NASA Contractor Report 3291

Calculation of Water Drop Trajectories to and About Arbitrary Three-Dimensional Bodies in Potential Airflow

Hillyer G. Norment

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Hillyer G. Norment
Atmospheric Science Associates
Bedford, Massachusetts

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CALCULATION OF WATER DROP TRAJECTORIES TO AND ABOUT ARBITRARY THREE-DIMENSIONAL BODIES IN POTENTIAL AIRFLOW

by Hillyer G. Norment
Atmospheric Science Associates

SUMMARY

Computer programs are described by which trajectories of water drops can be calculated to and about three-dimensional, non-lifting bodies of arbitrary shape. External potential airflow about the body is computed; flow into (but not through) inlets also can be simulated. Calculations can be done for any atmospheric conditions and for any subsonic airspeed. Experimentally derived relations between Reynolds and Davies numbers for water drops of all sizes, from the smallest cloud droplets to large raindrops, are used to represent effects of aerodynamic drag on the particles during integration of the water drop equations of motion, and effects of gravity settling are included. A variable time step numerical integration method is used.

The surface of the three-dimensional body is approximated by plane quadrilateral panels, over each of which a uniform potential source is assumed to be distributed. Source densities and the resulting potential flow field are calculated by the Hess-Smith method.

The following seven codes are described:

1. A code used to debug and plot the body surface data.

2. A modified version of the Hess-Smith code which processes the body data and yields data required to compute flow velocities at arbitrary points in space.

3. A code that computes flow velocities at arrays of points in three-dimensional space.

4. A code that computes trajectories of water drops toward the body from arrays of initial points in space.

5. A code that computes water drop trajectories and water drop fluxes to arbitrary target points.

6. A code that computes water drop trajectories tangent to the body.

7. A code that produces stereo pair plots that include both the body and trajectories.

Code descriptions include operating instructions, card inputs and printouts for example problems, and listings of the FORTRAN codes.

Various tests of simulation accuracy are discussed, and accuracy is found to be acceptible. Trajectory results for flow around ellipsoids are compared with prior calculations and acceptable agreement is found. Results, again for flow about ellipsoids, are compared with experimental data and are found to be superior to prior calculations.

INTRODUCTION

With the development of practical numerical methods by which potential flow about arbitrary three-dimensional bodies can be calculated, along with development of efficient methods for integration of particle equations of motion, it has become possible to compute trajectories of particles suspended in a fluid to or about a complex body that is in motion relative to the fluid. Past applications have been to the study of mounting sites of hydrometeor measurement instruments on cloud physics research airplanes (refs. 1 - 8). In the future the methods are to be used to study aircraft icing, an application for which they are ideally suited, and it is in preparation for such work that this code documentation is undertaken.

We distinguish two major categories of codes: flow codes and trajectory codes. The flow codes process data that describe the three-dimensional body and compute the fluid flow field around that body.* The trajectory codes use the results of the flow codes to compute trajectories of particles to and about the body. For aircraft icing studies, the body is, of course, an aircraft, the fluid is air and the particles are water drops. Table 1 identifies and briefly describes the executive codes in the two categories, and Table 2 does the same for the subroutine and function codes.

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*It is immaterial whether we consider the fluid to be stationary and the body in motion, or vice versa, but it is expedient here to consider the body stationary and the fluid in motion.

TABLE 1

EXECUTIVE CODES

A. FLOW CODES

Code	Description
PBOXC	Processes and plots data which define the three-dimensional body. Used to debug and plot the body data.
BOXC	Processes three-dimensional body data and prepares and stores data to be used by SR FLOVEL to calculate flow velocities as needed during trajectory calculations.
FLOPNT	Computes and prints flow velocities at user-specified arrays of points in space.

B. TRAJECTORY CODES

Code	Description
ARYTRJ	Computes trajectories, which begin at user-specified arrays of points in space, to and/or about the body.
CONFAC	Computes trajectories from the free stream to user-specified points in space. Also computes particle concentration factors at user-specified points in space. (Concentration factor is ratio of particle flux at the target point to free stream particle flux.)
TANTRA	Computes trajectories tangent to the body which are initiated along user-specified lines in the free stream. (Tangent trajectories are those trajectories that barely miss intersection with the body.)
STEREO	Prepares stereo-pair plots of the body along with particle trajectories.

TABLE 2

SUBROUTINE AND FUNCTION CODES

A. FLOW CODES

Code	Called By	Description
AFORM	BOXC	Computes the induced velocity matrix, A_{ij} (ref. 9).
ATAPES	BOXC	Reads A_{ij} matrix from an appropriate tape.
DATPROS	INPUT	Translates, scales and rotates input body data before processing.
FLOVEL	TRAJECT CONFAC ARYTRJ FLOPNT	Returns flow velocity for a given point in space.
FLOWS	BOXC	Sets up non-uniform free stream flows.
HEADER	BOXC INPUT AFORM VFORM PRINT1	Writes a printout header.
INPUT	BOXC	Processes input body coordinate data into quadrilaterals. Produces the "first output" (ref. 9, sec. 9.4).
PATPROS	PINPUT	Translates, scales and rotates input body data before processing. Punches the translated, scaled and rotated data if so requested.
PEADER	PINPUT	Writes a printout header.
PICTUR	PBOXC	Plots the body surface data.
PINPUT	PBOXC	Processes input body coordinate data into quadrilaterals. Produces the "first output" (ref. 9, sec. 9.4).
PRINT1	BOXC	Computes and prints on-body velocities, and off-body velocities if so requested. Writes source strengths on unit 14 if so requested. Produces the "second output" (ref. 9., sec. 9.7).
SIGMA	BOXC	Solves linear equation matrix for surface source densities by the Seidel iterative method.
SOLVIT	BOXC	Solves linear equation matrix for surface source densities by the direct method.

TABLE 2, cont.

Code	Called By	Description
UNIFRM	FLOWS	Sets up uniform free stream flows.
VFORM	BOXC	Computes velocity components induced at each quadrilateral by all other quadrilaterals.
WTAP14	BOXC	Writes quadrilateral data needed for flow velocity computation onto unit 14 if so requested.

B. TRAJECTORY CODES

Code	Called By	Description
CDRR	PRFUN PARTCL	Given Reynolds number, returns Davies number for a sphere. Used for water drops for which Reynolds number is less than or equal to 200.
DVDQ	TRAJECT	Integrates particle equations of motion for each time step (ref. 11).
FALWAT	PARTCL	Returns still-air, terminal settling speed for a water drop. Uses equations of Beard (ref. 17).
IMPACT	TRAJECT	Used in runs under control of CONFAC to adjust trajectory initial y,z coordinates to avoid impact on the body on the next trajectory after impaction has occurred. This is a problem-specific subroutine.
MAP	CONFAC	Controls the iterative calculation of trajectories to a specified target point.
MATINV	MAP	Linear equation solver.
PARTCL	ARYTRJ CONFAC TANTRA	Reads particle specification data and returns still-air, terminal particle settling speed and other particle data as required for the particular type of particle. This is a particle type-specific code. The version provided here is for water drops.
POLYGON	CONFAC	Calculates area of a plane polygon of N vertices. Provides cross-sectional areas of particle flux tubes which are used to compute concentration factors.
PRFUN	TRAJECT	Given the particle Reynolds number, returns the factor which when multiplied by $\vec{v}_p - \vec{v}_a$ yields the first term on the right side of eq. (1). This is a particle type-specific function. The version provided here is for water drops.

TABLE 2, cont.

Code	Called By	Description
SETFLO	FLOPNT ARYTRJ CONFAC TANTRA	Reads BOXC output data stored on unit 14 that is required by SR FLOVEL for flow velocity calculations. If flow velocities are calculated by other than the Hess-Smith method, this code must be replaced with a dummy.
STRPNT	TANTRA	Specified a curve in three-dimensional space on which lie the initial points of all trajectories used in computing a tangent trajectory to the body. Also specified coarse and fine step sizes to be used in traversing the curve in search of the tangent trajectory, and it steps along the curve to define new initial trajectory points under control of TANTRA. The version supplied here uses straight line curves.
TRAJECT	ARYTRJ TANTRA MAP	Computes particle trajectories. (See p. 38)
TRANSFM	CONFAC MAP	Transforms coordinate system from the "flow system" to the "flux tube system", or reverse. (See pp. 44, 45.)
WCDRR	PRFUN PARTCL	Given Reynolds number, returns Davies number for a water drop. Used for case where the Reynolds number is greater than 200.

METHODOLOGY

THREE-DIMENSIONAL FLOW

The code of Hess and Smith (refs. 9, 10) for calculation of nonlifting potential flow about arbitrary three-dimensional bodies is used. The code requires input of a digital description of the body surface. This consists of the coordinates of the corner points of a large number of quadrilaterals. (Examples of digital descriptions of portions of a C130 airplane are shown in Fig. 1.) Each quadrilateral panel is taken to be a uniform-distributed source. On the basis of the boundary condition that there be zero flux through the center of each panel, and given the direction of the free-stream flow, the code finds the source strengths of all panels by inversion of a large matrix that includes all possible panel interactions. The matrix is inverted only once for each airplane geometry, provided that the results are stored for future use.

This potential flow method works quite satisfactorily where the local Mach number does not exceed approximately one-half (ref. 10). By making simple adjustments to the calculations the method can be extended to higher Mach numbers as long as there are no supersonic regions in the real flow.

Particle trajectory calculations require flow velocities point-by-point along each trajectory. In calculating each flow velocity, contributions from all panels are summed. There are three algorithms for computing contributions: (1) for panels that are close to the calculation point, a detailed calculation is used that accounts for exact panel shape, (2) for panels at intermediate distances a multipole expansion is used, and (3) for remote panels a point source approximation is used. Mathematical details are found in references 9 and 10.

To perform these calculations, we have developed a subroutine (FLOVEL) that consists of various extracted and modified portions of the Hess-Smith code. This subroutine is generalized such that given geometrical properties, source strength and other data for every quadrilateral,

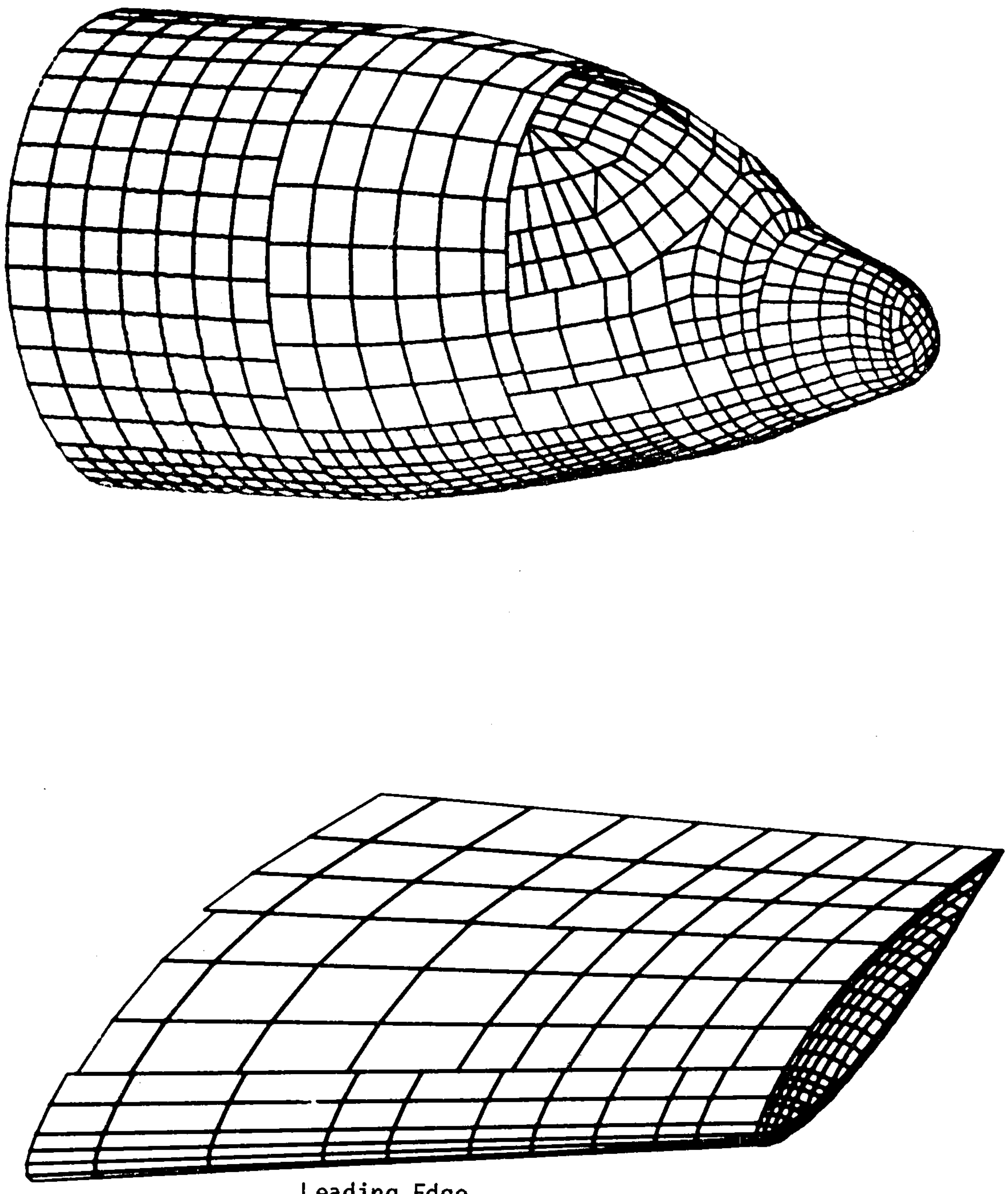


Figure 1. Digital descriptions of the forward fuselage and outer wing of a Lockheed C130E airplane.

it will provide the flow velocity for any specified point in space. It also checks each quadrilateral to determine if it has been penetrated by the particle.

Hess and Smith have evaluated the accuracy of their method for a variety of cases and have found excellent agreement with experiment (refs. 9 and 10). We have also done some evaluation studies (ref. 1), and in the Validation section below our prior work is summarized and results of some new studies of tangent trajectories to ellipsoids are presented and compared with prior work.

Of course accuracy also depends on the fineness of resolution of the panel description of the body, and naturally some compromise is called for. The smaller the panels the finer the resolution, and the fewer of them for which the most exacting of the three algorithms must be used. On the other hand, the number of panels increases inversely as the square of their linear size. In past studies on airplanes we have used the following criteria in setting up panel structures: For those parts of the airplane traversed by particle trajectories, we try to keep the panel edges between 6" to 8" in length. Where allowed by simplicity of surface shape, remote panels can be larger. Remote downstream complexities of shape are ignored. The cylindrical portion of a fuselage is extended to approximately five times the length of the nose section, as recommended by Hess and Smith (ref. 10).

For a particular computer, time required for trajectory calculation is largely dependent on the number of velocities required. On the CDC 6600 computer, one velocity calculation requires on the order of 0.15 second for a typical problem. The number of velocities required per trajectory varies from about 60 to 300. A typical number of trajectories required is 25. Thus, computing time, even on a large computer, can be considerable. Computing times required on the UNIVAC 1100 are included here for each of the test problems. (See p. 60.)

Though the flow codes retain additional capabilities, for the calculations described here we require the following:

1. A unit free stream speed in the direction of the positive x axis.

2. All velocities are normalized and scaled to be consistent with the unit free stream speed.

3. All distances are normalized by dividing by a user-specified characteristic dimension of the body.

Body coordinates may be recorded in any convenient units and can be appropriately scaled and translated prior to processing via use of SR's PATPROS and DATPROS. These subroutines also allow rotation of the body about the y axis to adjust angle of attack.

PARTICLE TRAJECTORY CALCULATION

We assume that the bulk air flow is not perturbed by the particles. Moreover, since particle density is large compared to that of air, we can neglect buoyancy and inertial reaction of the fluid to obtain the three-dimensional, normalized equation

$$\frac{d\vec{v}_p}{d\tau} = \frac{1}{N_F}\left[\frac{1}{v_s}(\vec{v}_a - \vec{v}_p)\frac{N_D N_{R,s}}{N_{D,s} N_R} - \vec{k}\right] \quad . \tag{1}$$

Non-dimensional quantities are:

$\vec{v}_p$, $\vec{v}_a$	particle and air velocities
v_s	still-air, terminal settling speed of the particle
$\vec{k}$	unit vector in the z (upward) direction
τ	time

$N_D = C_D N_R^2$ Davies number

$N_F = V^2/(Lg)$ Froude number

$N_R = \frac{\rho\delta}{\eta} |\vec{v}_a - \vec{v}_p| V$ Reynolds number

Dimensioned quantities are:

δ particle diameter

ρ air density

η air viscosity

g gravity acceleration constant

V free stream airspeed

L a characteristic dimension of the body

Here length is normalized by dividing by L, velocity by V and time by L/V. $N_{D,s}$ and $N_{R,s}$ are for still-air, terminal particle settling.

We initiate the calculation far enough upstream to be essentially beyond the influence of the body where we can take $\vec{v}_p = -\vec{k}v_s$. We compute $\vec{v}_a$ at the initial point, calculate N_R from these data, calculate N_D from N_R using the relations discussed in the next section, and proceed straightforwardly with a numerical integration of eq. (1). The integration is done via use of the code DVDQ of Krogh (ref. 11). This code uses an Adams-type predictor - corrector algorithm with variable time step. It also tests for computational stability and loss of accuracy via roundoff error. It was tested by Hull, et al., (ref. 12) along with a number of other codes and found to be most efficient in terms of numbers of function evaluations (flow velocities) required.

AERODYNAMIC DRAG OF WATER DROPS

Davies (ref. 13) shows that still-air terminal settling of spheres can be generalized in terms of the dimensionless numbers $N_{R,s}$ and $N_{D,s}$. Over the range from the smallest spheres, which settle under viscous flow conditions and obey Stokes law, to spheres much larger than of interest here, and for any Newtonian fluid, a reproducible single-valued relationship between $N_{R,s}$ and $N_{D,s}$ exists. Furthermore, $N_{D,s}$ is independent of settling speed, being a function of fluid and sphere properties only; thus for given sphere and fluid, $N_{R,s}$ and hence V_s can be calculated. Polynomials by which $N_{R,s}$ can be computed as a function of $N_{D,s}$ were derived by Davies from a composite of many sets of experimental data.

Since the work of Davies it has been found repeatedly that this treatment is applicable to particles of other shapes, providing settling is steady and particle orientation is stable.

For the trajectory calculations required here, the problem must be turned around. In addition to gravity settling, there is a particle velocity component (relative to air) caused by the disturbance of the passing airplane. At any time step in the numerical integration of eq. (1), $\vec{v}_a - \vec{v}_p$ (and hence N_R) is known, and N_D must be determined. For viscous motion (i.e., Stokes flow, where $N_R < 1$) $N_D = 24\ N_R$ and eq. (1) can be integrated without question. However, for larger N_R the steady-state drag data determined experimentally for terminal settling must be used to compute accelerative particle motion.

Experimental measurements by Keim (ref. 14) and a theoretical analysis by Crowe, et al. (ref. 15) indicate that if the acceleration modulus,

$$N_A = \delta\left|\frac{dV_p}{dt}\right| / V_p^2 ,$$

is smaller than about 10^{-2}, steady-state drag coefficients can be used without significant error to compute accelerative motion. N_A has never been found to exceed 10^{-2} in our trajectory calculations.

For water drops small enough to be essentially spherical ($N_R \lessapprox 200$) we calculate N_D from a polynomial function in N_R derived from Davies data (ref. 13). (Function CDRR) For larger drops ($N_R > 200$), which have a flattened, non-spherical shape, we calculate N_D from polynomials in N_R derived from the water drop data of Gunn and Kinser (ref. 16). (Function WCDRR).

Still-air, terminal settling speeds for water drops are computed via use of Beard's equations (ref. 17). (SR FALWAT)

Water drops of any size, from submicron to the breakup size at about 8000 μm diameter, can be handled by these methods. However, the user should be aware that computation time goes up as droplet diameter goes down, and the time required for drops of diameter 1 μm or less may be large.

We have also developed aerodynamic drag relationships from observed settling data for various forms of ice crystals and have used these to study trajectories of ice to and around various airplanes (refs. 1, 2, 5, 7), though these are not included here.

FLOW CODE DESCRIPTIONS

PROGRAM PBOXC

General Discussion

This program is derived from the Douglas Aircraft Company code BOXC which was developed by Hess and Smith (ref. 9). It processes and produces CALCOMP plots of the three-dimensional body surface description data and is used primarily to debug these data. Processing and printing go as far as the "first output" (ref. 9, sec. 9.4). A secondary use is to store the body surface data such that it can be retrieved later and used by PGM STEREO to plot the body along with trajectories stored by one of the trajectory codes.

The surface of a general three-dimensional body is defined in terms of "rows" and "columns", the so-called m and n lines, of coordinates of points on the surface as described below. The m and n lines of points are combined by the code to form quadrilateral elements, or panels, such that when considered together they represent a reasonable approximation to the surface. (For example see Figs. 1 and 8.) Adjacent panels should be contiguous, or as nearly contiguous as possible. The data for general bodies may be scaled and translated in the three coordinate directions, and rotated about the y axis prior to processing.

The code also has the capability of generating ellipsoids of prolate, oblate or general shape with the only restriction being that their major and minor axes lie on the coordinate axes.

When the user elects to prepare plots of the body, the code automatically prepares a number of plots, each from a unique viewing angle, the number varying according to symmetry. For an asymmetric body fourteen plots are prepared. These consist of the six views from both directions along each coordinate axis, and the eight plots from 45 degree angles in each octant.

For a body with one plane of symmetry nine plots are prepared, for two symmetry planes six plots, and for three planes four plots. The user is urged to make liberal use of the plots to find errors in the body data.

Symmetry Planes

Up to three reflection planes may be specified, though only the first two are used in PBOXC for plotting. The surface descriptions for general bodies and ellipsoids are reflected across these planes. The number of symmetry planes is specified by parameter NSYM which has allowed values of 0, 1, 2, 3. The symmetry planes, in order of their application to the data, are:

Order of Application	Symmetry Plane
1	y = 0
2	z = 0
3	x = 0

For example, if NSYM = 1, for each point with coordinates (x,y,z), another point with coordinates (x, -y, z) is created. If NSYM = 2, for each point with coordinates x, y, z, three additional points with coordinates (x, -y, z), (x, -y, -z) and (x, y, -z) are created. If NSYM = 3, seven additional points are created.

Only the primary data points should be input. If reflected as well as primary data are input, the flow calculations will be in error.

Surface Description Data For General Bodies (IFLAG = 0)

The user must examine the body, or drawings of it, and devise a layout plan for subdividing its surface into sections that are compatible with the requirements of m line, n line surface point input while providing panels of appropriate size which cover the surface without leaving gaps or introducing unwanted discontinuities. Also a coordinate system must be established, but this can be manipulated at processing time by use of the scaling and translation capability of the code.

The important thing is to understand the requirements of the m and n line input. Here we give a brief summary of the requirements; the user is encouraged to carefully study sec. 9.1 of reference 9 to obtain a thorough understanding of them.

Points which define the corners of the quadrilateral panels are labeled with integers m and n which identify hypothetical "rows" and "columns" on which they lie. The integers m and n are not input to the computer; they are used for data organization and sequencing only.

To ensure a proper computation, the rows and columns must be organized by the following rule: <u>If an observer is located in the flow and is oriented so that locally he sees points on the surface with m values increasing upward, he must also see n values increasing toward the right</u>.

A surface may be subdivided into sections, each of which must be independent. That is, all quadrilaterals in each section must be closed. Where an edge of a section is contiguous with another, the input for each section must define the common edge, though they need not use the same points on the edge.

Figure 2 illustrates a surface description that is subdivided into four sections. Note how the sectioning can be used to change resolution or to deal with structural complexities.

Coordinates are punched into cards, one point per card; also in each card is punched the integer parameter STAT which is used to identify the m,n status of each point. All points in a section are ordered in the sequence (m,n):

(1,1), (2,1), (3,1),..., (1,2), (2,2), (3,2),...(1,3), (2,3), (3,3),...

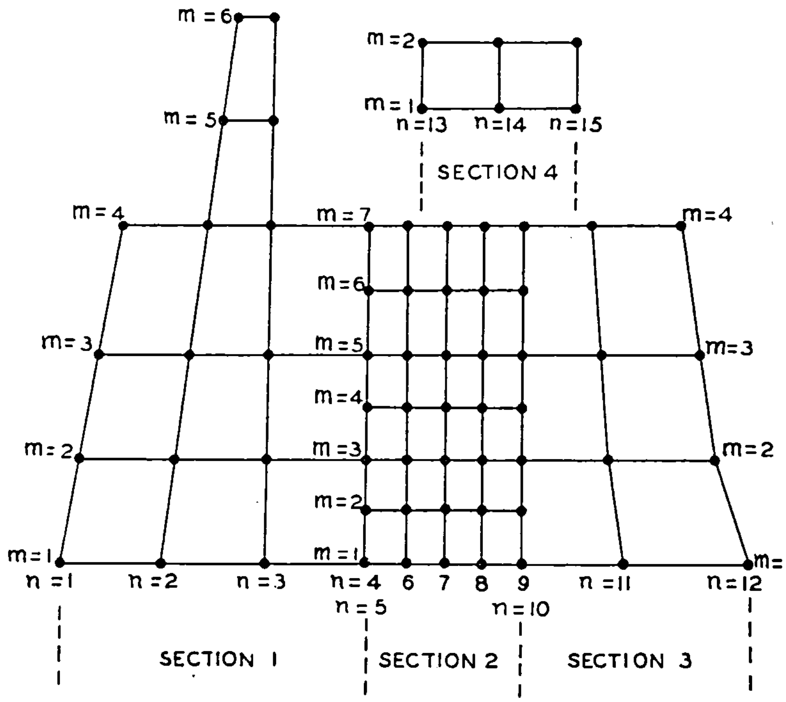


Figure 2. Plan view of the input points on a body divided into sections. (From ref. 9)

The STAT parameters are as follows for each section:

(m,n)	STAT
(1,1)	2
(1,n≠1)	1
all others	0 or blank

For the last card of the last section, STAT = 3.

Input order of sections is immaterial, but within sections, the data must be ordered according to the underlined rule given above.

Surface Description Data for Ellipsoids (IFLAG = 2 or 3)

Ellipsoids are generated by specifying the semi-axis lengths B and C (A = 1 always), and by specifying the numbers of "latitudinal" and "longitudinal" element divisions (Fig. 3), NLM1 and MMIN respectively.

There are two modes for specification:

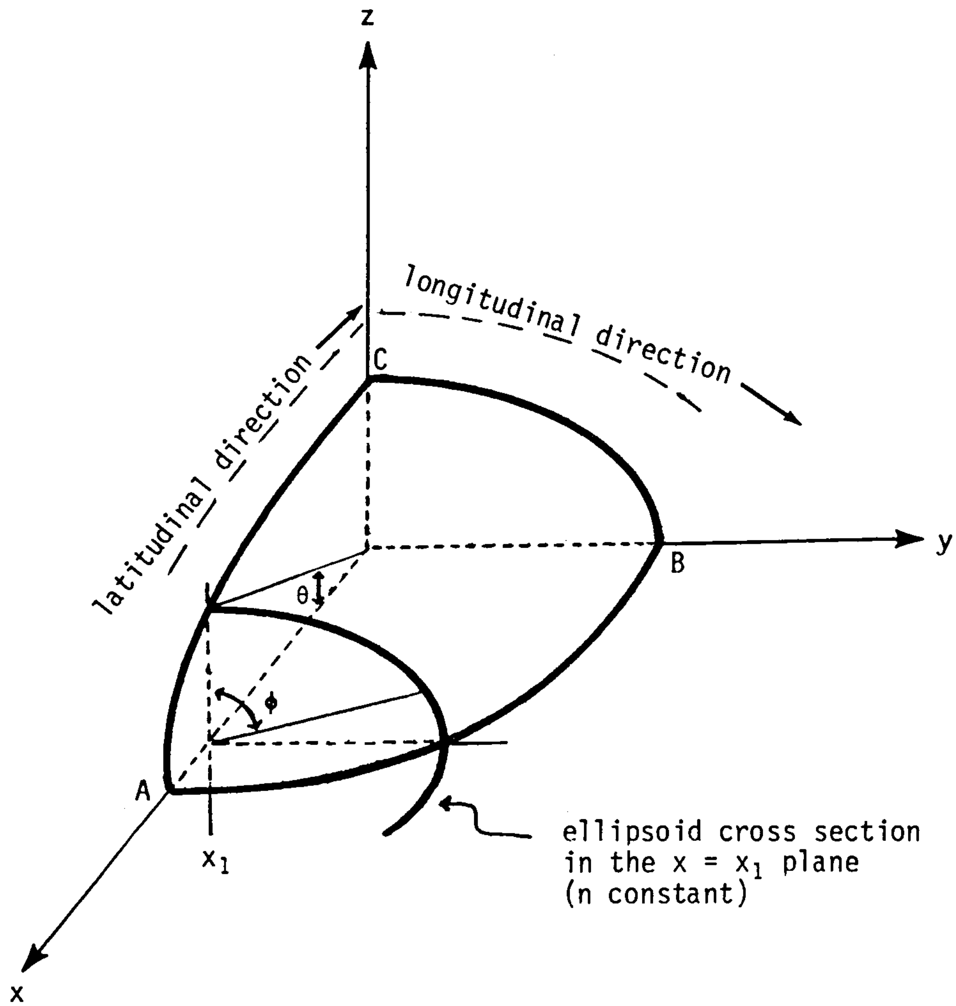
Mode 1. IFLAG = 1, NSYM = 3

All three symmetry planes are used and NLM1 and MMIN are specified for one octant only. Element increments are computed for NLM1 and MMIN equal increments in angles θ and ϕ (Fig. 3).

Mode 2. IFLAG = 2, NSYM = 2

Only two symmetry planes are used, and (x, z) values in the y = 0 plane must be input for $-1 \leq x \leq 1$, beginning at (1,0) and proceeding to (-1,0) for either all positive z or all negative z (i.e., for 180° in angle θ). (The code automatically ensures that the "underlined" input rule is obeyed.) Thus, NLM1 must be specified for the entire x axis, but MMIN is for one octant only as for the other option, and element increments in the "longitudinal" direction are created at equal increments of the angle ϕ.

Body surface data for generated ellipsoids cannot be plotted nor can the data be translated, scaled, and rotated by subroutine PATPROS or DATPROS.



θ is in the y = 0 plane

ϕ is in the $x = x_1$ plane

n lines run in the latitudinal direction from $\theta = 0$ to $\theta = \pi$

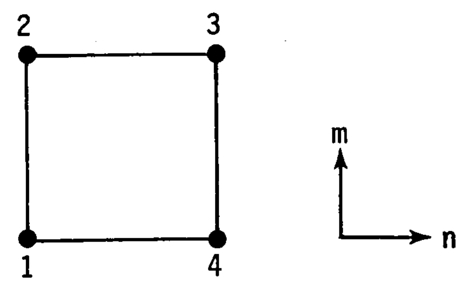
m lines run in the longitudinal direction from $\phi = 0$ to $\phi = 2\pi$

Figure 3. Definition of angles θ and ϕ, and m and n line directions used by PBOXC and BOXC for generation of ellipsoids.

Printed Output

The printed output is the result of the first stage of surface data processing (ref. 9, sec. 9.4). For each quadrilateral panel on the surface it consists of:

1. Coordinates (X,Y,Z) of the four points on a quadrilateral in the order



   around the quadrilateral.

2. Components (NX,NY,NZ) of the unit normal vector to the plane of the quadrilateral. This vector should point toward the exterior of the body rather than toward its interior. If it points in the wrong direction the data have been input in violation of the "underlined rule" on p. 17, and the data must be reordered.

3. Coordinates (NPX,NPY,NPZ) of the quadrilateral null point (ref. 9., sec. 9.3).

4. The common projection distance (D) of the four input points into the plane of the quadrilateral. (The four points from which a plane quadrilateral is formed do not in general, and need not, lie exactly in a plane.)

5. The maximum diagonal length (T) of the quadrilateral.

6. The area (A) of the quadrilateral.

Additional output appears for certain abnormal quadrilaterals. If the integer 1 or 2 appears at the far right of the page, they indicate the following conditions:

Integer 1. The null point point was found to lie outside of the quadrilateral. The coordinates listed are for the quadrilateral centroid.

Integer 2. The iterative procedure used to determine the null point did not converge and thus the null point is only approximate

(ref. 9, sec. 9.3).

Subroutines Required

PINPUT, PICTURE, PEADER, PATPROS, plotting subroutines.

External Storage Units

Units 5 and 6 are the system input and print units respectively.

Unit 8 temporary storage.

Unit 9 storage for surface data to be used later for plotting by PGM STEREO.

