODE0 .LT. NODE1 )           GO TO 4900
       IF( NODE0 .GT. NODE1 )           GO TO 4800
       PRINT         = 1
                                        GO TO 4900
 4800  CONTINUE
       LTH           = LTH + 1
       IF( LTH .GE. ARGEND )            IOPSN = 0
       IF( LTH .GT. ARGEND )            GOTO 4900
       NODE1         = IX( LTH )
                                        GO TO 4700
 4900  CONTINUE
       IF( PRINT .EQ. 0 )               GO TO 6000
C
C******************
C      PRINTING THE FIRST PART OF -OMAP- PRINT OUT
C
C      CALL TOPLIN                                                  CSC
```

APPENDIX A, CONTINUED

```
C       WRITE( OUTPUT,5001 ) NODE,TYPE,NODE,NODEO,TIMEN,TSTEPU          CSC
C5001   FORMAT(*0*,58X,*NODE*,I6,//,                                    CSC
C     *         * A OMAP OF INPUT *,A6,* NODE *,I6,* (INTERNAL*,I6,     CSC
C     *         *) AT *,G13.6,* (TIME UNITS) OVER A TIME STEP OF *,G13.6, CSC
C     *         *(TIME UNITS).*,/ )                                     CSC
        TEMPN           = T( NODEO )
        IF((ITRAN .GT. 0) .AND. (NODEO .LE. NDPA)) GO TO 5100
C       WRITE( OUTPUT,5002 ) NODE,TEMPN                                 CSC
C5002   FORMAT(* THE TEMPERATURE OF NODE *,I6,* IS *,G13.6,* (DEG.)* )  CSC
                                        GO TO 5300
 5100   CONTINUE
        TEMPO           = EXTRA( ITNTH+NODEO-1) + ABSZRO
        WRITE( OUTPUT,5101 ) NODE,TEMPO,TEMPN
 5101   FORMAT(* THE TEMPERATURE OF NODE *,I6,
     *         * AT THE START OF THE TIME STEP WAS *,G13.6,
     *         * (DEG), AND *,G13.6,* (DEG) AT THE END.* )
 5300   CONTINUE
        NLINE           = NLINE + 5
        IF( TYPE .NE. DIFF )            GO TO 5900
C
C*******************
C       SUM CONDUCTANCE FOR NODEO
C
        SUMGL           = 0.0
        SUMGRL          = 0.0
 5400   CONTINUE
        IF( LGLT .NE. 15 )              GO TO 5500
        CALL UNPACK
        LGLT            = 0
 5500   CONTINUE
        LGLT            = LGLT + 1
        NG              = LG(LGLT)
        NT              = LT(LGLT)
        INFO            = INFOGT(LGLT)
        GNG             = G( NG )
C
C*******************
C       CHECK FOR CONDUCTOR TYPE
C
        IF((INFO.AND.48).NE.0)          GO TO 5600
C
C*******************
C       LINEAR
C
        SUMGL           = SUMGL + GNG
                                        GO TO 5700
 5600   CONTINUE
C
C*******************
C       RADIATION
C
        TIA             = T( NODEO ) - ABSZRO
        TNTA            = T( NT ) - ABSZRO
        SUMGRL          = SUMGRL + GNG*(TNTA**2 + TIA**2)*(TNTA + TIA)
 5700   CONTINUE
C
C*******************
C       CHECK FOR MORE ADJOINING NODES
C
        IF((INFO .AND. 1B) .EQ. 0 )     GO TO 5400
C
C*******************
C       CHECK FOR ZERO SUM OF CONDUCTORS
C
```

APPENDIX A, CONTINUED

```
      SUMG          = SUMGL + SBCNST*SUMGRL
      IF( SUMG .GT. 0.0 )                GO TO 5800
      NLINE         = NLINE + 2
      WRITE( OUTPUT,5701 ) NODE
 5701 FORMAT(*0++CAUTION++  THE SUM OF CONDUCTORS ATTACHED TO INPUT *,
     *        *NODE *,I5,* IS NOT GREATER THAN ZERO.* )
      SUMG          = 1.E300
 5800 CONTINUE
      CSG           = C( NODEO )/SUMG
C     WRITE( OUTPUT,5801 ) NODE, C( NODEO ), CSG                          CSC
C5801 FORMAT(*0THE CAPACITANCE OF NODE*,I6,* IS *,G13.6,                  CSC
C    *        * (ENERGY UNITS/DEG), AND THE CAP./SUM OF CONDUC IS *,      CSC
C    *        G13.6,* (TIME UNITS).* )                                    CSC
      NLINE         = NLINE + 2
C
C*******************
C     PRINT THE NODE CONNECTIONS
C
 5900 CONTINUE
C     WRITE( OUTPUT,5901 ) NODE                                           CSC
C5901 FORMAT(*-*,42X,*THE ADJOINING NODES TO NODE *,I5,* ARE...*,/,       CSC
C    *        1X2(*INPUT (INTERNAL)*7X),6X*CONDUCTOR*6X                   CSC
C    *        *HEAT TRANSFER RATE*,5X,*TEMPERATURE DF*,/,7X,*NODE*,7X,    CSC
C    *        *TYPE*,5X,*CONDUCTOR*,7X,*TYPE*,8X,*VALUE*,5X,              CSC
C    *        *(ENERGY UNITS/TIME UNITS) ADJOINING NODE*/1X15(*-*),       CSC
C    *        1X6(*-*),1X16(*-*),1X9(*-*),1X13(*-*),1X25(*-*),1X14(*-*)   CSC
      NLINE         = NLINE + 6
 6000 CONTINUE
C
C*******************
C     RESTORE THE NODE POINTERS TO THE -PCS- .
C
      LGLT          = LGLTS
      IPKWRD        = IPKWRDS
      CALL UNPACK
C
C*******************
C     COMPUTING INSTANTANEOUS HEAT RATES FOR EACH CONDUCTIVE PATH
C
      QDSL          = 0.0
      QDSP          = 0.0
      QDSL1         = 0.0
      QDS           = 0.0
      TETA          = 0.0
      IF( TYPE .NE. BOUN )           QDS = Q( NODEO )
      TIA           = T( NODEO ) - ABSZRO
 6100 CONTINUE
      IF( LGLT .NE. 15 )             GO TO 6200
      CALL UNPACK
      LGLT          = 0
 6200 CONTINUE
      LGLT          = LGLT + 1
      NG            = LG( LGLT )
      NT            = LT( LGLT )
      GNG           = G( NG )
      TNTA          = T( NT ) - ABSZRO
      NCAC          = IX( IGDRCT+NG )
      INFO          = INFOGT( LGLT )
      TYPEN         = BOUN
      IF( NT .LE. NDAH )             TYPEN = HEAT
      IF( NT .LE. NDPA )             TYPEN = ARTH
      IF( NT .LE. NND )              TYPEN = DIFF
      L1W           = INFO .AND. 6P
      IF( L1W .EQ. 0 )               TYPEC = REG
```

APPENDIX A, CONTINUED

```
      IF( L1W .EQ. 4 )                TYPEC = RAD
      IF( L1W .EQ. 2 )                TYPEC = REG1W
      IF( L1W .EQ. 6 )                TYPEC = RAD1W
      IF((INFO.AND.4B).NE.0)          GO TO 6300
C
C*******************
C     LINEAR CONDUCTOR
C
      HT          = GNG*(TNTA - TIA)
                                      GO TO 6400
 6300 CONTINUE
C
C*******************
C     RADIATION CONDUCTOR
C
      HT          = GNG*SBCNST*(TNTA**4-TIA**4)
 6400 CONTINUE
C
C*******************
C     KEEPING TRACK OF SUMATIONS OF...
C             TOTAL HEAT TRANSFER.............QDSL
C             TOTAL RADIATION HEAT TRANSFER.....QDSP
C             TOTAL LINEAR 1-WAY TRANSFER.......QDSL1
C
      IF( L1W .EQ. 0 )                QDSL = QDSL + HT
      IF( L1W .EQ. 2 )                QDSL1 = QDSL1 + HT
      IF( L1W .GT. 2 )                QDSP = QDSP + HT
      IF( PRINT .EQ. 0 )              GO TO 6600
C
C*******************
C     PRINT SECOND PART OF OMAP PRINT OUT
C
     IF (NLINE.LT.47)  GO TO 6500
C     CALL TOPLIN                                                       CSC
C     WRITE( OUTPUT,5901 ) NODE                                         CSC
      NLINE       = NLINE + 6
 6500 CONTINUE
      NLINE       = NLINE + 1
C     WRITE( OUTPUT,6501 ) ND(NT), NT, TYPEN, NCAC, NG, TYPEC, GNG, HT,CSC
C    1                      T(NT)                                       CSC
C6501 FORMAT(1X,I6,* (*I6,*) *A8,I6,* (*I6,*) *A10,G13.6,               CSC
C    *       2(7X,G13.6) )                                             CSC
      WRITE( OUTPUT,6501 ) NODE, ND(NT), HT                             CSC
      WRITE( NUSER2,6501 ) NODE, ND(NT), HT                             CSC
 6501 FORMAT(1X,I4,6X,I4,6X,G13.6)                                      CSC
 6600 CONTINUE
      IF((INFO .AND. 1B) .EQ. 0 )     GO TO 6100
C
C*******************
C     CALCULATION OF NEGATIVE RATE OF CHANGE OF THE INTERNAL ENERGY
C
      CIENP       = 0.0
      NRCIE       = 0
      IF( ITRAN .EQ. 0 )              GO TO 6700
      IF( NODEO .GT. NND )            GO TO 6700
      NRCIE       = 1
      CIENP       = C(NODEO) * (TIA - EXTRA(ITNTH+NODEO-1)) / TSTEPU
      IF( TSTEPU .EQ. 0.0 )           CIENP = 0.0
 6700 CONTINUE
      IF((OPT .AND. 20B) .EQ. 0 )     GO TO 6800
C
C*******************
C     WRITE OUT THE FILE FOR -ONET-
C
```

APPENDIX A, CONTINUED

```
      ONETT       = QDSL + QDSL1 + QDSR + QDS - CIENR
      CALL WRITSO (ONETF(1),ONETD(1),9)
 6800 CONTINUE
      IF( PRINT .EQ. 0 )                GO TO 7000
C
C*******************
C     PRINT THE THIRD PART OF -QMAP- PRINT OUT
C
C     IF (NLINE.GE.36)  CALL TOPLIN                                          CSC
C     WRITE( OUTPUT,6900 ) NODE,QDSL,QDSL1,QDSR                              CSC
C6900 FORMAT(*0*,47X,*THE TOTALS ON NODE *,I6,* ARE...*,/,                   CSC
C    *       21X,*LINEAR HEAT TRANSFER (CONDUCTION/CONVECTION)... *,         CSC
C    *       G13.6,/,                                                        CSC
C    *       21X,*LINEAR 1-WAY TRANSFER (ENTHALPY TRANSFER)..... *,          CSC
C    *       G13.6,/,                                                        CSC
C    *       21X*RADIATION HEAT TRANSFER*24(*.*),1XG13.6)                    CSC
C     IF( NODEO.LE.NDAH )               WRITE( OUTPUT,6901 )  QDS            CSC
C6901 FORMAT(21X*HEAT SOURCE/SINKS APPLIED*22(*.*),1XG13.6)                  CSC
      TETB        = QDSL + QDSL1 + QDSR + QDS
C     WRITE( OUTPUT,6902 ) TETB                                              CSC
C6902 FORMAT(68X,15(*-*),/,69X,G13.6,* ENERGY UNITS/TIME UNIT* )             CSC
      IF( NRCIE .EQ. 0 )                GO TO 7000
      WRITE( OUTPUT,6903 ) CIENR
 6903 FORMAT(21X*LESS THE INTERNAL ENERGY CHANGE* 16(*.*),1XG13.6)
      TETB        = TETB - CIENR
C     WRITE( OUTPUT,6902 ) TETB                                              CSC
 7000 CONTINUE
 7100 CONTINUE
      GO TO NPET,( 2100, 2200, 2300, 2810 )
 9999 CONTINUE
      NLINE       = 60
      CALL NAJFLD (LOCF(EXTRA(NTH)),4)
      CALL CLOSEX (ONETF(1),1,0)
      RETURN
      END
      SUBROUTINE CNTRL(PLOCIN,XT,YT,XC,YC,ISTA,IFIN)
      DIMENSION XNODES(8,8), YNODES(8,8), PSURF(8,8)
      DIMENSION TCAL(36),PSUR(6,6),G(24),B(24),THOLD(108)
      DIMENSION PLOCIN(81,2), XT(81),YT(2)
C
C
      TRANSX(THETA,X,Y,XC) = COS(THETA)*X - SIN(THETA)*Y + XC
      TRANSY(THETA,X,Y,YC) = SIN(THETA)*X + COS(THETA)*Y + YC
C
      DO = .5325
      DS = 1.0
      XLENGTH = 6.045
      ANGLE = 45.0
      PI = 3.1416954
      THETA = ANGLE*PI/180.
C
C      CALCULATE NODE POSITIONS
C
      DO 30 J=1,8
      DO 20 I=1,6
      XNODES(I+1,J) = DO+(I-1)*DS
   20 CONTINUE
      XNODES(1,J) = 0.0
      XNODES(8,J) = XLENGTH
   30 CONTINUE
      DO 40 I=1,8
      DO 50 J=1,6
      YNODES(I,J+1) = DO+(J-1)*DS
   50 CONTINUE
```

APPENDIX A, CONTINUED

```
      YNODES(I,1) = 0.0
      YNODES(I,8) = XLENGTH
   40 CONTINUE
C     CALCULATE SURFACE PRESSURES OVER THE SUBJECT TILE
C
C
C     CALL PNTERP(PLOCIN,XT,YT,ISTA,IFIN)
      DO 60 I=1,8
      DO 70 J=1,8
      XN = TRANSX(-THETA,XNODES(I,J),YNODES(I,J),XC)
      YN = TRANSY(-THETA,XNODES(I,J),YNODES(I,J),YC)
      CALL PRESND(81,XT,2,YT,81,PLOCIN,XN,YN,PPES)
      PSURF(I,J) = PRES
   70 CONTINUE
   60 CONTINUE
      DO 61 I=1,6
      DO 62 J=1,6
      PSUR(I,J) = PSURF(I+1,J+1)
   62 CONTINUE
   61 CONTINUE
C
      CALL PMITAS(THOLD,G,R)
      DO 100 I=1,36
      TCAL(I) = THOLD(I)
  100 CONTINUE
C
      CALL CALFM(TCAL,G,PSUR,R)
      RETURN
      END
      SUBROUTINE PNTERP(PLOCIN,XT,YT,ISTA,IFIN)
C
      DIMENSION X1(50), Y1(50), PLOC1(50)
      DIMENSION X2(50), Y2(50), PLOC2(50)
      DIMENSION TITLE(8), YP(50), TEMP(50)
      DIMENSION PLOCIN(81,2), XNODES(150), YNODES(150)
      DIMENSION XT(81), YT(2)
      DIMENSION XLINC(16),YLINC(16)
C
C
C     READ INPUT DATA
C
C
      READ(5,100) (TITLE(I), I=1,8)
      READ(5,200) NRUN,XMACH,PHI,QPSF,PPSIA
      WRITE(6,250) (TITLE(I), I=1,8)
      WRITE(6,260) NRUN,XMACH,PHI,QPSF,PPSIA
      WRITE(6,270)
      READ(5,290) N1
      DO 10 I=1,N1
      READ(5,300) X1(I), Y1(I), PLOC1(I)
      WRITE(6,280) NRUN,X1(I),Y1(I),PLOC1(I)
   10 CONTINUE
      READ(5,290) N2
      DO 20 I=1,N2
      READ(5,300) X2(I), Y2(I), PLOC2(I)
      WRITE(6,280) NRUN,X2(I),Y2(I),PLOC2(I)
   20 CONTINUE
C
  100 FORMAT(8A10)
  200 FORMAT(A4,F10.4,F10.2,F10.1,F10.3)
  250 FORMAT(1H ,8A10)
  260 FORMAT(1H ,/" RUN      MACH      PHI      Q       P"/" NUMBER
     1   DEG.    PSF     PSIA"/1H ,I4,F9.4,F8.2,F7.1,F9.0)
  270 FORMAT(1H ,//" RUN          X           Y           P-LOC"/" NUMBER
     1                              PSIA")
```

APPENDIX A, CONTINUED

```
  290 FORMAT(I5)
  300 FORMAT(F12.5,F12.5,F12.3)
  280 FORMAT(1H ,A4,3F12.5)
C
C     DETERMINE THE RANGE OVER WHICH THE DATA SETS ARE TO
C     BE INTERPOLATED. OUTSIDE THE RANGE THE DATA IS
C     EXTRAPOLATED WITH STRAIGHT, FLAT LINES.
C
      XSTAR1 =IFIX(X1(1) + .5)
      XSTAR2 = IFIX(X2(1) + .5)
      IF(XSTAR1 .LT. X1(1))  XSTAR1 = XSTAR1 + .5
      IF(XSTAR2 .LT. X2(1))  XSTAR2 = XSTAR2 +.5
      WRITE(6,24) XSTAR1,XSTAR2
   24 FORMAT(1H ,"XSTAR1=",F12.5,"   XSTAR2=",F12.5)
      XSTOP1 = IFIX(X1(N1) + .5)
      XSTOP2 = IFIX(X2(N2) + .5)
      IF(XSTOP1 .GT. X1(N1))  XSTOP1 = XSTOP1 - .5
      IF(XSTOP2 .GT. X2(N2))  XSTOP2 = XSTOP2 - .5
      WRITE(6,31) XSTOP1,XSTOP2
   31 FORMAT(1H ,"XSTOP1=",F12.5,"   XSTOP2=",F12.5)
C
      YT(1) = Y1(1)
      YT(2) = Y2(1)
C
C
C
C     INTERPOLATE THE TWO DATA SETS TO A REGULAR GRID
C     USING CUBIC SPLINES.  (AKCLIB)
C
C
      SIGMA = 2.5
      ISLPSW = 3
C
C           FIRST DATA SET
C
      CALL CURV1(N1,X1,PLOC1,SPL1,SPLN,ISLPSW,YP,TEMP,SIGMA,IERR)
      IF(IERR-1) 50,60,60
C
   50 DO 40 K=ISTA,IFIN
      I=K-ISTA+1
      XT(I) = .5*(K-1)
      IF(XT(I) .LT. XSTAR1) PLOCIN(I,1)=CURV2(X1(1),N1,X1,PLOC1,YP,
     1                                        SIGMA)
      IF(XT(I) .GE. XSTAR1 .OR. XT(I) .LE. XSTOP1)
     1          PLOCIN(I,1)=CURV2(XT(I),N1,X1,PLOC1,YP,SIGMA)
      IF(XT(I) .GT. XSTOP1)  PLOCIN(I,1)=CURV2(X1(N1),N1,X1,PLOC1,YP,
     1                                         SIGMA)
   40 CONTINUE
C
C
C           SECOND DATA SET
C
      CALL CURV1(N2,X2,PLOC2,SPL1,SPLN,ISLPSW,YP,TEMP,SIGMA,IERR)
      IF(IERR-1) 90,60,60
C
   90 DO 110 K=ISTA,IFIN
      I=K-ISTA+1
      XT(I) = .5*(K-1)
      IF(XT(I) .LT. XSTAR2) PLOCIN(I,2)=CURV2(X2(1),N2,X2,PLOC2,YP,
     1                                        SIGMA)
      IF(XT(I) .GE. XSTAR2 .OR. XT(I) .LE. XSTOP2)
     1           PLOCIN(I,2) = CURV2(XT(I),N2,X2,PLOC2,YP,SIGMA)
      IF(XT(I) .GT. XSTOP2)  PLOCIN(I,2)=CURV2(X2(N2),N2,X2,PLOC2,YP,
     1                                         SIGMA)
```

APPENDIX A, CONTINUED

```
  110 CONTINUE
   60 CONTINUE
      IF(IERR -1 .EQ. 0) PRINT IERR
      IF(IERR -1 .EQ. 1) PRINT IERR
      RETURN
      END
      SUBROUTINE PRESND(NX,X,NY,Y,MAXF,F,XO,YO,PRES)
      DIMENSION IPT(2),IORDER(2),X(NX),Y(NY),F(MAXF,NY)
      IPT(1) = -1
      IPT(2) = -1
      IORDER(1) = 1
      IORDER(2) = 1
      CALL IBI(NX,X,NY,Y,MAXF,F,IORDER,IPT,XO,YO,PRES,IERR)
C     GO TO(100,200,300,400),
C 100 WRITE(6,600)
C     GO TO 500
C 200 WRITE(6,700)
C     GO TO 500
C 300 WRITE(6,800)
C     GO TO 500
C 400 WRITE(6,900)
C 600 FORMAT(1H ,
C 700 FORMAT(1H ,
C 800 FORMAT(1H ,
C 900 FORMAT(1H ,
 1000 FORMAT(1H ,I11,1H,,F12.3,1H,,F10.1,2F12.5)
  500 RETURN
      END
      SUBROUTINE LONG(XC,YC,ANGLE,XLENGTH,DS,DO,XNODES,YNODES,NNODES,N)
C
      DIMENSION XNODES(NNODES), YNODES(NNODES)
C
      TRANSX(THETA,X,Y,XC) = COS(THETA)*X - SIN(THETA)*Y + XC
      TRANSY(THETA,X,Y,YC) = SIN(THETA)*X + COS(THETA)*Y + YC
C
      XNTL = FLOAT(NNODES)/FLOAT(N)
      NTL = XNTL + .5
      TOTAL = XNTL*XLENGTH
      PI = 3.14159623
      THETA = ANGLE*PI/180.0
      Y = 0.0
      XREF = 0.0
      DO 20 J = 1,NTL
      DO 10 I=1,N
      X = DO + (I-1)*DS + XREF
      IF(X .GT. TOTAL) GO TO 50
      XNODES((J-1)*N+I) = TRANSX(THETA,X,Y,XC)
      YNODES((J-1)*N+I) = TRANSY(THETA,X,Y,YC)
   30 FORMAT(1H ,F12.5)
   10 CONTINUE
      XREF = X + DO
   20 CONTINUE
   50 CONTINUE
      RETURN
      END
      SUBROUTINE SHOPT(XC,YC,ANGLE,XLENGTH,DS,DO,XNODES,YNODES,NNODES)
C
      DIMENSION XNODES(NNODES), YNODES(NNODES)
C
      TRANSX(THETA,X,Y,XC) = COS(THETA)*X - SIN(THETA)*Y + XC
      TRANSY(THETA,X,Y,YC) = SIN(THETA)*X + COS(THETA)*Y + YC
C
      PI = 3.14159623
      THETA = ANGLE*PI/180.0
```

APPENDIX A, CONTINUED

```
      X = 0.0
      DO 10 I = 1,NNODES
      Y = DO + (I-1)*DS
      XNODES(I) = TRANSX(THETA,X,Y,XC)
      YNODES(I) = TRANSY(THETA,X,Y,YC)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE GENPT(XREF,YREF,XLENGTH,XLINC,YLINC,N)
C
      DIMENSION XLINC(N),YLINC(N)
C
      DLENGTH = XLENGTH*SQRT(.5)
C
      XLINC(2) = XREF - 1.5*DLENGTH
      YLINC(2) = YREF + 1.5*DLENGTH
      XLINC(1) = XREF - 2.5*DLENGTH
      YLINC(1) = YREF +  .5*DLENGTH
      XLINC(3) = XREF
      YLINC(3) = YREF + 2. *DLENGTH
      XLINC(4) = XREF + 1.5*DLENGTH
      YLINC(4) = YREF + 2.5*DLENGTH
      XLINC(5) = XLINC(1)
      YLINC(5) = YLINC(1)
      XLINC(6) = XLINC(1) + DLENGTH
      YLINC(6) = YLINC(1) - DLENGTH
      XLINC(7) = XLINC(1) + 2.0*DLENGTH
      YLINC(7) = YLINC(1) - 2.0*DLENGTH
      XLINC(8) = XLINC(1) + 3.0*DLENGTH
      YLINC(8) = YLINC(1) - 3.0*DLENGTH
      XLINC(9) = XLINC(2) + .5*DLENGTH
      YLINC(9) = YLINC(2) - .5*DLENGTH
      XLINC(10) = XREF
      YLINC(10) = YREF
      XLINC(11) = XLINC(2) + 2.5*DLENGTH
      YLINC(11) = YLINC(2) - 2.5*DLENGTH
      XLINC(12) = XLINC(2) + 3.5*DLENGTH
      YLINC(12) = YLINC(2) - 3.5*DLENGTH
      XLINC(13) = XLINC(3) + .5*DLENGTH
      YLINC(13) = YLINC(3) - .5*DLENGTH
      XLINC(14) = XLINC(3) + 1.5*DLENGTH
      YLINC(14) = YLINC(3) - 1.5*DLENGTH
      XLINC(15) = XLINC(3) + 2.5*DLENGTH
      YLINC(15) = YLINC(3) - 2.5*DLENGTH
      XLINC(16) = XLINC(3) + 3.5*DLENGTH
      YLINC(16) = YLINC(3) - 3.5*DLENGTH
      DO 10 I=1,16
   10 CONTINUE
  100 FORMAT(1H ,2F12.5)
      RETURN
      END
      SUBROUTINE FINDND(XC,YC,ANGLE,XLENGTH,DS,DO,XNODES,YNODES,NNODES)
C
      DIMENSION XNODES(NNODES),YNODES(NNODES)
C
      TRANSX(THETA,X,Y,XC) = COS(THETA)*X-SIN(THETA)*Y+XC
      TRANSY(THETA,X,Y,YC) = SIN(THETA)*X+COS(THETA)*Y+YC
C
      N = NNODES/4.0
      PI = 3.14159654
      THETA = ANGLE*PI/180.0
C
C     SIDE 1
C
```

APPENDIX A, CONTINUED

```
      N1 = 1
      N2 = N
      DO 10 I=N1,N2
      X = 0.0
      Y = DO+(I-1)*DS
   23 FORMAT(1H ,4F12.5)
      XNODES(I) = TRANSX(THETA,X,Y,XC)
      YNODES(I) = TRANSY(THETA,X,Y,YC)
   10 CONTINUE
C
C     SIDE 2
C
      N1 = N2 + 1
      N2 = N1 + N - 1
      I1 = 1
      DO 20 I=N1,N2
      X = DO + (I1-1)*DS
      Y = XLENGTH
      XNODES(I) = TRANSX(THETA,X,Y,XC)
      YNODES(I) = TRANSY(THETA,X,Y,YC)
      I1 = I1 + 1
   20 CONTINUE
C
C     SIDE 3
C
      N1 = N2 + 1
      N2 = N1 + N - 1
      I1 = 1
      DO 30 I = N1,N2
      X = XLENGTH
      Y = XLENGTH - (DO+(I1-1)*DS)
      XNODES(I) = TRANSX(THETA,X,Y,XC)
      YNODES(I) = TRANSY(THETA,X,Y,YC)
      I1 = I1 + 1
   30 CONTINUE
C
C     SIDE 4
C
      N1 = N2 + 1
      N2 = N1 + N - 1
      I1 = 1
      DO 40 I = N1,N2
      X = XLENGTH - (DO+(I1-1)*DS)
      Y = 0.0
      XNODES(I) = TRANSX(THETA,X,Y,XC)
      YNODES(I) = TRANSY(THETA,X,Y,YC)
      I1 = I1 + 1
   40 CONTINUE
C
      RETURN
      END
      SUBROUTINE CALFM(T,G,PSUR,B)
      REAL T(36), PSUR(6,6), PTBL(6,6), A(6,6), F(24), GM(24),
     A     H(24), FX(24), FY(24), MX(24), MY(24), B(24),
     B     G(24), MXX, MYY, MZZ, MXTOT, MYTOT, MZTOT,KS
C
C     SUBROUTINE TO COMPUTE THE FORCES AND MOMENTS
C     UPON THE THERMAL PROCTECTION SYSTEM (TPS) TILES.
C
      NAMELIST/SHOCK/U,RHO,XMU,XSHOCK,XZERO,KS,DELTAX,DTILE,FLOSIGN
C     READ AND PRINT INPUT CONSTANTS FROM SHOCK NAMELIST
      FLOSIGN=1.0
      READ(7,SHOCK)
      WRITE(6,SHOCK)
```

APPENDIX A, CONTINUED

```
      I=0.
C     EPS = ERROR CRITERIA FOR SKIN FRICTION COMPUTATION.
      EPS=1.E-04
C     XLTILE = DISTANCE ALONG DIAGONAL OF THE TILE
C              WHICH IS THE X-AXIS LENGTH.
      XLTILE=6.*SQRT(2.)
C     THE TILE IS DIVIDED INTO 36 SMALLER DIVISIONS.
C     A DIVISION OF A 6 X 6 TILE HAS AN AREA OF 1.
C     ARRAY 'A' CONTAINS THE AREA OF EACH DIVISION.
      DO 100 M=1,6
      DO 100 N=1,6
  100 A(M,N)=1.
C     GRAV = ACCELERATION DUE TO GRAVITY (FT/SEC**2).
      GRAV=32.2
C     'PTBL' CONTAINS THE TILE BOND LINE PRESSURES
C     THAT WERE CONTAINED IN 'T'.
      DO 200 M=1,6
      DO 200 N=1,6
      I=I+1
C     PSUR(M,N)=T(36+I)
  200 PTBL(M,N)=T(I)
      CALL PRTOUT(R,G,PSUR,PTBL)
C
C     CALCULATION OF THE NORMAL FORCE.
C
      FM=0.
      DO 300 M=1,6
      DO 300 N=1,6
  300 FM=FM+(PTBL(M,N)-PSUR(M,N))*A(M,N)
C
C     CALCULATION OF THE MOMENT ABOUT THE X-AXIS.
C
      MXX=0.
      DO 400 M=1,6
      DO 400 N=1,6
      Y=(M-N+6.)*SQRT(2.)/2.
  400 MXX=MXX+(PTBL(M,N)-PSUR(M,N))*A(M,N)*(XLTILE/2.-Y)
C
C     CALCULATION OF THE MOMENT ABOUT THE Y-AXIS.
C
      MYY=0.
      DO 500 M=1,6
      DO 500 N=1,6
      X=(M+N-1.)*SQRT(2.)/2.
  500 MYY=MYY+(PTBL(M,N)-PSUR(M,N))*A(M,N)*(XLTILE/2.-X)
      MZZ=0.
C
C     CALCULATION OF THE GAP MOMENTS ABOUT THE X AND Y
C     AXIS AND CALCULATION OF THE GAP FORCES IN
C     THE X AND Y DIRECTION.
C
      GMX=0.
      GMY=0.
      GFX=0.
      GFY=0.
      DO 600 I=1,24
C     RAW GAP FORCE.
      F(I)=(R(I)-G(I))/2.*DTILE+G(I)*DTILE
C     RAW GAP MOMENT.
      GM(I)=(R(I)-G(I))/3.*(DTILE**2.)+G(I)/2.*(DTILE**2.)
      H(I)=GM(I)/F(I)
C     CALCULATE THE SIGN OF X AND Y.
      SIGNX=1.
      IF (I.GE.7.AND.I.LE.18) SIGNX=-1.
```

APPENDIX A, CONTINUED

```
      SIGNY=1.
      IF (I.LT.13) SIGNY=-1.
C     GAP FORCE IN THE X DIRECTION.
      FX(I)=SIGNX*F(I)/SQRT(2.)
C     GAP FORCE IN THE Y DIRECTION.
      FY(I)=SIGNY*F(I)/SQRT(2.)
C     GAP MOMENT ABOUT THE X-AXIS.
      MX(I)=-FY(I)*H(I)
C     GAP MOMENT ABOUT THE Y-AXIS.
      MY(I)=FX(I)*H(I)
C
C     SUM OF THE GAP FORCES AND MOMENTS.
C
      GFX=GFX+FX(I)
      GFY=GFY+FY(I)
      GMX=GMX+MX(I)
  600 GMY=GMY+MY(I)
C     CALCULATE THE GAP MOMENT ABOUT THE Z-AXIS.
      GMZ=0.
      J=0.
      DO 700 I=1,4
      DO 700 II=1,6
      J=J+1
      XL=3.5-II
  700 GMZ=GMZ+F(J)*XL
C
C     CALCULATION OF THE SKIN FRICTIONAL FORCE IN THE
C     X DIRECTION AND THE MOMENT ABOUT THE Y-AXIS.
C
      SFXSV=0.
      SMYSV=0.
  750 CONTINUE
      SFX=0.
      SMY=0.
      X=XZERO-DELTAX
  800 X=X+DELTAX
      XP=X-XSHOCK
      IF (X.GT.(XZERO+6.*SQRT(2.))) GO TO 850
      DELTA=0.37*X*(RHO*U*X/(12.*XMU))**(-.2)
      XPAT=XP/DELTA
      CALL NTUPP(XPAT,ANS)
      CFP=(2.87+1.58*ALOG10(X/KS))**(-2.5)
      TW=CFP*RHO*(U**2.)/(2.*GRAV)
      TWB=TW*ANS
      DELTAA=-2*(X-XZERO)*DELTAX+12*SQRT(2.)*DELTAX
      IF (X.LE.(XZERO+6*SQRT(2.)/2.)) DELTAA=2*(X-XZERO)*DELTAX
      DFX=FLOSIGN*TWB*DELTAA/144.
      DMY=DFX*DTILE
      SFX=SFX+DFX
      SMY=SMY+DMY
      GO TO 800
  850 CONTINUE
      ERR1=ABS(SFX-SFXSV)/ABS(SFX)
      ERR2=ABS(SMY-SMYSV)/ABS(SMY)
      SFXSV=SFX
      SMYSV=SMY
      DELTAX=0.5*DELTAX
      IF (ERR1.GT.EPS.OR.ERR2.GT.EPS) GO TO 750
C
C     END OF COMPUTATION OF SKIN FRICTION FORCE AND MOMENT.
C
C     COMBINING ALL FORCES AND MOMENTS INTO TOTAL
C     FORCES AND MOMENTS UPON THE TILE.
C
```

APPENDIX A, CONTINUED