PBOXC Card Input

Card No.	Variables and Format	Description	
1	HEDR(15), IFLAG, NSYM, KMACH, KASE, (15A4, I1, 10X, I1, 1X, I1, 2X, A4)	HEDR (Cols. 1-60)	Hollerith run identification
		IFLAG (Col. 61)	Body surface description input control
		IFLAG = 0	Input data for a general, three-dimensional body (See pp. 16 ff.)
		IFLAG = 1	Generate an ellipsoid using the mode 1 option, with three reflection planes. (See p. 19.) Be sure that NSYM = 3.
		IFLAG = 2	Generate an ellipsoid using the mode 2 option, with two reflection planes, and input x,z coordinates for the ellipsoid via cards no. 5C. (See p. 19.) Be sure that NSYM = 2.
		NSYM (Col. 72)	Number of data reflection planes. Limited to values 0,1,2,3. (See p. 16.)
		KMACH (Col. 74)	A non-zero value indicates that a Mach number is to be read via card no. 2. (See p. 26.)
		KASE (Cols. 77-80)	Hollerith body identification.
2	MACH, (F10.6)	Mach number	This card is input only if KMACH $\neq$ 0 on card 1. (See p. 26.)
3	IPROS, IPUNCH, IPRNT, IPICT, ICRT, (5L1)	Logical variables which cause the following if true:	
		IPROS	Body surface data for a general body are to be translated, scaled and rotated about the y axis before processing, and card 4 is to be input.
		IPUNCH	Body surface data are copied to the system punch unit after translating, scaling and rotating about the y axis.
		IPRNT	Body surface data are processed and printed up to the "first output". (See p. 21 and ref. 9, sec. 9.4.)
		IPICT	Body surface data for a general body are plotted.
		ICRT	Plotting is via CRT. If ICRT is false, plotting is via pen and ink.
4.	ANGLE, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS, ZTRANS, (7F10.0)	This card is input only if IPROS (card 3) is true.	
		ANGLE	Angle (degrees) that the body is rotated about the y axis. A positive value causes a counterclockwise rotation from the aspect of a viewer looking down the positive y axis toward the origin. (Note: For a nose-up airplane angle of attack, ANGLE is negative.)
		XSCALE, YSCALE, ZSCALE	Scale factors to be applied to surface point x, y and z coordinates respectively after translation. Default values are unity.
		XTRANS, YTRANS, ZTRANS	Translations to be applied to surface point x, y and z coordinates before scaling.

- -

Card No.	Variables and Format	Description	
5A	X,Y,Z,STAT, XX, YY, ZZ, STATT, (3F10.0, I2/3F10.0,I2)	Cards 5A apply to general bodies (IFLAG = 0, see pp. 16 ff).	
		X,Y,Z and XX, YY, ZZ	Are coordinates of points used to define the body surface.
		STAT STATT (Col. 32)	Are point status integers. Allowed values are 0, 1, 2, 3. The meanings of these values are: 0 This point is on the same n line as the last point 1 This point starts a new n line 2 This point starts a new section 3 This is the last point in the input.

Card No.	Variables and Formats	Description
5A cont.		Note: For the last coordinate card STAT or STATT = 3. A blank card should follow this if there is an odd number of body surface points.
5B	NLM1, MMIN, B, C, (2I5, 2F10.5)	Card 5B applies to generated ellipsoids (IFLAG > 0) NLM1 Number of "latitudinal" element divisions MMIN Number of "longitudinal" element divisions B y semi-axis of the ellipse C z semi-axis of the ellipse (See p. 19 Modes 1 and 2, and Fig. 3.)
5C	x_1, z_1, x_2, z_2, ...x_{NLM1+1}, z_{NLM1+1} (8F10.0) . . .	Cards 5C apply to generated ellipsoids for which the x,z coordinates are input (IFLAG = 2, NSYM = 2). (x_i, z_i) are coordinates in the y = 0 plane, beginning at (1,0) and proceeding to (-1,0), that define the "latitudinal" element subdivisions. (See p. 19 Mode 2, and Fig. 3.)
6,7	LINE1, LINE2, (7A6/7A6)	Cards 6 and 7 are read only if ICRT is true (card 3). These are two lines of 42 columns each of Hollerith labeling for a microfiche film.

PROGRAM BOXC

General Discussion

Program BOXC is the Hess-Smith code for calculation of potential flow about arbitrary, three-dimensional, non-lifting bodies as described in ref. 9, with the following exceptions:

1. Overlay, common and subroutine argument structures have been changed to accommodate the code to the CDC 6600 and UNIVAC 1100/42 computers.

2. SR WTAP14 has been added to store on external unit 14 all data needed by the trajectory codes for flow velocity calculations.

3. A provision has been added to allow a group of surface elements to leak inward a specified fraction of the free stream flow. This is used to simulate effects on external flow of air flow into inlet aperatures.

4. A provision has been added to scale, translate and rotate surface point coordinates for general bodies before they are processed. (SR DATPROS)

To understand the theory and details of the calculations, the user must study reference 9.

The code has the capability to compute flow about the body for the free stream vector along each of the three axial directions. For nonsymmetrical bodies the capability extends to any free stream direction, and for bodies with one plane of symmetry, which must be the y = 0 plane, to any direction in the y = 0 plane (ref. 9, sec. 9.56). However, these general capabilities have not been used in the past, and furthermore, the trajectory codes and other important features of the flow calculations which are discussed below assume that the free stream vector is in the direction of the positive x axis. Changes of body orientation and/or location relative to the flow coordinate system are accomplished via use of SR DATPRO, which in its present form also is designed to allow for arbitrary specification of airplane angle-of-attack. In any case the free stream flow speed must be unity. The card input instructions below specify unit onset flow in the positive x direction.

Use and application of symmetry planes as well as preparation of body surface description data are the same as for PGM PBOXC.

Up to 1000 quadrilaterals can be accommodated for description of the basic body surface, before multiplication by symmetry plane reflection.

Compressibility Effects

According to Hess and Smith (ref. 10, pp. 7 and 35) their method works satisfactorily where the local Mach number does not exceed approximately one-half. For higher Mach numbers the Gothert transformation (ref. 18) is applied as follows:

1. All distances in the free-stream direction, that is the x direction, are scaled by dividing by $\beta = \sqrt{1 - M^2}$, where M is free stream Mach number.

2. Perturbation velocities computed at the scaled distances are themselves scaled by dividing by β for the y and z components, and by dividing by β^2 for the x component.

If the Gothert transformation is to be applied, the parameter KMACH (card 1) is given a value greater than zero, and the Mach number is input via card 5.

Flow Inlets

We have added a feature to the code (in SR UNIFRM) to allow simulation of flow up to the aperture of a flow inlet. The code cannot handle internal flows.

The aperture is represented by quadrilateral panels in the same manner as the body surface. To illustrate this, Fig. 4 shows the panelling of the orifice in the tip of the intake tube of a cloud water meter, the EWER, which is mounted under the wing of a C130 research airplane (ref. 7). Inlet aperture panel coordinates must be the first in the deck of surface point cards (cards 6A).

Input card no. 4 contains the number of aperature quadrilaterals and also the fraction of the free-stream flow speed that is "leaked" through the apertures. This leakage is taken to be the same for each aperture quadrilateral. If there is no flow inlet, card 4 is blank.

Off-Body Points

The code provides for computation of flow velocities at off-body points. If the parameter NOFF (card 1) is given a value greater than zero, coordinates of the off-body points are input following the surface points via the same format. The only status flag (STAT or STATT) required is 3 for the final point.

Printed Output

The printed output consists of two main parts: the first is the result of preliminary processing of the surface description data which yields "the first output" (ref. 9, sec. 9.4) described above on p. 21. The second output contains the final results and consists of the following for each quadrilateral (ref. 9, sec. 9.7):

1. Null point coordinates (NX, NY, NZ) (ref. 9, sec. 9.3).

2. Velocity magnitude (VT) at the null point.

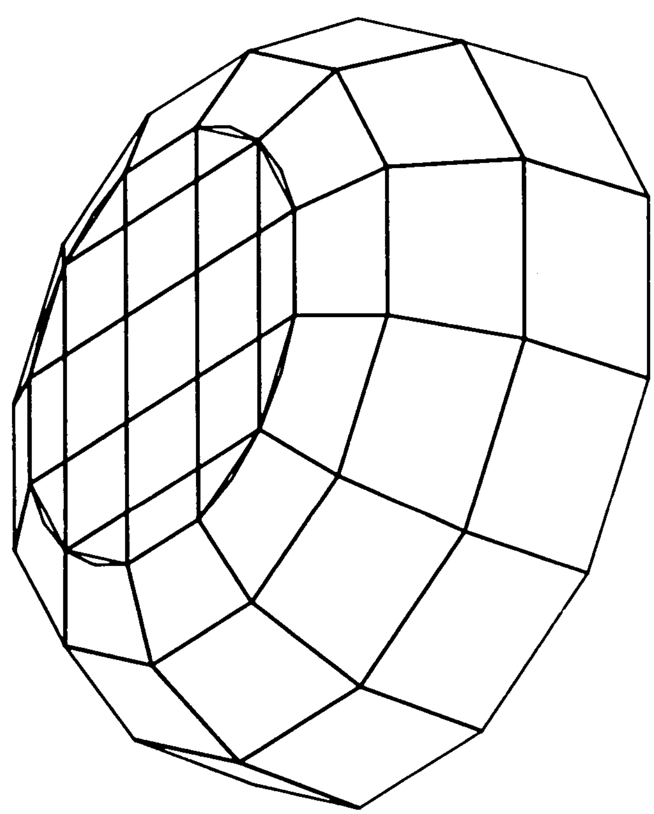


Figure 4. Computer plot of tip and orifice of a EWER cloud water content meter probe (ref. 7).

3. Square of the null point velocity magnitude (VTSO).

4. Pressure coefficient (CP) (ref. 9, eq. (137)).

5. Null point velocity components (VX, VY, VZ).

6. Direction cosines of the null point velocity (DCX, DCY, DCZ).

7. Unit normal vector to the plane of the quadrilateral (NX, NY, NZ).

8. Component of velocity normal to the quadrilateral plane at the null point (VN). (Note: VN should be essentially zero unless the quadrilateral is part of a flow inlet (see p. 26), in which case it should equal the input free-stream flow fraction.)

9. Source strength of the quadrilateral (SIG).

Unit 14 Output

If parameter KTP14 is unity (card 1), the following data are stored on external unit 14 (in binary format) for use later by SR FLOVEL in calculating flow velocities at arbitrary points in space:

> Body identification, KASE (see card 1), number of symmetry planes, NSYM, the number of quadrilaterals, NQUAD, in the basic body unit (i.e., before multiplication by symmetry plane reflections), free-stream Mach number, MACH, and $(1 - \text{MACH}^2)^{-\frac{1}{2}}$.
>
> For each quadrilateral is stored the "twenty-eight quantities" (ref. 9, sec. 9.51), plus the distances between quadrilateral points 1 and 2, 2 and 3, 3 and 4, and 4 and 1. (See p. 21.)

Overlay Structure and Subroutines Required

To conserve storage the program is run with the overlay structure shown in Fig. 5, which also identifies the subroutines required.

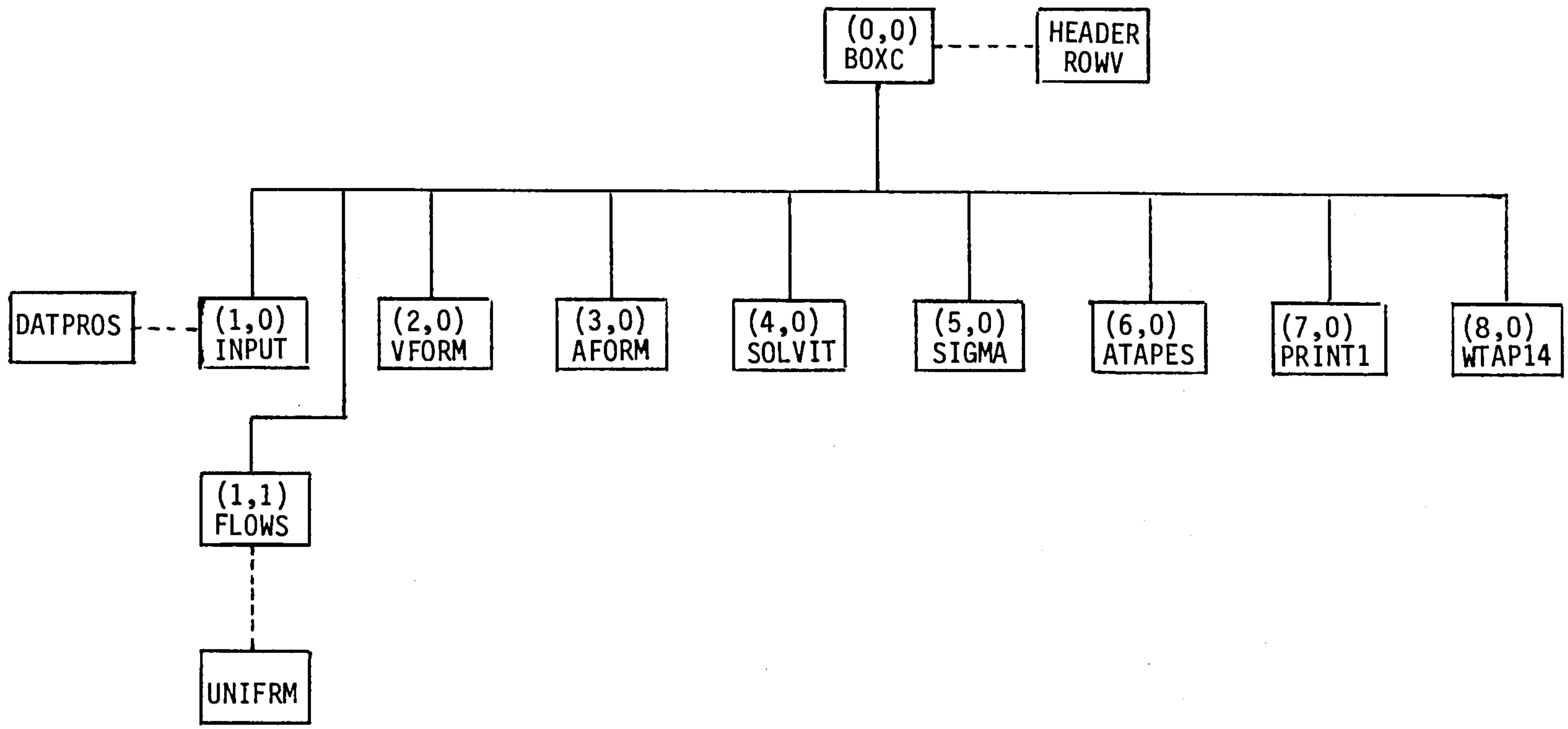


Figure 5. Overlay structure for program BOXC. The integer pairs (i,j) indicate the primary, i, and secondary, j, overlay levels.

External Storage Units

Units 5 and 6 are the system input and print units. Unit 14 contains the data to be used by SR FLOVEL to compute flow velocities at arbitrary points in space. The following units are used for temporary storage: 1, 3, 4, 8, 9, 10, 11, 12, 13.

BOXC Card Input

Card No.	Variables and Format	Description	
1	HEDR(15), IFLAG, LIST, AFLOW, BFLOW, CFLOW, ISIG, IPRS, MPR, NCODE, NNON, NSYM, NOFF, KMACH, KTP14, KASE, (15A4, 2I1, 3L1, 4I1, I2, 4I1, 1X, A4)	HEDR (cols. 1-60)	Hollerith run identification
		IFLAG (col. 61)	Body surface description input control. Same as for card 1 of PBOXC. (See pp. 16ff.)
		LIST (col. 62)	A value of zero (or blank) causes full execution. Otherwise, calculation is stopped after the "first output". (See p. 21.)
		AFLOW, BFLOW, CFLOW (Cols. 63, 64, 65)	Logical parameters which specify the free-stream flow axis. These parameters should be T,F,F respectively.
		ISIG (Col. 66)	Always zero or blank.
		IPRS (Col. 67)	Always zero or blank.
		MPR (Col. 68)	Normal value is zero or blank. Non-zero values cause printout of the following matrices (ref. 9): 1 print V_{ij} 2 print A_{ij} 3 print V_{ij} and A_{ij} (output is voluminous for large cases)
		NCODE (Col. 69)	Always zero or blank.
		NNON (Cols. 70,71)	Always zero or blank.
		NSYM (Col. 72)	Number of symmetry planes. Same as for card 1 of PBOXC. (See p. 16.)
		NOFF (Col. 73)	Number of off-body points for which velocity calculations are to be calculated. (See cards 7)
		KMACH (Col. 74)	A non-zero value indicates that a Mach number is to be read via card 5.
		KTP14 (Col. 75)	If given a value of one, the unit 14 output is prepared. (See p. 29)
		KASE (Cols. 77-80)	Hollerith body identification.
2	IPROS, (L1)	If true, body surface data for a general body (IFLAG = 0) are to be translated, scaled, and rotated about the y axis before processing, and card 3 is to be input.	
3	ANGLE, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS, ZTRANS, (7F10.0)	This card is input only if IPROS (card 2) is true. Same as card 4 of PBOXC.	
4	LEAK, FRACT, (I4, F10.0)	LEAK	Number of quadrilaterals used to define a flow inlet in the body.
		FRACT	Fraction of the free-stream air speed that passes through the null point of each inlet quadrilateral.
		If there is no flow inlet, input a blank card. (Note: the inlet quadrilateral data (cards 6A) must be the first body data input.) (See p. 26)	

BOXC Card Input, cont.

Card No.	Variable and Format	Description
5	MACH, (F10.6)	Free-stream Mach number. This card is input only if parameter KMACH (card 1) is non-zero.
6A	X, Y, Z, STAT, XX, YY, ZZ, STATT, (3F10.0, I2/3F10.0, I2) . .	Cards 6A apply to general bodies (IFLAG = 0) Coordinates and status flags for points used to describe the body surface. Same as cards 5A of PBOXC. (See pp. 16 ff)
6B	NLM1, MMIN, B, C, (2I5, 2F10.5)	Card 6B applies to generated ellipsoids (IFLAG > 0). Same as card 5B of PBOXC. (See p. 19)
6C	x_1, z_1, x_2, z_2,.... x_{NLM1+1}, z_{NLM1+1} (8F10.0).	Cards 6C apply to generated ellipsoids for which the x,z coordinates are input. (IFLAG = 2, NSYM = 2). Same as cards 5C of PBOXC. (See p. 19)
7	X, Y, Z, STAT, XX, YY, ZZ, STATT, (3F10.0, I2/3F10.0, I2)	Off-body points for which flow velocities are to be calculated. Cards 7 are input only if NOFF (card 1) is greater than zero. STAT or STATT for the last point must be 3. If there are an odd number of points, the deck of off-body point cards should be terminated with a blank card.

SUBROUTINE FLOVEL

Given the coordinates of a point in space (XNPP, YNPP, ZNPP) and the current time step, H, used in the integration of the particle equations of motion, SR FLOVEL returns the flow velocity components (VXPP, VYPP, VZPP) at that point, and an indicator, INBODY, of whether the body surface has been penetrated. INBODY = 0 if the point is exterior to the body, but INBODY = 1 if it is detected to be inside the body.

The discussion to follow assumes that a Hess-Smith (ref. 9) flow field is being considered. However, if the user wishes to compute flow by use of some other method, for example, flow about an ellipsoid via an analytical equation, he may replace FLOVEL by a subroutine of his own design.*

SR FLOVEL is based mainly on the Hess-Smith subroutine VFORM, with modifications required to include the quadrilateral source strengths, and to set the INBODY parameter. Application of the source strengths (i.e., σ values) is straightforward, as indicated by eq. (140) of reference 9, and needs no further discussion. Determination of whether or not the body has been penetrated is discussed next.

FLOVEL calculates and sums velocities induced at the specified point by each quadrilateral. Three modes of induced velocity calculation are used (ref. 9, sec. 9.52): 1. where the distance between the point and the quadrilateral is sufficiently large the quadrilateral is approximated by a simple point source, 2. for intermediate distances the quadrilateral is approximated by a point source plus a point quadrupole, and 3. for short distances an exact calculation is used. For each quadrilateral for which

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*In the trajectory codes a call of SR SETFLO precedes the first call of FLOVEL. SETFLO reads the data stored on unit 14 by PGM BOXC (see p. 29), which data are required by FLOVEL for calculation of a Hess-Smith flow velocity, and puts these data into COMMON storage. If a user-designed version of FLOVEL is used, SETFLO must be replaced by a dummy subroutine.

the exact calculation is required the following tests are made in sequence, and if any one is satisfied, penetration is taken not to have occurred:

1. The vector of separation between the point and the center of the quadrilateral is projected onto the normal vector to the quadrilateral, and the sign of the projection is checked to see if the point is on the exterior side of the quadrilateral.

2. If the distance of the point to the center of the quadrilateral is greater than one-half of the maximum quadrilateral diagonal, penetration of the quadrilateral has not occurred.

3. If the absolute value of the projection calculated in test 1 is greater than the time step, H, penetration of the quadrilateral has not occurred.

For test 3 we assume that the maximum particle speed is about unity, so that the maximum distance a particle can travel in one time step is roughly H.

These tests are applicable only during trajectory calculations when the particle is advancing by small steps such that if penetration occurs the particle will be close to the point of penetration when the tests are made. The tests will not give a penetration indication for interior points that are not close to the body surface.

PROGRAM FLOPNT

General Description

This program computes flow velocities at an array of points in three-dimensional space. The array is oriented parallel with the three coordinate axes. Flow velocities are computed by SR FLOVEL, which uses data that, for example, are prepared by program BOXC for flow about an arbitrary three-dimensional body.

Initial coordinates, array increment values along the three coordinate directions and the number of increments desired along each direction (including the initial point) are input. Also input are integers M(3) which control the order of incrementing along three axes. For example, suppose M(1) = 3, M(2) = 1, M(3) = 2:

1. The x and z coordinates are held fixed while y is incremented over its range.

2. y is returned to its initial value, z is incremented once, and y is incremented over its range.

3. This is repeated until z covers its complete range.

4. z is returned to its initial value, x is incremented once, and y is incremented over its complete range.

5. etc.

The printed output is self-explanatory and consists of point coordinates, velocity components and speed.

If data prepared by BOXC are used, SR SETFLO reads these data from unit 14; units 5 and 6 are used for input and printing, respectively.

Subroutines called are: SETFLO, FLOVEL.

FLOPNT Card Input

Card No.	Variables and Format	Description
1	KASE, (A4)	Body identification. Read by SR SETFLO, and must be identical to the identification on card 1 of BOXC.
2	HOLL(18), (18A4)	Run identification.
3	M(3), (3I2)	Coordinate incrementation sequence control. (See discussion above.)
4	X(I), D(I), N(I); I = 1 (2E10.0, I4)	X(1) initial x coordinate, D(1) x coordinate increment (dimensionless); N(1) number of increments desired in the x direction (including initial value).
5	X(I), D(I), N(I); I = 2	Same as card 4 but for the y axis.
6	X(I), D(I), N(I); I = 3	Same as card 4 but for the z axis.
3'	Cards 3 - 6 are repeated for another array.	
.	.	
.	.	
.	.	
.	.	
.	.	
3	Blank card	A blank card 3 terminates the run.

TRAJECTORY CODE DESCRIPTIONS

GENERAL UTILITY CODES

Subroutine PARTCL

Subroutine PARTCL is called by all three of the executive trajectory codes (Table 1B) to input particle specification data and compute still-air, terminal particle settling speed and other data depending on particle type. This is a particle type - specific code, the version used here being for water drops. It calls SR FALWAT.

Subroutine TRAJECT

Trajectories are calculated by SR TRAJECT with the assistance of: SR DVDQ, the numerical integrator code, SR FLOVEL and the functions PRFUN and IMPACT. It also stores trajectory point coordinates at user-specified (normalized) time intervals (TPRINT) in arrays XPLOT(60), YPLOT(60), ZPLOT(60), providing logical parameter IPLOT is specified as true.

Function PRFUN

Function PRFUN is a particle type - specific code which is called by TRAJEC to provide the N_D - N_R relation used in calculating the particle equations of motion (eq. (1)). Actually, through use of the pre-calculated quantity COF (= $N_{D,s} v_s N_F / N_{R,s}$), PRFUN returns the factor on the first term on the right side of eq. (1) which when multiplied by $\vec{v}_a - \vec{v}_p$ yields the particle equation of motion. The version of PRFUN used here is for water drops, and it calls functions CDRR and WCDRR.

Subroutine IMPACT

Subroutine IMPACT is called by TRAJECT following penetration of a particle into the body. When used with CONFAC, IMPACT adjusts trajectory initial y and z coordinates such as to avoid impaction by the next trajectory (see p. 44); accordingly IMPACT is a problem-specific code. No such adjustment is required for cases run under control of ARYTRJ and TANTRA*, so that a dummy version of IMPACT is used.

Subroutine SETFLO

Subroutine SETFLO reads data prepared by PGM BOXC from external unit 14. These data are required by SR FLOVEL for calculation of flow velocities about a Hess-Smith three-dimensional body. SETFLO reads a four-character Hollerith identification of the body and checks to see if it is identical to the identification obtained from unit 14. If not, a comment is printed and the calculation is stopped.

If flow around the body is calculated by some means other than the Hess-Smith method, SETFLO must be replaced with a dummy subroutine.

Subroutine DVDQ

This is the variable order, ordinary differential equation integrator of Krogh (ref. 11). Operating instructions, which have proven to be quite adequate, are found in the glossary of the DVDQ card listings. The version used here automatically adapts to the word size of the computer used.

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*Be very sure that IMPACT does not adjust initial trajectory coordinates during tangent trajectory determination under control of TANTRA.

PROGRAM ARYTRJ

General Description

SR TRAJECT is called to compute particle trajectories initiated at an array of points in three-dimensional space. Particle properties are computed by SR PARTCL and SR PRFUN. Flow velocities are computed by SR FLOVEL, which uses data that, for example, are prepared by program BOXC for flow around an arbitrary three-dimensional body. SR DVDQ integrates the particle equations of motion.

Initial coordinates of the initial point array, array increment values for the three coordinate directions and the number of increments desired along each direction (including the initial point) are input. Also input are integers M(3) which control the order of incrementing along the three axes and a skip parameter NSKIP. For example, suppose M(1) = 3, M(2) = 1, M(3) = 2:

1. The x and z coordinates are held fixed while y is incremented over its range.

2. y is returned to its initial value, z is incremented once, and y is incremented over its range.

3. This is repeated until z covers its complete range.

4. z is returned to its initial value, x is incremented once, and y is incremented over its complete range.

5. etc.

Trajectories are computed to the limiting x coordinate value XLIMIT or until penetration of the body is sensed.

If not every trajectory is desired, the parameter NSKIP is set greater than zero. Then, after the first trajectory, only every NSKIP + 1 th trajectory is computed.

Subroutines Required

FLOVEL, SETFLO, PARTCL, FALWAT, TRAJECT, IMPACT (dummy), PRFUN, DVDQ, WCDRR, CDRR

External Storage Units

Units 5 and 6 are the system input and print units, respectively.
Unit 9 is used for temporary storage.
Unit 10 is used to store trajectory data for plotting by PGM STEREO.
Unit 14 is used by SR SETFLO for input of data prepared by PGM BOXC.

Printed Output

The printed output is largely self-explanatory. For each trajectory are printed at time interval TPRINT: time, point coordinates (X, Y, Z), particle velocity components (VPX, VPY, VPZ), flow velocity components (VX, VY, VZ), time step (H), Reynolds number (R), acceleration modulus (AC) and cumulative number of flow velocity computations (NEVAL). (All dimensionless)

Other quantities are: angle between the projection of the initial flow velocity vector in the z = 0 plane and the x axis (ALPHAO), angle between the initial flow velocity vector and its projection in the z = 0 plane (BETAO), angle between the projection of the final particle velocity vector in the z = 0 plane and the x axis (ALPHAR), angle between the final particle velocity vector and its projection in the z = 0 plane (BETAR), direction cosines of the drag vector at the final point, and the angle between the projection of the drag vector in the z = 0 plane and the x axis (A), and the angle between the drag vector and the z axis (GAMMA). (All angles are in degrees.)

ARYTRJ Card Input

Card No.	Variables and Format	Description
1	KASE, (A4)	Body identification. Read by SR SETFLO. Must be identical to parameter KASE on card 1 of the BOXC input.
2	HOLL (18), IPLOT, (18A4, 7X, L1)	HOLL — 72 columns of Hollerith run identification IPLOT (col. 80) — Logical variable: if true, trajectory data are written on unit 10 for plotting by PGM STEREO.
3	V, ELL, RHO, TEMP, XFINAL, (8F10.5)	V — Free stream airspeed (m s^{-1}) ELL — Characteristic dimension of the body (m). Corresponds to L as defined for eq. (1). RHO — Ambient air density (kg m^{-3}) TEMP — Ambient temperature ($^{\circ}$K) XFINAL — x coordinate for trajectory cut off (i.e., maximum x coordinate) (normalized, dimensionless)
4	TPRINT, HI, HMINI, EPSI(3), (8F10.5)	TRRINT — Time interval for trajectory point print. Default value = 0.1. HI — Initial numerical integration time step. (See SR DVDQ). Default value = 0.1 HMINI — Initial numerical integration minimum time step. (See SR DVDQ). Default value = .005. EPSI(3) — Parameters used to control numerical integration local error. (See SR DVDQ). Default values = 1.0E-5. All normalized, dimensionless.
5	DIAM, (7F10.0)	Water drop diameter (μm). This card is read by SR PARTCL.
6	M(3), NSKIP, (4I4)	M(3) — Array incrementation control NSKIP — Array skip parameter (See discussion above.)
7	X(I), D(I), N(I); I = 1 (2F10.0, I4)	X(1) — Initial x coordinate (dimensionless) D(1) — x coordinate increment (dimensionless) N(1) — Number of increments desired in the x direction (including the initial value)
8	X(I), D(I), N(I); I = 2	Same as card 7, but for the y direction.
9	X(I), D(I), N(I); I = 3	Same as card 7, but for the z direction.
5'	Cards 5 - 9 are repeated for another particle and another array	
. . . .	. . . .	
5	Blank card	A blank card 5 terminates the run.

PROGRAM CONFAC

General Discussion

Program CONFAC computes trajectories to user-specified target points. It operates in two modes:

1. Single trajectories are calculated to each target point (NW = 0).

2. A central trajectory is computed to the target point, and NW trajectories, evenly spaced about a circle in the target plane of radius RW about the central trajectory, are calculated such as to define a particle flux tube.

Mode 2 is used to calculate concentration factor, C_F, which is the ratio of particle flux at the target point to the free-stream particle flux. It is easy to show that

$$C_F \approx \frac{\text{area of flux tube cross section in the free stream}}{\text{area of flux tube cross section at the target point}}$$

The areas are those of plane polygons of NW vertices as calculated by SR POLYGON. Concentration ratio, C_M, the ratio of particle concentration at the target point to free stream concentration, is obtained via the relation

$$C_M = C_F/|\vec{v}_p| \quad .$$

The desired trajectories are calculated by an iterative method which finds a trajectory that passes within a user-specified distance tolerance (RW*TOL) of the desired target point. To initialize, the user may input four sets of coordinate guesses: two sets of y and z coordinates for the initial and target planes. No special care need be taken in making these guesses since convergence should be rapid as long as the coordinates are in the correct general neighborhood. On default of input, the initial coordinate guesses are supplied by the code.

The trajectory iteration procedure is described in detail in reference 1. (See pp. 13 - 16 and Appendix A.) SR MAP controls the iteration and calls SR TRAJECT to calculate trajectories. If convergence is not achieved after calculating twenty-five trajectories, the calculation proceeds to the next particle or stops. The limiting number of trajectories can be changed by changing the value of ILIM in a DATA statement in SR MAP.

SR IMPACT is a problem-specific code whose purpose is to adjust trajectory initial y and z coordinates when penetration of the body occurs such that penetration will be avoided on the next attempt. After twenty-five penetrations, the calculation proceeds to the next particle or stops. The limiting number of penetrations can be changed by changing the value of JLIM in PGM CONFAC.

Subroutines Required

FLOVEL, MAP, PARTCL, POLYGON, DVDQ, SETFLO, FALWAT, PRFUN, IMPACT, TRAJECT, TRANSFM, MATINV, WCDRR, CDRR.

External Storage Units

Same as for ARYTRJ.

Printed Output

The printed output is largely self-explanatory, and contains all of the data described for PGM ARYTRJ.

Detailed trajectory data are printed only for the final trajectory which is the result of a successful convergence to the desired target point. For other trajectories, only the initial and final y and z coordinates are printed. Except for the initial coordinate guesses, these coordinates are given in the "flux tube coordinate system", and are so identified and distinguished in the output from the "flow coordinate system". The "flow system" is the coordinate system (normalized) by use of which the body is described and the flow is computed. The "flux tube system" at any point along the trajectory has its origin at the flux tube center and its y and z axis in the plane normal to the central trajectory. Flux tube system coordinates are given in the initial and target planes in the output.

For cases where flux tubes are calculated, a summary of the initial and final coordinates of all NW + 1 trajectories are printed, the areas of the polygons with NW vertices in the initial and final planes are printed, and the concentration factor and concentration ratio are printed.

CONFAC Card Input

Card No.	Variables and Format	Description
1	KASE, (A4)	Body identification. Read by SR SETFLO. Must be identical to parameter KASE on card 1 of the BOXC input.
2	HOLL(18), IPLOT, (18A4, 7X, L1)	HOLL — 72 columns of Hollerith run identification. IPLOT (col. 80) — Logical variable: if true, trajectory data are written on unit 10 for plotting by PGM STEREO.
3	V, ELL, RHO, TEMP, XSTART, (8F10.5)	V — Free stream airspeed (m s^{-1}) ELL — Characteristic dimension of the body (m). Corresponds to L as defined for eq. (1). RHO — Ambient air density (kg m^{-3}). TEMP — Ambient temperature (^{o}K). XSTART — Initial x coordinate of trajectory. (normalized, dimensionless)
4	TPRINT, HI, HMINI, EPSI(3), (8F10.5)	Same as for ARYTRJ.
5	NW, RW, TOL, (I10, 7F10.5)	NW — Number of trajectories used to define flux tube peripheries for concentration factor calculation. If NW = 0, single trajectories are calculated to target points defined by cards 9.
6	YE(I), ZE(I), YI(I), Z(I); (I = 2), (8F10.5)	YE, ZE — Initial guesses of trajectory y and z coordinates in the target plane.
7	YE(I), ZE(I), YI(I), Z(I); (I = 3), (8F10.5)	YI, ZI — Initial guesses of trajectory coordinates in the initial plane. These coordinates are in the coordinate system used to define the body and the flow field (normalized, dimensionless). The data in the two cards can be very approximate, but if not blank, the two cards should not be identical. On input of two blank cards, the code supplies default estimates based on the first target coordinates.
8	DIAM, (7F10.0)	Water drop diameter (μm). This card is input by SR PARTCL.
9	XW, YW, ZW, (8F10.5)	x,y,z coordinates of the target point (normalized, dimensionless).
8'	Cards 8 and 9 are repeated for as many particles as desired.*	
9'		
.	.	
.	.	
.	.	
.	.	
8	Blank card	A blank card 8 terminates the run.

*Previous trajectory y and z coordinates are used as trajectory iteration initialization estimates for each new target point. Thus, if target points are widely spaced, separate runs should be made for each.

PROGRAM TANTRA

General Discussion

The purpose of this code is to compute tangent particle trajectories to a three-dimensional body. The code is designed to be as general and as automatic as practical, but owing to the unlimited number of geometrical possibilities in three dimensions, some compromise is necessary. Since we cannot know a priori what parts of a body the tangents will touch, we do not, in general, have the option of specifying target points on the body or even target planes through the body. Therefore, we specify curves in the free stream well ahead of the body on which all trajectories are initiated for a particular tangent determination.

Given the equation of the starting-point curve and an initial point on the curve, the code computes the trajectory from this point toward the body until penetration of the body occurs or until a specified x-coordinate stop point is reached. If penetration occurs, a specified coarse step is taken along the starting-point curve in direction away from the body, and another trajectory is computed. If penetration does not occur, the coarse step is taken along the starting-point curve in direction toward the body, and another trajectory is calculated. Once penetration occurs for trajectories that initially miss the body, or the reverse for trajectories that initially impact, the initial point is backed up one step along the curve away from the body if necessary, and the process of stepping toward the body is resumed with a fine step size until the tangent trajectory is found. Thus, the tangent trajectory misses the body by no greater than the tolerance implied by the fine step size. Note that this does not imply that the tolerance is the fine step size. Separation of trajectories in the free stream will not be the same as separation of the same trajectories near the body, nor even approximately the same except for very large, heavy particles which have sufficient inertia to essentially ignore the flow around the body. In general, trajectory separations near the body will be less than in the free stream.

Specification of the starting-point curve is done via SR STRPNT, which in the version supplied uses straight line curves. The user provides the coordinates of two points on the line:

Point 1. Initial coordinates of the initial trajectory

Point 2. Coordinates of any other point on the line which is closer to the body than Point 1.

Point 2 must be closer to the body than Point 1 to ensure that stepping along the starting-point curve proceeds in the proper direction. Point 2 need not be, and in general will not be, the initial point of a trajectory. Note that both of these points must be sufficiently far upstream to be essentially in the free stream. Also specified are the coarse and fine stepping distances. All coordinates and distances are normalized. (See eq. (1).)

If so specified (IPLOT = true), tangent trajectory data are stored on unit 10 for plotting later by PGM STEREO.

Subroutines Required

FLOVEL, SETFLO, PARTCL, FALWAT, STRPNT, TRAJECT, IMPACT*, PRFUN, DVDQ, WCDRR, CDRR.

External Storage Units

Same as for ARYTRJ.

Printed Output

Trajectory data are as described for PGM ARYTRJ and are printed for every trajectory computed regardless of whether or not the trajectory is

*Be sure that IMPACT is a dummy subroutine. Resetting of initial trajectory coordinates by SR IMPACT will ruin a tangent trajectory determination.

accepted as the tangent trajectory. Beyond that, the output is fully labeled and self-explanatory. All input data are printed: including the points used to define the starting-point line, coarse and fine increments, and starting point coordinates. The switching from coarse to fine step size is clearly identified, as are the tangent trajectory data.

TANTRA Card Input

Card No.	Variables and Format	Data Description
1-4		Cards 1 through 4 are the same as for ARYTRJ.
5	DIAM, (7F10.0)	Water drop diameter (μm). This card is read by SR PARTCL.
6	DCORS, DFINE, (8F10.0)	Respectively, the coarse and fine step sizes to be used in stepping along the starting-point line (normalized, dimensionless). Card 6 is read by SR STRPNT.
7	X,Y,Z,X1,Y1,Z1, (8F10.0)	X,Y,Z — Coordinates of Point 1, which specifies the initial trajectory coordinates on the starting-point line (normalized, dimensionless). X1,Y1,Z1 — Coordinates of Point 2, which is any point on the starting-point line that is closer to the body than Point 1 (normalized, dimensionless). Note that the starting-point line should be far enough upstream of the body to be essentially in the free stream. Card 7 is read by SR STRPNT.
6' 7'		Cards 6 and 7 are repeated for as many trajectories as desired.
6	Blank card	A blank card 6 signals end of calculation for this water drop, and another card 5 is read.
5' 6" 7" . . .		
6	Blank card	
5	Blank card	A blank card 5 terminates the run.

PROGRAM STEREO

General Discussion

Program STEREO is used to plot results of the trajectory calculations. Both body and trajectories are plotted. The body data are obtained from unit 9, on which the data were stored by SR PINPUT under control of PGM PBOXC, and the trajectory data are obtained from unit 10, on which the data were stored under control of either ARYTRJ, CONFAC or TANTRA.

Plots are prepared in pairs, members of a pair being separated by a specified angle on each side of a specified viewing direction. Proper specification of the angles, which usually requires some trial-and-error-experimentation, may provide plots which can be used for stereo viewing as illustrated by Figure 6.

The viewing direction is defined by specifying two angles, THETA and PSI. The operation of these angles is as follows: We assume a right-handed coordinate system with its positive z axis directed upward and the free-stream flow in the direction of the positive x axis. First rotate the coordinate system about the y axis by angle THETA such that positive THETA tilts the positive x axis upward. Then rotate about the new z axis by angle PSI such that for positive PSI the rotation is clockwise when viewed from above. The view direction separation angle, DELTA is applied to angle PSI such that the members of a stereo pair are actually viewed from angles THETA, PSI-DELTA and THETA, PSI + DELTA, and are plotted in that order.

For a particular case (i.e., body and set of trajectories), the user must specify the number of trajectories and the (upstream) x coordinate at which plotting of the trajectory data is to be begun. This need not have the same value as the initial x coordinates of the data stored on unit 10.

Translating and scaling of the data such that it will properly fit into the plot area is handled automatically by the program.

Only system and plot subroutines are required.

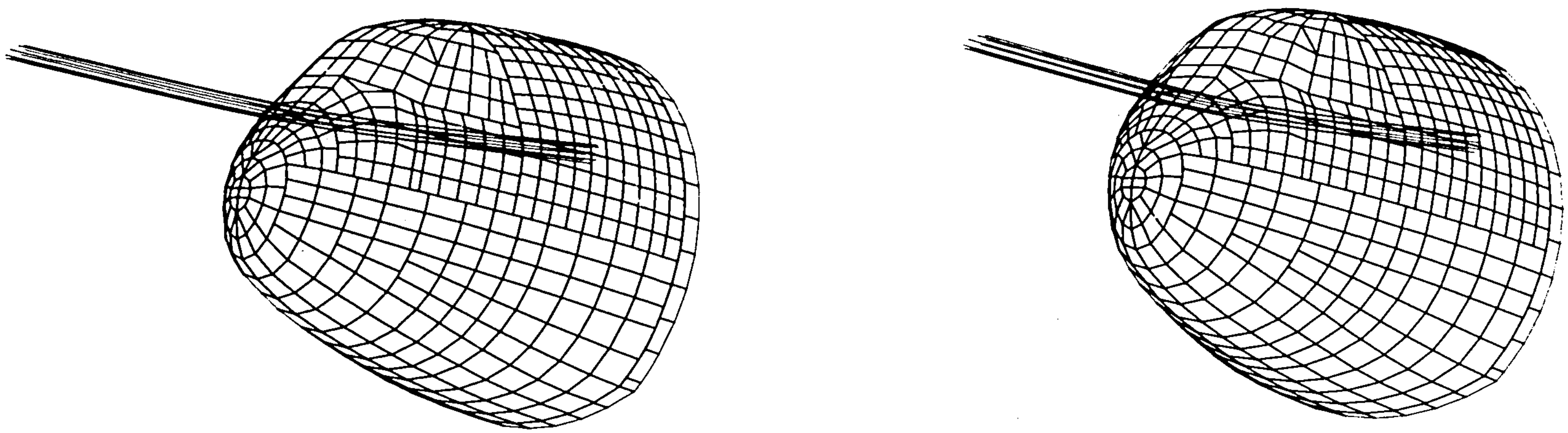

Figure 6. Stereographic plots of an eight-trajectory, 20 μm-diameter water drop flux tube to a particle replicator mounted on the forward fuselage of a Lockheed C130A airplane. The central trajectory is also shown. $C_F = 1.15$. (Ref. 1) Three-dimensional perspective can be attained by staring at the center of the figure and then crossing the eyes such that the two images merge.

External Storage Units

Units 5 and 6 are the system input and print units.

Unit 9 contains the three-dimensional body surface data, plus some scaling information, as stored by SR PINPUT.

Unit 10 contains the trajectory data as stored under control of PGMS ARYTRJ, CONFAC or TANTRA.

Printed Output

The printed output is simple. It consists of a run identification, the input data and some scaling information. For each trajectory is printed: 1. the coordinates (XTRAJ, YTRAJ, ZTRAJ) of each point before translation, scaling and projection onto the plot plane, and 2. the translated, scaled and projected coordinates (XPLOT, YPLOT) of each point plotted.

STEREO Card Input

Card No.	Variables and Format	Description	
1	HOLL(18), (18A4)	72 columns of Hollerith run identification.	
2	ICRT, NTRJS, XSTART, (L1, I9, F10.0)	ICRT	A logical variable which when true causes plotting to be via CRT. Otherwise, plotting is via pen and ink.
		NTRJS	Number of trajectories to be plotted.
		XSTART	x coordinate at which trajectory plotting is to begin. Need not correspond to the initial x coordinates of trajectories stored on unit 10.
3,4	LINE1, LINE2, (7A6/7A6)	Cards 3 and 4 are read only if ICRT is true (card 2). Two lines of 42 columns each of Hollerith labeling for a microfiche film.	
5,6	THETA, PSI, DELTA, HLABEL(18), (3F10.2/ 18A4)	THETA PSI DELTA	Viewing angles and viewing angle separation (degrees). (See definitions above.)
		HLABEL	72 columns of Hollerith labeling for the plots.
5',6'	Cards 5 and 6 are repeated for as many additional plot pairs as desired.		
5,6	Blank cards	Blank cards 5 and 6 terminate the run.	

VALIDATION

PRIOR WORK

Hess and Smith (refs. 9 and 10) present results of a wide range of studies where flow velocities and pressures calculated by their method are compared with other theory and with experiment. Outstanding agreement with the data from other sources is evident.

In reference 1 we present results of several studies that examine accuracy of the trajectory calculations. To check accuracy of the numerical integrations we computed trajectories of 1 μm diameter water drops in axisymmetric airflow about an ellipsoid of fineness ratio 2 and found the largest deviation from the stream line flow to be 0.006%. Thus very small particles are computed to essentially follow the stream flow as they should do.

To determine differences between trajectories computed by a body constructed from Hess-Smith panels and a body with an analytically defined surface, we computed trajectories of water drops about ellipsoids of fineness ratio 2 of both types in axisymmetic air flow at 5 kft altitude in a standard atmosphere (ref. 1). The Hess-Smith ellipsoid was constructed from 1800 panels, and the length of the semi-major axes of the ellipsoids was taken to be 4.67m. Results are shown in Fig. 7 for comparison of trajectory intersections with the extended minor axis. All of the Hess-Smith points are slightly farther from the ellipsoid surface than the analytical points, but the discrepancies are not large. The largest discrepancy, for 100 μm drops at 31 cm, is very atypical in that this point is on the edge of a shadow zone, where: trajectory distortions are near their maxima, concentration factors become very large, and we expect and find "pathlogical" computational results caused by trajectories crossing each other in this region of extremely high concentration gradients.

Also in reference 1 we compare our tangent trajectories with those calculated by Dorsch et al. (ref. 19) for axisymmetric flow about an ellipsoid

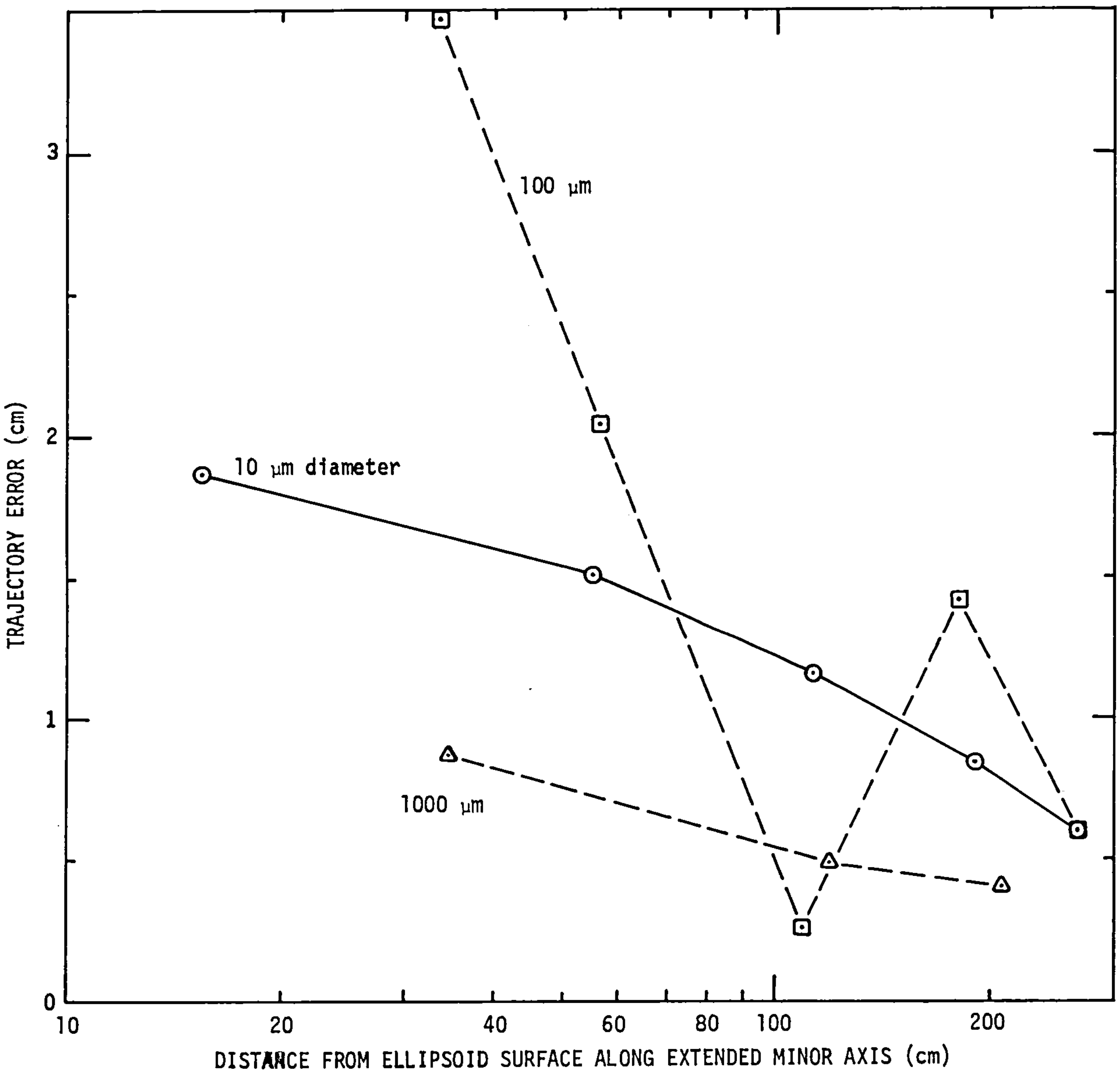

Figure 7. Comparison of water drop trajectories about an ellipsoid of fineness ratio 2 using exact and approximate potential airflow. The ellipsoid semi-minor axis is of length 2.335m. (From ref. 1)

of fineness ratio 5 for the two conditions of flow and particle size given in Figure 4 of reference 19. Particle equations of motion without gravity were used. In terms of the distance of the tangent trajectory from the symmetry axis in the free stream, r_0, we have

Stokes Number	Free Stream Reynolds Number	r_0 Dorsch, et al., ref. 19	r_0 Norment and Zalosh, ref. 1
1	4096	.077	.075
1/30	512	.020	.015

Here r_0 is a fraction of the ellipsoid semi-major axis length. Differences in our method of calculation and that of Dorsch et al. are discussed in the next section.

ADDITIONAL VERIFICATION

The work of comparison of calculated tangent trajectories to an ellipsoid of fineness ratio 5 with those calculated by Dorsch et al. (ref. 19) was extended to include cases given in Table 1 of reference 19. Three cases were chosen for study as follows:

Altitude: 5000 ft Temperature: 20°F

Water droplet diameter: 20 μm

Ellipsoid semi-major axis length: 5 ft.

Free stream speeds: 100, 300, 500 mph.

The Dorsch, et al. calculations were done neglecting gravity, with use of very early drag data and the equations of motion were integrated with a mechanical differential analyser. Our calculations included gravity and were done by the codes described herein. In both studies flow about an analytical ellipsoid was used. Our calculations were three-dimensional, but confined to the y = 0 plane. To account for effects of gravity (i.e., droplet settling) we calculated tangent trajectories above and below the ellipsoid and averaged the results. (If r_0 values are adjusted for droplet settling between initial and impact points, the result is the same as the average r_0 values obtained from the above and below tangent trajectories.) Results are:

Free Stream Speed (mph)	r_0 Dorsch, et al., Ref. 19	This Study Upper Side	This Study Lower Side	This Study Average
100	.024	.0198	.0174	.019
300	.041	.0373	.0365	.037
500	.054	.0460	.0456	.045

Lewis and Ruggeri (ref. 20) present experimental data obtained in the NACA Lewis wind tunnel used for icing studies. Data were obtained at constant free stream airspeed and atmospheric conditions for axisymmetric flow about an ellipsoid of fineness ratio 2.5. Local impingment efficiencies were measured as a function of s/R (s is the distance measured aftward along the ellipsoid surface from the nose of the ellipsoid, and R is the semi-minor ellipsoid axis) for four narrow distributions of droplet sizes. The relevant datum here is the maximum s/R for each droplet distribution which is produced by the maximum droplet diameter, δ_{max}, in its distribution.

Lewis and Ruggeri give the following flow and dimensional data:

Free stream speed: 157 kts (80.767 m s^{-1})
Temperature: 50°F (283.16°K)
Pressure: 28" Hg (94583 Pa)
Semi-minor ellipsoid axis: 15 inches (0.381m)

We calculate air density to be 1.1637 kg m^{-3}.

Lewis and Ruggeri also give theoretical s/R results. Our calculations were done as described previously in this section. x,z coordinates of limiting impingement points were converted to $(s/R)_{max}$ values by a graphical method. Results are as follows:

	$(s/R)_{max}$ From Ref. 20					
δ_{max} (μm)	Exp. Mean from Figs. 10,23	Theor. from Fig. 23	% Error Relative to Exp.	$(s/R)_{max}$ This Study	% Error Relative to Exp.	% Error Relative to Ref. 20 Theory
24	.23	.52	+160	.385	+67	-26
35	.405	.75	+ 88	.648	+60	-14
45	.525	.9	+ 64	.847	+61	- 6
64.5	.745	1.2	+ 60	1.18	+58	-1.7

Note that in all cases our calculations are closer to the experimental values, though for the larger particles our theoretical results differ little from those reported by Lewis and Ruggeri.

EXAMPLE PROBLEMS

GENERAL DISCUSSION

Example card input data are given below and printouts are presented in the microfiche addition included with this report for each of the seven codes listed in Table 1. A special three-dimensional test body, which is described in the next section, was used for the calculations.

All of the codes use less than 65,000 central processor storage words, and most use substantially less. Program BOXC uses the most storage and STEREO uses the least.

Total running times on the UNIVAC 1100/42 computer at NASA Lewis Research center for the example problems are:

Code	Total Running Time (minutes : seconds)
PBOXC	0:54
BOXC	4:23
FLOPNT	0:39
ARYTRJ	1:24
CONFAC	2:44
TANTRA	2:47
STEREO	0:47

THE TEST BODY

A special asymmetric test body was designed and is described in terms of 189 Hess-Smith panels. A listing of the data cards for the body follows the PBOXC card input below, and Fig. 8 shows computer plots of the body.

The structure of the body is as follows:

1. The more pointed end, which faces the free stream flow, is half of a prolate ellipsoid

$$\frac{x^2}{9} + \frac{y^2}{4} + z^2 = 1; \; -3 \le x \le 0.$$

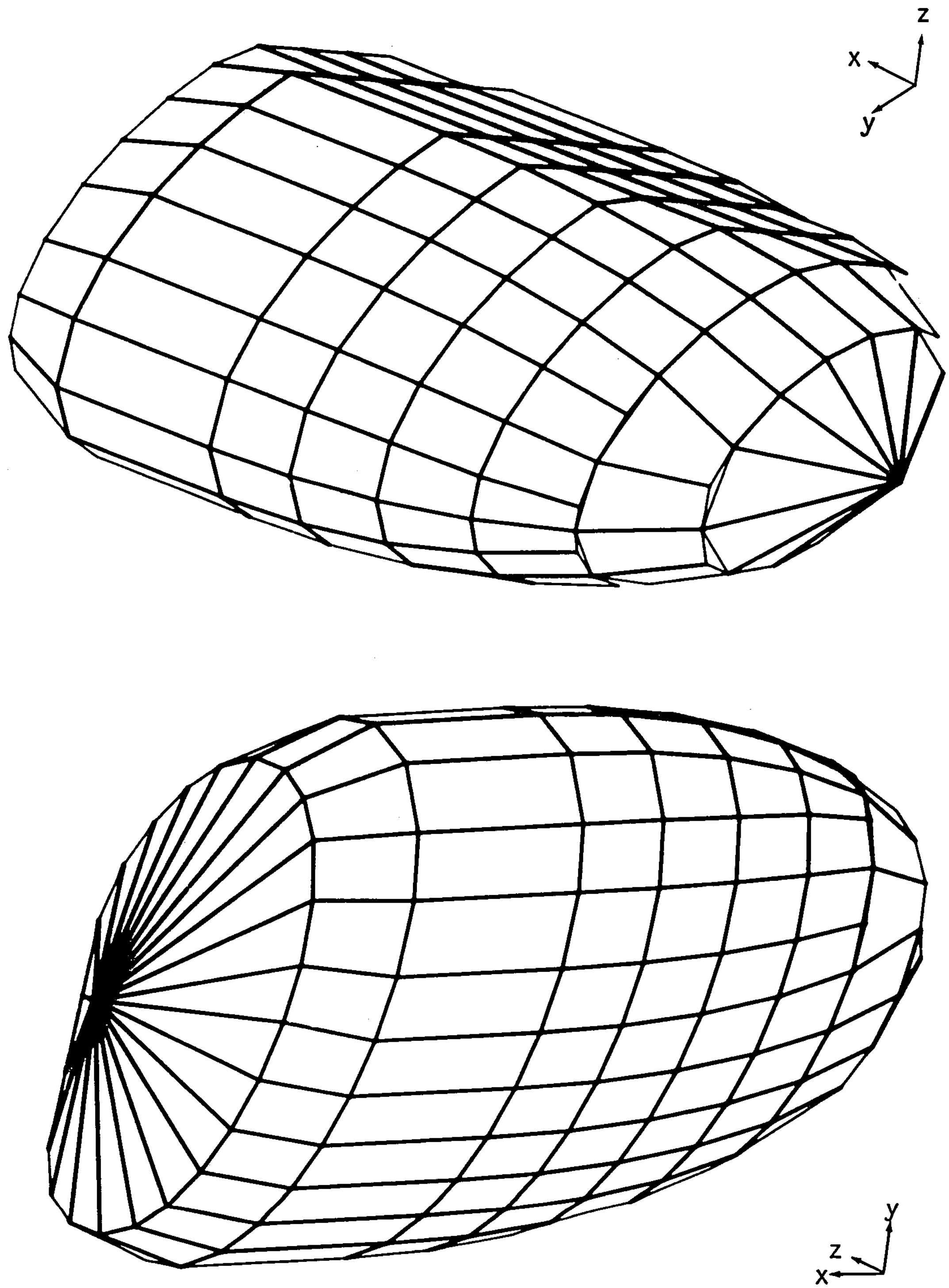

Figure 8. Asymmetric test problem body.

2. The central section is a cylinder

$$\frac{y^2}{4} + z^2 = 1 \; ; \quad 0 \leq x \leq 1.$$

3. The blunt end is half of an oblate ellipsoid

$$(x - 1)^2 + \frac{y^2}{4} + z^2 = 1 \; ; \quad 1 \leq x \leq 2.$$

4. The body is truncated by the plane

$$y - 2z = 2.$$

EXAMPLE PROBLEM/CARD INPUT AND PRINTOUT

PBOXC

Card No.*	Cols. 1–20	Col. 33	Col. 36	Col. 46	Cols. 72–76	Cols. 77–80
1	TEST BØDY					TEST
3	FFTTT					
5A	2.0	2	1	1	SMBD	1
	2.0		1	2	SMBD	2
	2.0		1	3	SMBD	3
	(See data card listing which follows.)					
6	TEST BØDY PLØTS					
7	02/14/80					

*Card numbers are the same as those given in the code description section.

Numbers punched in columns 35-36 and 45-46 correspond to the m and n designations used to organize the data. They are not read by the computer. (See pp. 16 ff.)

Test Problem Data Cards

Columns: 10 20 30 32

2.0			2	1	1	SMBD	1
2.0				1	2	SMBD	2
2.0				1	3	SMBD	3
2.0				1	4	SMBD	4
2.0				1	5	SMBD	5
2.0				1	6	SMBD	6
2.0				1	7	SMBD	7
2.0				1	8	SMBD	8
2.0				1	9	SMBD	9
2.0				1	10	SMBD	10
2.0				1	11	SMBD	11
2.0				1	12	SMBD	12
2.0				1	13	SMBD	13
2.0				1	14	SMBD	14
2.0				1	15	SMBD	15
2.0				1	16	SMBD	16
2.0				1	17	SMBD	17
2.0				1	18	SMBD	18
2.0				1	19	SMBD	19
2.0				1	20	SMBD	20
2.0				1	21	SMBD	21
2.0				1	22	SMBD	22
2.0				1	23	SMBD	23
2.0				1	24	SMBD	24
1.5	1.7320	0.0	1	2	1	SMBD	25
1.5	1.67	0.2297		2	2	SMBD	26
1.5	1.46	0.4659		2	3	SMBD	27
1.5	1.14	0.6520		2	4	SMBD	28
1.5	0.8	0.7681		2	5	SMBD	29
1.5	0.4	0.8426		2	6	SMBD	30
1.5	0.0	0.8660		2	7	SMBD	31
1.5	-0.4	0.8		2	8	SMBD	32
1.5	-0.8	0.6		2	9	SMBD	33
1.5	-1.2	0.4		2	10	SMBD	34
1.5	-1.6	0.2		2	11	SMBD	35
1.5	-1.7320	0.0		2	12	SMBD	36
1.5	-1.67	-0.2297		2	13	SMBD	37
1.5	-1.46	-0.4659		2	14	SMBD	38
1.5	-1.14	-0.6520		2	15	SMBD	39
1.5	-0.8	-0.7681		2	16	SMBD	40
1.5	-0.4	-0.8426		2	17	SMBD	41
1.5	0.0	-0.8660		2	18	SMBD	42
1.5	0.4	-0.8426		2	19	SMBD	43
1.5	0.8	-0.7681		2	20	SMBD	44
1.5	1.14	-0.6520		2	21	SMBD	45
1.5	1.46	-0.4659		2	22	SMBD	46
1.5	1.67	-0.2297		2	23	SMBD	47
1.5	1.7320	0.0		2	24	SMBD	48
1.0	2.0	0.0	1	3	1	SMBD	49
1.0	1.87	0.3546		3	2	SMBD	50
1.0	1.6	0.6		3	3	SMBD	51
1.0	1.2	0.8		3	4	SMBD	52
1.0	0.8	0.9165		3	5	SMBD	53
1.0	0.4	0.9798		3	6	SMBD	54
1.0	0.0	1.0		3	7	SMBD	55
1.0	-0.4	0.8		3	8	SMBD	56

1.0	-0.8	0.6		3	9	SMBD 57
1.0	-1.2	0.4		3	10	SMBD 58
1.0	-1.6	0.2		3	11	SMBD 59
1.0	-2.0	0.0		3	12	SMBD 60
1.0	-1.87	-0.3546		3	13	SMBD 61
1.0	-1.6	-0.6		3	14	SMBD 62
1.0	-1.2	-0.8		3	15	SMBD 63
1.0	-0.8	-0.9165		3	1	SMBD 64
1.0	-0.4	-0.9798		3	1	SMBD 65
1.0	0.0	-1.0		3	18	SMBD 66
1.0	0.4	-0.9798		3	19	SMBD 67
1.0	0.8	-0.9165		3	20	SMBD 68
1.0	1.2	-0.8		3	21	SMBD 69
1.0	1.6	-0.6		3	22	SMBD 70
1.0	1.87	-0.3546		3	23	SMBD 71
1.0	2.0	0.0		3	24	SMBD 72
0.0	2.0	0.0	1	8	1	SMBD 73
0.0	1.87	0.3546		8	2	SMBD 74
0.0	1.6	0.6		8	3	SMBD 75
0.0	1.2	0.8		8	4	SMBD 76
0.0	0.8	0.9165		8	5	SMBD 77
0.0	0.4	0.9798		8	6	SMBD 78
0.0	0.0	1.0		8	7	SMBD 79
0.0	-0.4	0.8		8	8	SMBD 80
0.0	-0.8	0.6		8	9	SMBD 81
0.0	-1.2	0.4		8	10	SMBD 82
0.0	-1.6	0.2		8	11	SMBD 83
0.0	-2.0	0.0		8	12	SMBD 84
0.0	-1.87	-0.3546		8	13	SMBD 85
0.0	-1.6	-0.6		8	14	SMBD 86
0.0	-1.2	-0.8		8	15	SMBD 87
0.0	-0.8	-0.9165		8	16	SMBD 88
0.0	-0.4	-0.9798		8	17	SMBD 89
0.0	0.0	-1.0		8	18	SMBD 90
0.0	0.4	-0.9798		8	19	SMBD 91
0.0	0.8	-0.9165		8	20	SMBD 92
0.0	1.2	-0.8		8	21	SMBD 93
0.0	1.6	-0.6		8	22	SMBD 94
0.0	1.87	-0.3546		8	23	SMBD 95
0.0	2.0	0.0		8	24	SMBD 96
-0.5	1.9720	0.0	1	9	1	SMBD 97
-0.5	1.85	0.3415		9	2	SMBD 98
-0.5	1.585	0.5866		9	3	SMBD 99
-0.5	1.195	0.7844		9	4	SMBD 100
-0.5	0.8	0.9012		9	5	SMBD 101
-0.5	0.4	0.9655		9	6	SMBD 102
-0.5	0.0	0.9860		9	7	SMBD 103
-0.5	-0.4	0.8		9	8	SMBD 104
-0.5	-0.8	0.6		9	9	SMBD 105
-0.5	-1.2	0.4		9	10	SMBD 106
-0.5	-1.6	0.2		9	11	SMBD 107
-0.5	-1.9720	0.0		9	12	SMBD 108
-0.5	-1.85	-0.3415		9	13	SMBD 109
-0.5	-1.585	-0.5866		9	14	SMBD 110
-0.5	-1.195	-0.7844		9	15	SMBD 111
-0.5	-0.8	-0.9012		9	16	SMBD 112