```
      FXTOT=GFX+SFX
      FYTOT=GFY
      FZTOT=FM
      MXTOT=MXX+GMX
      MYTOT=MYY+GMY+SMY
      MZTOT=GMZ
C
C     END OF FORCES AND MOMENTS COMPUTATION.
C
      WRITE(6,1000)
 1000 FORMAT(33X,30HTOTAL FORCES AND TOTAL MOMENTS,///,
     A6X,5HFXTOT,11X,5HFYTOT,11X,5HFZTOT,11X,5HMXTOT,11X,
     B5HMYTOT,11X,5HMZTOT,//)
      WRITE(6,2000) FXTOT, FYTOT, FZTOT, MXTOT, MYTOT, MZTOT
 2000 FORMAT(1X,6(E16.8),////)
      WRITE(6,3000)
 3000 FORMAT(11X,10HGAP FORCES,30X,11HGAP MOMENTS,///,
     A7X,3HGFX,13X,3HGFY,13X,3HGMX,13X,
     B3HGMY,13X,3HGMZ,//)
      WRITE(6,4000) GFX, GFY, GMX, GMY, GMZ
 4000 FORMAT(1X,5(E16.8),////)
      WRITE(6,5000) SFX, SMY
 5000 FORMAT(1X,32HSKIN FRICTION FORCES AND MOMENTS,
     A///,7X,3HSFX,13X,3HSMY,//,1X,2(E16.8),////)
      WRITE(6,6000) FM
 6000 FORMAT(1X,15HNORMAL FORCE FM,E16.8,////)
      WRITE(6,7000) MXX, MYY, MZZ
 7000 FORMAT(14X,20HNORMAL FORCE MOMENTS,///,
     A7X,2HMX,13X,2HMY,13X,2HMZ,//,3(E16.8),////)
      RETURN
      END
      SUBROUTINE NTURP(X,Y)
      DIMENSION XOD(31), TOT(31)
      DATA XOD/-8.0,-7.0,-6.5,-6.0,-5.5,-5.0,-4.0,-3.0,-2.0,
     A         -1.0,-0.5, 0.0, 0.5, 1.0, 2.0, 3.0, 4.0, 5.0,
     B          6.0, 7.0, 8.0, 9.0,10.0,10.5,11.0,11.5,12.0,
     C         12.5,13.0,13.5,14.0/
      DATA TOT/1.000,0.993,0.986,0.961,0.929,0.871,0.750,0.643,
     A         0.550,0.479,0.450,0.436,0.429,0.429,0.436,0.454,
     B         0.479,0.518,0.554,0.586,0.618,0.700,0.782,0.825,
     C         0.882,0.914,0.946,0.964,0.979,0.989,1.000/
      DO 900 I=1,30
      IF (XOD(I).LE.X.AND.X.LE.XOD(I+1)) GO TO 950
  900 CONTINUE
      IF (X.LT.(-8).OR.X.GT.14) Y=1.
      RETURN
  950 Y=TOT(I)+(TOT(I+1)-TOT(I))*(X-XOD(I))/(XOD(I+1)-XOD(I))
      RETURN
      END
      SUBROUTINE PRTOUT(B,G,PSUR,PTRL)
      DIMENSION T(72),B(24),G(24),PSUR(6,6),PTRL(6,6)
      WRITE(6,3)
    3 FORMAT(1X,19HB(1-24), TOP OF GAP,/)
      K=1
      DO 30 I=1,4
      N=K
      M=K+5
      WRITE(6,8000) (B(J),J=N,M)
      K=K+6
   30 CONTINUE
      WRITE(6,4)
    4 FORMAT(1X,22HG(1-24), BOTTOM OF GAP,/)
      K=1
      DO 40 I=1,4
```

APPENDIX A, CONTINUED

```
      N=K
      M=K+5
      WRITE(6,8000) (G(J),J=N,M)
      K=K+6
   40 CONTINUE
      WRITE(6,5)
    5 FORMAT(1X,10HARRAY PSUR,/)
      DO 50 I=1,6
   50 WRITE(6,9000) (PSUR(I,J),J=1,6)
      WRITE(6,6)
    6 FORMAT(1X,10HARRAY PTBL,/)
      DO 60 I=1,6
   60 WRITE(6,9000) (PTBL(I,J),J=1,6)
 8000 FORMAT(6(1X,F16.8),/)
 9000 FORMAT(6(1X,F16.8),/)
      RETURN
      END
$STOP
      END
      BCD 3END OF DATA
```

APPENDIX A, CONTINUED

Pressure Profile

```
MF-6 REGION  (REPRESENTATION A)
 MF6    1.812       49.51   -  656      285.
  22
   0.0       -17.0       3.74
  10.0       -17.0       3.74
  12.0       -17.0       3.74
  14.0       -17.0       3.74
  16.0       -17.0       3.83
  18.0       -17.0       3.92
  19.0       -17.0       3.98
  19.5       -17.0       4.025
  20.0       -17.0       4.10
  20.5       -17.0       4.22
  22.0       -17.0       4.88
  23.0       -17.0       5.30
  24.0       -17.0       5.54
  25.0       -17.0       5.65
  26.0       -17.0       5.72
  28.0       -17.0       5.80
  30.0       -17.0       5.96
  32.0       -17.0       6.07
  34.0       -17.0       6.19
  36.0       -17.0       6.30
  38.0       -17.0       6.42
  40.0       -17.0       6.52
  22
   0.0        17.0       3.74
  10.0        17.0       3.74
  12.0        17.0       3.74
  14.0        17.0       3.74
  16.0        17.0       3.83
  18.0        17.0       3.92
  19.0        17.0       3.98
  19.5        17.0       4.025
  20.0        17.0       4.10
  20.5        17.0       4.22
  22.0        17.0       4.88
  23.0        17.0       5.30
  24.0        17.0       5.54
  25.0        17.0       5.65
  26.0        17.0       5.72
  28.0        17.0       5.80
  30.0        17.0       5.96
  32.0        17.0       6.07
  34.0        17.0       6.19
  36.0        17.0       6.30
  38.0        17.0       6.42
  40.0        17.0       6.52
```

```
A
EDIT 2.1.7
A
EDIT 2.1.7
A
EDIT 2.1.7
     BCD 3CONSTANTS DATA
     NDSTOR=6500,ITERMX=600 ,DRLXCA=1.E-9,ARLXCA=1.E-9
     TIMEO=0.,TIMEND=32.,TSTEPO=4.
     EXTLIM=.5
     100=1.47        $TILE THICKNESS (IN)
     101=6.0         $TILE SIDE LENGTH (IN)
     102=0.16*10.    $SIP THICKNESS (IN)
     103=.06         $TERMINATOR GAP (IN)
     106=.05         $GAP WIDTH (IN)
     107=00.0000     $VISCOSITY (LBM/FT-SEC)
     108=0.0000      $DENSITY OF GAS (LB/FT**3)
     109=1.0/26.7*.16    $SIP/GAP DP FACTOR (IN/PSI)
     110=1.21/26.7*.16   $SIP/SURFACE DP FACTOR (IN/PSI)
     111=0.1        $INITIAL EDGE CLEARANCE (IN)
     112=0.1         $EDGE CLEARANCE (IN)
     113=.5         $SIP/TILE DISCHARGE COEFFICIENT
     114=.1          $SIP/FILLER BAR CLEARANCE (IN)
     115=115.       $TEMPERATURE (F)
     116=0.0        $AVERAGE PRESSURE
     117=5.5        $LBF TO MOVE .05 IN LATERALLY
     118=0.0        $CLOSURE OF GAP 1
     119=0.0        $CLOSURE OF GAP 2
     120=.001        $MINIMUM GAP CLEARANCE (IN)
     121=1.E-3         $MINIMUM EDGE CLEARANCE (IN)
     123=1.0        $PERMEABILITY FACTOR
     1,,2,,3,,4,,5,,6,,7,,8,,9,,10,,11,,12,,13,,14,,15=0.
     ITEST=0,JTEST=0,KTEST= EDGAP,LTEST=0,MTEST=0
     NTEST=0    $ 0= 3 TILE MOVE; 1= 1 TILE MOVES
     END
     BCD 3ARRAY DATA    $VALUES SPECIFIED AT T=560R, LI900
A
EDIT 2.1.7
A
```

```
$XYCOOR
YC      = .1364E+02,
YC      = 0.0,
ISTA    = 1,
IFIN    = 81,
$END
MF-6 REGION  (REPRESENTATION A)

RUN      MACH      PHI      Q        P
NUMBER             DEG.     PSF      PSIA
****    1.8120   49.51  6560.0      285.

RUN          X            Y          P-LOC
NUMBER                                PSIA
 MF6      0.00000    -17.00000      3.74000
 MF6     10.00000    -17.00000      3.74000
 MF6     12.00000    -17.00000      3.74000
 MF6     14.00000    -17.00000      3.74000
 MF6     16.00000    -17.00000      3.83000
 MF6     18.00000    -17.00000      3.92000
 MF6     19.00000    -17.00000      3.98000
 MF6     19.50000    -17.00000      4.02500
 MF6     20.00000    -17.00000      4.10000
 MF6     20.50000    -17.00000      4.22000
 MF6     22.00000    -17.00000      4.88000
 MF6     23.00000    -17.00000      5.30000
 MF6     24.00000    -17.00000      5.54000
 MF6     25.00000    -17.00000      5.65000
 MF6     26.00000    -17.00000      5.72000
 MF6     28.00000    -17.00000      5.80000
 MF6     30.00000    -17.00000      5.96000
 MF6     32.00000    -17.00000      6.07000
 MF6     34.00000    -17.00000      6.19000
 MF6     36.00000    -17.00000      6.30000
 MF6     38.00000    -17.00000      6.42000
 MF6     40.00000    -17.00000      6.52000
 MF6      0.00000     17.00000      3.74000
 MF6     10.00000     17.00000      3.74000
 MF6     12.00000     17.00000      3.74000
 MF6     14.00000     17.00000      3.74000
 MF6     16.00000     17.00000      3.83000
 MF6     18.00000     17.00000      3.92000
 MF6     19.00000     17.00000      3.98000
 MF6     19.50000     17.00000      4.02500
 MF6     20.00000     17.00000      4.10000
 MF6     20.50000     17.00000      4.22000
 MF6     22.00000     17.00000      4.88000
 MF6     23.00000     17.00000      5.30000
 MF6     24.00000     17.00000      5.54000
 MF6     25.00000     17.00000      5.65000
 MF6     26.00000     17.00000      5.72000
 MF6     28.00000     17.00000      5.80000
 MF6     30.00000     17.00000      5.96000
 MF6     32.00000     17.00000      6.07000
 MF6     34.00000     17.00000      6.19000
 MF6     36.00000     17.00000      6.30000
 MF6     38.00000     17.00000      6.42000
 MF6     40.00000     17.00000      6.52000
XSTAP1=     0.00000   XSTAR2=       0.00000
XSTOP1=    40.00000   XSTOP2=      40.00000
```

```
DATE 84/03/23.TIME 19.00.11. MARTIN MARIETTA THERMAL ANALYZER SYSTEM (MITAS II-FD363) CDC6000 SCOPE3.4 VERSION  PAGE     1
    SHUTTLE TILE INTERNAL FLOW

++NOTE++ -STDSTL- REQUIRES  2244 WORDS OF DYNAMIC STORAGE

++CAUTION++  ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
             DRLXCC( 3028)=  .382975E-04 VS. DRLXCA=  .100000E-08
             ARLXCC( 3004)=  .382931E-04 VS. ARLXCA=  .100000E-08
             EBALSC        = 0.          VS. EBALSA= 0.
             EBALNC(    0)= 0.           VS. EBALNA= 0.

++CAUTION++  ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
             DRLXCC( 7030)= -.267802E-04 VS. DRLXCA=  .100000E-08
             ARLXCC( 7102)= -.267032E-04 VS. ARLXCA=  .100000E-08
             EBALSC        = 0.          VS. EBALSA= 0.
             EBALNC(    0)= 0.           VS. EBALNA= 0.

++CAUTION++  ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
             DRLXCC(   57)=  .187135E-04 VS. DRLXCA=  .100000E-08
             ARLXCC(  129)=  .186953E-04 VS. ARLXCA=  .100000E-08
             EBALSC        = 0.          VS. EBALSA= 0.
             EBALNC(    0)= 0.           VS. EBALNA= 0.

++CAUTION++  ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
             DRLXCC(   30)=  .561489E-04 VS. DRLXCA=  .100000E-08
             ARLXCC(  102)=  .560494E-04 VS. ARLXCA=  .100000E-08
             EBALSC        = 0.          VS. EBALSA= 0.
             EBALNC(    0)= 0.           VS. EBALNA= 0.

++CAUTION++  ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
             DRLXCC( 8055)= -.487474E-04 VS. DRLXCA=  .100000E-08
             ARLXCC( 8127)= -.484792E-04 VS. ARLXCA=  .100000E-08
             EBALSC        = 0.          VS. EBALSA= 0.
             EBALNC(    0)= 0.           VS. EBALNA= 0.

++CAUTION++  ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
             DRLXCC( 2056)=  .231362E-04 VS. DRLXCA=  .100000E-08
             ARLXCC( 2128)=  .231159E-04 VS. ARLXCA=  .100000E-08
             EBALSC        = 0.          VS. EBALSA= 0.
             EBALNC(    0)= 0.           VS. EBALNA= 0.
```

SHUTTLE TILE INTERNAL FLOW

```
++CAUTION++  ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
             DRLXCC( 1025)= -.111780E-03 VS. DRLXCA=  .100000E-08
             ARLXCC( 1097)= -.111041E-03 VS. ARLXCA=  .100000E-08
             EBALSC       =  0.          VS. EBALSA= 0.
             EBALNC(    0)= 0.           VS. EBALNA= 0.

++CAUTION++  ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
             DRLXCC( 7055)= -.145189E-03 VS. DRLXCA=  .100000E-08
             ARLXCC( 7127)= -.144175E-03 VS. ARLXCA=  .100000E-08
             EBALSC       =  0.          VS. EBALSA= 0.
             EBALNC(    0)= 0.           VS. EBALNA= 0.
```

TIMEN =	32.0000	EBALSC =	0.	CSGMIN(0) =	0.	DRLXCC(7055) =	-.145189E-03
TSTEPU =	4.00000	EBALNC(0) =	0.	CSGMAX(0) =	0.	ARLXCC(7127) =	-.144175E-03
		ITERCT =	1	DMXTCC(0) =	0.	AMXTCC(0) =	0.

DIFFUSION NODES

T 25=	4.42267	T 26=	4.48743	T 27=	4.55947	T 28=	4.63563	T 29=	4.71312	T 30=	4.78548
T 31=	4.48889	T 32=	4.57068	T 33=	4.64131	T 34=	4.71058	T 35=	4.77867	T 36=	4.84564
T 37=	4.55712	T 38=	4.63675	T 39=	4.70691	T 40=	4.77537	T 41=	4.84345	T 42=	4.91477
T 43=	4.61586	T 44=	4.69538	T 45=	4.76713	T 46=	4.83862	T 47=	4.91160	T 48=	4.99256
T 49=	4.67161	T 50=	4.74951	T 51=	4.82514	T 52=	4.90341	T 53=	4.98456	T 54=	5.07590
T 55=	4.73053	T 56=	4.79966	T 57=	4.88492	T 58=	4.97720	T 59=	5.07172	T 60=	5.16449
T 61=	4.51289	T 62=	4.55477	T 63=	4.61395	T 64=	4.67829	T 65=	4.73861	T 66=	4.78158
T 67=	4.55335	T 68=	4.59856	T 69=	4.65791	T 70=	4.72061	T 71=	4.77875	T 72=	4.82060
T 73=	4.60715	T 74=	4.65281	T 75=	4.71257	T 76=	4.77551	T 77=	4.83423	T 78=	4.87756
T 79=	4.66050	T 80=	4.70658	T 81=	4.76787	T 82=	4.83331	T 83=	4.89535	T 84=	4.94232
T 85=	4.70812	T 86=	4.75435	T 87=	4.81827	T 88=	4.88811	T 89=	4.95513	T 90=	5.00625
T 91=	4.74260	T 92=	4.78790	T 93=	4.85507	T 94=	4.93014	T 95=	5.00219	T 96=	5.05547
T 1025=	3.92848	T 1026=	3.93441	T 1027=	3.94100	T 1028=	3.94706	T 1029=	3.95058	T 1030=	3.94892
T 1031=	3.94305	T 1032=	3.96012	T 1033=	3.97147	T 1034=	3.98033	T 1035=	3.98518	T 1036=	3.97882
T 1037=	3.96458	T 1038=	3.98425	T 1039=	3.99892	T 1040=	4.01221	T 1041=	4.02426	T 1042=	4.03088
T 1043=	3.99017	T 1044=	4.00905	T 1045=	4.02580	T 1046=	4.04422	T 1047=	4.06826	T 1048=	4.11053
T 1049=	4.01614	T 1050=	4.03349	T 1051=	4.05092	T 1052=	4.07236	T 1053=	4.10090	T 1054=	4.14348
T 1055=	4.04978	T 1056=	4.05826	T 1057=	4.07456	T 1058=	4.09809	T 1059=	4.13018	T 1060=	4.17320
T 1061=	3.94739	T 1062=	3.95266	T 1063=	3.95962	T 1064=	3.96616	T 1065=	3.97054	T 1066=	3.97175
T 1067=	3.95958	T 1068=	3.96779	T 1069=	3.97722	T 1070=	3.98590	T 1071=	3.99212	T 1072=	3.99396
T 1073=	3.97877	T 1074=	3.98872	T 1075=	4.00078	T 1076=	4.01310	T 1077=	4.02433	T 1078=	4.03177
T 1079=	4.00102	T 1080=	4.01152	T 1081=	4.02565	T 1082=	4.04202	T 1083=	4.06010	T 1084=	4.07739

SHUTTLE TILE INTERNAL FLOW

T 1085=	4.02267	T 1086=	4.03285	T 1087=	4.04797	T 1088=	4.06695	T 1089=	4.08880	T 1090=	4.10911
T 1091=	4.04010	T 1092=	4.04852	T 1093=	4.06354	T 1094=	4.08381	T 1095=	4.10757	T 1096=	4.12897
T 2025=	4.18864	T 2026=	4.26007	T 2027=	4.31715	T 2028=	4.35656	T 2029=	4.39252	T 2030=	4.39287
T 2031=	4.20815	T 2032=	4.28689	T 2033=	4.34449	T 2034=	4.38875	T 2035=	4.42001	T 2036=	4.43085
T 2037=	4.23647	T 2038=	4.31725	T 2039=	4.37809	T 2040=	4.42954	T 2041=	4.47350	T 2042=	4.50585
T 2043=	4.27397	T 2044=	4.35256	T 2045=	4.41658	T 2046=	4.47707	T 2047=	4.54123	T 2048=	4.63073
T 2049=	4.31762	T 2050=	4.39000	T 2051=	4.45639	T 2052=	4.52407	T 2053=	4.59733	T 2054=	4.68845
T 2055=	4.36297	T 2056=	4.42600	T 2057=	4.49735	T 2058=	4.57467	T 2059=	4.65759	T 2060=	4.73432
T 2061=	4.24803	T 2062=	4.28667	T 2063=	4.33162	T 2064=	4.36987	T 2065=	4.39713	T 2066=	4.41070
T 2067=	4.26376	T 2068=	4.30448	T 2069=	4.35128	T 2070=	4.39284	T 2071=	4.42415	T 2072=	4.44063
T 2073=	4.28963	T 2074=	4.33188	T 2075=	4.38186	T 2076=	4.42933	T 2077=	4.46942	T 2078=	4.49559
T 2079=	4.32175	T 2080=	4.36441	T 2081=	4.41767	T 2082=	4.47222	T 2083=	4.52401	T 2084=	4.56627
T 2085=	4.35474	T 2086=	4.39654	T 2087=	4.45229	T 2088=	4.51238	T 2089=	4.57110	T 2090=	4.61008
T 2091=	4.37977	T 2092=	4.42008	T 2093=	4.47781	T 2094=	4.54203	T 2095=	4.60461	T 2096=	4.65061
T 3025=	4.77686	T 3026=	4.90016	T 3027=	4.94738	T 3028=	4.99022	T 3029=	5.01420	T 3030=	5.02292
T 3031=	4.80100	T 3032=	4.90392	T 3033=	4.96621	T 3034=	5.01084	T 3035=	5.03901	T 3036=	5.05043
T 3037=	4.83404	T 3038=	4.93124	T 3039=	4.99710	T 3040=	5.04546	T 3041=	5.07820	T 3042=	5.09263
T 3043=	4.87926	T 3044=	4.97272	T 3045=	5.04093	T 3046=	5.09475	T 3047=	5.13555	T 3048=	5.16119
T 3049=	4.93621	T 3050=	5.02513	T 3051=	5.09729	T 3052=	5.15955	T 3053=	5.21319	T 3054=	5.26319
T 3055=	5.00320	T 3056=	5.08839	T 3057=	5.17059	T 3058=	5.24639	T 3059=	5.31495	T 3060=	5.37097
T 3061=	4.85381	T 3062=	4.90787	T 3063=	4.95575	T 3064=	4.99519	T 3065=	5.02113	T 3066=	5.03327
T 3067=	4.87007	T 3068=	4.92065	T 3069=	4.97151	T 3070=	5.01301	T 3071=	5.04124	T 3072=	5.05491
T 3073=	4.89987	T 3074=	4.94800	T 3075=	5.00099	T 3076=	5.04574	T 3077=	5.07772	T 3078=	5.09415
T 3079=	4.93768	T 3080=	4.98625	T 3081=	5.04157	T 3082=	5.09090	T 3083=	5.12879	T 3084=	5.15074
T 3085=	4.98109	T 3086=	5.02937	T 3087=	5.08784	T 3088=	5.14308	T 3089=	5.18873	T 3090=	5.21880
T 3091=	5.01701	T 3092=	5.06535	T 3093=	5.12757	T 3094=	5.18864	T 3095=	5.24069	T 3096=	5.27484
T 4025=	5.08489	T 4026=	5.17530	T 4027=	5.26035	T 4028=	5.34661	T 4029=	5.43474	T 4030=	5.55123
T 4031=	5.17389	T 4032=	5.27625	T 4033=	5.35917	T 4034=	5.43898	T 4035=	5.52352	T 4036=	5.63011
T 4037=	5.26180	T 4038=	5.36158	T 4039=	5.43985	T 4040=	5.51309	T 4041=	5.59023	T 4042=	5.69729
T 4043=	5.35640	T 4044=	5.44676	T 4045=	5.51722	T 4046=	5.58158	T 4047=	5.64759	T 4048=	5.72878
T 4049=	5.46089	T 4050=	5.53854	T 4051=	5.59914	T 4052=	5.65233	T 4053=	5.70356	T 4054=	5.76065
T 4055=	5.58564	T 4056=	5.64935	T 4057=	5.69965	T 4058=	5.73936	T 4059=	5.77366	T 4060=	5.80649
T 4061=	5.20215	T 4062=	5.25522	T 4063=	5.32539	T 4064=	5.40043	T 4065=	5.47337	T 4066=	5.53374
T 4067=	5.25584	T 4068=	5.31048	T 4069=	5.37911	T 4070=	5.45086	T 4071=	5.52054	T 4072=	5.57739
T 4073=	5.32909	T 4074=	5.38183	T 4075=	5.44651	T 4076=	5.51282	T 4077=	5.57658	T 4078=	5.62816
T 4079=	5.41013	T 4080=	5.45828	T 4081=	5.51677	T 4082=	5.57561	T 4083=	5.63099	T 4084=	5.67483
T 4085=	5.49106	T 4086=	5.53346	T 4087=	5.58476	T 4088=	5.63509	T 4089=	5.68060	T 4090=	5.71469
T 4091=	5.55629	T 4092=	5.59378	T 4093=	5.63928	T 4094=	5.68249	T 4095=	5.71972	T 4096=	5.74560
T 5025=	5.63696	T 5026=	5.69384	T 5027=	5.74364	T 5028=	5.78918	T 5029=	5.83287	T 5030=	5.88454
T 5031=	5.69363	T 5032=	5.75113	T 5033=	5.79647	T 5034=	5.83838	T 5035=	5.88050	T 5036=	5.92891
T 5037=	5.75206	T 5038=	5.80211	T 5039=	5.84220	T 5040=	5.88079	T 5041=	5.92138	T 5042=	5.97102

SHUTTLE TILE INTERNAL FLOW

T 5043=	5.82536	T 5044=	5.85301	T 5045=	5.88572	T 5046=	5.92080	T 5047=	5.95897	T 5048=	6.00745
T 5049=	5.87409	T 5050=	5.89568	T 5051=	5.92705	T 5052=	5.96055	T 5053=	5.99503	T 5054=	6.03709
T 5055=	5.90167	T 5056=	5.93095	T 5057=	5.97207	T 5058=	6.00793	T 5059=	6.03721	T 5060=	6.05666
T 5061=	5.70691	T 5062=	5.73789	T 5063=	5.77704	T 5064=	5.81670	T 5065=	5.85338	T 5066=	5.89188
T 5067=	5.74008	T 5068=	5.77002	T 5069=	5.80701	T 5070=	5.84478	T 5071=	5.88025	T 5072=	5.90780
T 5073=	5.78578	T 5074=	5.81210	T 5075=	5.84553	T 5076=	5.88065	T 5077=	5.91449	T 5078=	5.94146
T 5079=	5.83583	T 5080=	5.85584	T 5081=	5.88497	T 5082=	5.91722	T 5083=	5.94887	T 5084=	5.97443
T 5085=	5.87516	T 5086=	5.89270	T 5087=	5.92021	T 5088=	5.95070	T 5089=	5.97968	T 5090=	6.00210
T 5091=	5.89773	T 5092=	5.91658	T 5093=	5.94585	T 5094=	5.97624	T 5095=	6.00259	T 5096=	6.01958
T 6025=	4.79623	T 6026=	4.85004	T 6027=	4.96724	T 6028=	5.06864	T 6029=	5.16641	T 6030=	5.26096
T 6031=	4.89575	T 6032=	4.99395	T 6033=	5.08783	T 6034=	5.17808	T 6035=	5.26761	T 6036=	5.36150
T 6037=	4.99095	T 6038=	5.09853	T 6039=	5.18576	T 6040=	5.27126	T 6041=	5.36054	T 6042=	5.46631
T 6043=	5.13346	T 6044=	5.19887	T 6045=	5.27527	T 6046=	5.35789	T 6047=	5.44734	T 6048=	5.56193
T 6049=	5.22578	T 6050=	5.27808	T 6051=	5.35667	T 6052=	5.44231	T 6053=	5.52746	T 6054=	5.63390
T 6055=	5.27651	T 6056=	5.32997	T 6057=	5.43942	T 6058=	5.54411	T 6059=	5.61567	T 6060=	5.68503
T 6061=	4.91767	T 6062=	4.96503	T 6063=	5.04571	T 6064=	5.13055	T 6065=	5.20866	T 6066=	5.26498
T 6067=	4.98070	T 6068=	5.03552	T 6069=	5.11182	T 6070=	5.19257	T 6071=	5.26816	T 6072=	5.32440
T 6073=	5.06546	T 6074=	5.12078	T 6075=	5.19336	T 6076=	5.27103	T 6077=	5.34577	T 6078=	5.40436
T 6079=	5.16143	T 6080=	5.20708	T 6081=	5.27450	T 6082=	5.34992	T 6083=	5.42386	T 6084=	5.48375
T 6085=	5.23594	T 6086=	5.27739	T 6087=	5.34487	T 6088=	5.42083	T 6089=	5.49241	T 6090=	5.54886
T 6091=	5.27755	T 6092=	5.31980	T 6093=	5.39417	T 6094=	5.47444	T 6095=	5.54216	T 6096=	5.59026
T 7025=	4.33896	T 7026=	4.35620	T 7027=	4.38710	T 7028=	4.43214	T 7029=	4.49037	T 7030=	4.54692
T 7031=	4.38662	T 7032=	4.41751	T 7033=	4.45232	T 7034=	4.49530	T 7035=	4.54572	T 7036=	4.60029
T 7037=	4.42281	T 7038=	4.45904	T 7039=	4.49660	T 7040=	4.54158	T 7041=	4.59545	T 7042=	4.66288
T 7043=	4.45297	T 7044=	4.49088	T 7045=	4.52911	T 7046=	4.57786	T 7047=	4.63866	T 7048=	4.71224
T 7049=	4.49552	T 7050=	4.51587	T 7051=	4.54862	T 7052=	4.60338	T 7053=	4.67987	T 7054=	4.73638
T 7055=	4.54780	T 7056=	4.52337	T 7057=	4.54199	T 7058=	4.60849	T 7059=	4.70770	T 7060=	4.83423
T 7061=	4.38661	T 7062=	4.40332	T 7063=	4.43280	T 7064=	4.47176	T 7065=	4.51429	T 7066=	4.54676
T 7067=	4.41368	T 7068=	4.43372	T 7069=	4.46503	T 7070=	4.50425	T 7071=	4.54604	T 7072=	4.57985
T 7073=	4.44544	T 7074=	4.46745	T 7075=	4.50059	T 7076=	4.54183	T 7077=	4.58647	T 7078=	4.62344
T 7079=	4.47585	T 7080=	4.49747	T 7081=	4.53120	T 7082=	4.57556	T 7083=	4.62557	T 7084=	4.66779
T 7085=	4.50551	T 7086=	4.52115	T 7087=	4.55265	T 7088=	4.60089	T 7089=	4.65958	T 7090=	4.71241
T 7091=	4.52854	T 7092=	4.53365	T 7093=	4.56071	T 7094=	4.61275	T 7095=	4.67980	T 7096=	4.74026
T 8025=	4.10021	T 8026=	4.10354	T 8027=	4.11908	T 8028=	4.14254	T 8029=	4.17442	T 8030=	4.21578
T 8031=	4.13645	T 8032=	4.15978	T 8033=	4.18139	T 8034=	4.20609	T 8035=	4.23454	T 8036=	4.26684
T 8037=	4.17561	T 8038=	4.20377	T 8039=	4.22889	T 8040=	4.25584	T 8041=	4.28500	T 8042=	4.31596
T 8043=	4.21709	T 8044=	4.24384	T 8045=	4.27079	T 8046=	4.30143	T 8047=	4.33539	T 8048=	4.37159
T 8049=	4.25736	T 8050=	4.28002	T 8051=	4.30839	T 8052=	4.34538	T 8053=	4.38988	T 8054=	4.43614
T 8055=	4.29469	T 8056=	4.31077	T 8057=	4.34033	T 8058=	4.38870	T 8059=	4.45801	T 8060=	4.50876
T 8061=	4.13617	T 8062=	4.14444	T 8063=	4.16060	T 8064=	4.18228	T 8065=	4.20668	T 8066=	4.22745
T 8067=	4.16096	T 8068=	4.17407	T 8069=	4.19311	T 8070=	4.21593	T 8071=	4.23982	T 8072=	4.25984

APPENDIX A, CONTINUED

SHUTTLE TILE INTERNAL FLOW

T 8073=	4.19504	T 8074=	4.21067	T 8075=	4.23229	T 8076=	4.25717	T 8077=	4.28227	T 8078=	4.30147
T 8079=	4.23111	T 8080=	4.24729	T 8081=	4.27087	T 8082=	4.29888	T 8083=	4.32752	T 8084=	4.34935
T 8085=	4.26367	T 8086=	4.27932	T 8087=	4.30464	T 8088=	4.33704	T 8089=	4.37170	T 8090=	4.39783
T 8091=	4.28620	T 8092=	4.30079	T 8093=	4.32746	T 8094=	4.36472	T 8095=	4.40692	T 8096=	4.43631

ARITHMETIC NODES

T 97=	4.42269	T 98=	4.48745	T 99=	4.55948	T 100=	4.63564	T 101=	4.71313	T 102=	4.78549
T 103=	4.48891	T 104=	4.55941	T 105=	4.63188	T 106=	4.70583	T 107=	4.77858	T 108=	4.84566
T 109=	4.55713	T 110=	4.62722	T 111=	4.70060	T 112=	4.77505	T 113=	4.84774	T 114=	4.91476
T 115=	4.61586	T 116=	4.68974	T 117=	4.76614	T 118=	4.84393	T 119=	4.92052	T 120=	4.99257
T 121=	4.67161	T 122=	4.74778	T 123=	4.82819	T 124=	4.91182	T 125=	4.99561	T 126=	5.07591
T 127=	4.73054	T 128=	4.79966	T 129=	4.88494	T 130=	4.97721	T 131=	5.07173	T 132=	5.16449
T 1024=	3.73973	T 1023=	3.73970	T 1022=	3.73966	T 1021=	3.73962	T 1020=	3.73958	T 1019=	3.73956
T 8024=	3.73958	T 8023=	3.73964	T 8022=	3.73979	T 8021=	3.74006	T 8020=	3.74046	T 8019=	3.74081
T 7024=	3.74113	T 7023=	3.74144	T 7022=	3.74385	T 7021=	3.75083	T 7020=	3.76307	T 7019=	3.77502
T 1007=	3.73953	T 1008=	3.73958	T 1009=	3.73971	T 1010=	3.73993	T 1011=	3.74006	T 1012=	3.73995
T 2021=	3.73989	T 2020=	3.73844	T 2019=	3.73769	T 24=	3.75647	T 23=	3.77759	T 22=	3.80088
T 21=	3.83406	T 20=	3.89161	T 19=	3.95582	T 6024=	4.02567	T 6023=	4.07218	T 6022=	4.16296
T 6021=	4.30936	T 6020=	4.50777	T 6019=	4.72815	T 2007=	3.75437	T 2008=	3.76700	T 2009=	3.78068
T 2010=	4.02547	T 2011=	4.03305	T 2012=	4.04217	T 7=	4.05376	T 8=	4.12188	T 9=	4.25657
T 10=	4.39505	T 11=	4.49692	T 12=	4.62068	T 4021=	4.96276	T 4020=	5.23842	T 4019=	5.45220
T 5024=	5.56200	T 5023=	5.63398	T 5022=	5.68592	T 5021=	5.73473	T 5020=	5.77505	T 5019=	5.81391
T 3007=	4.85106	T 3008=	4.91152	T 3009=	5.01275	T 3010=	5.13389	T 3011=	5.26323	T 3012=	5.34531
T 4007=	5.55148	T 4008=	5.63028	T 4009=	5.68743	T 4010=	5.72889	T 4011=	5.76069	T 4012=	5.78542
T 5007=	5.88464	T 5008=	5.92897	T 5009=	5.97109	T 5010=	6.00752	T 5011=	6.03716	T 5012=	6.05691
T 1001=	3.73973	T 1002=	3.73970	T 1003=	3.73965	T 1004=	3.73961	T 1005=	3.73956	T 1006=	3.73954
T 1018=	3.73958	T 1017=	3.73963	T 1016=	3.73975	T 1015=	3.73996	T 1014=	3.74022	T 1013=	3.74031
T 7001=	3.74109	T 7002=	3.74143	T 7003=	3.74385	T 7004=	3.75078	T 7005=	3.76291	T 7006=	3.77464
T 7018=	3.84010	T 7017=	3.87374	T 7016=	3.90951	T 7015=	3.94969	T 7014=	3.99657	T 7013=	4.05166
T 2001=	3.74019	T 2002=	3.74048	T 2003=	3.74074	T 2004=	3.74074	T 2005=	3.74083	T 2006=	3.74267
T 1=	3.76281	T 2=	3.78491	T 3=	3.81425	T 4=	3.84835	T 5=	3.88652	T 6=	3.93164
T 18=	4.02126	T 17=	4.06116	T 16=	4.13961	T 15=	4.25904	T 14=	4.40978	T 13=	4.54206
T 6018=	5.10942	T 6017=	5.29281	T 6016=	5.43952	T 6015=	5.54427	T 6014=	5.61577	T 6013=	5.65907