-0.5	-0.4	-0.9655		9	17	SMBD 113
-0.5	0.0	-0.9860		9	18	SMBD 114
-0.5	0.4	-0.9655		9	19	SMBD 115
-0.5	0.8	-0.9012		9	20	SMBD 116
-0.5	1.195	-0.7844		9	21	SMBD 117
-0.5	1.585	-0.5866		9	22	SMBD 118
-0.5	1.85	-0.3415		9	23	SMBD 119
-0.5	1.9720	0.0		9	24	SMBD 120
-1.0	1.8856	0.0	1	10	1	SMBD 121
-1.0	1.785	0.3039		10	2	SMBD 122
-1.0	1.54	0.5440		10	3	SMBD 123
-1.0	1.175	0.7374		10	4	SMBD 124
-1.0	0.8	0.8538		10	5	SMBD 125
-1.0	0.4	0.9214		10	6	SMBD 126
-1.0	0.0	0.9428		10	7	SMBD 127
-1.0	-0.4	0.8		10	8	SMBD 128
-1.0	-0.8	0.6		10	9	SMBD 129
-1.0	-1.2	0.4		10	10	SMBD 130
-1.0	-1.6	0.2		10	11	SMBD 131
-1.0	-1.8856	0.0		10	12	SMBD 132
-1.0	-1.785	-0.3039		10	13	SMBD 133
-1.0	-1.54	-0.5440		10	14	SMBD 134
-1.0	-1.175	-0.7374		10	15	SMBD 135
-1.0	-0.8	-0.8538		10	16	SMBD 136
-1.0	-0.4	-0.9214		10	17	SMBD 137
-1.0	0.0	-0.9428		10	18	SMBD 138
-1.0	0.4	-0.9214		10	19	SMBD 139
-1.0	0.8	-0.8538		10	20	SMBD 140
-1.0	1.175	-0.7374		10	21	SMBD 141
-1.0	1.54	-0.5440		10	22	SMBD 142
-1.0	1.785	-0.3039		10	23	SMBD 143
-1.0	1.8856	0.0		10	24	SMBD 144
-1.5	1.7320	0.0	1	11	1	SMBD 145
-1.5	1.67	0.2297		11	2	SMBD 146
-1.5	1.46	0.4659		11	3	SMBD 147
-1.5	1.14	0.6520		11	4	SMBD 148
-1.5	0.8	0.7681		11	5	SMBD 149
-1.5	0.4	0.8426		11	6	SMBD 150
-1.5	0.0	0.8660		11	7	SMBD 151
-1.5	-0.4	0.8		11	8	SMBD 152
-1.5	-0.8	0.6		11	9	SMBD 153
-1.5	-1.2	0.4		11	10	SMBD 154
-1.5	-1.6	0.2		11	11	SMBD 155
-1.5	-1.7320	0.0		11	12	SMBD 156
-1.5	-1.67	-0.2297		11	13	SMBD 157
-1.5	-1.46	-0.4659		11	14	SMBD 158
-1.5	-1.14	-0.6520		11	15	SMBD 159
-1.5	-0.8	-0.7681		11	16	SMBD 160
-1.5	-0.4	-0.8426		11	17	SMBD 161
-1.5	0.0	-0.8660		11	18	SMBD 162
-1.5	0.4	-0.8426		11	19	SMBD 163
-1.5	0.8	-0.7681		11	20	SMBD 164
-1.5	1.14	-0.6520		11	21	SMBD 165
-1.5	1.46	-0.4659		11	22	SMBD 166
-1.5	1.67	-0.2297		11	23	SMBD 167
-1.5	1.7320	0.0		11	24	SMBD 168

-2.0	1.4907	0.0	1	12	1	SMBD 169
-2.0	1.465	0.1378		12	2	SMBD 170
-2.0	1.322	0.3444		12	3	SMBD 171
-2.0	1.072	0.5179		12	4	SMBD 172
-2.0	0.8	0.6289		12	5	SMBD 173
-2.0	0.4	0.7180		12	6	SMBD 174
-2.0	0.0	0.7454		12	7	SMBD 175
-2.0	-0.4	0.7180		12	8	SMBD 176
-2.0	-0.8	0.6		12	9	SMBD 177
-2.0	-1.2	0.4		12	10	SMBD 178
-2.0	-1.4	0.2560		12	11	SMBD 179
-2.0	-1.4907	0.0		12	12	SMBD 180
-2.0	-1.465	-0.1378		12	13	SMBD 181
-2.0	-1.322	-0.3444		12	14	SMBD 182
-2.0	-1.072	-0.5179		12	15	SMBD 183
-2.0	-0.8	-0.6289		12	16	SMBD 184
-2.0	-0.4	-0.7180		12	17	SMBD 185
-2.0	0.0	-0.7454		12	18	SMBD 186
-2.0	0.4	-0.7180		12	19	SMBD 187
-2.0	0.8	-0.6289		12	20	SMBD 186
-2.0	1.072	-0.5179		12	21	SMBD 189
-2.0	1.322	-0.3444		12	22	SMBD 190
-2.0	1.465	-0.1378		12	23	SMBD 191
-2.0	1.4907	0.0		12	24	SMBD 192
-2.0	1.4907	0.0	2	13	1	SMBD 193
-2.0	1.322	0.3444		13	2	SMBD 194
-2.0	0.8	0.6289		13	3	SMBD 195
-2.0	0.4	0.7180		13	4	SMBD 196
-2.0	0.0	0.7457		13	5	SMBD 197
-2.0	-0.4	0.7180		13	6	SMBD 198
-2.0	-0.8	0.6		13	7	SMBD 199
-2.0	-1.2	0.4		13	8	SMBD 200
-2.0	-1.4907	0.0		13	9	SMBD 201
-2.0	-1.322	-0.3444		13	10	SMBD 202
-2.0	-0.8	-0.6289		13	11	SMBD 203
-2.0	-0.4	-0.7180		13	12	SMBD 204
-2.0	0.0	-0.7454		13	13	SMBD 205
-2.0	0.4	-0.7180		13	14	SMBD 206
-2.0	0.8	-0.6289		13	15	SMBD 207
-2.0	1.322	-0.3444		13	16	SMBD 208
-2.0	1.4907	0.0		13	17	SMBD 209
-2.5	1.055	0.0	1	14	1	SMBD 210
-2.5	1.0	0.2357		14	2	SMBD 211
-2.5	0.8	0.3815		14	3	SMBD 212
-2.5	0.4	0.5153		14	4	SMBD 213
-2.5	0.0	0.5528		14	5	SMBD 214
-2.5	-0.4	0.5153		14	6	SMBD 215
-2.5	-0.8	0.3815		14	7	SMBD 216
-2.5	-1.0	0.2357		14	8	SMBD 217
-2.5	-1.055	0.0		14	9	SMBD 218
-2.5	-1.0	-0.2357		14	10	SMBD 219
-2.5	-0.8	-0.3815		14	11	SMBD 220
-2.5	-0.4	-0.5153		14	12	SMBD 221
-2.5	0.0	-0.5528		14	13	SMBD 222
-2.5	0.4	-0.5153		14	14	SMBD 223
-2.5	0.8	-0.3815		14	15	SMBD 224

-2.5	1.0	-0.2357		14	16	SMBD 225
-2.5	1.055	0.0		14	17	SMBD 226
-2.5	1.055	0.0	2	15	1	SMBD 227
-2.5	0.8	0.3815		15	2	SMBD 228
-2.5	0.4	0.5153		15	3	SMBD 229
-2.5	0.0	0.5528		15	4	SMBD 230
-2.5	-0.4	0.5153		15	5	SMBD 231
-2.5	-0.8	0.3815		15	6	SMBD 232
-2.5	-1.055	0.0		15	7	SMBD 233
-2.5	-0.8	-0.3815		15	8	SMBD 234
-2.5	-0.4	-0.5153		15	9	SMBD 235
-2.5	0.0	-0.5528		15	10	SMBD 236
-2.5	0.4	-0.5153		15	11	SMBD 237
-2.5	0.8	-0.3815		15	12	SMBD 238
-2.5	1.055	0.0		15	13	SMBD 239
-3.0			1	16	1	SMBD 240
-3.0				16	2	SMBD 241
-3.0				16	3	SMBD 242
-3.0				16	4	SMBD 243
-3.0				16	5	SMBD 244
-3.0				16	6	SMBD 245
-3.0				16	7	SMBD 246
-3.0				16	8	SMBD 247
-3.0				16	9	SMBD 248
-3.0				16	10	SMBD 249
-3.0				16	11	SMBD 250
-3.0				16	12	SMBD 251
-3.0			3	16	13	SMBD 252

BOXC

Card No.	Cols. 1–10	Col. 31	Col. 36	Col. 46	Cols. 62–64	Cols. 73–80
1	TEST BODY				TFF	1 TEST
2						
4						
6A	2.0	2	1	1		SMBD 1
	2.0		1	2		SMBD 2
	2.0		1	3		SMBD 3

(See data card listing which follows the PBOXC input.)

FLOPNT

Card No.

```
         1 2 3 4 5 6 7 8 9 10 ... 80
         123456789012345678901234567890
1        TEST
2         TEST PROBLEM WITH TEST BODY
3         1 3 2
4        -4.5       1.         4
5         0.        0.         1
6         1.       -.5         5
3
```

ARYTRJ

```
Card
No.   1234567890123456789012345678901234567890123456789012345678901234567890123456789 80

1     TEST
2      TEST PROBLEM WITH TEST BODY
3      90.      1.0       .90925    268.659   0.
4      1.0
5      300.
6       3    1   2   2
7      -5.0     0.0          1
8      -1.0     2.0          2
9       1.0    -2.0          2
5
```

CONFAC

```
Card
No.   12345678901234567890123456789012345678901234567890123456789012345678901234567890
 1    TEST
 2     TEST PRØBLEM WITH TEST BØDY
 3     90.       1.        .90925     268.659   -5.
 4     1.
 5             4  .00328   .5
 6
 7
 8     300.
 9     -1.5      1.1       .8
 8
```

TANTRA

Card No.	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
1	TEST							
2	TEST PRØBLEM WITH TEST BØDY							T
3	90.	1.	.90925	268.659	0.			
4	1.							
5	200.							
6	.05	.005						
7	-5.	0.	-.45	-5.	0.	0.		
6								
5								

STEREO

```
Card
No.   1 2 3 4 5 6 7 8 9101112131415161718192021222324252627282930313233343536373839404142434445464748495051525354555657585960616263646566676869707172737475767778798O
1      PLØT TANGENT TRAJECTØRY TØ THE TEST BØDY
2     T        1 -5.0
3      PLØT TANGENT TRAJECTØRY TØ THE TEST BØDY
4      2/14/80
5      0.         160.      3.5
6      THETA=0, PSI=160, DELTA=3.5
5      0.         160.      3.0
6      THETA=0, PSI=160, DELTA=3.0
5      0.         160.      2.5
6      THETA=0, PSI=160, DELTA=2.5
5
6
```

Figure 9 shows a stereo pair of plots of the test body and the tangent trajectory calculated via the TANTRA test problem.

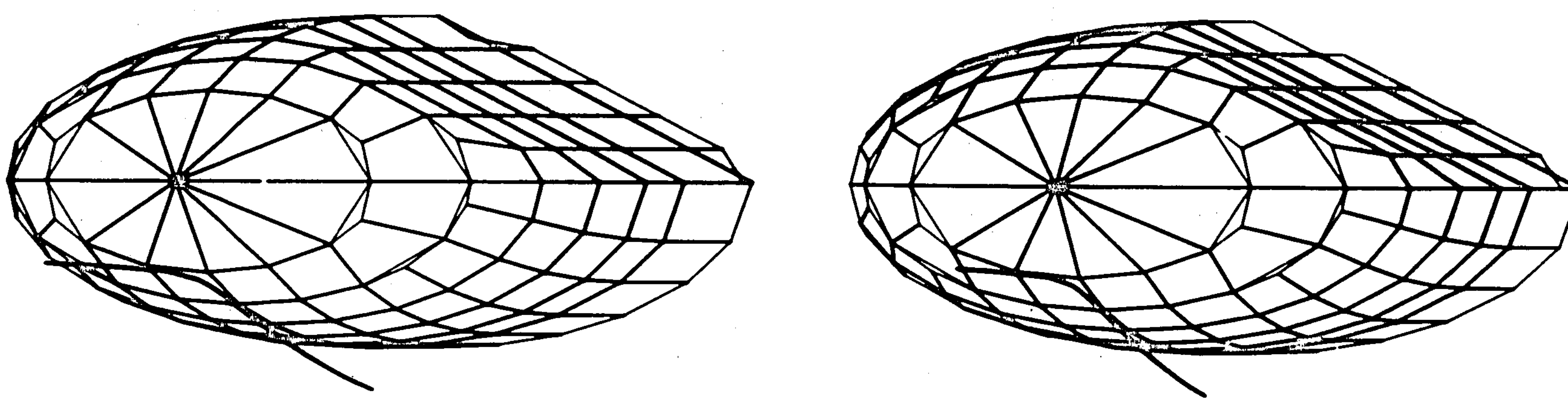

Figure 9. Stereographic plot of the tangent trajectory of a 200 μm diameter water drop to the lower side of the test body in the y = 0 plane. Plotted from the results of the TANTRA test problem. Three-dimensional perspective can be attained by staring at the center of the figure and then crossing the eyes such that the two images merge.

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MICROFICHE SUPPLEMENT TO NASA CR-3291

CONTENTS

PBOXC

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

P A R A M E T R I C   I N F O R M A T I O N

NO SYMMETRY SPECIFIED

PLOTS ARE PREPARED

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
1	1	2.000000	2.000000	1.500000	1.500000	.958086	1.591395
		0.000000	0.000000	1.670000	1.732000	.276584	1.389794
		0.000000	0.000000	.229700	0.000000	.074655	.094899
	2	2.000000	2.000000	1.500000	1.500000	.941794	1.598349
		0.000000	0.000000	1.460000	1.670000	.251249	1.254020
		0.000000	0.000000	.465900	.229700	.223380	.282927
	3	2.000000	2.000000	1.500000	1.500000	.915363	1.605113
		0.000000	0.000000	1.140000	1.460000	.202414	1.019539
		0.000000	0.000000	.652000	.465900	.348052	.445612
	4	2.000000	2.000000	1.500000	1.500000	.891771	1.609275
		0.000000	0.000000	.800000	1.140000	.146221	.750320
		0.000000	0.000000	.768100	.652000	.428210	.557494
	5	2.000000	2.000000	1.500000	1.500000	.874522	1.620269
		0.000000	0.000000	.400000	.800000	.088802	.447901
		0.000000	0.000000	.842600	.768100	.476787	.613081
	6	2.000000	2.000000	1.500000	1.500000	.865649	1.624811
		0.000000	0.000000	0.000000	.400000	.029238	.147089
		0.000000	0.000000	.866000	.842600	.499797	.641222
	7	2.000000	2.000000	1.500000	1.500000	.863087	1.626041
		0.000000	0.000000	-.400000	0.000000	-.082222	-.148316
		0.000000	0.000000	.800000	.866000	.498318	.623224
	8	2.000000	2.000000	1.500000	1.500000	.872872	1.627233
		0.000000	0.000000	-.800000	-.400000	-.218218	-.442846
		0.000000	0.000000	.600000	.800000	.436436	.524111
	9	2.000000	2.000000	1.500000	1.500000	.872872	1.618821
		0.000000	0.000000	-1.200000	-.800000	-.218218	-.751160
		0.000000	0.000000	.400000	.600000	.436436	.386778
	10	2.000000	2.000000	1.500000	1.500000	.872872	1.607148
		0.000000	0.000000	-1.600000	-1.200000	-.218218	-1.085976
		0.000000	0.000000	.200000	.400000	.436436	.242716
	11	2.000000	2.000000	1.500000	1.500000	.945063	1.589795
		0.000000	0.000000	-1.732000	-1.600000	-.272824	-1.365206
		0.000000	0.000000	0.000000	.200000	.180064	.084464
	12	2.000000	2.000000	1.500000	1.500000	.958086	1.591395
		0.000000	0.000000	-1.670000	-1.732000	-.276584	-1.389794
		0.000000	0.000000	-.229700	0.000000	-.074655	-.094899

IC SCIENCE ASSOCIATES
RD, MASSACHUSETTS

X	X	NX	NPX	D
Y	Y	NY	NPY	T
Z	Z	NZ	NPZ	A
00000	1.500000	.958086	1.591395	0.
70000	1.732000	.276584	1.389794	.1803E+01
229700	0.000000	.074655	.094899	.2076E+00
500000	1.500000	.941794	1.598349	.8882E-15
60000	1.670000	.251249	1.254020	.1758E+01
65900	.229700	.223380	.282927	.2350E+00
500000	1.500000	.915363	1.605113	.2665E-14
140000	1.460000	.202414	1.019539	.1612E+01
652000	.465900	.348052	.445612	.2299E+00
500000	1.500000	.891771	1.609275	.2665E-14
800000	1.140000	.146221	.750320	.1405E+01
768100	.652000	.428210	.557494	.1985E+00
500000	1.500000	.874522	1.620269	.9992E-15
400000	.800000	.088802	.447901	.1217E+01
842600	.768100	.476787	.613081	.2097E+00
500000	1.500000	.865649	1.624811	.2220E-15
000000	.400000	.029238	.147089	.1058E+01
866000	.842600	.499797	.641222	.2001E+00
500000	1.500000	.863087	1.626041	.2220E-15
400000	0.000000	-.082222	-.148316	.1025E+01
800000	.866000	.498316	.623224	.2007E+00
500000	1.500000	.872872	1.627233	.8882E-15
800000	-.400000	-.218218	-.442846	.1118E+01
600000	.800000	.436436	.524111	.2291E+00
500000	1.500000	.872872	1.618821	.1776E-14
200000	-.800000	-.218218	-.751160	.1360E+01
400000	.600000	.436436	.386778	.2291E+00
500000	1.500000	.872872	1.607148	.8882E-15
600000	-1.200000	-.218218	-1.085976	.1688E+01
200000	.400000	.436436	.242716	.2291E+00
500000	1.500000	.945063	1.589795	0.
732000	-1.600000	-.272824	-1.365206	.1803E+01
000000	.200000	.180064	.084464	.1833E+00
500000	1.500000	.958086	1.591395	0.
670000	-1.732000	-.276584	-1.389794	.1803E+01
229700	0.000000	-.074655	-.094899	.2076E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
1	13	2.000000	2.000000	1.500000	1.500000	.941794	1.598349
		0.000000	0.000000	-1.460000	-1.670000	-.251249	-1.254020
		0.000000	0.000000	-.465900	-.229700	-.223380	-.282927
	14	2.000000	2.000000	1.500000	1.500000	.915363	1.605113
		0.000000	0.000000	-1.140000	-1.460000	-.202414	-1.019539
		0.000000	0.000000	-.652000	-.465900	-.348052	-.445612
	15	2.000000	2.000000	1.500000	1.500000	.891771	1.609275
		0.000000	0.000000	-.800000	-1.140000	-.146221	-.750320
		0.000000	0.000000	-.768100	-.652000	-.428210	-.557494
	16	2.000000	2.000000	1.500000	1.500000	.874522	1.620269
		0.000000	0.000000	-.400000	-.800000	-.088802	-.447901
		0.000000	0.000000	-.842600	-.768100	-.476787	-.613081
	17	2.000000	2.000000	1.500000	1.500000	.865649	1.624811
		0.000000	0.000000	0.000000	-.400000	-.029238	-.147089
		0.000000	0.000000	-.866000	-.842600	-.499797	-.641222
	18	2.000000	2.000000	1.500000	1.500000	.865649	1.624811
		0.000000	0.000000	.400000	0.000000	.029238	.147089
		0.000000	0.000000	-.842600	-.866000	-.499797	-.641222
	19	2.000000	2.000000	1.500000	1.500000	.874522	1.620269
		0.000000	0.000000	.800000	.400000	.088802	.447901
		0.000000	0.000000	-.768100	-.842600	-.476787	-.613081
	20	2.000000	2.000000	1.500000	1.500000	.891771	1.609275
		0.000000	0.000000	1.140000	.800000	.146221	.750320
		0.000000	0.000000	-.652000	-.768100	-.428210	-.557494
	21	2.000000	2.000000	1.500000	1.500000	.915363	1.605113
		0.000000	0.000000	1.460000	1.140000	.202414	1.019539
		0.000000	0.000000	-.465900	-.652000	-.348052	-.445612
	22	2.000000	2.000000	1.500000	1.500000	.941794	1.598349
		0.000000	0.000000	1.670000	1.460000	.251249	1.254020
		0.000000	0.000000	-.229700	-.465900	-.223380	-.282927
	23	2.000000	2.000000	1.500000	1.500000	.958086	1.591395
		0.000000	0.000000	1.732000	1.670000	.276584	1.389794
		0.000000	0.000000	0.000000	-.229700	-.074655	-.094899
2	1	1.500000	1.500000	1.000000	1.000000	.435365	1.220560
		1.732000	1.670000	1.870000	2.000000	.855263	1.831729
		0.000000	.229700	.354600	0.000000	.281038	.149900

FOLDOUT FRAME 1

	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ	O / T / A
000	1.500000	.941794	1.598349	.8882E-15
000	-1.670000	-.251249	-1.254020	.1758E+01
900	-.229700	-.223380	-.282927	.2350E+00
000	1.500000	.915363	1.605113	.2665E-14
000	-1.460000	-.202414	-1.019539	.1612E+01
000	-.465900	-.348052	-.445612	.2299E+00
000	1.500000	.891771	1.609275	.2665E-14
000	-1.140000	-.146221	-.750320	.1405E+01
100	-.652000	-.428210	-.557494	.1985E+00
000	1.500000	.874522	1.620269	.9992E-15
000	-.800000	-.088802	-.447901	.1217E+01
600	-.768100	-.476787	-.613081	.2097E+00
000	1.500000	.865649	1.624811	.2220E-15
000	-.400000	-.029238	-.147089	.1058E+01
000	-.842600	-.499797	-.641222	.2001E+00
000	1.500000	.865649	1.624811	.2220E-15
000	0.000000	.029238	.147089	.1058E+01
600	-.866000	-.499797	-.641222	.2001E+00
000	1.500000	.874522	1.620269	.9992E-15
000	.400000	.088802	.447901	.1217E+01
100	-.842600	-.476787	-.613081	.2097E+00
000	1.500000	.891771	1.609275	.2665E-14
000	.800000	.146221	.750320	.1405E+01
000	-.768100	-.428210	-.557494	.1985E+00
000	1.500000	.915363	1.605113	.2665E-14
000	1.140000	.202414	1.019539	.1612E+01
900	-.652000	-.348052	-.445612	.2299E+00
000	1.500000	.941794	1.598349	.8882E-15
000	1.460000	.251249	1.254020	.1758E+01
700	-.465900	-.223380	-.282927	.2350E+00
000	1.500000	.958086	1.591395	0.
000	1.670000	.276584	1.389794	.1803E+01
000	-.229700	-.074655	-.094899	.2076E+00
000	1.000000	.435365	1.220560	.5764E-02
000	2.000000	.655263	1.831729	.6416E+00
600	0.000000	.261038	.149900	.1708E+00

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

P

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
2	2	1.500000	1.500000	1.000000	1.000000	.390089	1.2417
		1.670000	1.460000	1.600000	1.870000	.652170	1.6528
		.229700	.465900	.600000	.354600	.650004	.4146
	3	1.500000	1.500000	1.000000	1.000000	.324553	1.2416
		1.460000	1.140000	1.200000	1.600000	.447006	1.3516
		.465900	.652000	.800000	.600000	.833577	.6318
	4	1.500000	1.500000	1.000000	1.000000	.288009	1.2429
		1.140000	.800000	.800000	1.200000	.287154	.9857
		.652000	.768100	.916500	.800000	.913561	.7861
	5	1.500000	1.500000	1.000000	1.000000	.270929	1.2501
		.800000	.400000	.400000	.800000	.163401	.6000
		.768100	.842600	.979800	.916500	.948629	.8766
	6	1.500000	1.500000	1.000000	1.000000	.261384	1.2500
		.400000	0.000000	0.000000	.400000	.052527	.2000
		.842600	.866000	1.000000	.979800	.963805	.9220
	7	1.500000	1.500000	1.000000	1.000000	.126140	1.2460
		0.000000	-.400000	-.400000	0.000000	-.312996	-.1995
		.866000	.800000	.800000	1.000000	.941341	.8671
	8	1.500000	1.500000	1.000000	1.000000	0.000000	1.2500
		-.400000	-.800000	-.800000	-.400000	-.447214	-.6000
		.800000	.600000	.600000	.800000	.894427	.7000
	9	1.500000	1.500000	1.000000	1.000000	0.000000	1.2500
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.0000
		.600000	.400000	.400000	.600000	.894427	.5000
	10	1.500000	1.500000	1.000000	1.000000	0.000000	1.2500
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.4000
		.400000	.200000	.200000	.400000	.894427	.3000
	11	1.500000	1.500000	1.000000	1.000000	.159008	1.2167
		-1.600000	-1.732000	-2.000000	-1.600000	-.593315	-1.7392
		.200000	0.000000	0.000000	.200000	.789109	.1020
	12	1.500000	1.500000	1.000000	1.000000	.435365	1.2250
		-1.732000	-1.670000	-1.870000	-2.000000	-.855263	-1.8317
		0.000000	-.229700	-.354600	0.000000	-.281038	-.1499
	13	1.500000	1.500000	1.000000	1.000000	.390089	1.2417
		-1.670000	-1.460000	-1.600000	-1.870000	-.652170	-1.6528
		-.229700	-.465900	-.600000	-.354600	-.650004	-.4146

FOLDOUT FRA

NX NY NZ	NPX NPY NPZ	D T A
.390089	1.241719	.8288E-02
.652170	1.652830	.6561E+00
.650004	.414680	.1846E+00
.324553	1.241630	.6043E-02
.447006	1.351646	.6814E+00
.833577	.631851	.2159E+00
.288009	1.242990	.4216E-02
.287154	.985715	.6600E+00
.913561	.786135	.2025E+00
.270929	1.250180	.2656E-02
.163401	.600088	.6744E+00
.948629	.876683	.2108E+00
.261384	1.250017	.7710E-03
.052527	.200026	.6594E+00
.963805	.922094	.2075E+00
.126140	1.246098	.3153E-01
-.312996	-.199566	.6708E+00
.941341	.867167	.2125E+00
0.000000	1.250000	.3553E-14
-.447214	-.600000	.6708E+00
.894427	.700000	.2236E+00
0.000000	1.250000	.3553E-14
-.447214	-1.000000	.6708E+00
.894427	.500000	.2236E+00
0.000000	1.250000	.6661E-14
-.447214	-1.400000	.6708E+00
.894427	.300000	.2236E+00
.159008	1.216789	.3975E-01
-.593315	-1.739216	.6708E+00
.789109	.102018	.1685E+00
.435365	1.220560	.5764E-02
-.855263	-1.831729	.6416E+00
-.281038	-.149900	.1708E+00
.390089	1.241719	.8288E-02
-.652170	-1.652830	.6561E+00
-.650004	-.414680	.1846E+00

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
2	14	1.500000 -1.460000 -.465900	1.500000 -1.140000 -.652000	1.000000 -1.200000 -.800000	1.000000 -1.600000 -.600000	.324553 -.447006 -.833577	1.241630 -1.351646 -.631851
	15	1.500000 -1.140000 -.652000	1.500000 -.800000 -.768100	1.000000 -.800000 -.916500	1.000000 -1.200000 -.800000	.286009 -.287154 -.913561	1.242990 -.985715 -.786135
	16	1.500000 -.800000 -.768100	1.500000 -.400000 -.842600	1.000000 -.400000 -.979800	1.000000 -.800000 -.916500	.270929 -.163401 -.948629	1.250180 -.600088 -.876683
	17	1.500000 -.400000 -.842600	1.500000 0.000000 -.866000	1.000000 0.000000 -1.000000	1.000000 -.400000 -.979800	.261384 -.052527 -.963805	1.250017 -.200026 -.922094
	18	1.500000 0.000000 -.866000	1.500000 .400000 -.842600	1.000000 .400000 -.979800	1.000000 0.000000 -1.000000	.261384 .052527 -.963805	1.250017 .200026 -.922094
	19	1.500000 .400000 -.842600	1.500000 .800000 -.768100	1.000000 .800000 -.916500	1.000000 .400000 -.979800	.270929 .163401 -.948629	1.250180 .600088 -.876683
	20	1.500000 .800000 -.768100	1.500000 1.140000 -.652000	1.000000 1.200000 -.800000	1.000000 .800000 -.916500	.288009 .287154 -.913561	1.242990 .985715 -.786135
	21	1.500000 1.140000 -.652000	1.500000 1.460000 -.465900	1.000000 1.600000 -.600000	1.000000 1.200000 -.800000	.324553 .447006 -.833577	1.241630 1.351646 -.631851
	22	1.500000 1.460000 -.465900	1.500000 1.670000 -.229700	1.000000 1.870000 -.354600	1.000000 1.600000 -.600000	.390089 .652170 -.650004	1.241719 1.652830 -.414680
	23	1.500000 1.670000 -.229700	1.500000 1.732000 0.000000	1.000000 2.000000 0.000000	1.000000 1.870000 -.354600	.435365 .855263 -.281038	1.220560 1.831729 -.149900
3	1	1.000000 2.000000 0.000000	1.000000 1.870000 .354600	0.000000 1.870000 .354600	0.000000 2.000000 0.000000	0.000000 .938893 .344208	.500000 1.935000 .177300
	2	1.000000 1.870000 .354600	1.000000 1.600000 .600000	0.000000 1.600000 .600000	0.000000 1.870000 .354600	0.000000 .672591 .740014	.500000 1.735000 .477300

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FOLDOUT FRAME

X Y Z	NX NY NZ	NPX NPY NPZ	D T A
1.000000	.324553	1.241630	.6043E-02
-1.600000	-.447006	-1.351646	.6814E+00
-.600000	-.833577	-.631851	.2159E+00
1.000000	.286009	1.242990	.4216E-02
-1.200000	-.287154	-.985715	.6600E+00
-.800000	-.913561	-.786135	.2025E+00
1.000000	.270929	1.250180	.2656E-02
-.800000	-.163401	-.600088	.6744E+00
-.916500	-.948629	-.876683	.2108E+00
1.000000	.261384	1.250017	.7710E-03
-.400000	-.052527	-.200026	.6594E+00
-.979800	-.963805	-.922094	.2075E+00
1.000000	.261384	1.250017	.7710E-03
0.000000	.052527	.200026	.6594E+00
-1.000000	-.963805	-.922094	.2075E+00
1.000000	.270929	1.250180	.2656E-02
.400000	.163401	.600088	.6744E+00
-.979800	-.948629	-.876683	.2108E+00
1.000000	.288009	1.242990	.4216E-02
.800000	.287154	.985715	.6600E+00
-.916500	-.913561	-.786135	.2025E+00
1.000000	.324553	1.241630	.6043E-02
1.200000	.447006	1.351646	.6814E+00
-.800000	-.833577	-.631851	.2159E+00
1.000000	.390089	1.241719	.8288E-02
1.600000	.652170	1.652830	.6561E+00
-.600000	-.650004	-.414680	.1846E+00
1.000000	.435365	1.220560	.5764E-02
1.670000	.855263	1.831729	.6416E+00
-.354600	-.281038	-.149900	.1708E+00
0.000000	0.000000	.500000	0.
2.000000	.938893	1.935000	.1069E+01
0.000000	.344208	.177300	.3777E+00
0.000000	0.000000	.500000	.4885E-14
1.870000	.672591	1.735000	.1064E+01
.354600	.740014	.477300	.3649E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
3	3	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.600000	1.200000	1.200000	1.600000	.447214	1.400000
		.600000	.800000	.800000	.600000	.894427	.700000
	4	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.200000	.800000	.800000	1.200000	.279631	1.000000
		.800000	.916500	.916500	.800000	.960107	.858250
	5	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.800000	.400000	.400000	.800000	.156305	.600000
		.916500	.979800	.979800	.916500	.987709	.948150
	6	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.400000	0.000000	0.000000	.400000	.050436	.200000
		.979800	1.000000	1.000000	.979800	.998727	.989900
	7	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		0.000000	-.400000	-.400000	0.000000	-.447214	-.200000
		1.000000	.800000	.800000	1.000000	.894427	.900000
	8	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.600000	-2.000000	-2.000000	-1.600000	-.447214	-1.800000
		.200000	0.000000	0.000000	.200000	.894427	.100000
	12	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-2.000000	-1.870000	-1.870000	-2.000000	-.938893	-1.935000
		0.000000	-.354600	-.354600	0.000000	-.344208	-.177300
	13	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.870000	-1.600000	-1.600000	-1.870000	-.672591	-1.735000
		-.354600	-.600000	-.600000	-.354600	-.740014	-.477300
	14	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.600000	-1.200000	-1.200000	-1.600000	-.447214	-1.400000
		-.600000	-.800000	-.800000	-.600000	-.894427	-.700000

FOLDOUT FRA

NX NY NZ	NPX NPY NPZ	D T A
0.000000	.500000	.6661E-14
.447214	1.400000	.1095E+01
.894427	.700000	.4472E+00
0.000000	.500000	.2442E-14
.279631	1.000000	.1083E+01
.960107	.858250	.4166E+00
0.000000	.500000	.2442E-14
.156305	.600000	.1079E+01
.987709	.948150	.4050E+00
0.000000	.500000	.5551E-16
.050436	.200000	.1077E+01
.998727	.989900	.4005E+00
0.000000	.500000	.3109E-14
-.447214	-.200000	.1095E+01
.894427	.900000	.4472E+00
0.000000	.500000	.3553E-14
-.447214	-.600000	.1095E+01
.894427	.700000	.4472E+00
0.000000	.500000	.3553E-14
-.447214	-1.000000	.1095E+01
.894427	.500000	.4472E+00
0.000000	.500000	.6661E-14
-.447214	-1.400000	.1095E+01
.894427	.300000	.4472E+00
0.000000	.500000	.4441E-15
-.447214	-1.800000	.1095E+01
.894427	.100000	.4472E+00
0.000000	.500000	0.
-.938893	-1.935000	.1069E+01
-.344208	-.177300	.3777E+00
0.000000	.500000	.4885E-14
-.672591	-1.735000	.1064E+01
-.740014	-.477300	.3649E+00
0.000000	.500000	.6661E-14
-.447214	-1.400000	.1095E+01
-.894427	-.700000	.4472E+00

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
3	15	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.200000	-.800000	-.800000	-1.200000	-.279631	-1.000000
		-.800000	-.916500	-.916500	-.800000	-.960107	-.858250
	16	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.800000	-.400000	-.400000	-.800000	-.156305	-.600000
		-.916500	-.979800	-.979800	-.916500	-.987709	-.948150
	17	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.400000	0.000000	0.000000	-.400000	-.050436	-.200000
		-.979800	-1.000000	-1.000000	-.979800	-.998727	-.989900
	18	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		0.000000	.400000	.400000	0.000000	.050436	.200000
		-1.000000	-.979800	-.979800	-1.000000	-.998727	-.989900
	19	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.400000	.800000	.800000	.400000	.156305	.600000
		-.979800	-.916500	-.916500	-.979800	-.987709	-.948150
	20	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.800000	1.200000	1.200000	.800000	.279631	1.000000
		-.916500	-.800000	-.800000	-.916500	-.960107	-.858250
	21	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.200000	1.600000	1.600000	1.200000	.447214	1.400000
		-.800000	-.600000	-.600000	-.800000	-.894427	-.700000
	22	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.600000	1.870000	1.870000	1.600000	.672591	1.735000
		-.600000	-.354600	-.354600	-.600000	-.740014	-.477300
	23	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.870000	2.000000	2.000000	1.870000	.938893	1.935000
		-.354600	0.000000	0.000000	-.354600	-.344208	-.177300
4	1	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		2.000000	1.870000	1.850000	1.972000	.939127	1.923092
		0.000000	.354600	.341500	0.000000	.339980	.174052
	2	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		1.870000	1.600000	1.585000	1.850000	.675158	1.726269
		.354600	.600000	.586600	.341500	.736411	.470688
	3	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		1.600000	1.200000	1.195000	1.585000	.449471	1.395016
		.600000	.800000	.784400	.586600	.892614	.632774

FOLDOUT FRA

X	NX	NPX	D
Y	NY	NPY	T
Z	NZ	NPZ	A
0.000000	0.000000	.500000	.2442E-14
1.200000	-.279631	-1.000000	.1083E+01
-.800000	-.960107	-.858250	.4166E+00
0.000000	0.000000	.500000	.2442E-14
-.800000	-.156305	-.600000	.1079E+01
-.916500	-.987709	-.948150	.4050E+00
0.000000	0.000000	.500000	.5551E-16
-.400000	-.050436	-.200000	.1077E+01
-.979800	-.998727	-.989900	.4005E+00
0.000000	0.000000	.500000	.3553E-14
0.000000	.050436	.200000	.1077E+01
1.000000	-.998727	-.989900	.4005E+00
0.000000	0.000000	.500000	.2220E-14
.400000	.156305	.600000	.1079E+01
-.979800	-.987709	-.948150	.4050E+00
0.000000	0.000000	.500000	.3109E-14
.800000	.279631	1.000000	.1083E+01
-.916500	-.960107	-.858250	.4166E+00
0.000000	0.000000	.500000	.6661E-14
1.200000	.447214	1.400000	.1095E+01
-.800000	-.894427	-.700000	.4472E+00
0.000000	0.000000	.500000	.6217E-14
1.600000	.672591	1.735000	.1064E+01
-.600000	-.740014	-.477300	.3649E+00
0.000000	0.000000	.500000	.6217E-14
1.870000	.938893	1.935000	.1069E+01
-.354600	-.344208	-.177300	.3777E+00
-.500000	-.049532	-.248068	.7648E-03
1.972000	.939127	1.923092	.6238E+00
0.000000	.339980	.174052	.1853E+00
-.500000	-.043145	-.249477	.7887E-03
1.850000	.675158	1.726269	.6205E+00
.341500	.736411	.470688	.1816E+00
-.500000	-.034875	-.249169	.6327E-03
1.585000	.449471	1.395016	.6693E+00
.586600	.892614	.692774	.2213E+00

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
4	4	0.000000	0.000000	-.500000	-.500000	-.031043	-.249537
		1.200000	.800000	.800000	1.195000	.281449	.998756
		.800000	.916500	.901200	.784400	.959074	.850538
	5	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		.800000	.400000	.400000	.800000	.157442	.600001
		.916500	.979800	.965500	.901200	.987096	.940749
	6	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		.400000	0.000000	0.000000	.400000	.050789	.200000
		.979800	1.000000	.986000	.965500	.998310	.982825
	7	0.000000	0.000000	-.500000	-.500000	-.012608	-.249496
		0.000000	-.400000	-.400000	0.000000	-.434526	-.199997
		1.000000	.800000	.800000	.986000	.900571	.896509
	8	0.000000	0.000000	-.500000	-.500000	0.000000	-.250000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	0.000000	0.000000	-.500000	-.500000	0.000000	-.250000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	0.000000	0.000000	-.500000	-.500000	0.000000	-.250000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	0.000000	0.000000	-.500000	-.500000	-.012880	-.247831
		-1.600000	-2.000000	-1.972000	-1.600000	-.460010	-1.793015
		.200000	0.000000	0.000000	.200000	.887820	.100024
	12	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		-2.000000	-1.870000	-1.850000	-1.972000	-.939127	-1.923092
		0.000000	-.354600	-.341500	0.000000	-.339980	-.174052
	13	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		-1.870000	-1.600000	-1.585000	-1.850000	-.675158	-1.726269
		-.354600	-.600000	-.586600	-.341500	-.736411	-.470688
	14	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		-1.600000	-1.200000	-1.195000	-1.585000	-.449471	-1.395016
		-.600000	-.800000	-.784400	-.586600	-.892614	-.692774
	15	0.000000	0.000000	-.500000	-.500000	-.031043	-.249537
		-1.200000	-.800000	-.800000	-1.195000	-.281449	-.998756
		-.800000	-.916500	-.901200	-.784400	-.959074	-.850538

FOLDOUT FRAME

ES

NX NY NZ	NPX NPY NPZ	D T A
-.031043	-.249537	.4237E-03
.281449	.998756	.6507E+00
.959074	.850538	.2072E+00
-.029218	-.250016	.2468E-03
.157442	.600001	.6451E+00
.987096	.940749	.2026E+00
-.028252	-.250002	.7487E-04
.050789	.200000	.6412E+00
.998310	.982825	.2003E+00
-.012608	-.249496	.3152E-02
-.434526	-.199997	.6708E+00
.900571	.896509	.2221E+00
0.000000	-.250000	.3553E-14
-.447214	-.600000	.6708E+00
.894427	.700000	.2236E+00
0.000000	-.250000	.3553E-14
-.447214	-1.000000	.6708E+00
.894427	.500000	.2236E+00
0.000000	-.250000	.6661E-14
-.447214	-1.400000	.6708E+00
.894427	.300000	.2236E+00
-.012880	-.247831	.3220E-02
-.460010	-1.793015	.6708E+00
.887820	.100024	.2174E+00
-.049532	-.248068	.7648E-03
-.939127	-1.923092	.6238E+00
-.339980	-.174052	.1853E+00
-.043145	-.249477	.7887E-03
-.675158	-1.726269	.6205E+00
-.736411	-.470688	.1816E+00
-.034875	-.249169	.6327E-03
-.449471	-1.395016	.6693E+00
-.892614	-.692774	.2213E+00
-.031043	-.249537	.4237E-03
-.281449	-.998756	.6507E+00
-.959074	-.850538	.2072E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
4	16	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		-.800000	-.400000	-.400000	-.800000	-.157442	-.600001
		-.916500	-.979800	-.965500	-.901200	-.987096	-.940749
	17	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		-.400000	0.000000	0.000000	-.400000	-.050789	-.200000
		-.979800	-1.000000	-.986000	-.965500	-.998310	-.982825
	18	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		0.000000	.400000	.400000	0.000000	.050789	.200000
		-1.000000	-.979800	-.965500	-.986000	-.998310	-.982825
	19	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		.400000	.800000	.800000	.400000	.157442	.600001
		-.979800	-.916500	-.901200	-.965500	-.987096	-.940749
	20	0.000000	0.000000	-.500000	-.500000	-.031043	-.249537
		.800000	1.200000	1.195000	.800000	.281449	.998756
		-.916500	-.800000	-.784400	-.901200	-.959074	-.850538
	21	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		1.200000	1.600000	1.585000	1.195000	.449471	1.395016
		-.800000	-.600000	-.586600	-.784400	-.892614	-.692774
	22	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		1.600000	1.870000	1.850000	1.585000	.675158	1.726269
		-.600000	-.354600	-.341500	-.586600	-.736411	-.470608
	23	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		1.870000	2.000000	1.972000	1.850000	.939127	1.923092
		-.354600	0.000000	0.000000	-.341500	-.339980	-.174052
5	1	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		1.972000	1.850000	1.785000	1.885600	.934141	1.874150
		0.000000	.341500	.303900	0.000000	.322188	.161626
	2	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747369
		1.850000	1.585000	1.540000	1.785000	.683173	1.690281
		.341500	.586600	.544000	.303900	.718091	.444215
	3	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		1.585000	1.195000	1.175000	1.540000	.457325	1.373892
		.586600	.784400	.737400	.544000	.882618	.663304
	4	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		1.195000	.800000	.800000	1.175000	.288525	.992572
		.784400	.901200	.853800	.737400	.952677	.819383

FOLDOUT FRA

ASSOCIATES
USETTS

X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ	D / T / A
500000	-.029218	-.250016	.2468E-03
800000	-.157442	-.600001	.6451E+00
901200	-.987096	-.940749	.2026E+00
500000	-.028252	-.250002	.7487E-04
400000	-.050789	-.200000	.6412E+00
965500	-.998310	-.982825	.2003E+00
500000	-.028252	-.250002	.7487E-04
000000	.050789	.200000	.6412E+00
986000	-.998310	-.982825	.2003E+00
500000	-.029218	-.250016	.2468E-03
400000	.157442	.600001	.6451E+00
965500	-.987096	-.940749	.2026E+00
500000	-.031043	-.249537	.4237E-03
800000	.281449	.998756	.6507E+00
901200	-.959074	-.850538	.2072E+00
500000	-.034875	-.249169	.6327E-03
195000	.449471	1.395016	.6693E+00
784400	-.892614	-.692774	.2213E+00
500000	-.043145	-.249477	.7887E-03
585000	.675158	1.726269	.6205E+00
586600	-.736411	-.470688	.1816E+00
500000	-.049532	-.248068	.7648E-03
850000	.939127	1.923092	.6238E+00
341500	-.339980	-.174052	.1853E+00
000000	-.153543	-.743334	.1969E-02
885600	.934141	1.874150	.6143E+00
000000	.322188	.161626	.1727E+00
000000	-.132740	-.747369	.2518E-02
785000	.683173	1.690281	.6222E+00
303900	.718091	.444215	.1776E+00
000000	-.108809	-.747752	.1887E-02
540000	.457325	1.373892	.6640E+00
544000	.882618	.663304	.2139E+00
000000	-.095703	-.747958	.1347E-02
175000	.288525	.992572	.6461E+00
737400	.952677	.819363	.2021E+00

FOLDOUT FRAME 2

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

P

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
5	5	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.7500
		.800000	.400000	.400000	.800000	.162020	.6000
		.901200	.965500	.921400	.853800	.982682	.9104
	6	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.7500
		.400000	0.000000	0.000000	.400000	.052106	.2000
		.965500	.986000	.942800	.921400	.994858	.9539
	7	-.500000	-.500000	-1.000000	-1.000000	-.039925	-.7485
		0.000000	-.400000	-.400000	0.000000	-.379842	-.1999
		.986000	.800000	.800000	.942800	.924189	.8822
	8	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.7500
		-.400000	-.800000	-.800000	-.400000	-.447214	-.6000
		.800000	.600000	.600000	.800000	.894427	.7000
	9	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.7500
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.0000
		.600000	.400000	.400000	.600000	.894427	.5000
	10	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.7500
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.4000
		.400000	.200000	.200000	.400000	.894427	.3000
	11	-.500000	-.500000	-1.000000	-1.000000	-.044855	-.7413
		-1.600000	-1.972000	-1.885600	-1.600000	-.519160	-1.7647
		.200000	0.000000	0.000000	.200000	.853499	.1002
	12	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.7433
		-1.972000	-1.850000	-1.785000	-1.885600	-.934141	-1.8741
		0.000000	-.341500	-.303900	0.000000	-.322188	-.1616
	13	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.7473
		-1.850000	-1.585000	-1.540000	-1.785000	-.683173	-1.6902
		-.341500	-.586600	-.544000	-.303900	-.718091	-.4442
	14	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.7477
		-1.585000	-1.195000	-1.175000	-1.540000	-.457325	-1.3738
		-.586600	-.784400	-.737400	-.544000	-.882618	-.6633
	15	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.7479
		-1.195000	-.800000	-.800000	-1.175000	-.288525	-.9925
		-.784400	-.901200	-.853800	-.737400	-.952677	-.8193
	16	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.7500
		-.800000	-.400000	-.400000	-.800000	-.162020	-.6000
		-.901200	-.965500	-.921400	-.853800	-.982682	-.9104

FOLDOUT FRAME

ASSOCIATES
USETTS

X Y Z	NX NY NZ	NPX NPY NPZ	D T A
000000	-.089915	-.750055	.8107E-03
800000	.162020	.600009	.6500E+00
853800	.982682	.910468	.2035E+00
000000	-.086851	-.750005	.2238E-03
400000	.052106	.200003	.6436E+00
921400	.994858	.953924	.2010E+00
000000	-.039925	-.748551	.9981E-02
000000	-.379842	-.199961	.6668E+00
942800	.924189	.882279	.2164E+00
000000	0.000000	-.750000	.3553E-14
400000	-.447214	-.600000	.6708E+00
800000	.894427	.700000	.2236E+00
000000	0.000000	-.750000	.3553E-14
800000	-.447214	-1.000000	.6708E+00
600000	.894427	.500000	.2236E+00
000000	0.000000	-.750000	.6661E-14
200000	-.447214	-1.400000	.6708E+00
400000	.894427	.300000	.2236E+00
000000	-.044855	-.741375	.1121E-01
600000	-.519160	-1.764760	.6545E+00
200000	.853499	.100234	.1926E+00
000000	-.153543	-.743334	.1969E-02
885600	-.934141	-1.874150	.6143E+00
000000	-.322188	-.161626	.1727E+00
000000	-.132740	-.747389	.2518E-02
785000	-.683173	-1.690281	.6222E+00
303900	-.718091	-.444215	.1776E+00
000000	-.108809	-.747752	.1887E-02
540000	-.457325	-1.373892	.6640E+00
544000	-.882618	-.663304	.2139E+00
000000	-.095703	-.747958	.1347E-02
175000	-.288525	-.992572	.6461E+00
737400	-.952677	-.819383	.2021E+00
00000	-.089915	-.750055	.8107E-03
00000	-.162020	-.600009	.6500E+00
53800	-.982682	-.910468	.2035E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
5	17	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		-.400000	0.000000	0.000000	-.400000	-.052106	-.200003
		-.965500	-.986000	-.942800	-.921400	-.994858	-.953924
	18	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		0.000000	.400000	.400000	0.000000	.052106	.200003
		-.986000	-.965500	-.921400	-.942800	-.994858	-.953924
	19	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.750055
		.400000	.800000	.800000	.400000	.162020	.600009
		-.965500	-.901200	-.853800	-.921400	-.982682	-.910468
	20	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		.800000	1.195000	1.175000	.800000	.288525	.992572
		-.901200	-.784400	-.737400	-.853800	-.952677	-.819383
	21	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		1.195000	1.585000	1.540000	1.175000	.457325	1.373892
		-.784400	-.586600	-.544000	-.737400	-.882618	-.663304
	22	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747389
		1.585000	1.850000	1.785000	1.540000	.683173	1.690281
		-.586600	-.341500	-.303900	-.544000	-.718091	-.444215
	23	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		1.850000	1.972000	1.885600	1.785000	.934141	1.874150
		-.341500	0.000000	0.000000	-.303900	-.322188	-.161626
6	1	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		1.885600	1.785000	1.670000	1.732000	.921489	1.773614
		0.000000	.303900	.229700	0.000000	.280799	.134912
	2	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245329
		1.785000	1.540000	1.460000	1.670000	.702123	1.614691
		.303900	.544000	.465900	.229700	.670724	.386555
	3	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		1.540000	1.175000	1.140000	1.460000	.475316	1.329324
		.544000	.737400	.652000	.465900	.857948	.600627
	4	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		1.175000	.800000	.800000	1.140000	.304683	.979004
		.737400	.853800	.768100	.652000	.936981	.753512
	5	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		.800000	.400000	.400000	.800000	.172638	.600034
		.853800	.921400	.842600	.768100	.971923	.846449

FOLDOUT FRAME

DY

X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ	D / T / A
-1.000000	-1.000000	-.086851	-.750005	.2238E-03
0.000000	-.400000	-.052106	-.200003	.6436E+00
-.942800	-.921400	-.994858	-.953924	.2010E+00
-1.000000	-1.000000	-.086851	-.750005	.2238E-03
.400000	0.000000	.052106	.200003	.6436E+00
-.921400	-.942800	-.994858	-.953924	.2010E+00
-1.000000	-1.000000	-.089915	-.750055	.8107E-03
.800000	.400000	.162020	.600009	.6500E+00
-.853800	-.921400	-.982682	-.910468	.2035E+00
-1.000000	-1.000000	-.095703	-.747958	.1347E-02
1.175000	.800000	.288525	.992572	.6461E+00
-.737400	-.853800	-.952677	-.819383	.2021E+00
-1.000000	-1.000000	-.108609	-.747752	.1887E-02
1.540000	1.175000	.457325	1.373892	.6640E+00
-.544000	-.737400	-.882618	-.663314	.2139E+00
-1.000000	-1.000000	-.132740	-.747389	.2518E-02
1.785000	1.540000	.683173	1.690281	.6222E+00
-.303900	-.544000	-.718091	-.444215	.1776E+00
-1.000000	-1.000000	-.153543	-.743334	.1969E-02
1.885600	1.785000	.934141	1.874150	.6143E+00
0.000000	-.303900	-.322188	-.161626	.1727E+00
-1.500000	-1.500000	-.268347	-1.229655	.3684E-02
1.670000	1.732000	.921489	1.773614	.5910E+00
.229700	0.000000	.280799	.134912	.1448E+00
-1.500000	-1.500000	-.239065	-1.245329	.5490E-02
1.460000	1.670000	.702123	1.614691	.6180E+00
.465900	.229700	.670724	.386555	.1696E+00
-1.500000	-1.500000	-.194936	-1.245068	.3782E-02
1.140000	1.460000	.475316	1.329324	.6494E+00
.652000	.465900	.857948	.600627	.1996E+00
-1.500000	-1.500000	-.170981	-1.245783	.2596E-02
.800000	1.140000	.304683	.979004	.6374E+00
.768100	.652000	.936981	.753512	.1908E+00
-1.500000	-1.500000	-.159881	-1.250120	.1677E-02
.400000	.800000	.172638	.600034	.6584E+00
.842600	.768100	.971923	.846449	.2058E+00

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

PAGE

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
6	6	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250012
		.400000	0.000000	0.000000	.400000	.055250	.200010
		.921400	.942800	.866000	.842600	.986601	.893198
	7	-1.000000	-1.000000	-1.500000	-1.500000	-.074106	-1.248100
		0.000000	-.400000	-.400000	0.000000	-.251846	-.199835
		.942800	.800000	.800000	.866000	.964926	.852389
	8	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250000
		-.800000	-1.200000	-1.200000	-.600000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	-1.000000	-1.000000	-1.500000	-1.500000	-.105654	-1.225923
		-1.600000	-1.885600	-1.732000	-1.600000	-.687853	-1.707445
		.200000	0.000000	0.000000	.200000	.718119	.100626
	12	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		-1.885600	-1.785000	-1.670000	-1.732000	-.921489	-1.773614
		0.000000	-.303900	-.229700	0.000000	-.280799	-.134912
	13	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245329
		-1.785000	-1.540000	-1.460000	-1.670000	-.702123	-1.614691
		-.303900	-.544000	-.465900	-.229700	-.670724	-.386555
	14	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		-1.540000	-1.175000	-1.140000	-1.460000	-.475316	-1.329324
		-.544000	-.737400	-.652000	-.465900	-.857948	-.600627
	15	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		-1.175000	-.800000	-.800000	-1.140000	-.304683	-.979004
		-.737400	-.853800	-.768100	-.652000	-.936981	-.753512
	16	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		-.800000	-.400000	-.400000	-.800000	-.172638	-.600034
		-.853800	-.921400	-.842600	-.768100	-.971923	-.846449
	17	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250012
		-.400000	0.000000	0.000000	-.400000	-.055250	-.200010
		-.921400	-.942800	-.866000	-.842600	-.986601	-.893198

FOLDOUT FRA

ST BODY

	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
00	-1.500000	-1.500000	-.153515	-1.250012	.4933E-03
00	0.000000	.400000	.055250	.200010	.6481E+00
00	.866000	.842600	.986601	.893198	.2027E+00
00	-1.500000	-1.500000	-.074106	-1.248100	.1853E-01
00	-.400000	0.000000	-.251846	-.199835	.6560E+00
00	.800000	.866000	.964926	.852389	.2073E+00
00	-1.500000	-1.500000	0.000000	-1.250000	.3553E-14
00	-.800000	-.400000	-.447214	-.600000	.6708E+00
00	.600000	.800000	.894427	.700000	.2236E+00
00	-1.500000	-1.500000	0.000000	-1.250000	.3553E-14
00	-1.200000	-.600000	-.447214	-1.000000	.6708E+00
00	.400000	.600000	.894427	.500000	.2236E+00
00	-1.500000	-1.500000	0.000000	-1.250000	.6661E-14
00	-1.600000	-1.200000	-.447214	-1.400000	.6708E+00
00	.200000	.400000	.894427	.300000	.2236E+00
00	-1.500000	-1.500000	-.105654	-1.225923	.2641E-01
00	-1.732000	-1.600000	-.687853	-1.707445	.6096E+00
00	0.000000	.200000	.718119	.100626	.1454E+00
00	-1.500000	-1.500000	-.268347	-1.229655	.3684E-02
00	-1.673000	-1.732000	-.921489	-1.773614	.5910E+00
00	-.229700	0.000000	-.280799	-.134912	.1448E+00
00	-1.500000	-1.500000	-.239065	-1.245329	.5490E-02
00	-1.460000	-1.670000	-.702123	-1.614691	.6180E+00
00	-.465900	-.229700	-.670724	-.386555	.1696E+00
00	-1.500000	-1.500000	-.194936	-1.245068	.3782E-02
00	-1.140000	-1.460000	-.475316	-1.329324	.6494E+00
00	-.652000	-.465900	-.857948	-.600627	.1996E+00
0	-1.500000	-1.500000	-.170981	-1.245783	.2596E-02
0	-.800000	-1.140000	-.304683	-.979004	.6374E+00
0	-.768100	-.652000	-.936981	-.753512	.1908E+00
0	-1.500000	-1.500000	-.159881	-1.250120	.1677E-02
0	-.400000	-.800000	-.172638	-.600034	.6584E+00
0	-.842600	-.768100	-.971923	-.846449	.2058E+00
0	-1.500000	-1.500000	-.153515	-1.250012	.4933E-03
0	0.000000	-.400000	-.055250	-.200010	.6481E+00
0	-.866000	-.842600	-.986601	-.893198	.2027E+00

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
6	18	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250012
		0.000000	.400000	.400000	0.000000	.055250	.200010
		-.942800	-.921400	-.842600	-.866000	-.986601	-.893198
	19	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		.400000	.800000	.800000	.400000	.172638	.600034
		-.921400	-.853800	-.768100	-.842600	-.971923	-.846449
	20	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		.800000	1.175000	1.140000	.800000	.304683	.979004
		-.853800	-.737400	-.652000	-.768100	-.936981	-.753512
	21	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		1.175000	1.540000	1.460000	1.140000	.475316	1.329324
		-.737400	-.544000	-.465900	-.652000	-.857948	-.600627
	22	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245329
		1.540000	1.785000	1.670000	1.460000	.702123	1.614691
		-.544000	-.303900	-.229700	-.465900	-.670724	-.386555
	23	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		1.785000	1.885600	1.732000	1.670000	.921489	1.773614
		-.303900	0.000000	0.000000	-.229700	-.280799	-.134912
7	1	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.699678
		1.732000	1.670000	1.465000	1.490700	.885202	1.611865
		0.000000	.229700	.137800	0.000000	.211244	.096576
	2	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.733772
		1.670000	1.460000	1.322000	1.465000	.725701	1.434752
		.229700	.465900	.344400	.137800	.578529	.297994
	3	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.738932
		1.460000	1.140000	1.072000	1.322000	.507279	1.250730
		.465900	.652000	.517900	.344400	.804085	.497910
	4	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.738266
		1.140000	.800000	.800000	1.072000	.335023	.954054
		.652000	.768100	.628900	.517900	.902837	.644837
	5	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.750276
		.800000	.400000	.400000	.800000	.193980	.600104
		.768100	.842600	.718000	.628900	.948555	.739306
	6	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.750025
		.400000	0.000000	0.000000	.400000	.061556	.200030
		.842600	.866000	.745400	.718000	.969388	.792992

FOLDOUT FRA

TEST BODY

	X	X	NX	NPX	D
	Y	Y	NY	NPY	T
	Z	Z	NZ	NPZ	A
0000	-1.500000	-1.500000	-.153515	-1.250012	.4933E-03
5000	.400000	0.000000	.055250	.200010	.6481E+00
1400	-.842600	-.866000	-.986601	-.893198	.2027E+00
5000	-1.500000	-1.500000	-.159881	-1.250120	.1677E-02
0000	.800000	.400000	.172638	.600034	.6584E+00
3800	-.768100	-.842600	-.971923	-.846449	.2058E+00
0000	-1.500000	-1.500000	-.170981	-1.245783	.2596E-02
5000	1.140000	.800000	.304683	.979004	.6374E+00
7400	-.652000	-.768100	-.936981	-.753512	.1968E+00
0000	-1.500000	-1.500000	-.194936	-1.245068	.3782E-02
0000	1.460000	1.140000	.475316	1.329324	.6494E+00
4000	-.465900	-.652000	-.857948	-.600627	.1996E+00
0000	-1.500000	-1.500000	-.239065	-1.245329	.5490E-02
5000	1.670000	1.460000	.702123	1.614691	.6180E+00
3900	-.229700	-.465900	-.670724	-.386555	.1696E+00
0000	-1.500000	-1.500000	-.268347	-1.229655	.3684E-02
5600	1.732000	1.670000	.921489	1.773614	.5910E+00
0000	0.000000	-.229700	-.280799	-.134912	.1448E+00
0000	-2.000000	-2.000000	-.414479	-1.699678	.3180E-02
0000	1.465000	1.490700	.885202	1.611865	.5833E+00
0700	.137800	0.000000	.211244	.096576	.1038E+00
0000	-2.000000	-2.000000	-.372374	-1.733772	.7874E-02
0000	1.322000	1.465000	.725701	1.434752	.6199E+00
5900	.344400	.137800	.578529	.297994	.1525E+00
000	-2.000000	-2.000000	-.310024	-1.738932	.6345E-02
000	1.072000	1.322000	.507279	1.250730	.6350E+00
000	.517900	.344400	.804085	.497910	.1772E+00
000	-2.000000	-2.000000	-.269527	-1.738266	.4544E-02
000	.800000	1.072000	.335023	.954054	.6218E+00
100	.628900	.517900	.902837	.644837	.1695E+00
000	-2.000000	-2.000000	-.250229	-1.750276	.3462E-02
000	.400000	.800000	.193980	.600104	.6750E+00
600	.718000	.628900	.948555	.739306	.2108E+00
00	-2.000000	-2.000000	-.237694	-1.750025	.9694E-03
00	0.000000	.400000	.061556	.200030	.6572E+00
00	.745400	.718000	.969388	.792992	.2063E+00

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

PA

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
7	7	-1.500000	-1.500000	-2.000000	-2.000000	-.197278	-1.7495
		0.000000	-.400000	-.400000	0.000000	-.113683	-.1997
		.866000	.800000	.718000	.745400	.973734	.7824
	8	-1.500000	-1.500000	-2.000000	-2.000000	-.075980	-1.7473
		-.400000	-.800000	-.800000	-.400000	-.368319	-.5998
		.800000	.600000	.600000	.718000	.926589	.6797
	9	-1.500000	-1.500000	-2.000000	-2.000000	0.000000	-1.7500
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.0000
		.600000	.400000	.400000	.600000	.894427	.5000
	10	-1.500000	-1.500000	-2.000000	-2.000000	-.050829	-1.7204
		-1.200000	-1.600000	-1.400000	-1.200000	-.496741	-1.3528
		.400000	.200000	.256000	.400000	.866409	.3141
	11	-1.500000	-1.500000	-2.000000	-2.000000	-.348626	-1.7625
		-1.600000	-1.732000	-1.490700	-1.400000	-.842191	-1.5505
		.200000	0.000000	0.000000	.256000	.411307	.1139
	12	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.6996
		-1.732000	-1.670000	-1.465000	-1.490700	-.885202	-1.6118
		0.000000	-.229700	-.137800	0.000000	-.211244	-.0965
	13	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.7337
		-1.670000	-1.460000	-1.322000	-1.465000	-.725701	-1.4847
		-.229700	-.465900	-.344400	-.137800	-.578529	-.2979
	14	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.7389
		-1.460000	-1.140000	-1.072000	-1.322000	-.507279	-1.2507
		-.465900	-.652000	-.517900	-.344400	-.804085	-.4979
	15	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.7382
		-1.140000	-.800000	-.800000	-1.072000	-.335023	-.9540
		-.652000	-.768100	-.628900	-.517900	-.902837	-.6448
	16	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.7502
		-.800000	-.400000	-.400000	-.800000	-.193980	-.6001
		-.768100	-.842600	-.718000	-.628900	-.948555	-.7393
	17	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.7500
		-.400000	0.000000	0.000000	-.400000	-.061556	-.2000
		-.842600	-.866000	-.745400	-.718000	-.969388	-.7929
	18	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.7500
		0.000000	.400000	.400000	0.000000	.061556	.2000
		-.866000	-.842600	-.718000	-.745400	-.969388	-.7929