T 3001=	3.89872	T 3002=	3.91056	T 3003=	3.94098	T 3004=	3.98968	T 3005=	4.06295	T 3006=	4.17469
T 3018=	4.43905	T 3017=	4.59329	T 3016=	4.80912	T 3015=	5.03271	T 3014=	5.21767	T 3013=	5.33417
T 4018=	5.58579	T 4017=	5.64946	T 4016=	5.69973	T 4015=	5.73941	T 4014=	5.77368	T 4013=	5.80651
T 5018=	5.88812	T 5017=	5.93098	T 5016=	5.97213	T 5015=	6.00799	T 5014=	6.03727	T 5013=	6.05671
T 1097=	3.92849	T 1098=	3.93442	T 1099=	3.94101	T 1100=	3.94707	T 1101=	3.95059	T 1102=	3.94894
T 1103=	3.94306	T 1104=	3.95681	T 1105=	3.96804	T 1106=	3.97737	T 1107=	3.98287	T 1108=	3.97883
T 1109=	3.96458	T 1110=	3.98157	T 1111=	3.99677	T 1112=	4.01126	T 1113=	4.02433	T 1114=	4.03089
T 1115=	3.99018	T 1116=	4.00792	T 1117=	4.02594	T 1118=	4.04626	T 1119=	4.07180	T 1120=	4.11053
T 1121=	4.01615	T 1122=	4.03378	T 1123=	4.05255	T 1124=	4.07566	T 1125=	4.10540	T 1126=	4.14349

SHUTTLE TILE INTERNAL FLOW

T 1127=	4.04979	T 1128=	4.05828	T 1129=	4.07457	T 1130=	4.09810	T 1131=	4.13020	T 1132=	4.17322
T 2097=	4.18865	T 2098=	4.26007	T 2099=	4.31715	T 2100=	4.35657	T 2101=	4.38253	T 2102=	4.39288
T 2103=	4.20815	T 2104=	4.27964	T 2105=	4.33955	T 2106=	4.38652	T 2107=	4.41927	T 2108=	4.43086
T 2109=	4.23647	T 2110=	4.30965	T 2111=	4.37402	T 2112=	4.43003	T 2113=	4.47652	T 2114=	4.50586
T 2115=	4.27398	T 2116=	4.34711	T 2117=	4.41570	T 2118=	4.48197	T 2119=	4.54964	T 2120=	4.63073
T 2121=	4.31763	T 2122=	4.38763	T 2123=	4.45829	T 2124=	4.53095	T 2125=	4.60715	T 2126=	4.68846
T 2127=	4.36299	T 2128=	4.42603	T 2129=	4.49737	T 2130=	4.57468	T 2131=	4.65759	T 2132=	4.73434
T 3097=	4.77686	T 3098=	4.90017	T 3099=	4.94739	T 3100=	4.99022	T 3101=	5.01420	T 3102=	5.02292
T 3103=	4.80100	T 3104=	4.89683	T 3105=	4.96168	T 3106=	5.00896	T 3107=	5.03831	T 3108=	5.05043
T 3109=	4.83404	T 3110=	4.92306	T 3111=	4.99279	T 3112=	5.04514	T 3113=	5.07934	T 3114=	5.09264
T 3115=	4.87926	T 3116=	4.96701	T 3117=	5.04022	T 3118=	5.09867	T 3119=	5.14061	T 3120=	5.16120
T 3121=	4.93622	T 3122=	5.02366	T 3123=	5.10094	T 3124=	5.16745	T 3125=	5.22203	T 3126=	5.26317
T 3127=	5.00321	T 3128=	5.08800	T 3129=	5.17059	T 3130=	5.24639	T 3131=	5.31496	T 3132=	5.37097
T 4097=	5.08490	T 4098=	5.17530	T 4099=	5.26035	T 4100=	5.34661	T 4101=	5.43474	T 4102=	5.54990
T 4103=	5.17389	T 4104=	5.26268	T 4105=	5.34811	T 4106=	5.43369	T 4107=	5.52419	T 4108=	5.62962
T 4109=	5.26180	T 4110=	5.35054	T 4111=	5.43297	T 4112=	5.51313	T 4113=	5.59580	T 4114=	5.68694
T 4115=	5.35640	T 4116=	5.44184	T 4117=	5.51754	T 4118=	5.58779	T 4119=	5.65678	T 4120=	5.72857
T 4121=	5.46089	T 4122=	5.54002	T 4123=	5.60527	T 4124=	5.66185	T 4125=	5.71348	T 4126=	5.76061
T 4127=	5.58517	T 4128=	5.64917	T 4129=	5.69954	T 4130=	5.73933	T 4131=	5.77366	T 4132=	5.80649
T 5097=	5.63696	T 5098=	5.69384	T 5099=	5.74364	T 5100=	5.78918	T 5101=	5.83287	T 5102=	5.88430
T 5103=	5.69363	T 5104=	5.74400	T 5105=	5.79076	T 5106=	5.83561	T 5107=	5.88063	T 5108=	5.92882
T 5109=	5.75206	T 5110=	5.79688	T 5111=	5.83904	T 5112=	5.88116	T 5113=	5.92450	T 5114=	5.97093
T 5115=	5.82536	T 5116=	5.85160	T 5117=	5.88666	T 5118=	5.92483	T 5119=	5.96465	T 5120=	6.00736
T 5121=	5.87409	T 5122=	5.89691	T 5123=	5.93059	T 5124=	5.96629	T 5125=	6.00138	T 5126=	6.03702
T 5127=	5.90167	T 5128=	5.93093	T 5129=	5.97199	T 5130=	6.00785	T 5131=	6.03713	T 5132=	6.05660
T 6097=	4.79623	T 6098=	4.85005	T 6099=	4.96725	T 6100=	5.06864	T 6101=	5.16641	T 6102=	5.26096
T 6103=	4.89575	T 6104=	4.99257	T 6105=	5.07963	T 6106=	5.17342	T 6107=	5.26823	T 6108=	5.36151
T 6109=	4.99095	T 6110=	5.09122	T 6111=	5.18140	T 6112=	5.27342	T 6113=	5.36800	T 6114=	5.46632
T 6115=	5.13346	T 6116=	5.19615	T 6117=	5.27785	T 6118=	5.36743	T 6119=	5.46055	T 6120=	5.55186
T 6121=	5.22578	T 6122=	5.27930	T 6123=	5.36347	T 6124=	5.45482	T 6125=	5.54181	T 6126=	5.63382
T 6127=	5.27651	T 6128=	5.32997	T 6129=	5.43925	T 6130=	5.54368	T 6131=	5.61550	T 6132=	5.69574
T 7097=	4.33897	T 7098=	4.35621	T 7099=	4.38711	T 7100=	4.43215	T 7101=	4.49038	T 7102=	4.54694
T 7103=	4.38663	T 7104=	4.41042	T 7105=	4.44524	T 7106=	4.49111	T 7107=	4.54543	T 7108=	4.60030
T 7109=	4.42282	T 7110=	4.45289	T 7111=	4.49137	T 7112=	4.54040	T 7113=	4.59866	T 7114=	4.66288
T 7115=	4.45301	T 7116=	4.48641	T 7117=	4.52617	T 7118=	4.57944	T 7119=	4.64457	T 7120=	4.71228
T 7121=	4.49554	T 7122=	4.51310	T 7123=	4.54685	T 7124=	4.60563	T 7125=	4.68657	T 7126=	4.78638
T 7127=	4.54768	T 7128=	4.52339	T 7129=	4.54204	T 7130=	4.60851	T 7131=	4.70770	T 7132=	4.83423
T 8097=	4.10021	T 8098=	4.10355	T 8099=	4.11909	T 8100=	4.14255	T 8101=	4.17443	T 8102=	4.21579
T 8103=	4.13645	T 8104=	4.15364	T 8105=	4.17485	T 8106=	4.20115	T 8107=	4.23227	T 8108=	4.26684
T 8109=	4.17562	T 8110=	4.19910	T 8111=	4.22473	T 8112=	4.25400	T 8113=	4.28566	T 8114=	4.31597
T 8115=	4.21710	T 8116=	4.24180	T 8117=	4.27028	T 8118=	4.30364	T 8119=	4.33952	T 8120=	4.37160

APPENDIX A, CONTINUED

SHUTTLE TILE INTERNAL FLOW

T 8121=	4.25737	T 8122=	4.28017	T 8123=	4.31033	T 8124=	4.34993	T 8125=	4.39621	T 8126=	4.43615
T 8127=	4.29470	T 8128=	4.31078	T 8129=	4.34036	T 8130=	4.38871	T 8131=	4.45797	T 8132=	4.50873

HEATER NODES
++NONE++
BOUNDARY NODES

T 1224=	3.73977	T 1223=	3.73970	T 1222=	3.73963	T 1221=	3.73957	T 1220=	3.73951	T 1219=	3.73945
T 8224=	3.73940	T 8223=	3.73939	T 8222=	3.73945	T 8221=	3.73975	T 8220=	3.74046	T 8219=	3.74121
T 7224=	3.74043	T 7223=	3.73679	T 7222=	3.73391	T 7221=	3.73935	T 7220=	3.76358	T 7219=	3.79782
T 1207=	3.73940	T 1208=	3.73939	T 1209=	3.73945	T 1210=	3.73975	T 1211=	3.74046	T 1212=	3.74121
T 2221=	3.74043	T 2220=	3.73679	T 2219=	3.73391	T 224=	3.73935	T 223=	3.76358	T 222=	3.79782
T 221=	3.83526	T 220=	3.86684	T 219=	3.89778	T 6224=	3.93286	T 6223=	3.97628	T 6222=	4.04756
T 6221=	4.19683	T 6220=	4.46016	T 6219=	4.79233	T 2207=	3.73963	T 2208=	3.76464	T 2209=	3.79899
T 2210=	3.83421	T 2211=	3.86584	T 2212=	3.89669	T 207=	3.93412	T 208=	3.97779	T 209=	4.05101
T 210=	4.19132	T 211=	4.44958	T 212=	4.78128	T 4221=	5.12506	T 4220=	5.37207	T 4219=	5.53250
T 5224=	5.61971	T 5223=	5.67905	T 5222=	5.72362	T 5221=	5.75306	T 5220=	5.77816	T 5219=	5.81771
T 3207=	4.19683	T 3208=	4.46017	T 3209=	4.79234	T 3210=	5.11617	T 3211=	5.36557	T 3212=	5.52797
T 4207=	5.62181	T 4208=	5.68083	T 4209=	5.72462	T 4210=	5.75228	T 4211=	5.77706	T 4212=	5.81609
T 5207=	5.87570	T 5208=	5.93534	T 5209=	5.98508	T 5210=	6.02379	T 5211=	6.06003	T 5212=	6.09982
T 1201=	3.73977	T 1202=	3.73970	T 1203=	3.73963	T 1204=	3.73957	T 1205=	3.73951	T 1206=	3.73945
T 1218=	3.73940	T 1217=	3.73939	T 1216=	3.73945	T 1215=	3.73975	T 1214=	3.74046	T 1213=	3.74121
T 7201=	3.74043	T 7202=	3.73679	T 7203=	3.73391	T 7204=	3.73935	T 7205=	3.76359	T 7206=	3.79783
T 7218=	3.83526	T 7217=	3.86684	T 7216=	3.89778	T 7215=	3.93286	T 7214=	3.97628	T 7213=	4.04756
T 2201=	3.73976	T 2202=	3.74049	T 2203=	3.74121	T 2204=	3.74049	T 2205=	3.73693	T 2206=	3.73392
T 201=	3.73963	T 202=	3.76464	T 203=	3.79899	T 204=	3.83421	T 205=	3.86584	T 206=	3.89669
T 218=	3.93412	T 217=	3.97779	T 216=	4.05101	T 215=	4.19132	T 214=	4.44958	T 213=	4.78129
T 6218=	5.12506	T 6217=	5.37207	T 6216=	5.53250	T 6215=	5.61971	T 6214=	5.67905	T 6213=	5.72362
T 3201=	3.83526	T 3202=	3.86684	T 3203=	3.89778	T 3204=	3.93286	T 3205=	3.97628	T 3206=	4.04756
T 3218=	4.19683	T 3217=	4.46017	T 3216=	4.79234	T 3215=	5.11617	T 3214=	5.36557	T 3213=	5.52797
T 4218=	5.62181	T 4217=	5.68083	T 4216=	5.72462	T 4215=	5.75228	T 4214=	5.77706	T 4213=	5.81609
T 5218=	5.87570	T 5217=	5.93534	T 5216=	5.98508	T 5215=	6.02379	T 5214=	6.06003	T 5213=	6.09982

3.26711E-02 -3.61680E-02

APPENDIX A, CONTINUED

SHUTTLE TILE INTERNAL FLOW

EDGAP (1)	1.00000E-03	EDGAP (2)	1.00000E-03	EDGAP (3)	1.00000E-03	EDGAP (4)	1.00000E-03	EDGAP (5)	1.00000E-03
EDGAP (6)	1.00000E-03	EDGAP (7)	1.00000E-03	EDGAP (8)	1.00000E-03	EDGAP (9)	1.00000E-03	EDGAP (10)	1.00000E-03
EDGAP (11)	1.00000E-03	EDGAP (12)	1.00000E-03	EDGAP (13)	1.00000E-03	EDGAP (14)	1.00000E-03	EDGAP (15)	1.00000E-03
EDGAP (16)	1.00000E-03	EDGAP (17)	1.00000E-03	EDGAP (18)	1.00000E-03	EDGAP (19)	1.00000E-03	EDGAP (20)	1.00000E-03
EDGAP (21)	1.00000E-03	EDGAP (22)	1.00000E-03	EDGAP (23)	1.00000E-03	EDGAP (24)	1.00000E-03	EDGAP (25)	1.00000E-03
EDGAP (26)	1.00000E-03	EDGAP (27)	1.00000E-03	EDGAP (28)	1.00000E-03	EDGAP (29)	1.00000E-03	EDGAP (30)	1.00000E-03
EDGAP (31)	1.00000E-03	EDGAP (32)	1.00000E-03	EDGAP (33)	1.00000E-03	EDGAP (34)	1.00000E-03	EDGAP (35)	1.00000E-03
EDGAP (36)	1.00000E-03	EDGAP (37)	1.00000E-03	EDGAP (38)	1.00000E-03	EDGAP (39)	1.00000E-03	EDGAP (40)	1.00000E-03
EDGAP (41)	1.00000E-03	EDGAP (42)	1.00000E-03	EDGAP (43)	1.00000E-03	EDGAP (44)	1.00000E-03	EDGAP (45)	1.00000E-03
EDGAP (46)	1.00000E-03	EDGAP (47)	1.00000E-03	EDGAP (48)	1.00000E-03	EDGAP (49)	1.00000E-03	EDGAP (50)	1.00000E-03
EDGAP (51)	1.00000E-03	EDGAP (52)	1.00000E-03	EDGAP (53)	1.00000E-03	EDGAP (54)	1.00000E-03	EDGAP (55)	1.00000E-03
EDGAP (56)	1.00000E-03	EDGAP (57)	1.00000E-03	EDGAP (58)	1.00000E-03	EDGAP (59)	9.94881E-02	EDGAP (60)	1.00064E-01
EDGAP (61)	1.00000E-03	EDGAP (62)	1.00000E-03	EDGAP (63)	1.00000E-03	EDGAP (64)	1.00000E-03	EDGAP (65)	1.00000E-03
EDGAP (66)	1.00000E-03	EDGAP (67)	1.00000E-03	EDGAP (68)	9.96326E-02	EDGAP (69)	9.99536E-02	EDGAP (70)	1.00000E-03
EDGAP (71)	1.00000E-03	EDGAP (72)	1.00000E-03	EDGAP (73)	1.00000E-03	EDGAP (74)	1.00000E-03	EDGAP (75)	1.00000E-03
EDGAP (76)	1.00000E-03	EDGAP (77)	9.97298E-02	EDGAP (78)	9.98984E-02	EDGAP (79)	1.00000E-03	EDGAP (80)	1.00000E-03
EDGAP (81)	1.00000E-03	EDGAP (82)	1.00000E-03	EDGAP (83)	1.00000E-03	EDGAP (84)	1.00000E-03	EDGAP (85)	1.00000E-03
EDGAP (86)	9.98300E-02	EDGAP (87)	9.98818E-02	EDGAP (88)	9.95814E-02	EDGAP (89)	1.00000E-03	EDGAP (90)	1.00000E-03
EDGAP (91)	1.00000E-03	EDGAP (92)	1.00000E-03	EDGAP (93)	1.00000E-03	EDGAP (94)	9.92579E-02	EDGAP (95)	9.98812E-02
EDGAP (96)	9.98340E-02	EDGAP (97)	9.96730E-02	EDGAP (98)	1.00000E-03	EDGAP (99)	1.00000E-03	EDGAP (100)	1.00000E-03
EDGAP (101)	1.00000E-03	EDGAP (102)	1.00000E-03	EDGAP (103)	1.00000E-03	EDGAP (104)	1.00000E-03	EDGAP (105)	1.00000E-03
EDGAP (106)	9.97264E-02	EDGAP (107)	1.00000E-03	EDGAP (108)	1.00000E-03	EDGAP (109)	1.00000E-03	EDGAP (110)	1.00000E-03
EDGAP (111)	1.00000E-03	EDGAP (112)	1.00000E-03	EDGAP (113)	9.99305E-02	EDGAP (114)	9.96873E-02	EDGAP (115)	1.00000E-03
EDGAP (116)	1.00000E-03	EDGAP (117)	1.00000E-03	EDGAP (118)	1.00000E-03	EDGAP (119)	1.00000E-03	EDGAP (120)	1.00000E-03
EDGAP (121)	1.00000E-03	EDGAP (122)	9.99754E-02	EDGAP (123)	9.98348E-02	EDGAP (124)	9.95408E-02	EDGAP (125)	1.00000E-03
EDGAP (126)	1.00000E-03	EDGAP (127)	1.00000E-03	EDGAP (128)	1.00000E-03	EDGAP (129)	1.00000E-03	EDGAP (130)	1.00000E-03
EDGAP (131)	9.99065E-02	EDGAP (132)	9.98853E-02	EDGAP (133)	9.94523E-02	EDGAP (134)	1.00000E-03	EDGAP (135)	1.00000E-03
EDGAP (136)	1.00000E-03	EDGAP (137)	1.00000E-03	EDGAP (138)	1.00000E-03	EDGAP (139)	1.00000E-03	EDGAP (140)	9.98193E-02
EDGAP (141)	9.99060E-02	EDGAP (142)	9.93255E-02	EDGAP (143)	1.00000E-03	EDGAP (144)	1.00000E-03	EDGAP (145)	1.00000E-03
EDGAP (146)	1.00000E-03	EDGAP (147)	1.00000E-03	EDGAP (148)	1.00000E-03	EDGAP (149)	9.97722E-02	EDGAP (150)	9.99683E-02
EDGAP (151)	1.00000E-03	EDGAP (152)	1.00000E-03	EDGAP (153)	1.00000E-03	EDGAP (154)	1.00000E-03	EDGAP (155)	1.00000E-03
EDGAP (156)	1.00000E-03	EDGAP (157)	1.00000E-03	EDGAP (158)	9.97380E-02	EDGAP (159)	1.00000E-03	EDGAP (160)	1.00000E-03
EDGAP (161)	1.00000E-03	EDGAP (162)	1.00000E-03	EDGAP (163)	1.00000E-03	EDGAP (164)	1.00000E-03	EDGAP (165)	1.00000E-03
EDGAP (166)	1.00000E-03	EDGAP (167)	1.00000E-03	EDGAP (168)	1.00000E-03	EDGAP (169)	1.00000E-03	EDGAP (170)	1.00000E-03
EDGAP (171)	1.00000E-03	EDGAP (172)	1.00000E-03	EDGAP (173)	1.00000E-03	EDGAP (174)	1.00000E-03	EDGAP (175)	1.00000E-03
EDGAP (176)	1.00000E-03	EDGAP (177)	1.00000E-03	EDGAP (178)	1.00000E-03	EDGAP (179)	1.00000E-03	EDGAP (180)	1.00000E-03
EDGAP (181)	1.00000E-03	EDGAP (182)	1.00000E-03	EDGAP (183)	1.00000E-03	EDGAP (184)	1.00000E-03	EDGAP (185)	1.00000E-03
EDGAP (186)	1.00000E-03	EDGAP (187)	1.00000E-03	EDGAP (188)	1.00000E-03	EDGAP (189)	1.00000E-03	EDGAP (190)	1.00000E-03
EDGAP (191)	1.00000E-03	EDGAP (192)	1.00000E-03	EDGAP (193)	1.00000E-03	EDGAP (194)	1.00000E-03	EDGAP (195)	1.00000E-03
EDGAP (196)	1.00000E-03	EDGAP (197)	1.00000E-03	EDGAP (198)	1.00000E-03	EDGAP (199)	1.00000E-03	EDGAP (200)	1.00000E-03
EDGAP (201)	1.00000E-03	EDGAP (202)	1.00000E-03	EDGAP (203)	1.00000E-03	EDGAP (204)	1.00000E-03	EDGAP (205)	1.00000E-03
EDGAP (206)	1.00000E-03	EDGAP (207)	1.00000E-03	EDGAP (208)	1.00000E-03	EDGAP (209)	1.00000E-03	EDGAP (210)	1.00000E-03
EDGAP (211)	1.00000E-03	EDGAP (212)	1.00000E-03	EDGAP (213)	1.00000E-03	EDGAP (214)	1.00000E-03	EDGAP (215)	1.00000E-03
EDGAP (216)	1.00000E-03								

SHUTTLE TILE INTERNAL FLOW

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++CAUTION++   ITERMX(  600) EXCEEDED BEFORE RELAXATION CRITERIA MET...
                   DRLXCC( 8025)= -.494811E-04 VS. DRLXCA=   .100000E-08
                   ARLXCC( 8097)= -.491024E-04 VS. ARLXCA=   .100000E-08
                   EBALSC         = 0.          VS. EBALSA= 0.
                   EBALNC(     0)= 0.           VS. EBALNA= 0.
```

```
TIMEN  =  32.0000      EBALSC          = 0.          CSGMIN(    0) = 0.      DRLXCC(  8025) = -.494811E-04
TSTEPU =  4.00000      EBALNC(     0)  = 0.          CSGMAX(    0) = 0.      ARLXCC(  8097) = -.491024E-04
                       ITERCT          =      601    DMXTCC(    0) = 0.      AMXTCC(     0) = 0.
```

DIFFUSION NODES

T 25=	4.49376	T 26=	4.57054	T 27=	4.63778	T 28=	4.69736	T 29=	4.75394	T 30=	4.81931
T 31=	4.54650	T 32=	4.63247	T 33=	4.70063	T 34=	4.76208	T 35=	4.82102	T 36=	4.88326
T 37=	4.60153	T 38=	4.68721	T 39=	4.75625	T 40=	4.82001	T 41=	4.88262	T 42=	4.95086
T 43=	4.66070	T 44=	4.74138	T 45=	4.81084	T 46=	4.87771	T 47=	4.94516	T 48=	5.02102
T 49=	4.72037	T 50=	4.79422	T 51=	4.86574	T 52=	4.93785	T 53=	5.01151	T 54=	5.09450
T 55=	4.78157	T 56=	4.84357	T 57=	4.92473	T 58=	5.00788	T 59=	5.09109	T 60=	5.17567
T 61=	4.57815	T 62=	4.62210	T 63=	4.67768	T 64=	4.73302	T 65=	4.78307	T 66=	4.82082
T 67=	4.61126	T 68=	4.65725	T 69=	4.71389	T 70=	4.77045	T 71=	4.82177	T 72=	4.85968
T 73=	4.65731	T 74=	4.70369	T 75=	4.76138	T 76=	4.81988	T 77=	4.87371	T 78=	4.91397
T 79=	4.70757	T 80=	4.75298	T 81=	4.81160	T 82=	4.87268	T 83=	4.92993	T 84=	4.97344
T 85=	4.75488	T 86=	4.79873	T 87=	4.85885	T 88=	4.92338	T 89=	4.98461	T 90=	5.03130
T 91=	4.78961	T 92=	4.83147	T 93=	4.89416	T 94=	4.96278	T 95=	5.02780	T 96=	5.07623
T 1025=	3.96713	T 1026=	3.98106	T 1027=	4.00067	T 1028=	4.02451	T 1029=	4.05174	T 1030=	4.07656
T 1031=	3.98635	T 1032=	4.01315	T 1033=	4.03461	T 1034=	4.05499	T 1035=	4.07260	T 1036=	4.07986
T 1037=	4.01255	T 1038=	4.04054	T 1039=	4.06293	T 1040=	4.08331	T 1041=	4.10044	T 1042=	4.10752
T 1043=	4.04050	T 1044=	4.06757	T 1045=	4.09076	T 1046=	4.11374	T 1047=	4.13787	T 1048=	4.15859
T 1049=	4.07070	T 1050=	4.09463	T 1051=	4.11839	T 1052=	4.14451	T 1053=	4.17387	T 1054=	4.21017
T 1055=	4.11029	T 1056=	4.12134	T 1057=	4.14653	T 1058=	4.17763	T 1059=	4.21387	T 1060=	4.25051
T 1061=	3.99508	T 1062=	4.00625	T 1063=	4.02323	T 1064=	4.04266	T 1065=	4.06141	T 1066=	4.07438
T 1067=	4.00967	T 1068=	4.02363	T 1069=	4.04150	T 1070=	4.06000	T 1071=	4.07606	T 1072=	4.09528
T 1073=	4.03175	T 1074=	4.04666	T 1075=	4.06533	T 1076=	4.08426	T 1077=	4.10062	T 1079=	4.11033
T 1079=	4.05650	T 1080=	4.07140	T 1081=	4.09089	T 1082=	4.11176	T 1083=	4.13178	T 1084=	4.14742
T 1085=	4.08100	T 1086=	4.09490	T 1087=	4.11496	T 1088=	4.13801	T 1089=	4.16138	T 1090=	4.18021
T 1091=	4.10100	T 1092=	4.11233	T 1093=	4.13266	T 1094=	4.15769	T 1095=	4.18368	T 1096=	4.20376
T 2025=	4.23864	T 2026=	4.30072	T 2027=	4.35089	T 2028=	4.39072	T 2029=	4.41884	T 2030=	4.43149
T 2031=	4.26503	T 2032=	4.33568	T 2033=	4.38743	T 2034=	4.42832	T 2035=	4.45742	T 2036=	4.46753
T 2037=	4.30051	T 2038=	4.37197	T 2039=	4.42651	T 2040=	4.47229	T 2041=	4.51005	T 2042=	4.53566
T 2043=	4.33857	T 2044=	4.41158	T 2045=	4.46997	T 2046=	4.52320	T 2047=	4.57636	T 2048=	4.64904

SHUTTLE TILE INTERNAL FLOW

T 2049=	4.38143	T 2050=	4.45483	T 2051=	4.51713	T 2052=	4.57744	T 2053=	4.63475	T 2054=	4.71116
T 2055=	4.43087	T 2056=	4.50413	T 2057=	4.57124	T 2058=	4.64628	T 2059=	4.69421	T 2060=	4.76161
T 2061=	4.29732	T 2062=	4.33155	T 2063=	4.37203	T 2064=	4.40814	T 2065=	4.43468	T 2066=	4.44821
T 2067=	4.31686	T 2068=	4.35336	T 2069=	4.39554	T 2070=	4.43350	T 2071=	4.46216	T 2072=	4.47709
T 2073=	4.34730	T 2074=	4.38530	T 2075=	4.43024	T 2076=	4.47248	T 2077=	4.50730	T 2078=	4.52934
T 2079=	4.38241	T 2080=	4.42196	T 2081=	4.47033	T 2082=	4.51833	T 2083=	4.56197	T 2084=	4.59691
T 2085=	4.41791	T 2086=	4.45867	T 2087=	4.51024	T 2088=	4.56313	T 2089=	4.61106	T 2090=	4.64997
T 2091=	4.44587	T 2092=	4.48741	T 2093=	4.54156	T 2094=	4.59869	T 2095=	4.64638	T 2096=	4.68436
T 3025=	4.79221	T 3026=	4.91643	T 3027=	4.95950	T 3028=	4.99771	T 3029=	5.02353	T 3030=	5.03274
T 3031=	4.81697	T 3032=	4.92022	T 3033=	4.98008	T 3034=	5.02182	T 3035=	5.04827	T 3036=	5.05530
T 3037=	4.85617	T 3038=	4.95033	T 3039=	5.01291	T 3040=	5.05811	T 3041=	5.08838	T 3042=	5.10132
T 3043=	4.90789	T 3044=	4.99533	T 3045=	5.05866	T 3046=	5.10821	T 3047=	5.14541	T 3048=	5.16876
T 3049=	4.96920	T 3050=	5.05137	T 3051=	5.11668	T 3052=	5.17311	T 3053=	5.22107	T 3054=	5.26321
T 3055=	5.03636	T 3056=	5.12060	T 3057=	5.19119	T 3058=	5.25976	T 3059=	5.32180	T 3060=	5.37309
T 3061=	4.86983	T 3062=	4.92328	T 3063=	4.96882	T 3064=	5.00577	T 3065=	5.03097	T 3066=	5.04268
T 3067=	4.88734	T 3068=	4.93700	T 3069=	4.98566	T 3070=	5.02473	T 3071=	5.05123	T 3072=	5.06353
T 3073=	4.91946	T 3074=	4.96663	T 3075=	5.01676	T 3076=	5.05857	T 3077=	5.08818	T 3078=	5.10315
T 3079=	4.96210	T 3080=	5.00764	T 3081=	5.05903	T 3082=	5.10447	T 3083=	5.13908	T 3084=	5.15894
T 3085=	5.00851	T 3086=	5.05333	T 3087=	5.10672	T 3088=	5.15696	T 3089=	5.19814	T 3090=	5.22473
T 3091=	5.04578	T 3092=	5.09142	T 3093=	5.14741	T 3094=	5.20264	T 3095=	5.24971	T 3096=	5.28059
T 4025=	5.11042	T 4026=	5.19593	T 4027=	5.27602	T 4028=	5.35391	T 4029=	5.43953	T 4030=	5.55133
T 4031=	5.18627	T 4032=	5.28890	T 4033=	5.36937	T 4034=	5.44542	T 4035=	5.52707	T 4036=	5.63020
T 4037=	5.27019	T 4038=	5.37015	T 4039=	5.44692	T 4040=	5.51796	T 4041=	5.59289	T 4042=	5.68736
T 4043=	5.36524	T 4044=	5.45318	T 4045=	5.52209	T 4046=	5.58496	T 4047=	5.64943	T 4048=	5.72083
T 4049=	5.46654	T 4050=	5.54228	T 4051=	5.60184	T 4052=	5.65419	T 4053=	5.70459	T 4054=	5.76068
T 4055=	5.58587	T 4056=	5.64951	T 4057=	5.69976	T 4058=	5.73943	T 4059=	5.77371	T 4060=	5.80652
T 4061=	5.21969	T 4062=	5.27048	T 4063=	5.33724	T 4064=	5.40795	T 4065=	5.47797	T 4066=	5.53601
T 4067=	5.26850	T 4068=	5.32212	T 4069=	5.38847	T 4070=	5.45727	T 4071=	5.52446	T 4072=	5.57938
T 4073=	5.33826	T 4074=	5.39030	T 4075=	5.45343	T 4076=	5.51776	T 4077=	5.57963	T 4078=	5.62975
T 4079=	5.41730	T 4080=	5.46444	T 4081=	5.52166	T 4082=	5.57913	T 4083=	5.63318	T 4084=	5.67601
T 4085=	5.49581	T 4086=	5.53740	T 4087=	5.58783	T 4088=	5.63730	T 4089=	5.68202	T 4090=	5.71550
T 4091=	5.55868	T 4092=	5.59584	T 4093=	5.64090	T 4094=	5.68369	T 4095=	5.72054	T 4096=	5.74616
T 5025=	5.63744	T 5026=	5.69466	T 5027=	5.74397	T 5028=	5.78945	T 5029=	5.83331	T 5030=	5.88452
T 5031=	5.69410	T 5032=	5.75165	T 5033=	5.79683	T 5034=	5.83865	T 5035=	5.88071	T 5036=	5.92892
T 5037=	5.75278	T 5038=	5.80259	T 5039=	5.84252	T 5040=	5.88102	T 5041=	5.92152	T 5042=	5.97103
T 5043=	5.82608	T 5044=	5.85341	T 5045=	5.88597	T 5046=	5.92097	T 5047=	5.95906	T 5048=	6.00745
T 5049=	5.87433	T 5050=	5.89588	T 5051=	5.92719	T 5052=	5.96065	T 5053=	5.99509	T 5054=	6.03710
T 5055=	5.90171	T 5056=	5.93095	T 5057=	5.97207	T 5058=	6.00793	T 5059=	6.03721	T 5060=	6.05666
T 5061=	5.70741	T 5062=	5.73842	T 5063=	5.77742	T 5064=	5.81700	T 5065=	5.85364	T 5066=	5.88201
T 5067=	5.74057	T 5068=	5.77048	T 5069=	5.80737	T 5070=	5.84504	T 5071=	5.88045	T 5072=	5.90790
T 5073=	5.78630	T 5074=	5.81253	T 5075=	5.84584	T 5076=	5.88087	T 5077=	5.91464	T 5078=	5.94152