FOLDOUT FRAME

IC SCIENCE ASSOCIATES
RD, MASSACHUSETTS

X	X	NX	NPX	D
Y	Y	NY	NPY	T
Z	Z	NZ	NPZ	A
00000	-2.000000	-.197278	-1.749550	.9397E-02
00000	0.000000	-.113683	-.199759	.6572E+00
18000	.745400	.973734	.782469	.2054E+00
00000	-2.000000	-.075980	-1.747311	.1900E-01
00000	-.400000	-.368319	-.599857	.6708E+00
20000	.718000	.926589	.679777	.2158E+00
00000	-2.000000	0.000000	-1.750000	.3553E-14
00000	-.800000	-.447214	-1.000000	.6708E+00
00000	.600000	.894427	.500000	.2236E+00
00000	-2.000000	-.050829	-1.720409	.1271E-01
00000	-1.200000	-.496741	-1.352829	.6708E+00
56000	.400000	.866409	.314114	.1731E+00
00000	-2.000000	-.348626	-1.762537	.1445E-01
00700	-1.400000	-.842191	-1.550513	.6525E+00
00000	.256000	.411307	.113943	.1354E+00
00000	-2.000000	-.414479	-1.699678	.3180E-02
55000	-1.490700	-.885202	-1.611865	.5833E+00
37800	0.000000	-.211244	-.096576	.1038E+00
10000	-2.000000	-.372374	-1.733772	.7874E-02
2000	-1.465000	-.725701	-1.484752	.6199E+00
4400	-.137800	-.578529	-.297994	.1525E+00
0000	-2.000000	-.310024	-1.738932	.6345E-02
2000	-1.322000	-.507279	-1.250730	.6350E+00
7900	-.344400	-.804085	-.497910	.1772E+00
0000	-2.000000	-.269527	-1.738266	.4544E-02
0000	-1.072000	-.335023	-.954054	.6218E+00
8900	-.517900	-.902837	-.644837	.1695E+00
0000	-2.000000	-.250229	-1.750276	.3462E-02
0000	-.800000	-.103980	-.600104	.6750E+00
8000	-.628900	-.948555	-.739306	.2108E+00
0000	-2.000000	-.237694	-1.750025	.9694E-03
0000	-.400000	-.061556	-.200030	.6572E+00
5400	-.718000	-.969388	-.792992	.2063E+00
000	-2.000000	-.237694	-1.750025	.9694E-03
000	0.000000	.061556	.200030	.6572E+00
000	-.745400	-.969388	-.792992	.2063E+00

FOLDOUT FRAME 2

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NP
7	19	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.75
		.400000	.800000	.800000	.400000	.193980	.60
		-.842600	-.768100	-.628900	-.718000	-.948555	-.73
	20	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.73
		.800000	1.140000	1.072000	.800000	.335023	.95
		-.768100	-.652000	-.517900	-.628900	-.902837	-.644
	21	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.738
		1.140000	1.460000	1.322000	1.072000	.507279	1.250
		-.652000	-.465900	-.344400	-.517900	-.804085	-.497
	22	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.733
		1.460000	1.670000	1.465000	1.322000	.725701	1.484
		-.465900	-.229700	-.137800	-.344400	-.578529	-.297
	23	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.699
		1.670000	1.732000	1.490700	1.465000	.885202	1.611
		-.229700	0.000000	0.000000	-.137800	-.211244	-.036
		************			************		
8	1	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218
		1.490700	1.322000	1.000000	1.055000	.747834	1.240
		0.000000	.344400	.235700	0.000000	.288382	.149
	2	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214
		1.322000	.800000	.800000	1.000000	.463200	.990
		.344400	.628900	.381500	.235700	.777203	.411
	3	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.250
		.800000	.400000	.400000	.800000	.246251	.600
		.628900	.718000	.515300	.381500	.883807	.560
	4	-2.000000	-2.000000	-2.500000	-2.500000	-.366809	-2.250
		.400000	0.000000	0.000000	.400000	.075569	.200
		.718000	.745700	.552800	.515300	.927222	.632
	5	-2.000000	-2.000000	-2.500000	-2.500000	-.366809	-2.250
		0.000000	-.400000	-.400000	0.000000	-.075569	-.200
		.745700	.718000	.515300	.552800	.927222	.632
	6	-2.000000	-2.000000	-2.500000	-2.500000	-.372805	-2.250
		-.400000	-.800000	-.800000	-.400000	-.278586	-.600
		.718000	.600000	.381500	.515300	.885102	.553

FOLDOUT FRAME

TEST BODY

X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
.500000	-2.000000	-2.000000	-.250229	-1.750276	.3462E-02
.800000	.800000	.400000	.193980	.600104	.6750E+00
.768100	-.628900	-.718000	-.948555	-.739306	.2108E+00
.500000	-2.000000	-2.000000	-.269527	-1.738266	.4544E-02
.140000	1.072000	.800000	.335023	.954054	.6218E+00
.652000	-.517900	-.628900	-.902837	-.644837	.1695E+00
.500000	-2.000000	-2.000000	-.310024	-1.738932	.6345E-02
.460000	1.322000	1.072000	.507279	1.250730	.6350E+00
.465900	-.344400	-.517900	-.804085	-.497910	.1772E+00
.500000	-2.000000	-2.000000	-.372374	-1.733772	.7874E-02
.670000	1.465000	1.322000	.725701	1.484752	.6199E+00
.229700	-.137800	-.344400	-.578529	-.297994	.1525E+00
.500000	-2.000000	-2.000000	-.414479	-1.699678	.3180E-02
.732000	1.490700	1.465000	.885202	1.611865	.5833E+00
.000000	0.000000	-.137800	-.211244	-.036576	.1038E+00
****		************			************
.000000	-2.500000	-2.500000	-.597981	-2.218024	.1342E-01
.322000	1.000000	1.055000	.747834	1.240723	.7391E+00
.344400	.235700	0.000000	.288382	.149617	.1939E+00
.000000	-2.500000	-2.500000	-.425912	-2.214445	.1034E-01
.800000	.800000	1.000000	.463200	.990269	.7238E+00
.628900	.381500	.235700	.777203	.411287	.2322E+00
.000000	-2.500000	-2.500000	-.397801	-2.250969	.9877E-02
.400000	.400000	.800000	.246251	.600392	.7233E+00
.718000	.515300	.381500	.883807	.560379	.2263E+00
000000	-2.500000	-2.500000	-.366809	-2.250072	.2272E-02
000000	0.000000	.400000	.075569	.200101	.6805E+00
745700	.552800	.515300	.927222	.632913	.2157E+00
000000	-2.500000	-2.500000	-.366809	-2.250072	.2272E-02
400000	-.400000	0.000000	-.075569	-.200101	.6805E+00
718000	.515300	.552800	.927222	.632913	.2157E+00
000000	-2.500000	-2.500000	-.372805	-2.250383	.3496E-02
800000	-.800000	-.400000	-.278586	-.600126	.7233E+00
600000	.381500	.515300	.885102	.553499	.2260E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	
8	7	-2.000000 -.800000 .600000	-2.000000 -1.200000 .400000	-2.500000 -1.000000 .235700	-2.500000 -.800000 .381500	-.396212 -.458473 .795499	-2.218355 -.956945 .416059	
	8	-2.000000 -1.200000 .400000	-2.000000 -1.490700 0.000000	-2.500000 -1.055000 0.000000	-2.500000 -1.000000 .235700	-.537231 -.740960 .402941	-2.212088 -1.209729 .166619	
	9	-2.000000 -1.490700 0.000000	-2.000000 -1.322000 -.344400	-2.500000 -1.000000 -.235700	-2.500000 -1.055000 0.000000	-.597981 -.747834 -.288382	-2.218024 -1.240723 -.149617	
	10	-2.000000 -1.322000 -.344400	-2.000000 -.800000 -.628900	-2.500000 -.800000 -.381500	-2.500000 -1.000000 -.235700	-.425912 -.463200 -.777203	-2.214445 -.990269 -.411287	
	11	-2.000000 -.800000 -.628900	-2.000000 -.400000 -.718000	-2.500000 -.400000 -.515300	-2.500000 -.800000 -.381500	-.397801 -.246251 -.883807	-2.250969 -.600392 -.560379	
	12	-2.000000 -.400000 -.718000	-2.000000 0.000000 -.745400	-2.500000 0.000000 -.552800	-2.500000 -.400000 -.515300	-.366578 -.075231 -.927341	-2.250074 -.200104 -.632837	
	13	-2.000000 0.000000 -.745400	-2.000000 .400000 -.718000	-2.500000 .400000 -.515300	-2.500000 0.000000 -.552800	-.366578 .075231 -.927341	-2.250074 .200104 -.632837	
	14	-2.000000 .400000 -.718000	-2.000000 .800000 -.628900	-2.500000 .800000 -.381500	-2.500000 .400000 -.515300	-.397801 .246251 -.883807	-2.250969 .600392 -.560379	
	15	-2.000000 .800000 -.628900	-2.000000 1.322000 -.344400	-2.500000 1.000000 -.235700	-2.500000 .800000 -.381500	-.425912 .463200 -.777203	-2.214445 .990269 -.411287	
	16	-2.000000 1.322000 -.344400	-2.000000 1.490700 0.000000	-2.500000 1.055000 0.000000	-2.500000 1.000000 -.235700	-.597981 .747834 -.288382	-2.218024 1.240723 -.149617	
			***********		***********			******
9	1	-2.500000 1.055000 0.000000	-2.500000 .800000 .381500	-3.000000 0.000000 0.000000	-3.000000 0.000000 0.000000	-.868756 .411733 .275208	-2.626833 .687692 .149145	0. . .

17

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
00000	-2.500000	-.396212	-2.218355	.1214E-01
00000	-.800000	-.458473	-.956945	.6502E+00
35700	.381500	.795499	.416059	.1886E+00
00000	-2.500000	-.537231	-2.212088	.2711E-01
55000	-1.000000	-.740960	-1.209729	.7391E+00
00000	.235700	.402941	.166619	.2145E+00
00000	-2.500000	-.597981	-2.218024	.1342E-01
00000	-1.055000	-.747834	-1.240723	.7391E+00
35700	0.000000	-.288382	-.149617	.1939E+00
00000	-2.500000	-.425912	-2.214445	.1034E-01
00000	-1.000000	-.463200	-.990269	.7238E+00
81500	-.235700	-.777203	-.411287	.2322E+00
00000	-2.500000	-.397801	-2.250969	.9877E-02
00000	-.800000	-.246251	-.600392	.7233E+00
15300	-.381500	-.883807	-.560379	.2263E+00
00000	-2.500000	-.366578	-2.250074	.2342E-02
00000	-.400000	-.075231	-.200104	.6804E+00
52800	-.515300	-.927341	-.632837	.2157E+00
00000	-2.500000	-.366578	-2.250074	.2342E-02
00000	0.000000	.075231	.200104	.6804E+00
15300	-.552800	-.927341	-.632837	.2157E+00
00000	-2.500000	-.397801	-2.250969	.9877E-02
00000	.400000	.246251	.600392	.7233E+00
31500	-.515300	-.883807	-.560379	.2263E+00
00000	-2.500000	-.425912	-2.214445	.1034E-01
00000	.800000	.463200	.990269	.7238E+00
35700	-.381500	-.777203	-.411287	.2322E+00
00000	-2.500000	-.597981	-2.218024	.1342E-01
55000	1.000000	.747834	1.240723	.7391E+00
0000	-.235700	-.288382	-.149617	.1939E+00
	************		************	
0000	-3.000000	-.868756	-2.626833	0.
0000	0.000000	.411733	.687692	.1167E+01
0000	0.000000	.275208	.149145	.2316E+00

FOLDOUT FRAME 2

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

P

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
9	2	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.629
		.800000	.400000	0.000000	0.000000	.200002	.434
		.381500	.515300	0.000000	0.000000	.597912	.336
	3	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		.400000	0.000000	0.000000	0.000000	.062764	.141
		.515300	.552800	0.000000	0.000000	.669478	.389
	4	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		0.000000	-.400000	0.000000	0.000000	-.062764	-.141
		.552800	.515300	0.000000	0.000000	.669478	.389
	5	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.629
		-.400000	-.800000	0.000000	0.000000	-.200002	-.434
		.515300	.381500	0.000000	0.000000	.597912	.336
	6	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.626
		-.800000	-1.055000	0.000000	0.000000	-.411733	-.687
		.381500	0.000000	0.000000	0.000000	.275208	.149
	7	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.626
		-1.055000	-.800000	0.000000	0.000000	-.411733	-.687
		0.000000	-.381500	0.000000	0.000000	-.275208	-.149
	8	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.629
		-.800000	-.400000	0.000000	0.000000	-.200002	-.434
		-.381500	-.515300	0.000000	0.000000	-.597912	-.336
	9	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		-.400000	0.000000	0.000000	0.000000	-.062764	-.141
		-.515300	-.552800	0.000000	0.000000	-.669478	-.389
	10	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.63
		0.000000	.400000	0.000000	0.000000	.062764	.14
		-.552800	-.515300	0.000000	0.000000	-.669478	-.38
	11	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.62
		.400000	.800000	0.000000	0.000000	.200002	.43
		-.515300	-.381500	0.000000	0.000000	-.597912	-.33
	12	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.62
		.800000	1.055000	0.000000	0.000000	.411733	.68
		-.381500	0.000000	0.000000	0.000000	-.275208	-.1

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189 BASIC ELEMENTS WERE INPUT

FOLDOUT FRAME

X	NX	NPX	D
Y	NY	NPY	T
Z	NZ	NPZ	A
.000000	-.776209	-2.629150	.1332E-14
.000000	.200002	.434170	.1018E+01
.000000	.597912	.336208	.1672E+00
.000000	-.740175	-2.635472	.2220E-15
.000000	.062764	.141262	.8219E+00
.000000	.669478	.389779	.1494E+00
.000000	-.740175	-2.635472	.3053E-15
.000000	-.062764	-.141262	.8219E+00
.000000	.669478	.389779	.1494E+00
.000000	-.776209	-2.629150	.1110E-14
.000000	-.200002	-.434170	.1018E+01
.000000	.597912	.336208	.1672E+00
.000000	-.868756	-2.626833	.8882E-15
.000000	-.411733	-.687692	.1167E+01
.000000	.275208	.149145	.2316E+00
.000000	-.868756	-2.626833	0.
.000000	-.411733	-.687692	.1167E+01
.000000	-.275208	-.149145	.2316E+00
.000000	-.776209	-2.629150	.1332E-14
.000000	-.200002	-.434170	.1018E+01
.000000	-.597912	-.336208	.1672E+00
.000000	-.740175	-2.635472	.2220E-15
.000000	-.062764	-.141262	.8219E+00
.000000	-.669478	-.389779	.1494E+00
.000000	-.740175	-2.635472	.3053E-15
.000000	.062764	.141262	.8219E+00
.000000	-.669478	-.389779	.1494E+00
.000000	-.776209	-2.629150	.1110E-14
.000000	.200002	.434170	.1018E+01
.000000	-.597912	-.336208	.1672E+00
.000000	-.868756	-2.626833	.8882E-15
.000000	.411733	.687692	.1167E+01
.000000	-.275208	-.149145	.2316E+00

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CRT PLOTS

```
MINIMUM AND MAXIMUM COORDINATES IN THE   SCALED,   TRANSLATED,   ROTATED SYSTEM -
  X AXIS=   -3.00000E+00    2.00000E+00
  Y AXIS=   -2.00000E+00    2.00000E+00
  Z AXIS=   -1.00000E+00    1.00000E+00

COORDINATE TRANSLATIONS USED TO CENTER THE PLOTS - DELX, DELY, DELZ -
   AFTER SCALING, TRANSLATING, ROTATING -    5.00000E-01   0.          0.

VIEW OF BODY LOOKING DOWN THE     -Y  AXIS TOWARD THE ORIGIN
45-DEGREE VIEW FROM THE  +X  -Y  +Z SIDE
45-DEGREE VIEW FROM THE  +X  -Y  -Z SIDE
45-DEGREE VIEW FROM THE  -X  -Y  +Z SIDE
45-DEGREE VIEW FROM THE  -X  -Y  -Z SIDE
VIEW OF BODY LOOKING DOWN THE     -Z  AXIS TOWARD THE ORIGIN
45-DEGREE VIEW FROM THE  -X  +Y  -Z SIDE
45-DEGREE VIEW FROM THE  +X  +Y  -Z SIDE
VIEW OF BODY LOOKING DOWN THE     -X  AXIS TOWARD THE ORIGIN
45-DEGREE VIEW FROM THE  -X  +Y  +Z SIDE
VIEW OF BODY LOOKING DOWN THE     +X  AXIS TOWARD THE ORIGIN
VIEW OF BODY LOOKING DOWN THE     +Y  AXIS TOWARD THE ORIGIN
VIEW OF BODY LOOKING DOWN THE     +Z  AXIS TOWARD THE ORIGIN
45-DEGREE VIEW FROM THE  +X  +Y  +Z SIDE
```

BOXC

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PROGRAM BOXC                ATMOSPHERIC SCIENCE ASSOCIATES
                               BEDFORD, MASSACHUSETTS                        PAGE    1
 BODY ID.  TEST
                          TEST BODY

          INPUT PARAMETERS-

            IFLAG= 0     LIST= 0     ISIG=  0      IPRS= 0      MPR= 0

            NCODE= 0     NNON= 0     NOFF=  0     KMACH= 0     KTP14= 1

          NUMBER OF LEAKY QUADRALATERALS=   0   FRACTION OF FREE-STREAM VELOCITY LEAKED= 0.