SHUTTLE TILE INTERNAL FLOW

T 5079=	5.83629	T 5080=	5.85619	T 5081=	5.88522	T 5082=	5.91740	T 5083=	5.94898	T 5084=	5.97449
T 5085=	5.87542	T 5086=	5.89292	T 5087=	5.92038	T 5088=	5.95081	T 5089=	5.97975	T 5090=	6.00214
T 5091=	5.89787	T 5092=	5.91670	T 5093=	5.94594	T 5094=	5.97631	T 5095=	6.00263	T 5096=	6.01961
T 6025=	4.83930	T 6026=	4.89248	T 6027=	5.00178	T 6028=	5.09520	T 6029=	5.18559	T 6030=	5.27752
T 6031=	4.92529	T 6032=	5.02211	T 6033=	5.11231	T 6034=	5.19816	T 6035=	5.28352	T 6036=	5.37419
T 6037=	5.00988	T 6038=	5.11768	T 6039=	5.20304	T 6040=	5.28586	T 6041=	5.37256	T 6042=	5.47762
T 6043=	5.14602	T 6044=	5.21173	T 6045=	5.28674	T 6046=	5.36727	T 6047=	5.45373	T 6048=	5.56214
T 6049=	5.23450	T 6050=	5.28625	T 6051=	5.36304	T 6052=	5.44724	T 6053=	5.53059	T 6054=	5.63402
T 6055=	5.28086	T 6056=	5.33422	T 6057=	5.43955	T 6058=	5.54422	T 6059=	5.61575	T 6060=	5.68590
T 6061=	4.95142	T 6062=	4.99718	T 6063=	5.07360	T 6064=	5.15346	T 6065=	5.22718	T 6066=	5.28128
T 6067=	5.00774	T 6068=	5.06123	T 6069=	5.13459	T 6070=	5.21174	T 6071=	5.28404	T 6072=	5.33826
T 6073=	5.08504	T 6074=	5.13964	T 6075=	5.21034	T 6076=	5.28551	T 6077=	5.35786	T 6078=	5.41498
T 6079=	5.17510	T 6080=	5.22064	T 6081=	5.28623	T 6082=	5.35972	T 6083=	5.43147	T 6084=	5.48915
T 6085=	5.24541	T 6086=	5.28623	T 6087=	5.35228	T 6088=	5.42677	T 6089=	5.49683	T 6090=	5.55184
T 6091=	5.28421	T 6092=	5.32581	T 6093=	5.39841	T 6094=	5.47766	T 6095=	5.54458	T 6096=	5.59214
T 7025=	4.42798	T 7026=	4.44870	T 7027=	4.47372	T 7028=	4.50066	T 7029=	4.54070	T 7030=	4.59252
T 7031=	4.46596	T 7032=	4.49492	T 7033=	4.52478	T 7034=	4.55935	T 7035=	4.60214	T 7036=	4.65492
T 7037=	4.49690	T 7038=	4.52780	T 7039=	4.56129	T 7040=	4.60140	T 7041=	4.65137	T 7042=	4.71940
T 7043=	4.51955	T 7044=	4.55166	T 7045=	4.58789	T 7046=	4.63302	T 7047=	4.69001	T 7048=	4.76450
T 7049=	4.53555	T 7050=	4.56649	T 7051=	4.60401	T 7052=	4.65447	T 7053=	4.72221	T 7054=	4.81514
T 7055=	4.54371	T 7056=	4.56965	T 7057=	4.60493	T 7058=	4.66054	T 7059=	4.74378	T 7060=	4.86074
T 7061=	4.46826	T 7062=	4.48397	T 7063=	4.50823	T 7064=	4.53760	T 7065=	4.57085	T 7066=	4.59916
T 7067=	4.48961	T 7068=	4.50775	T 7069=	4.53472	T 7070=	4.56745	T 7071=	4.60328	T 7072=	4.63340
T 7073=	4.51449	T 7074=	4.53433	T 7075=	4.56426	T 7076=	4.60120	T 7077=	4.64197	T 7078=	4.67734
T 7079=	4.53561	T 7080=	4.55660	T 7081=	4.58913	T 7082=	4.63041	T 7083=	4.67677	T 7084=	4.71704
T 7085=	4.55048	T 7086=	4.57168	T 7087=	4.60598	T 7088=	4.65156	T 7089=	4.70476	T 7090=	4.75239
T 7091=	4.55785	T 7092=	4.57825	T 7093=	4.61300	T 7094=	4.66183	T 7095=	4.72149	T 7096=	4.77647
T 8025=	4.17849	T 8026=	4.16985	T 8027=	4.18848	T 8028=	4.21825	T 8029=	4.25094	T 8030=	4.28684
T 8031=	4.20262	T 8032=	4.22675	T 8033=	4.24896	T 8034=	4.27430	T 8035=	4.30133	T 8036=	4.32890
T 8037=	4.24376	T 8038=	4.27089	T 8039=	4.29481	T 8040=	4.31982	T 8041=	4.34651	T 8042=	4.37555
T 8043=	4.28374	T 8044=	4.31127	T 8045=	4.33597	T 8046=	4.36206	T 8047=	4.39134	T 8048=	4.42748
T 8049=	4.32652	T 8050=	4.35092	T 8051=	4.37551	T 8052=	4.40293	T 8053=	4.43559	T 8054=	4.47823
T 8055=	4.37298	T 8056=	4.39209	T 8057=	4.41695	T 8058=	4.44554	T 8059=	4.48248	T 8060=	4.53039
T 8061=	4.20776	T 8062=	4.21313	T 8063=	4.22955	T 8064=	4.25263	T 8065=	4.27680	T 8066=	4.29576
T 8067=	4.22935	T 8068=	4.24181	T 8069=	4.26053	T 8070=	4.28302	T 8071=	4.30567	T 8072=	4.32286
T 8073=	4.26296	T 8074=	4.27785	T 8075=	4.29809	T 8076=	4.32093	T 8077=	4.34359	T 8078=	4.36129
T 8079=	4.29911	T 8080=	4.31461	T 8081=	4.33567	T 8082=	4.35950	T 8083=	4.38385	T 8084=	4.40370
T 8085=	4.33367	T 8086=	4.34853	T 8087=	4.36984	T 8088=	4.39475	T 8089=	4.42114	T 8090=	4.44347
T 8091=	4.35976	T 8092=	4.37351	T 8093=	4.39487	T 8094=	4.42059	T 8095=	4.44875	T 8096=	4.47295
					ARITHMETIC NODES						
T 97=	4.49376	T 98=	4.57052	T 99=	4.63777	T 100=	4.69736	T 101=	4.75386	T 102=	4.81933

APPENDIX A, CONTINUED

SHUTTLE TILE INTERNAL FLOW

T 103=	4.54650	T 104=	4.62237	T 105=	4.69264	T 106=	4.75815	T 107=	4.82095	T 108=	4.88327
T 109=	4.60154	T 110=	4.67804	T 111=	4.75060	T 112=	4.82002	T 113=	4.88679	T 114=	4.95087
T 115=	4.66071	T 116=	4.73577	T 117=	4.80992	T 118=	4.88278	T 119=	4.95355	T 120=	5.02103
T 121=	4.72038	T 122=	4.79255	T 123=	4.86871	T 124=	4.94577	T 125=	5.02174	T 126=	5.09451
T 127=	4.78157	T 128=	4.84357	T 129=	4.92474	T 130=	5.00789	T 131=	5.09110	T 132=	5.17569
T 1024=	3.73973	T 1023=	3.73971	T 1022=	3.73967	T 1021=	3.73962	T 1020=	3.73959	T 1019=	3.73957
T 8024=	3.73959	T 8023=	3.73965	T 8022=	3.73980	T 8021=	3.74008	T 8020=	3.74047	T 8019=	3.74083
T 7024=	3.74115	T 7023=	3.74145	T 7022=	3.74387	T 7021=	3.75084	T 7020=	3.76309	T 7019=	3.77503
T 1007=	3.73955	T 1008=	3.73960	T 1009=	3.73972	T 1010=	3.73995	T 1011=	3.74008	T 1012=	3.73998
T 2021=	3.73991	T 2020=	3.73847	T 2019=	3.73772	T 24=	3.75680	T 23=	3.77797	T 22=	3.80119
T 21=	3.83439	T 20=	3.89199	T 19=	3.95609	T 6024=	4.02567	T 6023=	4.07219	T 6022=	4.16297
T 6021=	4.30936	T 6020=	4.50777	T 6019=	4.72816	T 2007=	3.75438	T 2008=	3.76702	T 2009=	3.78071
T 2010=	4.02530	T 2011=	4.03292	T 2012=	4.04208	T 7=	4.05372	T 8=	4.12186	T 9=	4.25657
T 10=	4.39505	T 11=	4.49694	T 12=	4.62073	T 4021=	4.96280	T 4020=	5.23848	T 4019=	5.45232
T 5024=	5.56219	T 5023=	5.63410	T 5022=	5.68598	T 5021=	5.73476	T 5020=	5.77506	T 5019=	5.81393
T 3007=	4.85084	T 3008=	4.91134	T 3009=	5.01263	T 3010=	5.13384	T 3011=	5.26323	T 3012=	5.34531
T 4007=	5.55157	T 4008=	5.63036	T 4009=	5.68750	T 4010=	5.72894	T 4011=	5.76073	T 4012=	5.79545
T 5007=	5.88446	T 5008=	5.92898	T 5009=	5.97110	T 5010=	6.00752	T 5011=	6.03716	T 5012=	6.05691
T 1001=	3.73973	T 1002=	3.73971	T 1003=	3.73966	T 1004=	3.73962	T 1005=	3.73958	T 1006=	3.73955
T 1018=	3.73959	T 1017=	3.73965	T 1016=	3.73977	T 1015=	3.73998	T 1014=	3.74024	T 1013=	3.74033
T 7001=	3.74111	T 7002=	3.74145	T 7003=	3.74387	T 7004=	3.75080	T 7005=	3.76293	T 7006=	3.77467
T 7018=	3.84016	T 7017=	3.87385	T 7016=	3.90966	T 7015=	3.94984	T 7014=	3.99669	T 7013=	4.05174
T 2001=	3.74020	T 2002=	3.74049	T 2003=	3.74075	T 2004=	3.74075	T 2005=	3.74083	T 2006=	3.74268
T 1=	3.76315	T 2=	3.78534	T 3=	3.81469	T 4=	3.84875	T 5=	3.88684	T 6=	3.93189
T 18=	4.02127	T 17=	4.06116	T 16=	4.13961	T 15=	4.25904	T 14=	4.40979	T 13=	4.54210
T 6018=	5.10946	T 6017=	5.29288	T 6016=	5.43964	T 6015=	5.54437	T 6014=	5.61585	T 6013=	2.65913
T 3001=	3.89879	T 3002=	3.91062	T 3003=	3.94102	T 3004=	3.98970	T 3005=	4.06296	T 3006=	4.17467
T 3018=	4.43904	T 3017=	4.59329	T 3016=	4.80913	T 3015=	5.03272	T 3014=	5.21768	T 3013=	5.33419
T 4018=	5.58600	T 4017=	5.64961	T 4016=	5.69984	T 4015=	5.73948	T 4014=	5.77372	T 4013=	5.80653
T 5018=	5.88813	T 5017=	5.93098	T 5016=	5.97214	T 5015=	6.00800	T 5014=	6.03727	T 5013=	6.05672
T 1097=	3.96715	T 1098=	3.98108	T 1099=	4.00069	T 1100=	4.02452	T 1101=	4.05179	T 1102=	4.07656
T 1103=	3.98636	T 1104=	4.00875	T 1105=	4.03046	T 1106=	4.05211	T 1107=	4.07109	T 1108=	4.07986
T 1109=	4.01256	T 1110=	4.03681	T 1111=	4.05999	T 1112=	4.08207	T 1113=	4.10046	T 1114=	4.10753
T 1115=	4.04051	T 1116=	4.06561	T 1117=	4.09031	T 1118=	4.11538	T 1119=	4.14082	T 1120=	4.16860
T 1121=	4.07071	T 1122=	4.09447	T 1123=	4.11990	T 1124=	4.14792	T 1125=	4.17833	T 1126=	4.21018
T 1127=	4.11032	T 1128=	4.12136	T 1129=	4.14654	T 1130=	4.17763	T 1131=	4.21387	T 1132=	4.25051
T 2097=	4.23865	T 2098=	4.30073	T 2099=	4.35090	T 2100=	4.39073	T 2101=	4.41885	T 2102=	4.43150
T 2103=	4.26504	T 2104=	4.32847	T 2105=	4.38209	T 2106=	4.42553	T 2107=	4.45621	T 2108=	4.46754
T 2109=	4.30051	T 2110=	4.36498	T 2111=	4.42262	T 2112=	4.47241	T 2113=	4.51231	T 2114=	4.53567
T 2115=	4.33858	T 2116=	4.40714	T 2117=	4.46991	T 2118=	4.52816	T 2119=	4.58381	T 2120=	4.64906
T 2121=	4.38145	T 2122=	4.45367	T 2123=	4.52036	T 2124=	4.58509	T 2125=	4.64395	T 2126=	4.71118

SHUTTLE TILE INTERNAL FLOW

T 2127=	4.43090	T 2128=	4.50413	T 2129=	4.57125	T 2130=	4.64625	T 2131=	4.69422	T 2132=	4.76164
T 3097=	4.79221	T 3098=	4.91645	T 3099=	4.95951	T 3100=	4.99771	T 3101=	5.02353	T 3102=	5.03275
T 3103=	4.81697	T 3104=	4.91317	T 3105=	4.97542	T 3106=	5.01960	T 3107=	5.04725	T 3108=	5.05630
T 3109=	4.85617	T 3110=	4.94244	T 3111=	5.00868	T 3112=	5.05757	T 3113=	5.08924	T 3114=	5.10135
T 3115=	4.90789	T 3116=	4.99025	T 3117=	5.05824	T 3118=	5.11201	T 3119=	5.15015	T 3120=	5.16976
T 3121=	4.96920	T 3122=	5.05068	T 3123=	5.12067	T 3124=	5.18088	T 3125=	5.22945	T 3126=	5.26320
T 3127=	5.03636	T 3128=	5.12060	T 3129=	5.19119	T 3130=	5.25976	T 3131=	5.32181	T 3132=	5.37310
T 4097=	5.11042	T 4098=	5.19593	T 4099=	5.27602	T 4100=	5.35391	T 4101=	5.43953	T 4102=	5.55008
T 4103=	5.18627	T 4104=	5.27570	T 4105=	5.35864	T 4106=	5.44016	T 4107=	5.52762	T 4108=	5.62973
T 4109=	5.27019	T 4110=	5.35927	T 4111=	5.44015	T 4112=	5.51793	T 4113=	5.59826	T 4114=	5.63763
T 4115=	5.36524	T 4116=	5.44832	T 4117=	5.52237	T 4118=	5.59100	T 4119=	5.65841	T 4120=	5.72863
T 4121=	5.46654	T 4122=	5.54369	T 4123=	5.60781	T 4124=	5.66350	T 4125=	5.71432	T 4126=	5.75065
T 4127=	5.58551	T 4128=	5.64935	T 4129=	5.69966	T 4130=	5.73940	T 4131=	5.77371	T 4132=	5.80652
T 5097=	5.63743	T 5098=	5.69466	T 5099=	5.74397	T 5100=	5.78945	T 5101=	5.83331	T 5102=	5.88432
T 5103=	5.69410	T 5104=	5.74454	T 5105=	5.79113	T 5106=	5.83588	T 5107=	5.88084	T 5108=	5.92863
T 5109=	5.75278	T 5110=	5.79738	T 5111=	5.83938	T 5112=	5.88138	T 5113=	5.92463	T 5114=	5.97094
T 5115=	5.82608	T 5116=	5.85202	T 5117=	5.88693	T 5118=	5.92500	T 5119=	5.96474	T 5120=	6.00737
T 5121=	5.87433	T 5122=	5.89711	T 5123=	5.93073	T 5124=	5.96637	T 5125=	6.00142	T 5126=	6.03702
T 5127=	5.90171	T 5128=	5.93093	T 5129=	5.97200	T 5130=	6.00785	T 5131=	6.03714	T 5132=	6.05660
T 6097=	4.83930	T 6098=	4.89248	T 6099=	5.00178	T 6100=	5.09520	T 6101=	5.18559	T 6102=	5.27752
T 6103=	4.92529	T 6104=	5.01390	T 6105=	5.10234	T 6106=	5.19299	T 6107=	5.28391	T 6108=	5.37419
T 6109=	5.00989	T 6110=	5.10813	T 6111=	5.19725	T 6112=	5.28717	T 6113=	5.37952	T 6114=	5.47762
T 6115=	5.14603	T 6116=	5.20792	T 6117=	5.28815	T 6118=	5.37579	T 6119=	5.46612	T 6120=	5.56211
T 6121=	5.23450	T 6122=	5.28681	T 6123=	5.36892	T 6124=	5.45887	T 6125=	5.54423	T 6126=	5.63395
T 6127=	5.28086	T 6128=	5.33422	T 6129=	5.43941	T 6130=	5.54382	T 6131=	5.61560	T 6132=	5.69581
T 7097=	4.42798	T 7098=	4.44870	T 7099=	4.47372	T 7100=	4.50066	T 7101=	4.54070	T 7102=	4.59253
T 7103=	4.46597	T 7104=	4.48944	T 7105=	4.51939	T 7106=	4.55606	T 7107=	4.60199	T 7108=	4.65493
T 7109=	4.49690	T 7110=	4.52322	T 7111=	4.55771	T 7112=	4.60127	T 7113=	4.65501	T 7114=	4.71939
T 7115=	4.51956	T 7116=	4.54845	T 7117=	4.58636	T 7118=	4.63544	T 7119=	4.69614	T 7120=	4.76450
T 7121=	4.53556	T 7122=	4.56432	T 7123=	4.60332	T 7124=	4.65716	T 7125=	4.72842	T 7126=	4.81515
T 7127=	4.54372	T 7128=	4.56965	T 7129=	4.60494	T 7130=	4.66055	T 7131=	4.74379	T 7132=	4.86074
T 8097=	4.17845	T 8098=	4.16986	T 8099=	4.18849	T 8100=	4.21825	T 8101=	4.25095	T 8102=	4.28684
T 8103=	4.20264	T 8104=	4.22053	T 8105=	4.24264	T 8106=	4.26984	T 8107=	4.29943	T 8108=	4.32891
T 8109=	4.24377	T 8110=	4.26635	T 8111=	4.29095	T 8112=	4.31828	T 8113=	4.34730	T 8114=	4.37557
T 8115=	4.28375	T 8116=	4.30957	T 8117=	4.33590	T 8118=	4.36436	T 8119=	4.39522	T 8120=	4.42750
T 8121=	4.32653	T 8122=	4.35172	T 8123=	4.37813	T 8124=	4.40741	T 8125=	4.44102	T 8126=	4.47825
T 8127=	4.37300	T 8128=	4.39210	T 8129=	4.41696	T 8130=	4.44555	T 8131=	4.48250	T 8132=	4.53042

HEATER NODES
++NONE++
BOUNDARY NODES

T 1224=	3.73977	T 1223=	3.73970	T 1222=	3.73963	T 1221=	3.73957	T 1220=	3.73951	T 1219=	3.73945

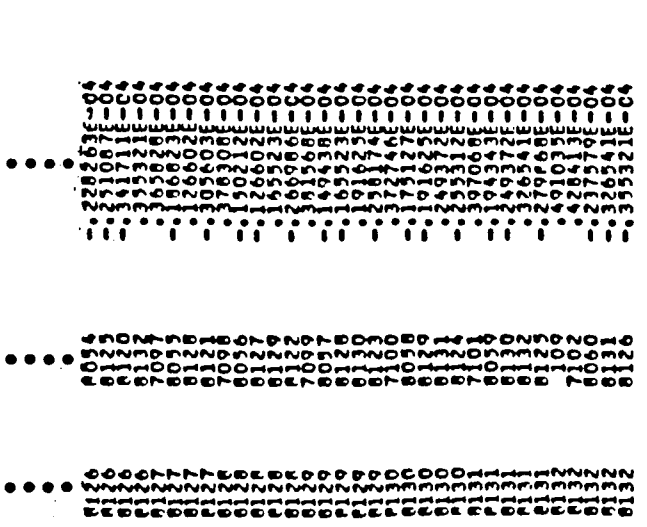
SHUTTLE TILE INTERNAL FLOW

T	8224=	3.73940	T	8223=	3.73939	T	8222=	3.73945	T	8221=	3.73975	T	8220=	3.74046	T 8219= 3.74121
T	7224=	3.74043	T	7223=	3.73679	T	7222=	3.73391	T	7221=	3.73935	T	7220=	3.76358	T 7219= 3.79782
T	1207=	3.73940	T	1206=	3.73939	T	1209=	3.73945	T	1210=	3.73975	T	1211=	3.74046	T 1212= 3.74121
T	2221=	3.74043	T	2220=	3.73679	T	2219=	3.73391	T	224=	3.73935	T	223=	3.76359	T 222= 3.79782
T	221=	3.83526	T	220=	3.86684	T	219=	3.89778	T	6224=	3.93286	T	6223=	3.97628	T 6222= 4.04756
T	6221=	4.19683	T	6220=	4.46016	T	6219=	4.79233	T	2207=	3.73963	T	2208=	3.76464	T 2209= 3.79899
T	2210=	3.83421	T	2211=	3.86584	T	2212=	3.89669	T	207=	3.93412	T	208=	3.97779	T 209= 4.05101
T	210=	4.19132	T	211=	4.44958	T	212=	4.78128	T	4221=	5.12506	T	4220=	5.37207	T 4219= 5.53250
T	9224=	5.61971	T	9223=	5.67905	T	9222=	5.72362	T	5221=	5.75306	T	5220=	5.77816	T 5219= 5.81771
T	3207=	4.19683	T	3208=	4.46017	T	3209=	4.79234	T	3210=	5.11617	T	3211=	5.36557	T 3212= 5.52797
T	4207=	5.62181	T	4208=	5.68083	T	4209=	5.72462	T	4210=	5.75228	T	4211=	5.77706	T 4212= 5.81609
T	5207=	5.87570	T	5208=	5.93534	T	5209=	5.98508	T	5210=	6.02379	T	5211=	6.06003	T 5212= 6.09982
T	1201=	3.73977	T	1202=	3.73970	T	1203=	3.73963	T	1204=	3.73957	T	1205=	3.73951	T 1206= 3.73945
T	1218=	3.73940	T	1217=	3.73939	T	1216=	3.73945	T	1215=	3.73975	T	1214=	3.74046	T 1213= 3.74121
T	7201=	3.74043	T	7202=	3.73679	T	7203=	3.73391	T	7204=	3.73935	T	7205=	3.76359	T 7206= 3.79783
T	7218=	3.83526	T	7217=	3.86684	T	7216=	3.89778	T	7215=	3.93286	T	7214=	3.97628	T 7213= 4.04756
T	2201=	3.73976	T	2202=	3.74049	T	2203=	3.74121	T	2204=	3.74049	T	2205=	3.73693	T 2206= 3.73392
T	201=	3.73963	T	202=	3.76464	T	203=	3.79899	T	204=	3.83421	T	205=	3.86584	T 206= 3.89669
T	218=	3.93412	T	217=	3.97779	T	216=	4.05101	T	215=	4.19132	T	214=	4.44958	T 213= 4.79129
T	6218=	5.12506	T	6217=	5.37207	T	6216=	5.53250	T	6215=	5.61971	T	6214=	5.67905	T 6213= 5.72362
T	3201=	3.83526	T	3202=	3.86684	T	3203=	3.89778	T	3204=	3.93286	T	3205=	3.97628	T 3206= 4.04756
T	3218=	4.19683	T	3217=	4.46017	T	3216=	4.79234	T	3215=	5.11617	T	3214=	5.36557	T 3213= 5.52797
T	4218=	5.62181	T	4217=	5.68083	T	4216=	5.72462	T	4215=	5.75228	T	4214=	5.77706	T 4213= 5.81609
T	5218=	5.87570	T	5217=	5.93534	T	5216=	5.98508	T	5215=	6.02379	T	5214=	6.06003	T 5213= 6.09982

A... ALL ARITHMETIC NODES WILL BE MAPPED

97	25	-.1920B9E-05
97	98	.5260B7E-04
97	103	.3505I9E-04
97	8120	-.4469O4E-04
97	2127	-.4241S8E-04
98	26	.1532B3E-04
98	97	-.5260B7E-04
98	99	.4981B8E-04
98	104	.3603I9E-04
98	2128	-.4554I6E-04
99	27	.1239I4E-04
99	98	-.4581B8E-04
99	100	.4206I5E-04
99	105	.3970S2E-04
99	2129	-.4631I3E-04
100	28	-.5698S6E-05
100	99	-.4206I5E-04
100	101	.4036B6E-04
100	106	.4345O0E-04
100	2130	-.3610I1E-04
101	29	-.1298B0E-04
101	100	-.4036B6E-04
101	102	.4738I8E-04
101	107	.4956I8E-04
101	2131	-.4259B0E-04
102	30	-.2285I1E-04
102	101	-.4738I8E-04
102	108	.4690I1E-04
102	3114	.6513I9E-04
102	2132	-.4178I5E-04
103	31	-.8026A4E-05
103	104	.5258I7E-04
103	97	-.3505I9E-04
103	109	.3806I4E-04
103	8126	-.4657I2E-04
104	103	-.5258I7E-04
104	105	.4948I1E-04
104	98	-.3603I9E-04
104	110	.3914I5E-04
105	104	-.4948I1E-04
•	•	•
•	•	•
•	•	•
•	•	•

APPENDIX A, CONTINUED



SHUTTLE TILE INTERNAL FLOW

EDGAP (1)	1.00000E-03	EDGAP (2)	1.00000E-03	EDGAP (3)	1.00000E-03	EDGAP (4)	1.00000E-03	EDGAP (5)	1.00000E-03
EDGAP (6)	1.00000E-03	EDGAP (7)	1.00000E-03	EDGAP (8)	1.00000E-03	EDGAP (9)	1.00000E-03	EDGAP (10)	1.00000E-03
EDGAP (11)	1.00000E-03	EDGAP (12)	1.00000E-03	EDGAP (13)	1.00000E-03	EDGAP (14)	1.00000E-03	EDGAP (15)	1.00000E-03
EDGAP (16)	1.00000E-03	EDGAP (17)	1.00000E-03	EDGAP (18)	1.00000E-03	EDGAP (19)	1.00000E-03	EDGAP (20)	1.00000E-03
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EDGAP (36)	1.00000E-03	EDGAP (37)	1.00000E-03	EDGAP (38)	1.00000E-03	EDGAP (39)	1.00000E-03	EDGAP (40)	1.00000E-03
EDGAP (41)	1.00000E-03	EDGAP (42)	1.00000E-03	EDGAP (43)	1.00000E-03	EDGAP (44)	1.00000E-03	EDGAP (45)	1.00000E-03
EDGAP (46)	1.00000E-03	EDGAP (47)	1.00000E-03	EDGAP (48)	1.00000E-03	EDGAP (49)	1.00000E-03	EDGAP (50)	1.00000E-03
EDGAP (51)	1.00000E-03	EDGAP (52)	1.00000E-03	EDGAP (53)	1.00000E-03	EDGAP (54)	1.00000E-03	EDGAP (55)	1.00000E-03
EDGAP (56)	1.00000E-03	EDGAP (57)	1.00000E-03	EDGAP (58)	1.00000E-03	EDGAP (59)	9.94881E-02	EDGAP (60)	1.00064E-01
EDGAP (61)	1.00000E-03	EDGAP (62)	1.00000E-03	EDGAP (63)	1.00000E-03	EDGAP (64)	1.00000E-03	EDGAP (65)	1.00000E-03
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EDGAP (71)	1.00000E-03	EDGAP (72)	1.00000E-03	EDGAP (73)	1.00000E-03	EDGAP (74)	1.00000E-03	EDGAP (75)	1.00000E-03
EDGAP (76)	1.00000E-03	EDGAP (77)	9.97298E-02	EDGAP (78)	9.98994E-02	EDGAP (79)	1.00000E-03	EDGAP (80)	1.00000E-03
EDGAP (81)	1.00000E-03	EDGAP (82)	1.00000E-03	EDGAP (83)	1.00000E-03	EDGAP (84)	1.00000E-03	EDGAP (85)	1.00000E-03
EDGAP (86)	9.98300E-02	EDGAP (87)	9.98818E-02	EDGAP (88)	9.95814E-02	EDGAP (89)	1.00000E-03	EDGAP (90)	1.00000E-03
EDGAP (91)	1.00000E-03	EDGAP (92)	1.00000E-03	EDGAP (93)	1.00000E-03	EDGAP (94)	9.92579E-02	EDGAP (95)	9.98812E-02
EDGAP (96)	9.98340E-02	EDGAP (97)	9.96730E-02	EDGAP (98)	1.00000E-03	EDGAP (99)	1.00000E-03	EDGAP (100)	1.00000E-03
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EDGAP (126)	1.00000E-03	EDGAP (127)	1.00000E-03	EDGAP (128)	1.00000E-03	EDGAP (129)	1.00000E-03	EDGAP (130)	1.00000E-03
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EDGAP (156)	1.00000E-03	EDGAP (157)	1.00000E-03	EDGAP (158)	9.97380E-02	EDGAP (159)	1.00000E-03	EDGAP (160)	1.00000E-03
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EDGAP (211)	1.00000E-03	EDGAP (212)	1.00000E-03	EDGAP (213)	1.00000E-03	EDGAP (214)	1.00000E-03	EDGAP (215)	1.00000E-03
EDGAP (216)	1.00000E-03								

APPENDIX A, CONTINUED

```
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RHO     = .1E-01,
XMU     = .128E-04,
XSHOCK  = .2902E+03,
XZERO   = .28384E+03,
KS      = .36E-01,
DELTAX  = .1E+00,
DTILE   = .147E+01,
FLOSIGN = .1E+01,
$END
B(1-24), TOP OF GAP
      3.73963311      3.76463875      3.79899422      3.83420721      3.86584139      3.89669428
      3.93411633      3.97779004      4.05100748      4.19131744      4.44957763      4.78128213
      4.78128734      4.44958204      4.19131943      4.05100853      3.97779042      3.93411658
      3.89777810      3.86683621      3.83525887      3.79782461      3.76358465      3.73934650
G(1-24), BOTTOM OF GAP
      3.76315110      3.78533574      3.81468761      3.84874537      3.88684009      3.93189097
      4.05372077      4.12186446      4.25656631      4.39504862      4.49693957      4.62072920
      4.54209849      4.40979090      4.25904499      4.13961473      4.06116254      4.02126720
      3.95608785      3.89199254      3.83439378      3.80119420      3.77797455      3.75679989
ARRAY PSUR
      3.75144864      3.78217724      3.81799893      3.85144838      3.88222398      3.91446633
      3.78217539      3.81799710      3.85144672      3.88222239      3.91446461      3.95311980
      3.81799527      3.85144506      3.88222080      3.91446290      3.95311742      4.00672179
      3.85144339      3.88221922      3.91446118      3.95311503      4.00671852      4.10095937
      3.88221763      3.91445947      3.95311265      4.00671525      4.10095065      4.29988419
      3.91445775      3.95311027      4.00671198      4.10094193      4.29987044      4.60187724
ARRAY PTBL
      4.49375718      4.57053951      4.63778196      4.69736158      4.75384345      4.81931356
      4.54649757      4.63247456      4.70062859      4.76208033      4.82102465      4.88326212
      4.60153316      4.68720678      4.75624859      4.82001131      4.88261904      4.95086033
      4.66070120      4.74137614      4.81083980      4.87770792      4.94516205      5.02102113
      4.72037471      4.79421891      4.86574390      4.93784914      5.01151309      5.09450125
      4.78157233      4.84356956      4.92472869      5.00787704      5.09108966      5.17566815
                              TOTAL FORCES AND TOTAL MOMENTS

     FXTOT           FYTOT           FZTOT           MXTOT           MYTOT           MZTOT

  -.50228019E+01  -.27205698E+00   .30952190E+02   .82696153E+00  -.43210101E+01  -.45789313E-01

          GAP FORCES                              GAP MOMENTS

     GFX             GFY             GMX             GMY             GMZ
```

```
  -.53522744E+01  -.27205698E+00   .13314665E+00  -.38881844E+01  -.45789313E-01

SKIN FRICTION FORCES AND MOMENTS

      SFX             SMY
   .32947248E+00   .48432454E+00

NORMAL FORCE FN   .30952180E+02

            NORMAL FORCE MOMENTS

      MX             MY             MZ
  .69381489E+00  -.91715027E+00  0.

++NOTE++  END OF EXECUTIONER PHASE.
```

APPENDIX B

Free Stream Velocity U:

U_∞ = XMACH $\sqrt{kgRT}$ (ft/sec)

XMACH = mach number

$k = \frac{C_p}{C_v} = 1.4$

g = gravitational constant, 32.2 $\frac{ft}{sec^2}$

R = gas constant, 53.3 $\frac{ft\text{-}lbf}{lbm\text{-}^0R}$

T = temperature, ^0R

Free Stream Density RHO:

$\rho_\infty = \frac{P}{RT} \quad \left(\frac{lbm}{ft^3}\right)$

P = free-stream pressure, $\frac{lbf}{ft^2}$

R = gas constant, 53.3 $\frac{ft\text{-}lbf}{lbm\text{-}^0R}$

T = temperature, ^0R

Viscosity Coefficients XMU:

μ_∞ = function (T,^0R) [Sutherland eq., ref. 6] $\left(\frac{lbm}{ft\text{-}sec}\right)$

APPENDIX B, CONTINUED

Boundary Layer Thickness of Turbulent Flow over a Flat Plate:

$$\delta_0 = .37X_0\left(\frac{\rho_\infty U_\infty X_0}{12\mu_\infty}\right)^{-1.5} \quad \text{(ft)}$$

X_0 = distance of subject tile to edge of Shuttle, ft

ρ_∞ = free stream density, lbm/ft^3

U_∞ = free stream velocity, ft/sec

μ_∞ = viscosity coefficient, lbm/(ft-sec)

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15. Supplementary Notes

16. Abstract

This paper is a user's guide for the computer program that calculates the steady-state aerodynamic loads on the Shuttle thermal-protection tiles. The main element in the program is the MITAS-II, Martin Marietta Interactive Thermal Analysis System. MITAS-II is used to calculate the mass flow in a nine-tile model designed to simulate conditions during a Shuttle flight. The procedures used to execute the program using the MITAS-II software are described. A list of the necessary software and data files along with a brief description of their functions is given. The format of the data file containing the surface pressure data is specified. The interpolation techniques used to calculate the pressure profile over the tile matrix are briefly described. In addition, the output from a sample run is explained. The actual output and the procedure file used to execute the program at NASA Langley Research Center on a CDC CYBER-175 are provided in the appendices.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
thermal protection system MITAS-II aerodynamic loads diffusion equations	~~FEDD Distribution~~ Subject Category 18

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Unclassified	Unclassified	110	

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