         P A R A M E T R I C   I N F O R M A T I O N

                            GENERATED UNIFORM FLOWS

                                  X-FLOW

         NO SYMMETRY SPECIFIED
```

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

PA

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
1	1	2.000000	2.000000	1.500000	1.500000	.958086	1.59139
		0.000000	0.000000	1.670000	1.732000	.276584	1.38979
		0.000000	0.000000	.229700	0.000000	.074655	.09489
	2	2.000000	2.000000	1.500000	1.500000	.941794	1.59834
		0.000000	0.000000	1.460000	1.670000	.251249	1.25402
		0.000000	0.000000	.465900	.229700	.223380	.28292
	3	2.000000	2.000000	1.500000	1.500000	.915363	1.60511
		0.000000	0.000000	1.140000	1.460000	.202414	1.01953
		0.000000	0.000000	.652000	.465900	.348052	.44561
	4	2.000000	2.000000	1.500000	1.500000	.891771	1.60927
		0.000000	0.000000	.800000	1.140000	.146221	.75032
		0.000000	0.000000	.768100	.652000	.428210	.55749
	5	2.000000	2.000000	1.500000	1.500000	.874522	1.62026
		0.000000	0.000000	.400000	.800000	.088802	.44790
		0.000000	0.000000	.842600	.768100	.476787	.61308
	6	2.000000	2.000000	1.500000	1.500000	.865649	1.62481
		0.000000	0.000000	0.000000	.400000	.029238	.14708
		0.000000	0.000000	.866000	.842600	.499797	.64122
	7	2.000000	2.000000	1.500000	1.500000	.863087	1.62604
		0.000000	0.000000	-.400000	0.000000	-.082222	-.14831
		0.000000	0.000000	.800000	.866000	.498318	.62322
	8	2.000000	2.000000	1.500000	1.500000	.872872	1.62723
		0.000000	0.000000	-.800000	-.400000	-.218218	-.44284
		0.000000	0.000000	.600000	.800000	.436436	.52411
	9	2.000000	2.000000	1.500000	1.500000	.872872	1.61882
		0.000000	0.000000	-1.200000	-.800000	-.218218	-.75116
		0.000000	0.000000	.400000	.600000	.436436	.38677
	10	2.000000	2.000000	1.500000	1.500000	.872872	1.60714
		0.000000	0.000000	-1.600000	-1.200000	-.218218	-1.08597
		0.000000	0.000000	.200000	.400000	.436436	.24271
	11	2.000000	2.000000	1.500000	1.500000	.945063	1.58979
		0.000000	0.000000	-1.732000	-1.600000	-.272824	-1.36520
		0.000000	0.000000	0.000000	.200000	.180064	.08446
	12	2.000000	2.000000	1.500000	1.500000	.958086	1.59139
		0.000000	0.000000	-1.670000	-1.732000	-.276584	-1.38979
		0.000000	0.000000	-.229700	0.000000	-.074655	-.09489

FOLDOUT FRAME

T BODY

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
1.500000	1.500000	.958086	1.591395	0.
1.670000	1.732000	.276584	1.389794	.1803E+01
.229700	0.000000	.074655	.094899	.2076E+00
1.500000	1.500000	.941794	1.596349	.8882E-15
1.460000	1.670000	.251249	1.254020	.1758E+01
.465900	.229700	.223380	.282927	.2356E+00
1.500000	1.500000	.915363	1.605113	.2665E-14
1.140000	1.460000	.202414	1.019539	.1612E+01
.652000	.465900	.348052	.445612	.2299E+00
1.500000	1.500000	.891771	1.609275	.2665E-14
.800000	1.140000	.146221	.750320	.1465E+01
.768100	.652000	.428210	.557494	.1985E+00
1.500000	1.500000	.874522	1.620269	.9992E-15
.400000	.800000	.088802	.447901	.1217E+01
.842600	.768100	.476787	.613081	.2097E+00
1.500000	1.500000	.865649	1.624811	.2220E-15
0.000000	.400000	.029238	.147089	.1058E+01
.866000	.842600	.499797	.641222	.2001E+00
1.500000	1.500000	.863087	1.626041	.2220E-15
-.400000	0.000000	-.082222	-.148316	.1025E+01
.800000	.866000	.498318	.623224	.2007E+00
1.500000	1.500000	.872872	1.627233	.8882E-15
-.800000	-.400000	-.218218	-.442846	.1118E+01
.600000	.800000	.436436	.524111	.2291E+00
1.500000	1.500000	.872872	1.618821	.1776E-14
-1.200000	-.800000	-.218218	-.751160	.1360E+01
.400000	.600000	.436436	.386778	.2291E+00
1.500000	1.500000	.872872	1.607148	.8882E-15
-1.600000	-1.200000	-.218218	-1.085976	.1688E+01
.200000	.400000	.436436	.242716	.2291E+00
1.500000	1.500000	.945063	1.589795	0.
-1.732000	-1.600000	-.272824	-1.365206	.1803E+01
0.000000	.200000	.180164	.084464	.1833E+00
1.500000	1.500000	.958086	1.591395	0.
-1.670000	-1.732000	-.276584	-1.389794	.1803E+01
-.229700	0.000000	-.074655	-.094899	.2076E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
1	13	2.000000	2.000000	1.500000	1.500000	.941794	1.598
		0.000000	0.000000	-1.460000	-1.670000	-.251249	-1.254
		0.000000	0.000000	-.465900	-.229700	-.223380	-.282
	14	2.000000	2.000000	1.500000	1.500000	.915363	1.605
		0.000000	0.000000	-1.140000	-1.460000	-.202414	-1.019
		0.000000	0.000000	-.652000	-.465900	-.348052	-.445
	15	2.000000	2.000000	1.500000	1.500000	.891771	1.609
		0.000000	0.000000	-.800000	-1.140000	-.146221	-.750
		0.000000	0.000000	-.768100	-.652000	-.428210	-.557
	16	2.000000	2.000000	1.500000	1.500000	.874522	1.620
		0.000000	0.000000	-.400000	-.800000	-.088802	-.447
		0.000000	0.000000	-.842600	-.768100	-.476787	-.613
	17	2.000000	2.000000	1.500000	1.500000	.865649	1.624
		0.000000	0.000000	0.000000	-.400000	-.029238	-.147
		0.000000	0.000000	-.866000	-.842600	-.499797	-.641
	18	2.000000	2.000000	1.500000	1.500000	.865649	1.624
		0.000000	0.000000	.400000	0.000000	.029238	.147
		0.000000	0.000000	-.842600	-.866000	-.499797	-.641
	19	2.000000	2.000000	1.500000	1.500000	.874522	1.620
		0.000000	0.000000	.800000	.400000	.088802	.447
		0.000000	0.000000	-.768100	-.842600	-.476787	-.613
	20	2.000000	2.000000	1.500000	1.500000	.891771	1.609
		0.000000	0.000000	1.140000	.800000	.146221	.750
		0.000000	0.000000	-.652000	-.768100	-.428210	-.557
	21	2.000000	2.000000	1.500000	1.500000	.915363	1.605
		0.000000	0.000000	1.460000	1.140000	.202414	1.019
		0.000000	0.000000	-.465900	-.652000	-.348052	-.445
	22	2.000000	2.000000	1.500000	1.500000	.941794	1.598
		0.000000	0.000000	1.670000	1.460000	.251249	1.254
		0.000000	0.000000	-.229700	-.465900	-.223380	-.282
	23	2.000000	2.000000	1.500000	1.500000	.958086	1.591
		0.000000	0.000000	1.732000	1.670000	.276584	1.369
		0.000000	0.000000	0.000000	-.229700	-.074655	-.094
2	1	1.500000	1.500000	1.000000	1.000000	.435365	1.220
		1.732000	1.670000	1.870000	2.000000	.855263	1.831
		0.000000	.229700	.354600	0.000000	.281038	.149

FOLDOUT FRAME 1

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
000000	1.500000	1.500000	.941794	1.598349	.8882E-15
000000	-1.460000	-1.670000	-.251249	-1.254020	.1758E+01
000000	-.465900	-.229700	-.223380	-.282927	.2350E+00
000000	1.500000	1.500000	.915363	1.605113	.2665E-14
000000	-1.140000	-1.460000	-.202414	-1.019539	.1612E+01
000000	-.652000	-.465900	-.348052	-.445612	.2299E+00
000000	1.500000	1.500000	.891771	1.609275	.2665E-14
00000	-.800000	-1.140000	-.146221	-.750320	.1405E+01
00000	-.768100	-.652000	-.428210	-.557494	.1985E+00
00000	1.500000	1.500000	.874522	1.620269	.9992E-15
00000	-.400000	-.800000	-.088802	-.447901	.1217E+01
00000	-.842600	-.768100	-.476787	-.613081	.2097E+00
00000	1.500000	1.500000	.865649	1.624811	.2220E-15
00000	0.000000	-.400000	-.029238	-.147089	.1058E+01
00000	-.866000	-.842600	-.499797	-.641222	.2001E+00
00000	1.500000	1.500000	.865649	1.624811	.2220E-15
00000	.400000	0.000000	.029238	.147089	.1058E+01
00000	-.842600	-.866000	-.499797	-.641222	.2001E+00
00000	1.500000	1.500000	.874522	1.620269	.9992E-15
00000	.800000	.400000	.088802	.447901	.1217E+01
00000	-.768100	-.842600	-.476787	-.613081	.2097E+00
0000	1.500000	1.500000	.891771	1.609275	.2665E-14
0000	1.140000	.800000	.146221	.750320	.1405E+01
0000	-.652000	-.768100	-.428210	-.557494	.1985E+00
0000	1.500000	1.500000	.915363	1.605113	.2665E-14
0000	1.460000	1.140000	.202414	1.019539	.1612E+01
0000	-.465900	-.652000	-.348052	-.445612	.2299E+00
0000	1.500000	1.500000	.941794	1.598349	.8882E-15
0000	1.670000	1.460000	.251249	1.254020	.1758E+01
0000	-.229700	-.465900	-.223380	-.282927	.2350E+00
000	1.500000	1.500000	.958086	1.591395	0.
000	1.732000	1.670000	.276584	1.389794	.1803E+01
000	0.000000	-.229700	-.074655	-.094899	.2076E+00
000	1.000000	1.000000	.435365	1.220560	.5764E-02
000	1.870000	2.000000	.655263	1.831729	.6416E+00
700	.354600	0.000000	.281036	.149900	.1708E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
2	2	1.500000	1.500000	1.000000	1.000000	.390089	1.241719
		1.670000	1.460000	1.600000	1.870000	.652170	1.652830
		.229700	.465900	.600000	.354600	.650004	.414680
	3	1.500000	1.500000	1.000000	1.000000	.324553	1.241630
		1.460000	1.140000	1.200000	1.600000	.447006	1.351646
		.465900	.652000	.800000	.600000	.833577	.631851
	4	1.500000	1.500000	1.000000	1.000000	.288009	1.242990
		1.140000	.800000	.800000	1.200000	.287154	.985715
		.652000	.768100	.916500	.800000	.913561	.786135
	5	1.500000	1.500000	1.000000	1.000000	.270929	1.250180
		.800000	.400000	.400000	.800000	.163401	.600088
		.768100	.842600	.979800	.916500	.948629	.876683
	6	1.500000	1.500000	1.000000	1.000000	.261384	1.250017
		.400000	0.000000	0.000000	.400000	.052527	.200026
		.842600	.866000	1.000000	.979800	.963805	.922094
	7	1.500000	1.500000	1.000000	1.000000	.126140	1.246098
		0.000000	-.400000	-.400000	0.000000	-.312996	-.199566
		.866000	.800000	.600000	1.000000	.941341	.867167
	8	1.500000	1.500000	1.000000	1.000000	0.000000	1.250000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	1.500000	1.500000	1.000000	1.000000	0.000000	1.250000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	1.500000	1.500000	1.000000	1.000000	0.000000	1.250000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	1.500000	1.500000	1.000000	1.000000	.159008	1.216789
		-1.600000	-1.732000	-2.000000	-1.600000	-.593315	-1.739216
		.200000	0.000000	0.000000	.200000	.789109	.102018
	12	1.500000	1.500000	1.000000	1.000000	.435365	1.220560
		-1.732000	-1.670000	-1.870000	-2.000000	-.855263	-1.831729
		0.000000	-.229700	-.354600	0.000000	-.281038	-.149900
	13	1.500000	1.500000	1.000000	1.000000	.390089	1.241719
		-1.670000	-1.460000	-1.600000	-1.870000	-.652170	-1.652830
		-.229700	-.465900	-.600000	-.354600	-.650004	-.414680

FOLDOUT FRAME

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	C T A
.000000	1.000000	.390089	1.241719	.8288E-02
.600000	1.870000	.652170	1.652830	.6561E+00
.600000	.354600	.650004	.414680	.1846E+00
.000000	1.000000	.324553	1.241630	.6043E-02
.200000	1.600000	.447006	1.351646	.6814E+00
.800000	.600000	.833577	.631851	.2159E+00
.000000	1.000000	.288009	1.242990	.4216E-02
.800000	1.200000	.287154	.985715	.6600E+00
.916500	.800000	.913561	.786135	.2025E+00
.000000	1.000000	.270929	1.250180	.2656E-02
.400000	.800000	.163401	.600088	.6744E+00
.979800	.916500	.948629	.876683	.2108E+00
.000000	1.000000	.261384	1.250017	.7718E-03
.000000	.400000	.052527	.200026	.6594E+00
.000000	.979800	.963805	.922094	.2075E+00
.000000	1.000000	.126140	1.246098	.3153E-01
.400000	0.000000	-.312996	-.199566	.6708E+00
.800000	1.000000	.941341	.867167	.2125E+00
.000000	1.000000	0.000000	1.250000	.3553E-14
.800000	-.400000	-.447214	-.600000	.6708E+00
.600000	.800000	.894427	.700000	.2236E+00
.000000	1.000000	0.000000	1.250000	.3553E-14
1.200000	-.600000	-.447214	-1.000000	.6708E+00
.400000	.600000	.894427	.500000	.2236E+00
.000000	1.000000	0.000000	1.250000	.6661E-14
1.600000	-1.200000	-.447214	-1.400000	.6708E+00
.200000	.400000	.894427	.300000	.2236E+00
.000000	1.000000	.159008	1.216789	.3975E-01
2.000000	-1.600000	-.593315	-1.739216	.6708E+00
.000000	.200000	.789109	.102018	.1685E+00
.000000	1.000000	.435365	1.220560	.5764E-02
1.870000	-2.000000	-.855263	-1.831729	.6416E+00
.354600	0.000000	-.281038	-.149900	.1708E+00
.000000	1.000000	.390089	1.241719	.8288E-02
.600000	-1.870000	-.652170	-1.652830	.6561E+00
.600000	-.354600	-.650004	-.414680	.1846E+00

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
2	14	1.500000	1.500000	1.000000	1.000000	.324553	1.241630
		-1.460000	-1.140000	-1.200000	-1.600000	-.447006	-1.351646
		-.465900	-.652000	-.800000	-.600000	-.833577	-.631851
	15	1.500000	1.500000	1.000000	1.000000	.288009	1.242990
		-1.140000	-.800000	-.800000	-1.200000	-.287154	-.985715
		-.652000	-.768100	-.916500	-.800000	-.913561	-.786135
	16	1.500000	1.500000	1.000000	1.000000	.270929	1.250180
		-.800000	-.400000	-.400000	-.800000	-.163401	-.600088
		-.768100	-.842600	-.979800	-.916500	-.948629	-.876683
	17	1.500000	1.500000	1.000000	1.000000	.261384	1.250017
		-.400000	0.000000	0.000000	-.400000	-.052527	-.200026
		-.842600	-.866000	-1.000000	-.979800	-.963805	-.922094
	18	1.500000	1.500000	1.000000	1.000000	.261384	1.250017
		0.000000	.400000	.400000	0.000000	.052527	.200026
		-.866000	-.842600	-.979800	-1.000000	-.963805	-.922094
	19	1.500000	1.500000	1.000000	1.000000	.270929	1.250180
		.400000	.800000	.800000	.400000	.163401	.600088
		-.842600	-.768100	-.916500	-.979800	-.948629	-.876683
	20	1.500000	1.500000	1.000000	1.000000	.288009	1.242990
		.800000	1.140000	1.200000	.800000	.287154	.985715
		-.768100	-.652000	-.800000	-.916500	-.913561	-.786135
	21	1.500000	1.500000	1.000000	1.000000	.324553	1.241630
		1.140000	1.460000	1.600000	1.200000	.447006	1.351646
		-.652000	-.465900	-.600000	-.800000	-.833577	-.631851
	22	1.500000	1.500000	1.000000	1.000000	.390089	1.241719
		1.460000	1.670000	1.870000	1.600000	.652170	1.652830
		-.465900	-.229700	-.354600	-.600000	-.650004	-.414680
	23	1.500000	1.500000	1.000000	1.000000	.435365	1.220560
		1.670000	1.732000	2.000000	1.870000	.855263	1.831729
		-.229700	0.000000	0.000000	-.354600	-.281038	-.149900
3	1	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		2.000000	1.870000	1.870000	2.000000	.938893	1.935000
		0.000000	.354600	.354600	0.000000	.344208	.177300
	2	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.870000	1.600000	1.600000	1.870000	.672591	1.735000
		.354600	.600000	.600000	.354600	.740014	.477300

FOLDOUT FRAME

ATES

NX NY NZ	NPX NPY NPZ	D T A
.324553	1.241630	.6043E-02
-.447006	-1.351646	.6814E+00
-.833577	-.631851	.2159E+00
.288009	1.242990	.4216E-02
-.287154	-.985715	.6600E+00
-.913561	-.786135	.2025E+00
.270929	1.250180	.2656E-02
-.163401	-.600088	.6744E+00
-.948629	-.876683	.2108E+00
.261384	1.250017	.7710E-03
-.052527	-.200026	.6594E+00
-.963805	-.922094	.2075E+00
.261384	1.250017	.7710E-03
.052527	.200026	.6594E+00
-.963805	-.922094	.2075E+00
.270929	1.250180	.2656E-02
.163401	.600088	.6744E+00
-.948629	-.876683	.2108E+00
.288009	1.242990	.4216E-02
.287154	.985715	.6600E+00
-.913561	-.786135	.2025E+00
.324553	1.241630	.6043E-02
.447006	1.351646	.6814E+00
-.833577	-.631851	.2159E+00
.390089	1.241719	.8288E-02
.652170	1.652830	.6561E+00
-.650004	-.414680	.1846E+00
.435365	1.220560	.5764E-02
.855263	1.831729	.6416E+00
-.281038	-.149960	.1708E+00
0.000000	.500000	0.
.938893	1.935000	.1069E+01
.344208	.177300	.3777E+00
0.000000	.500000	.4885E-14
.672591	1.735000	.1064E+01
.740014	.477300	.3649E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
3	3	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		1.600000	1.200000	1.200000	1.600000	.447214	1.40000
		.600000	.800000	.800000	.600000	.894427	.70000
	4	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		1.200000	.800000	.800000	1.200000	.279631	1.00000
		.800000	.916500	.916500	.800000	.960137	.85825
	5	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		.800000	.400000	.400000	.800000	.156305	.60000
		.916500	.979800	.979800	.916500	.987709	.94815
	6	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		.400000	0.000000	0.000000	.400000	.050436	.20000
		.979800	1.000000	1.000000	.979800	.998727	.98990
	7	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		0.000000	-.400000	-.400000	0.000000	-.447214	-.20000
		1.000000	.800000	.800000	1.000000	.894427	.90000
	8	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.60000
		.800000	.600000	.600000	.800000	.894427	.70000
	9	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.00000
		.600000	.400000	.400000	.600000	.894427	.50000
	10	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.40000
		.400000	.200000	.200000	.400000	.894427	.30000
	11	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		-1.600000	-2.000000	-2.000000	-1.600000	-.447214	-1.80000
		.200000	0.000000	0.000000	.200000	.894427	.10000
	12	1.000000	1.000000	0.000000	0.000000	0.000000	.5000
		-2.000000	-1.870000	-1.870000	-2.000000	-.938893	-1.9350
		0.000000	-.354600	-.354600	0.000000	-.344208	-.1773
	13	1.000000	1.000000	0.000000	0.000000	0.000000	.5000
		-1.870000	-1.600000	-1.600000	-1.870000	-.672591	-1.7350
		-.354600	-.600000	-.600000	-.354600	-.740014	-.4773
	14	1.000000	1.000000	0.000000	0.000000	0.000000	.5000
		-1.600000	-1.200000	-1.200000	-1.600000	-.447214	-1.4000
		-.600000	-.800000	-.800000	-.600000	-.894427	-.7000

FOLDOUT FRA

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
0000	0.000000	0.000000	0.000000	.500000	.6661E-14
0000	1.200000	1.600000	.447214	1.400000	.1095E+01
0000	.800000	.600000	.894427	.700000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.2442E-14
0000	.800000	1.200000	.279631	1.000000	.1083E+01
6500	.916500	.800000	.960137	.858250	.4166E+00
0000	0.000000	0.000000	0.000000	.500000	.2442E-14
0000	.400000	.800000	.156305	.600000	.1079E+01
9800	.979800	.916500	.987709	.948150	.4050E+00
0000	0.000000	0.000000	0.000000	.500000	.5551E-16
0000	0.000000	.400000	.050436	.200000	.1077E+01
0000	1.000000	.979800	.998727	.989900	.4005E+00
0000	0.000000	0.000000	0.000000	.500000	.3109E-14
0000	-.400000	0.000000	-.447214	-.200000	.1095E+01
0000	.800000	1.000000	.894427	.900000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.3553E-14
0000	-.800000	-.400000	-.447214	-.600000	.1095E+01
0000	.600000	.800000	.894427	.700000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.3553E-14
0000	-1.200000	-.800000	-.447214	-1.000000	.1095E+01
0000	.400000	.600000	.894427	.500000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.6661E-14
0000	-1.600000	-1.200000	-.447214	-1.400000	.1095E+01
0000	.200000	.400000	.894427	.300000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.4441E-15
0000	-2.000000	-1.600000	-.447214	-1.800000	.1095E+01
0000	0.000000	.200000	.894427	.100000	.4472E+00
000	0.000000	0.000000	0.000000	.500000	0.
000	-1.870000	-2.000000	-.938893	-1.935000	.1069E+01
600	-.354600	0.000000	-.344208	-.177300	.3777E+00
000	0.000000	0.000000	0.000000	.500000	.4885E-14
000	-1.600000	-1.870000	-.672591	-1.735000	.1064E+01
000	-.600000	-.354600	-.740014	-.477300	.3649E+00
000	0.000000	0.000000	0.000000	.500000	.6661E-14
000	-1.200000	-1.600000	-.447214	-1.400000	.1095E+01
000	-.800000	-.600000	-.894427	-.700000	.4472E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
3	15	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.200000	-.800000	-.800000	-1.200000	-.279631	-1.000000
		-.800000	-.916500	-.916500	-.800000	-.960107	-.858250
	16	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.800000	-.400000	-.400000	-.800000	-.156305	-.600000
		-.916500	-.979800	-.979800	-.916500	-.987709	-.948150
	17	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.400000	0.000000	0.000000	-.400000	-.050436	-.200000
		-.979800	-1.000000	-1.000000	-.979800	-.998727	-.989900
	18	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		0.000000	.400000	.400000	0.000000	.050436	.200000
		-1.000000	-.979800	-.979800	-1.000000	-.998727	-.989900
	19	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.400000	.800000	.800000	.400000	.156305	.600000
		-.979800	-.916500	-.916500	-.979800	-.987709	-.948150
	20	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.800000	1.200000	1.200000	.800000	.279631	1.000000
		-.916500	-.800000	-.800000	-.916500	-.960107	-.858250
	21	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.200000	1.600000	1.600000	1.200000	.447214	1.400000
		-.800000	-.600000	-.600000	-.800000	-.894427	-.700000
	22	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.600000	1.870000	1.870000	1.600000	.672591	1.735000
		-.600000	-.354600	-.354600	-.600000	-.740014	-.477300
	23	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.870000	2.000000	2.000000	1.870000	.938893	1.935000
		-.354600	0.000000	0.000000	-.354600	-.344206	-.177300
4	1	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		2.000000	1.870000	1.850000	1.972000	.939127	1.923092
		0.000000	.354600	.341500	0.000000	.339980	.174052
	2	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		1.870000	1.600000	1.585000	1.850000	.675158	1.726269
		.354600	.600000	.586600	.341500	.736411	.470688
	3	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		1.600000	1.200000	1.195000	1.585000	.449471	1.395016
		.600000	.800000	.784400	.586600	.892614	.692774

FOLDOUT FRAME /

NX NY NZ	NPX NPY NPZ	D T A
0.000000	.500000	.2442E-14
-.279631	-1.000000	.1083E+01
-.960107	-.858250	.4166E+00
0.000000	.500000	.2442E-14
-.156305	-.600000	.1079E+01
-.987709	-.948150	.4050E+00
0.000000	.500000	.5551E-16
-.050436	-.200000	.1077E+01
-.998727	-.989900	.4005E+00
0.000000	.500000	.3553E-14
.050436	.200000	.1077E+01
-.998727	-.989900	.4005E+00
0.000000	.500000	.2220E-14
.156305	.600000	.1079E+01
-.987709	-.948150	.4050E+00
0.000000	.500000	.3109E-14
.279631	1.000000	.1083E+01
-.960107	-.858250	.4166E+00
0.000000	.500000	.6661E-14
.447214	1.400000	.1095E+01
-.894427	-.700000	.4472E+00
0.000000	.500000	.6217E-14
.672591	1.735000	.1064E+01
-.740014	-.477300	.3649E+00
0.000000	.500000	.6217E-14
.938893	1.935000	.1069E+01
-.344208	-.177300	.3777E+00
-.049532	-.248068	.7648E-03
.939127	1.923092	.6238E+00
.339980	.174052	.1853E+00
-.043145	-.249477	.7887E-03
.675158	1.726269	.6205E+00
.736411	.470688	.1816E+00
-.034875	-.249169	.6327E-03
.449471	1.395016	.6693E+00
.892614	.692774	.2213E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
4	4	0.000000	0.000000	-.500000	-.500000	-.031043	-.249
		1.200000	.800000	.800000	1.195000	.281449	.998
		.800000	.916500	.901200	.784400	.959074	.850
	5	0.000000	0.000000	-.500000	-.500000	-.029218	-.250
		.800000	.400000	.400000	.800000	.157442	.600
		.916500	.979800	.965500	.901200	.987096	.940
	6	0.000000	0.000000	-.500000	-.500000	-.028252	-.250
		.400000	0.000000	0.000000	.400000	.050789	.200
		.979800	1.000000	.986000	.965500	.998310	.982
	7	0.000000	0.000000	-.500000	-.500000	-.012608	-.249
		0.000000	-.400000	-.400000	0.000000	-.434526	-.199
		1.000000	.800000	.800000	.986000	.900571	.896
	8	0.000000	0.000000	-.500000	-.500000	0.000000	-.250
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600
		.800000	.600000	.600000	.800000	.894427	.700
	9	0.000000	0.000000	-.500000	-.500000	0.000000	-.250
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000
		.600000	.400000	.400000	.600000	.894427	.500
	10	0.000000	0.000000	-.500000	-.500000	0.000000	-.250
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400
		.400000	.200000	.200000	.400000	.894427	.300
	11	0.000000	0.000000	-.500000	-.500000	-.012880	-.247
		-1.600000	-2.000000	-1.972000	-1.600000	-.460013	-1.793
		.200000	0.000000	0.000000	.200000	.887820	.100
	12	0.000000	0.000000	-.500000	-.500000	-.049532	-.248
		-2.000000	-1.870000	-1.850000	-1.972000	-.939127	-1.923
		0.000000	-.354600	-.341500	0.000000	-.339980	-.174
	13	0.000000	0.000000	-.500000	-.500000	-.043145	-.24
		-1.870000	-1.600000	-1.585000	-1.850000	-.675158	-1.72
		-.354600	-.600000	-.586600	-.341500	-.736411	-.47
	14	0.000000	0.000000	-.500000	-.500000	-.034875	-.24
		-1.600000	-1.200000	-1.195000	-1.585000	-.449471	-1.39
		-.600000	-.800000	-.784400	-.586600	-.892614	-.69
	15	0.000000	0.000000	-.500000	-.500000	-.031043	-.24
		-1.200000	-.800000	-.800000	-1.195000	-.281449	-.99
		-.800000	-.916500	-.901200	-.784400	-.959074	-.85

X	X	NX	NPX	D
Y	Y	NY	NPY	T
Z	Z	NZ	NPZ	A
00000	-.500000	-.031043	-.249537	.4237E-03
00000	1.195000	.281449	.998756	.6507E+00
01200	.784400	.959074	.850538	.2072E+00
00000	-.500000	-.029218	-.250016	.2468E-03
00000	.800000	.157442	.600061	.6451E+00
55500	.901200	.967096	.940749	.2026E+00
00000	-.500000	-.028252	-.250002	.7487E-04
00000	.400000	.050789	.200000	.6412E+00
36000	.965500	.998310	.982825	.2003E+00
00000	-.500000	-.012608	-.249496	.3152E-02
00000	0.000000	-.434526	-.199997	.6708E+00
00000	.986000	.900571	.896509	.2221E+00
00000	-.500000	0.000000	-.250000	.3553E-14
00000	-.400000	-.447214	-.600000	.6708E+00
00000	.800000	.894427	.700000	.2236E+00
00000	-.500000	0.000000	-.250000	.3553E-14
00000	-.800000	-.447214	-1.000000	.6708E+00
00000	.600000	.894427	.500000	.2236E+00
00000	-.500000	0.000000	-.250000	.6661E-14
00000	-1.200000	-.447214	-1.400000	.6708E+00
00000	.400000	.894427	.300000	.2236E+00
00000	-.500000	-.012880	-.247831	.3220E-02
22000	-1.600000	-.460010	-1.793015	.6708E+00
00000	.200000	.887620	.100024	.2174E+00
00000	-.500000	-.049532	-.248068	.7648E-03
50000	-1.972000	-.939127	-1.923092	.6238E+00
1500	0.100000	-.339980	-.174052	.1853E+00
00000	-.500000	-.043145	-.249477	.7887E-03
5000	-1.850000	-.675158	-1.726269	.6205E+10
66600	-.341500	-.736411	-.470688	.1816E+00
00000	-.500000	-.034875	-.249169	.6327E-03
5000	-1.585000	-.449471	-1.395016	.6693E+00
4400	-.586600	-.892614	-.692774	.2213E+00
00000	-.500000	-.031043	-.249537	.4237E-03
0000	-1.195000	-.281449	-.998756	.6507E+00
1200	-.784400	-.959074	-.850538	.2072E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X/Y/Z	X/Y/Z	X/Y/Z	X/Y/Z	NX/NY/NZ	NPX/NPY/NPZ
4	16	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		-.800000	-.400000	-.400000	-.800000	-.157442	-.600001
		-.916500	-.979800	-.965500	-.901200	-.987096	-.940749
	17	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		-.400000	0.000000	0.000000	-.400000	-.050789	-.200000
		-.979800	-1.000000	-.986000	-.965500	-.998310	-.982825
	18	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		0.000000	.400000	.400000	0.000000	.050789	.200000
		-1.000000	-.979800	-.965500	-.986000	-.998310	-.982825
	19	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		.400000	.800000	.800000	.400000	.157442	.600001
		-.979800	-.916500	-.901200	-.965500	-.987096	-.940749
	20	0.000000	0.000000	-.500000	-.500000	-.031043	-.249537
		.800000	1.200000	1.195000	.800000	.281449	.998756
		-.916500	-.800000	-.784400	-.901200	-.959074	-.850538
	21	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		1.200000	1.600000	1.585000	1.195000	.449471	1.395016
		-.800000	-.600000	-.586600	-.784400	-.892614	-.632774
	22	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		1.600000	1.870000	1.850000	1.585000	.675158	1.726269
		-.600000	-.354600	-.341500	-.586600	-.736411	-.470688
	23	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		1.870000	2.000000	1.972000	1.850000	.939127	1.923092
		-.354600	0.000000	0.000000	-.341500	-.339980	-.174052
5	1	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		1.972000	1.850000	1.785000	1.685600	.934141	1.874150
		0.000000	.341500	.303900	0.000000	.322188	.161626
	2	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747389
		1.850000	1.585000	1.540000	1.785000	.683173	1.690281
		.341500	.586600	.544000	.303900	.718091	.444215
	3	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		1.585000	1.195000	1.175000	1.540000	.457325	1.373892
		.586600	.784400	.737400	.544000	.882618	.663304
	4	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.74795
		1.195000	.800000	.800000	1.175000	.288525	.992572
		.784400	.901200	.853800	.737400	.952677	.81938

FOLDOUT FRA...

	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
000	-.500000	-.029218	-.250016	.2468E-03
000	-.800000	-.157442	-.600001	.6451E+00
500	-.901200	-.987096	-.940749	.2026E+00
000	-.500000	-.028252	-.250002	.7487E-04
000	-.400000	-.050789	-.200000	.6412E+00
000	-.965500	-.998310	-.982825	.2003E+00
000	-.500000	-.028252	-.250002	.7487E-04
000	0.000000	.050789	.200000	.6412E+00
500	-.986000	-.998310	-.982825	.2003E+00
000	-.500000	-.029216	-.250016	.2468E-03
000	.400000	.157442	.600001	.6451E+00
200	-.965500	-.987096	-.940749	.2026E+00
000	-.500000	-.031043	-.249537	.4237E-03
000	.800000	.281449	.998756	.6507E+00
400	-.901200	-.959074	-.850538	.2072E+00
000	-.500000	-.034875	-.249169	.6327E-03
000	1.195000	.449471	1.395016	.6693E+00
600	-.784400	-.892614	-.632774	.2213E+00
000	-.500000	-.043145	-.249477	.7887E-03
000	1.585000	.675158	1.726269	.6205E+00
500	-.586600	-.736411	-.470688	.1816E+00
000	-.500000	-.049532	-.248068	.7648E-03
000	1.650000	.939127	1.923092	.6238E+00
000	-.341500	-.339980	-.174052	.1853E+00
000	-1.000000	-.153543	-.743334	.1969E-02
000	1.685600	.934141	1.874150	.6143E+00
000	0.000000	.322188	.161626	.1727E+00
000	-1.000000	-.132740	-.747389	.2518E-02
000	1.785000	.683173	1.690281	.6222E+00
000	.333900	.718091	.444215	.1776E+00
000	-1.000000	-.108809	-.747752	.1887E-02
000	1.540000	.457325	1.373892	.6640E+00
400	.544000	.882618	.663304	.2139E+00
00	-1.000000	-.095703	-.747958	.1347E-02
00	1.175000	.288525	.992572	.6461E+00
00	.737400	.952677	.819383	.2021E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
5	5	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.750055
		.800000	.400000	.400000	.800000	.162020	.600009
		.901200	.965500	.921400	.853800	.982682	.910468
	6	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		.400000	0.000000	0.000000	.400000	.052106	.200003
		.965500	.986000	.942800	.921400	.994858	.953924
	7	-.500000	-.500000	-1.000000	-1.000000	-.039925	-.748551
		0.000000	-.400000	-.400000	0.000000	-.379842	-.199961
		.986000	.800000	.800000	.942800	.924189	.882279
	8	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.750000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.750000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.750000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	-.500000	-.500000	-1.000000	-1.000000	-.044855	-.741375
		-1.600000	-1.972000	-1.885600	-1.600000	-.519160	-1.764760
		.200000	0.000000	0.000000	.200000	.853499	.100234
	12	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		-1.972000	-1.850000	-1.785000	-1.885600	-.934141	-1.874150
		0.000000	-.341500	-.303900	0.000000	-.322188	-.161626
	13	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747389
		-1.850000	-1.585000	-1.540000	-1.785000	-.683173	-1.690281
		-.341500	-.586600	-.544000	-.303900	-.718091	-.444215
	14	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		-1.585000	-1.195000	-1.175000	-1.540000	-.457325	-1.373892
		-.586600	-.784400	-.737400	-.544000	-.882618	-.663304
	15	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		-1.195000	-.800000	-.800000	-1.175000	-.288525	-.992572
		-.784400	-.901200	-.853800	-.737400	-.952677	-.819383
	16	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.750055
		-.800000	-.400000	-.400000	-.800000	-.162020	-.600009
		-.901200	-.965500	-.921400	-.853800	-.982682	-.910468

FOLDOUT FRAME 1

DY

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	C T A
-1.000000 .400000 .921400	-1.000000 .800000 .853800	-.089915 .162020 .982682	-.750055 .600009 .910468	.8107E-03 .6500E+00 .2035E+00
-1.000000 0.000000 .942800	-1.000000 .400000 .921400	-.086851 .052106 .994858	-.750005 .200003 .953924	.2238E-03 .6436E+00 .2010E+00
-1.000000 -.400000 .800000	-1.000000 0.000000 .942800	-.039925 -.379842 .924189	-.748551 -.199961 .862279	.9981E-02 .6668E+00 .2164E+00
-1.000000 -.800000 .600000	-1.000000 -.400000 .800000	0.000000 -.447214 .894427	-.750000 -.600000 .700000	.3553E-14 .6708E+00 .2236E+00
-1.000000 -1.200000 .400000	-1.000000 -.800000 .600000	0.000000 -.447214 .894427	-.750000 -1.000000 .500000	.3553E-14 .6708E+00 .2236E+00
-1.000000 -1.600000 .200000	-1.000000 -1.200000 .400000	0.000000 -.447214 .894427	-.750000 -1.400000 .300000	.6661E-14 .6708E+00 .2236E+00
-1.000000 -1.885600 0.000000	-1.000000 -1.600000 .200000	-.044855 -.519160 .853499	-.741375 -1.764760 .100234	.1121E-01 .6545E+00 .1926E+00
-1.000000 -1.785000 -.303900	-1.000000 -1.885600 0.000000	-.153543 -.934141 -.322188	-.743334 -1.874150 -.161626	.1969E-02 .6143E+00 .1727E+00
-1.000000 -1.540000 -.544000	-1.000000 -1.785000 -.303900	-.132740 -.683173 -.718091	-.747389 -1.690281 -.444215	.2518E-02 .6222E+00 .1776E+00
-1.000000 -1.175000 -.737400	-1.000000 -1.540000 -.544000	-.108809 -.457325 -.882618	-.747752 -1.373892 -.663304	.1887E-02 .6640E+00 .2139E+00
-1.000000 -.800000 -.853800	-1.000000 -1.175000 -.737400	-.095703 -.288525 -.952677	-.747958 -.992572 -.819383	.1347E-02 .6461E+00 .2021E+00
-1.000000 -.400000 -.921400	-1.000000 -.800000 -.853800	-.089915 -.162020 -.982682	-.750055 -.600009 -.910468	.8107E-03 .6500E+00 .2035E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
5	17	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		-.400000	0.000000	0.000000	-.400000	-.052106	-.200003
		-.965500	-.986000	-.942800	-.921400	-.994858	-.953924
	18	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		0.000000	.400000	.400000	0.000000	.052106	.200003
		-.986000	-.965500	-.921400	-.942800	-.994858	-.953924
	19	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.750055
		.400000	.800000	.800000	.400000	.162020	.600009
		-.965500	-.901200	-.853800	-.921400	-.982682	-.910468
	20	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		.800000	1.195000	1.175000	.800000	.288525	.992572
		-.901200	-.784400	-.737400	-.853800	-.952677	-.819383
	21	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		1.195000	1.585000	1.540000	1.175000	.457325	1.373892
		-.784400	-.586600	-.544000	-.737400	-.882618	-.663304
	22	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747389
		1.585000	1.850000	1.785000	1.540000	.683173	1.690281
		-.586600	-.341500	-.303900	-.544000	-.718091	-.444215
	23	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		1.850000	1.972000	1.885600	1.785000	.934141	1.874150
		-.341500	0.000000	0.000000	-.303900	-.322188	-.161626
6	1	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		1.885600	1.785000	1.670000	1.732000	.921489	1.773614
		0.000000	.303900	.229700	0.000000	.280799	.134912
	2	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245329
		1.785000	1.540000	1.460000	1.670000	.702123	1.614691
		.303900	.544000	.465900	.229700	.670724	.386555
	3	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		1.540000	1.175000	1.140000	1.460000	.475316	1.329324
		.544000	.737400	.652000	.465900	.857948	.600627
	4	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		1.175000	.800000	.800000	1.140000	.304683	.979004
		.737400	.853800	.768100	.652000	.936981	.753512
	5	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		.800000	.400000	.400000	.800000	.172638	.600034
		.853800	.921400	.842600	.768100	.971923	.846449

	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
00	-1.000000	-.086851	-.750005	.2238E-03
00	-.400000	-.052106	-.200003	.6436E+00
00	-.921400	-.994858	-.953924	.2010E+00
00	-1.000000	-.086851	-.750005	.2238E-03
00	0.000000	.052106	.200003	.6436E+00
00	-.942800	-.994858	-.953924	.2010E+00
00	-1.000000	-.089915	-.750055	.8107E-03
00	.400000	.162020	.600009	.6500E+00
00	-.921400	-.982682	-.910468	.2035E+00
00	-1.000000	-.095703	-.747958	.1347E-02
00	.800000	.288525	.992572	.6461E+00
00	-.853800	-.952677	-.819383	.2021E+00
00	-1.000000	-.108609	-.747752	.1887E-02
00	1.175000	.457325	1.373892	.6640E+00
00	-.737400	-.882618	-.663304	.2139E+00
00	-1.000000	-.132740	-.747389	.2518E-02
00	1.540000	.683173	1.690281	.6222E+00
00	-.544000	-.718091	-.444215	.1776E+00
00	-1.000000	-.153543	-.743334	.1969E-02
00	1.785000	.934141	1.874150	.6143E+00
00	-.303900	-.322188	-.161626	.1727E+00
00	-1.500000	-.268347	-1.229655	.3684E-02
00	1.732000	.921489	1.773614	.5910E+00
00	0.000000	.280799	.134912	.1448E+00
0	-1.500000	-.239065	-1.245329	.5490E-02
00	1.670000	.702123	1.614691	.6180E+00
0	.229700	.670724	.386555	.1696E+00
0	-1.500000	-.194936	-1.245068	.3762E-02
0	1.460000	.475316	1.329324	.6494E+00
0	.465900	.857948	.600627	.1996E+00
0	-1.500000	-.170981	-1.245783	.2596E-02
0	1.140000	.304683	.979304	.6374E+00
0	.652000	.936981	.753512	.1908E+00
0	-1.500000	-.159881	-1.250120	.1677E-02
0	.800000	.172638	.600034	.6584E+00
0	.768100	.971923	.846449	.2658E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NP NP NP
6	6	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.25
		.400000	0.000000	0.000000	.400000	.055250	.20
		.921400	.942800	.866000	.842600	.986601	.89
	7	-1.000000	-1.000000	-1.500000	-1.500000	-.074106	-1.24
		0.000000	-.400000	-.400000	0.000000	-.251846	-.19
		.942800	.800000	.800000	.866000	.964926	.85
	8	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600
		.800000	.600000	.600000	.800000	.894427	.700
	9	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000
		.600000	.400000	.400000	.600000	.894427	.500
	10	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400
		.400000	.200000	.200000	.400000	.894427	.300
	11	-1.000000	-1.000000	-1.500000	-1.500000	-.105654	-1.225
		-1.600000	-1.885600	-1.732000	-1.600000	-.687853	-1.707
		.200000	0.000000	0.000000	.200000	.718119	.100
	12	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229
		-1.885600	-1.785000	-1.670000	-1.732000	-.921489	-1.773
		0.000000	-.303900	-.229700	0.000000	-.280799	-.134
	13	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245
		-1.785000	-1.540000	-1.460000	-1.670000	-.702123	-1.614
		-.303900	-.544000	-.465900	-.229700	-.670724	-.386
	14	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245
		-1.540000	-1.175000	-1.140000	-1.460000	-.475316	-1.329
		-.544000	-.737400	-.652000	-.465900	-.857948	-.600
	15	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245
		-1.175000	-.800000	-.800000	-1.140000	-.304683	-.979
		-.737400	-.853800	-.768100	-.652000	-.936981	-.753
	16	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250
		-.800000	-.400000	-.400000	-.800000	-.172638	-.600
		-.853800	-.921400	-.842600	-.768100	-.971923	-.846
	17	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250
		-.400000	0.000000	0.000000	-.400000	-.055250	-.200
		-.921400	-.942800	-.866000	-.842600	-.986601	-.893

FOLDOUT FRAME 1

X	X	NX	NPX	D
Y	Y	NY	NPY	T
Z	Z	NZ	NPZ	A
.500000	-1.500000	-.153515	-1.250012	.4933E-03
.000000	.400000	.055250	.200010	.6481E+00
.866000	.842600	.986601	.893198	.2027E+00
.500000	-1.500000	-.074106	-1.248100	.1853E-01
.400000	0.000000	-.251846	-.199835	.6560E+00
.800000	.866000	.964926	.852389	.2073E+00
.500000	-1.500000	0.000000	-1.250000	.3553E-14
.800000	-.400000	-.447214	-.600000	.6708E+00
.600000	.800000	.894427	.700000	.2236E+00
.500000	-1.500000	0.000000	-1.250000	.3553E-14
.200000	-.800000	-.447214	-1.000000	.6708E+00
.400000	.600000	.894427	.500000	.2236E+00
.500000	-1.500000	0.000000	-1.250000	.6661E-14
.600000	-1.200000	-.447214	-1.400000	.6708E+00
.200000	.400000	.894427	.300000	.2236E+00
.500000	-1.500000	-.105654	-1.225923	.2641E-01
.732000	-1.600000	-.687853	-1.707445	.6096E+00
.000000	.200000	.718119	.100626	.1454E+00
.500000	-1.500000	-.268347	-1.229655	.3684E-02
.670000	-1.732000	-.921489	-1.773614	.5910E+00
.229700	0.000000	-.280799	-.134912	.1448E+00
.500000	-1.500000	-.239065	-1.245329	.5490E-02
.460000	-1.670000	-.702123	-1.614691	.6180E+00
.465900	-.229700	-.670724	-.386555	.1696E+00
.500000	-1.500000	-.194936	-1.245068	.3782E-02
.140000	-1.460000	-.475316	-1.329324	.6494E+00
.652000	-.465900	-.857948	-.600627	.1996E+00
500000	-1.500000	-.170981	-1.245783	.2596E-02
800000	-1.140000	-.304683	-.979004	.6374E+00
768100	-.652000	-.936981	-.753512	.1908E+00
500000	-1.500000	-.159881	-1.250120	.1677E-02
400000	-.800000	-.172638	-.600034	.6584E+00
842600	-.768100	-.971923	-.846449	.2058E+00
500000	-1.500000	-.153515	-1.250012	.4933E-03
000000	-.400000	-.055250	-.200010	.6481E+00
866000	-.842600	-.986601	-.893198	.2027E+00

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
6	18	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250012
		0.000000	.400000	.400000	0.000000	.055250	.200010
		-.942800	-.921400	-.842600	-.866000	-.986601	-.893198
	19	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		.400000	.800000	.800000	.400000	.172638	.600034
		-.921400	-.853800	-.768100	-.842600	-.971923	-.846449
	20	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		.800000	1.175000	1.140000	.800000	.304683	.979004
		-.853800	-.737400	-.652000	-.768100	-.936981	-.753512
	21	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		1.175000	1.540000	1.460000	1.140000	.475316	1.329324
		-.737400	-.544000	-.465900	-.652000	-.857948	-.600627
	22	-1.000000	-1.000000	-1.500000	-1.500000	-.239865	-1.245329
		1.540000	1.785000	1.670000	1.460000	.702123	1.614691
		-.544000	-.303900	-.229700	-.465900	-.670724	-.386555
	23	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		1.785000	1.885600	1.732000	1.670000	.921489	1.773614
		-.303900	0.000000	0.000000	-.229700	-.280799	-.134912
7	1	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.699678
		1.732000	1.670000	1.465000	1.490700	.885202	1.611865
		0.000000	.229700	.137800	0.000000	.211244	.096576
	2	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.733772
		1.670000	1.460000	1.322000	1.465000	.725701	1.484752
		.229700	.465900	.344400	.137800	.578529	.297994
	3	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.738932
		1.460000	1.140000	1.072000	1.322000	.507279	1.250730
		.465900	.652000	.517900	.344400	.804085	.497910
	4	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.738266
		1.140000	.800000	.800000	1.072000	.335023	.954054
		.652000	.768100	.628900	.517900	.902837	.644837
	5	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.750276
		.800000	.400000	.400000	.800000	.193980	.600104
		.768100	.842600	.718000	.628900	.948555	.739306
	6	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.750025
		.400000	0.000000	0.000000	.400000	.061556	.200030
		.342600	.866000	.745400	.718000	.969388	.792992

FOLDOUT FRAME

BODY

X	X	NX	NPX	D
Y	Y	NY	NPY	T
Z	Z	NZ	NPZ	A
-1.500000	-1.500000	-.153515	-1.250012	.4933E-03
.400000	0.000000	.055250	.200010	.6481E+00
-.842600	-.866000	-.986601	-.893198	.2027E+00
-1.500000	-1.500000	-.159881	-1.250120	.1677E-02
.800000	.400000	.172638	.600034	.6584E+00
-.768100	-.842600	-.971923	-.846449	.2058E+00
-1.500000	-1.500000	-.170981	-1.245783	.2596E-02
1.140000	.800000	.304683	.979004	.6374E+00
-.652000	-.768100	-.936981	-.753512	.1908E+00
-1.500000	-1.500000	-.194936	-1.245068	.3782E-02
1.460000	1.140000	.475316	1.329324	.6494E+00
-.465900	-.652000	-.857948	-.600627	.1996E+00
-1.500000	-1.500000	-.239065	-1.245329	.5490E-02
1.670000	1.460000	.702123	1.614691	.6180E+00
-.229700	-.465900	-.670724	-.386555	.1696E+00
-1.500000	-1.500000	-.268347	-1.229655	.3664E-02
1.732000	1.670000	.921489	1.773614	.5910E+00
0.000000	-.229700	-.280799	-.134912	.1448E+00
-2.000000	-2.000000	-.414479	-1.699678	.3180E-02
1.465000	1.490700	.885202	1.611865	.5833E+00
.137800	0.000000	.211244	.096576	.1038E+00
-2.000000	-2.000000	-.372374	-1.733772	.7874E-02
1.322000	1.465000	.725701	1.484752	.6199E+00
.344400	.137800	.578529	.297994	.1525E+00
-2.000000	-2.000000	-.310024	-1.738932	.6345E-02
1.072000	1.322000	.507279	1.250730	.6350E+00
.517900	.344400	.804085	.497910	.1772E+00
-2.000000	-2.000000	-.269527	-1.738266	.4544E-02
.800000	1.072000	.335023	.954054	.6218E+00
.628900	.517900	.902837	.644837	.1695E+00
-2.000000	-2.000000	-.250229	-1.750276	.3462E-02
.400000	.800000	.193980	.600104	.6750E+00
.718000	.628900	.948555	.739306	.2108E+00
-2.000000	-2.000000	-.237694	-1.750025	.9694E-03
0.000000	.400000	.061556	.200030	.6572E+00
.745400	.718000	.969388	.792992	.2063E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
7	7	-1.500000	-1.500000	-2.000000	-2.000000	-.197278	-1.74955
		0.000000	-.400000	-.400000	0.000000	-.113683	-.19975
		.866000	.800000	.718000	.745400	.973734	.78246
	8	-1.500000	-1.500000	-2.000000	-2.000000	-.075980	-1.74731
		-.400000	-.800000	-.800000	-.400000	-.368319	-.59985
		.800000	.600000	.600000	.718000	.926589	.67977
	9	-1.500000	-1.500000	-2.000000	-2.000000	0.000000	-1.75000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.00000
		.600000	.400000	.400000	.600000	.894427	.50000
	10	-1.500000	-1.500000	-2.000000	-2.000000	-.050829	-1.72040
		-1.200000	-1.600000	-1.400000	-1.200000	-.496741	-1.35282
		.400000	.200000	.256000	.400000	.866409	.31411
	11	-1.500000	-1.500000	-2.000000	-2.000000	-.348626	-1.76253
		-1.600000	-1.732000	-1.490700	-1.400000	-.842191	-1.55051
		.200000	0.000000	0.000000	.256000	.411307	.11394
	12	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.69967
		-1.732000	-1.670000	-1.465000	-1.490700	-.885202	-1.61186
		0.000000	-.229700	-.137800	0.000000	-.211244	-.09657
	13	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.73377
		-1.670000	-1.460000	-1.322000	-1.465000	-.725701	-1.48475
		-.229700	-.465900	-.344400	-.137800	-.578529	-.29799
	14	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.73893
		-1.460000	-1.140000	-1.072000	-1.322000	-.507279	-1.25073
		-.465900	-.652000	-.517900	-.344400	-.804085	-.49791
	15	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.73826
		-1.140000	-.800000	-.800000	-1.072000	-.335023	-.95405
		-.652000	-.768100	-.628900	-.517900	-.902837	-.64483
	16	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.75027
		-.800000	-.400000	-.400000	-.600000	-.193980	-.60010
		-.768100	-.842600	-.718000	-.628900	-.948555	-.73930
	17	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.75002
		-.400000	0.000000	0.000000	-.400000	-.061556	-.20003
		-.842600	-.866000	-.745400	-.718000	-.969388	-.79299
	18	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.75002
		0.000000	.400000	.400000	0.000000	.061556	.20003
		-.866000	-.842600	-.718000	-.745400	-.969388	-.79299

FOLDOUT FRAME

	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ	C / T / A
000	-2.000000	-.197278	-1.749550	.9397E-02
000	0.000000	-.113683	-.199759	.6572E+00
000	.745400	.973734	.782469	.2054E+00
000	-2.000000	-.075989	-1.747311	.1900E-01
000	-.400000	-.368319	-.599857	.6708E+00
000	.718000	.926589	.679777	.2158E+00
000	-2.000000	0.000000	-1.750000	.3553E-14
000	-.800000	-.447214	-1.000000	.6708E+00
000	.600000	.894427	.500000	.2236E+00
000	-2.000000	-.050829	-1.720409	.1271E-01
000	-1.200000	-.496741	-1.352829	.6708E+00
000	.400000	.866409	.314114	.1731E+00
000	-2.000000	-.348626	-1.762537	.1445E-01
700	-1.400000	-.842191	-1.550513	.6525E+00
000	.256000	.411387	.113943	.1354E+00
000	-2.000000	-.414479	-1.699678	.3180E-02
000	-1.490700	-.885202	-1.611865	.5833E+00
800	0.000000	-.211244	-.096576	.1038E+00
000	-2.000000	-.372374	-1.733772	.7874E-02
000	-1.465000	-.725701	-1.484752	.6199E+00
400	-.137800	-.578529	-.297994	.1525E+00
000	-2.000000	-.310024	-1.738932	.6345E-02
000	-1.322000	-.507279	-1.250730	.6350E+00
900	-.344400	-.804085	-.497910	.1772E+00
000	-2.000000	-.269527	-1.738266	.4544E-02
000	-1.072000	-.335023	-.954054	.6218E+00
900	-.517900	-.962837	-.644837	.1695E+00
000	-2.000000	-.250229	-1.750276	.3462E-02
000	-.600000	-.193980	-.600104	.6750E+00
900	-.628900	-.948555	-.739376	.2108E+00
000	-2.000000	-.237694	-1.750025	.9694E-03
000	-.400000	-.061556	-.200030	.6572E+00
400	-.718000	-.969388	-.792992	.2063E+00
000	-2.000000	-.237694	-1.750025	.9694E-03
000	0.000000	.061556	.200030	.6572E+00
000	-.745400	-.969388	-.792992	.2063E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NP
7	19	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.75
		.400000	.800000	.800000	.400000	.193980	.60
		-.842600	-.768100	-.628900	-.718000	-.948555	-.73
	20	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.73
		.800000	1.140000	1.072000	.800000	.335023	.95
		-.768100	-.652000	-.517900	-.628900	-.902837	-.64
	21	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.73
		1.140000	1.460000	1.322000	1.072000	.507279	1.25
		-.652000	-.465900	-.344400	-.517900	-.804085	-.497
	22	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.733
		1.460000	1.670000	1.465000	1.322000	.725701	1.484
		-.465900	-.229700	-.137800	-.344400	-.578529	-.297
	23	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.699
		1.670000	1.732000	1.490700	1.465000	.885202	1.611
		-.229700	0.000000	0.000000	-.137800	-.211244	-.096

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N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NP
8	1	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218
		1.490700	1.322000	1.000000	1.055000	.747834	1.240
		0.000000	.344400	.235700	0.000000	.288382	.149
	2	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214
		1.322000	.800000	.800000	1.000000	.463200	.990
		.344400	.628900	.381500	.235700	.777203	.411
	3	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.250
		.800000	.400000	.400000	.800000	.246251	.600
		.628900	.718000	.515300	.381500	.883807	.560
	4	-2.000000	-2.000000	-2.500000	-2.500000	-.366809	-2.250
		.400000	0.000000	0.000000	.400000	.075569	.200
		.718000	.745700	.552800	.515300	.927222	.632
	5	-2.000000	-2.000000	-2.500000	-2.500000	-.366809	-2.250
		0.000000	-.400000	-.400000	0.000000	-.075569	-.200
		.745700	.718000	.515300	.552800	.927222	.632
	6	-2.000000	-2.000000	-2.500000	-2.500000	-.372805	-2.250
		-.400000	-.800000	-.800000	-.400000	-.278586	-.600
		.718000	.600000	.381500	.515300	.885102	.553

FOLDOUT FRA

	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
000	-2.000000	-.250229	-1.750276	.3462E-02
000	.400000	.193980	.600104	.6750E+00
900	-.718000	-.948555	-.739306	.2108E+00
000	-2.000000	-.269527	-1.738266	.4544E-02
000	.800000	.335023	.954054	.6218E+00
900	-.628900	-.902837	-.644837	.1695E+00
000	-2.000000	-.310024	-1.738932	.6345E-02
000	1.072000	.507279	1.250730	.6350E+00
400	-.517900	-.804085	-.497910	.1772E+00
000	-2.000000	-.372374	-1.733772	.7874E-02
000	1.322000	.725701	1.484752	.6199E+00
000	-.344400	-.578529	-.297994	.1525E+00
000	-2.000000	-.414479	-1.699678	.3180E-02
700	1.465000	.885202	1.611865	.5833E+00
000	-.137800	-.211244	-.096576	.1038E+00
	************		************	
00	-2.500000	-.597981	-2.218024	.1342E-01
00	1.055000	.747834	1.240723	.7391E+00
00	0.000000	.288382	.149617	.1939E+00
00	-2.500000	-.425912	-2.214445	.1034E-01
00	1.000000	.463200	.990269	.7238E+00
00	.235700	.777203	.411287	.2322E+00
00	-2.500000	-.397801	-2.250969	.9877E-02
00	.800000	.246251	.800392	.7233E+00
00	.381500	.883807	.560379	.2263E+00
00	-2.500000	-.366809	-2.250072	.2272E-02
00	.400000	.075569	.200101	.6805E+00
00	.515300	.927222	.632913	.2157E+00
00	-2.500000	-.366809	-2.250072	.2272E-02
00	0.000000	-.075569	-.200101	.6805E+00
00	.552800	.927222	.632913	.2157E+00
00	-2.500000	-.372805	-2.250383	.3496E-02
00	-.400000	-.278586	-.600126	.7233E+00
00	.515300	.885102	.553499	.2260E+00

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NP
		Y	Y	Y	Y	NY	NP
		Z	Z	Z	Z	NZ	NP
8	7	-2.000000	-2.000000	-2.500000	-2.500000	-.396212	-2.21
		-.800000	-1.200000	-1.000000	-.800000	-.458473	-.95
		.600000	.400000	.235700	.381500	.795499	.41
	8	-2.000000	-2.000000	-2.500000	-2.500000	-.537231	-2.21
		-1.200000	-1.490700	-1.055000	-1.000000	-.740960	-1.20
		.400000	0.000000	0.000000	.235700	.402941	.16
	9	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218
		-1.490700	-1.322000	-1.000000	-1.055000	-.747834	-1.240
		0.000000	-.344400	-.235700	0.000000	-.288382	-.149
	10	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214
		-1.322000	-.800000	-.800000	-1.000000	-.463200	-.990
		-.344400	-.628900	-.381500	-.235700	-.777203	-.411
	11	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.250
		-.800000	-.400000	-.400000	-.800000	-.246251	-.600
		-.628900	-.718000	-.515300	-.381500	-.883807	-.560
	12	-2.000000	-2.000000	-2.500000	-2.500000	-.366578	-2.250
		-.400000	0.000000	0.000000	-.400000	-.075231	-.200
		-.718000	-.745400	-.552800	-.515300	-.927341	-.632
	13	-2.000000	-2.000000	-2.500000	-2.500000	-.366578	-2.250
		0.000000	.400000	.400000	0.000000	.075231	.200
		-.745400	-.718000	-.515300	-.552800	-.927341	-.632
	14	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.250
		.400000	.800000	.800000	.400000	.246251	.600
		-.718000	-.628900	-.381500	-.515300	-.883807	-.560
	15	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214
		.800000	1.322000	1.000000	.800000	.463200	.990
		-.628900	-.344400	-.235700	-.381500	-.777203	-.411
	16	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218
		1.322000	1.490700	1.055000	1.000000	.747834	1.240
		-.344400	0.000000	0.000000	-.235700	-.288382	-.149
			************		************		
9	1	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.626
		1.055000	.800000	0.000000	0.000000	.411733	.687
		0.000000	.381500	0.000000	0.000000	.275208	.149

FOLDOUT FRAME 1

TMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

T BODY

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
-2.500000 -1.000000 .235700	-2.500000 -.800000 .381500	-.396212 -.458473 .795499	-2.218355 -.956945 .416059	.1214E-01 .6502E+00 .1886E+00
-2.500000 -1.055000 0.000000	-2.500000 -1.000000 .235700	-.537231 -.740960 .402941	-2.212088 -1.209729 .166619	.2711E-01 .7391E+00 .2145E+00
-2.500000 -1.000000 -.235700	-2.500000 -1.055000 0.000000	-.597981 -.747834 -.288382	-2.218024 -1.240723 -.149617	.1342E-01 .7391E+00 .1939E+00
-2.500000 -.800000 -.381500	-2.500000 -1.000000 -.235700	-.425912 -.463200 -.777203	-2.214445 -.990269 -.411287	.1034E-01 .7238E+00 .2322E+00
-2.500000 -.400000 -.515300	-2.500000 -.800000 -.381500	-.397801 -.246251 -.883807	-2.250969 -.600392 -.560379	.9877E-02 .7233E+00 .2263E+00
-2.500000 0.000000 -.552800	-2.500000 -.400000 -.515300	-.366578 -.075231 -.927341	-2.250074 -.200104 -.632837	.2342E-02 .6804E+00 .2157E+00
-2.500000 .400000 -.515300	-2.500000 0.000000 -.552800	-.366578 .075231 -.927341	-2.250074 .200104 -.632837	.2342E-02 .6804E+00 .2157E+00
-2.500000 .800000 -.381500	-2.500000 .400000 -.515300	-.397801 .246251 -.883807	-2.250969 .600392 -.560379	.9877E-02 .7233E+00 .2263E+00
-2.500000 1.000000 -.235700	-2.500000 .800000 -.381500	-.425912 .463200 -.777203	-2.214445 .990269 -.411287	.1034E-01 .7238E+00 .2322E+00
-2.500000 1.055000 0.000000	-2.500000 1.000000 -.235700	-.597981 .747834 -.288382	-2.218024 1.240723 -.149617	.1342E-01 .7391E+00 .1939E+00

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-3.000000 0.000000 0.000000	-3.000000 0.000000 0.000000	-.868756 .411733 .275208	-2.626833 .687692 .149145	0. .1167E+01 .2316E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
9	2	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.629
		.800000	.400000	0.000000	0.000000	.200002	.434
		.381500	.515300	0.000000	0.000000	.597912	.336
	3	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		.400000	0.000000	0.000000	0.000000	.062764	.141
		.515300	.552800	0.000000	0.000000	.669478	.389
	4	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		0.000000	-.400000	0.000000	0.000000	-.062764	-.141
		.552800	.515300	0.000000	0.000000	.669478	.389
	5	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.6291
		-.400000	-.800000	0.000000	0.000000	-.200002	-.4341
		.515300	.381500	0.000000	0.000000	.597912	.3362
	6	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.6268
		-.800000	-1.055000	0.000000	0.000000	-.411733	-.6876
		.381500	0.000000	0.000000	0.000000	.275208	.1491
	7	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.6268
		-1.055000	-.800000	0.000000	0.000000	-.411733	-.6876
		0.000000	-.381500	0.000000	0.000000	-.275208	-.1491
	8	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.6291
		-.800000	-.400000	0.000000	0.000000	-.200002	-.4341
		-.381500	-.515300	0.000000	0.000000	-.597912	-.3362
	9	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.6354
		-.400000	0.000000	0.000000	0.000000	-.062764	-.1412
		-.515300	-.552800	0.000000	0.000000	-.669478	-.3897
	10	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.6354
		0.000000	.400000	0.000000	0.000000	.062764	.1412
		-.552800	-.515300	0.000000	0.000000	-.669478	-.3897
	11	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.6291
		.400000	.800000	0.000000	0.000000	.200002	.4341
		-.515300	-.381500	0.000000	0.000000	-.597912	-.3362
	12	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.6268
		.800000	1.055000	0.000000	0.000000	.411733	.6876
		-.381500	0.000000	0.000000	0.000000	-.275208	-.1491

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FOLDOUT FRAME

T BODY

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
-3.000000	-3.000000	-.776209	-2.629150	.1332E-14
0.000000	0.000000	.200002	.434170	.1018E+01
0.000000	0.000000	.597912	.336208	.1672E+00
-3.000000	-3.000000	-.740175	-2.635472	.2220E-15
0.000000	0.000000	.062764	.141262	.8219E+00
0.000000	0.000000	.669478	.389779	.1494E+00
-3.000000	-3.000000	-.740175	-2.635472	.3053E-15
0.000000	0.000000	-.062764	-.141262	.8219E+00
0.000000	0.000000	.669478	.389779	.1494E+00
-3.000000	-3.000000	-.776209	-2.629150	.1110E-14
0.000000	0.000000	-.200002	-.434170	.1018E+01
0.000000	0.000000	.597912	.336208	.1672E+00
-3.000000	-3.000000	-.868756	-2.626833	.8882E-15
0.000000	0.000000	-.411733	-.687692	.1167E+01
0.000000	0.000000	.275208	.149145	.2316E+00
-3.000000	-3.000000	-.868756	-2.626833	0.
0.000000	0.000000	-.411733	-.687692	.1167E+01
0.000000	0.000000	-.275208	-.149145	.2316E+00
-3.000000	-3.000000	-.776209	-2.629150	.1332E-14
0.000000	0.000000	-.200002	-.434170	.1018E+01
0.000000	0.000000	-.597912	-.336208	.1672E+00
-3.000000	-3.000000	-.740175	-2.635472	.2220E-15
0.000000	0.000000	-.062764	-.141262	.8219E+00
0.000000	0.000000	-.669478	-.389779	.1494E+00
-3.000000	-3.000000	-.740175	-2.635472	.3053E-15
0.000000	0.000000	.062764	.141262	.8219E+00
0.000000	0.000000	-.669478	-.389779	.1494E+00
-3.000000	-3.000000	-.776209	-2.629150	.1110E-14
0.000000	0.000000	.200002	.434170	.1018E+01
0.000000	0.000000	-.597912	-.336208	.1672E+00
-3.000000	-3.000000	-.868756	-2.626833	.8882E-15
0.000000	0.000000	.411733	.687692	.1167E+01
0.000000	0.000000	-.275208	-.149145	.2316E+00

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FOLDOUT FRAME 2

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      189 BASIC ELEMENTS WERE INPUT
     FLOWS HAS SET UP  1  X  FLOWS,  0  Y  FLOWS, AND  0  Z  FLOWS.

NEAR ELEMENTS =  12340
INTERMEDIATE ELEMENTS =  12849
FAR ELEMENTS =  10532
     LEAVING VFORM
     LEAVING AFORM
THE  189 X  189 MATRIX WITH   1 RIGHT SIDES WAS SOLVED DIRECTLY.
     LEAVING ATAPES
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PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
1	1	1.591395 1.389794 .094899	.650542 .423205 .576795	.186355 -.603774 -.154707	.286460 -.928109 -.237813	.958086 .276584 .074655
	2	1.598349 1.254020 .282927	.722874 .522546 .477454	.242954 -.520217 -.439198	.336094 -.719651 -.607572	.941794 .251249 .223380
	3	1.605113 1.019539 .445612	.827395 .684582 .315418	.333138 -.389638 -.649454	.402599 -.470922 -.784950	.915363 .202414 .348052
	4	1.609275 .750320 .557494	.907577 .823696 .176304	.410662 -.257457 -.767312	.452482 -.283676 -.845451	.891771 .146221 .428210
	5	1.620269 .447901 .613081	.940808 .885119 .114881	.456097 -.124538 -.813378	.484793 -.132373 -.864553	.874522 .088802 .476787
	6	1.624811 .147089 .641222	.975755 .952098 .047902	.487598 .010372 -.845127	.499713 .010630 -.866126	.865649 .029238 .499797
	7	1.626041 -.148316 .623224	1.022582 1.045673 -.045673	.516020 .185219 -.863186	.504625 .181129 -.844124	.863087 -.082222 .498318
	8	1.627233 -.442846 .524111	1.027046 1.054824 -.054824	.501079 .385641 -.809336	.487683 .375486 -.788023	.872872 -.218218 .436436
	9	1.618821 -.751160 .386778	1.037872 1.077179 -.077179	.505683 .454951 -.783893	.487230 .436350 -.755286	.872872 -.218218 .436436
	10	1.607148 -1.085976 .242716	1.045350 1.092756 -.092756	.507243 .504246 -.762363	.485237 .482370 -.729290	.872872 -.218218 .436436
	11	1.589795 -1.365206 .084464	.843584 .711633 .288367	.275038 .631390 -.487141	.326094 .748462 -.577466	.945063 -.272824 .180064
	12	1.591395 -1.389794 -.094899	.659238 .434594 .565406	.182435 .633459 -.004927	.276812 .960895 -.007473	.958086 -.276584 -.074655

FOLDOUT FRAME 1

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

EST BODY

X-FLOW

VT / TSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
50542	.186355	.286460	.958086	.000000
23205	-.603774	-.928109	.276584	-.139050
76795	-.154737	-.237613	.074655	
22874	.242954	.336094	.941794	.000000
22546	-.520217	-.719651	.251249	-.137437
77454	-.439138	-.607572	.223380	
27395	.333138	.402599	.915363	.000000
84582	-.389638	-.470922	.202414	-.133778
15418	-.649454	-.784950	.348052	
07577	.410662	.452482	.891771	.000000
23696	-.257457	-.283676	.146221	-.130613
76304	-.767312	-.845451	.428210	
40808	.456097	.484793	.874522	.000000
35119	-.124538	-.132373	.088802	-.128792
14881	-.813378	-.864553	.476787	
75755	.487598	.499713	.865649	.000000
52098	.010372	.010630	.029238	-.127684
47902	-.845127	-.866126	.499797	
22582	.516023	.504625	.863087	.000000
35673	.185219	.181129	-.082222	-.127758
65673	-.863186	-.844124	.493318	
27046	.501079	.487683	.872872	.000000
54824	.385641	.375486	-.218218	-.134528
54824	-.809336	-.788023	.436436	
27872	.505633	.487230	.872872	.000000
27179	.454951	.436350	-.218218	-.136386
27179	-.783893	-.755286	.436436	
53350	.507243	.485237	.872872	.000000
22756	.504246	.482370	-.218218	-.128897
22756	-.762363	-.729290	.436436	
3584	.275038	.326094	.945063	.000000
1633	.631390	.748462	-.272824	-.140478
8367	-.487141	-.577466	.180064	
9238	.182435	.276812	.958086	.000000
594	.633458	.960895	-.276584	-.143742
406	-.004927	-.007473	-.074655	

FOLDOUT FRAME 2

PROGRAM BOXC ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
1	13	1.598349	.686910	.228408	.332515	.941794
		-1.254020	.471645	.545503	.794140	-.251249
		-.282927	.528155	.349431	.508700	-.223380
	14	1.605113	.794765	.319054	.401444	.915363
		-1.019539	.631651	.417354	.525129	-.202414
		-.445612	.368349	.596382	.750388	-.348052
	15	1.609275	.883063	.399194	.452056	.891771
		-.750320	.779800	.290707	.329203	-.146221
		-.557494	.220200	.732075	.829018	-.428210
	16	1.620269	.918614	.445350	.484818	.874522
		-.447901	.843852	.170819	.185953	-.088802
		-.613081	.156148	.785065	.854619	-.476787
	17	1.624811	.938859	.469935	.500602	.865649
		-.147089	.881457	.060633	.064581	-.029238
		-.641222	.118543	.810495	.863265	-.499797
	18	1.624811	.941987	.471601	.500645	.865649
		.147089	.887340	-.0[illegible]2714	-.045345	.029238
		-.641222	.112660	.814314	.864464	-.499797
	19	1.620269	.928862	.450482	.484982	.874522
		.447901	.862784	-.152091	-.163739	.088802
		-.613081	.137216	.797947	.859059	-.476787
	20	1.609275	.902372	.408274	.452446	.891771
		.750320	.814275	-.271614	-.301000	.146221
		-.557494	.185725	.757505	.839459	-.428210
	21	1.605113	.824376	.331816	.402505	.915363
		1.019539	.679596	-.397026	-.481607	.202414
		-.445612	.320404	.641767	.778488	-.348052
	22	1.598349	.721173	.242312	.335997	.941794
		1.254020	.520090	-.523530	-.726026	.251249
		-.282927	.479910	.432699	.599994	-.223380
	23	1.591395	.649987	.186167	.286416	.958086
		1.389794	.422484	-.604720	-.930356	.276584
		-.094899	.577516	.148733	.228917	-.074655
2	1	1.220560	1.298463	1.168799	.900141	.435365
		1.831729	1.686005	-.543418	-.418509	.855263
		.149900	-.686005	-.156877	-.120818	.281038

FOLDOUT FRAME

DCX DCY DCZ	NX NY NZ	VN SIG
.332515	.941794	.000000
.794140	-.251249	-.141206
.508700	-.223380	
.401444	.915363	.000000
.525129	-.202414	-.136358
.750388	-.348052	
.452056	.891771	.000000
.329203	-.146221	-.132383
.829018	-.428210	
.484818	.874522	.000000
.185953	-.088802	-.129915
.854619	-.476787	
.500602	.865649	.000000
.064581	-.029238	-.128441
.863265	-.499797	
.500645	.865649	.000000
-.045345	.029238	-.128168
.864464	-.499797	
.484982	.874522	.000000
-.163739	.088802	-.129054
.859059	-.476787	
.452446	.891771	.000000
-.301000	.146221	-.130873
.839459	-.428210	
.402505	.915363	.000000
-.481607	.202414	-.133979
.778488	-.348052	
.335997	.941794	.000000
-.726026	.251249	-.137551
.599994	-.223380	
.286416	.958086	.000000
-.930356	.276584	-.139085
.228917	-.074655	
.900141	.435365	.000000
-.418509	.855263	-.041547
-.120818	.281038	

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
2	2	1.241719	1.342441	1.235652	.920459	.390089
		1.652830	1.802147	-.395679	-.294746	.652170
		.414680	-.802147	-.344554	-.256670	.650004
	3	1.241630	1.394162	1.318375	.945640	.324553
		1.351646	1.943687	-.240723	-.172665	.447006
		.631851	-.943687	-.384222	-.275593	.833577
	4	1.242993	1.422806	1.362458	.957585	.288009
		.985715	2.024378	-.135694	-.095371	.287154
		.786135	-1.024378	-.386876	-.271910	.913561
	5	1.250180	1.439029	1.385168	.962571	.270929
		.600088	2.070805	-.055319	-.038442	.163401
		.876683	-1.070805	-.386075	-.268289	.948629
	6	1.250017	1.440042	1.388034	.963884	.261384
		.200026	2.073722	.055597	.038608	.052527
		.922094	-1.073722	-.379465	-.263509	.963805
	7	1.246098	1.454052	1.441656	.991475	.126140
		-.199566	2.114266	.103242	.071003	-.312996
		.867167	-1.114266	-.158854	-.109249	.941341
	8	1.250000	1.464273	1.463954	.999782	0.000000
		-.600000	2.144096	.027363	.018687	-.447214
		.700000	-1.144096	.013681	.009344	.894427
	9	1.250000	1.459110	1.458560	.999623	0.000000
		-1.000000	2.129001	.035829	.024556	-.447214
		.500000	-1.129001	.017915	.012278	.894427
	10	1.250000	1.413037	1.412346	.999511	0.000000
		-1.400000	1.996674	.039537	.027980	-.447214
		.300000	-.996674	.019768	.013990	.894427
	11	1.216789	1.329756	1.312795	.987245	.159008
		-1.739216	1.768252	.118463	.089086	-.593315
		.102018	-.768252	-.175463	-.131951	.789109
	12	1.220560	1.240825	1.106576	.891807	.435365
		-1.831729	1.539647	.561339	.452391	-.855263
		-.149900	-.539647	.005949	.004795	-.261038
	13	1.241719	1.307517	1.201637	.919023	.390089
		-1.652830	1.709599	.417526	.319327	-.652170
		-.414680	-.709599	.302225	.231144	-.650004

FOLDOUT FRAM

Y

X-FLOW

VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
1.235652	.920459	.390089	.000000
-.395679	-.294746	.652170	-.031945
-.344554	-.256670	.650004	
1.318375	.945640	.324553	.000000
-.240723	-.172665	.447006	-.019186
-.384222	-.275593	.833577	
1.362458	.957585	.288009	.000000
-.135694	-.095371	.287154	-.011885
-.386876	-.271910	.913561	
1.385168	.962571	.270929	.000000
-.055319	-.038442	.163401	-.008418
-.386075	-.268289	.948629	
1.388034	.963884	.261384	.000000
.055597	.038608	.052527	-.007881
-.379465	-.263509	.963805	
1.441656	.991475	.126140	.000000
.103242	.071003	-.312996	.022592
-.158854	-.109249	.941341	
1.463954	.999782	0.000000	.000000
.027353	.018687	-.447214	.051205
.013631	.009344	.894427	
1.458560	.999623	0.000000	.000000
.035829	.024556	-.447214	.049986
.017915	.012278	.894427	
1.412346	.999511	0.000000	.000000
.039537	.027980	-.447214	.047884
.019768	.013990	.894427	
1.312795	.987245	.159008	.000000
.118463	.089086	-.593315	.011237
-.175463	-.131951	.789109	
1.106576	.891807	.435365	.000000
.561339	.452391	-.855263	-.052420
.005949	.004795	-.261038	
1.201637	.919023	.390089	.000000
.417526	.319327	-.652170	-.039199
.302225	.231144	-.650004	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
2	14	1.241630	1.375733	1.300194	.945091	.324553
		-1.351646	1.892642	.259936	.186943	-.447006
		-.631851	-.892642	.366840	.266651	-.833577
	15	1.242990	1.414596	1.354205	.957309	.288009
		-.985715	2.001080	.156928	.110935	-.287154
		-.786135	-1.001080	.377600	.266931	-.913561
	16	1.250180	1.439188	1.385187	.962478	.270929
		-.600088	2.071262	.088699	.061631	-.163401
		-.876683	-1.071262	.380331	.264268	-.948629
	17	1.250017	1.449715	1.399282	.965212	.261384
		-.200026	2.101673	.030686	.021167	-.052527
		-.922094	-1.101673	.377813	.260612	-.963805
	18	1.250017	1.451738	1.401268	.965235	.261384
		.200026	2.107544	-.022042	-.015183	.052527
		-.922094	-1.107544	.378823	.260944	-.963805
	19	1.250180	1.445716	1.391589	.962560	.270929
		.600088	2.090095	-.079317	-.054863	.163401
		-.876683	-1.090095	.383776	.265457	-.948629
	20	1.242990	1.426664	1.366014	.957488	.288009
		.985715	2.035371	-.146440	-.102645	.287154
		-.786135	-1.035371	.384619	.269593	-.913561
	21	1.241630	1.396261	1.320233	.945549	.324553
		1.351646	1.949544	-.245998	-.176183	.447006
		-.631851	-.949544	.382116	.273671	-.833577
	22	1.241719	1.343418	1.236477	.920396	.390069
		1.652830	1.804772	-.398298	-.296481	.652170
		-.414680	-.804772	.342426	.254891	-.650004
	23	1.220560	1.298765	1.169035	.900112	.435365
		1.831729	1.686792	-.544235	-.419079	.855263
		-.149900	-.686792	.154603	.119039	-.281038
3	1	.500000	1.212633	1.212570	.999948	0.000000
		1.935000	1.470479	-.004275	-.003526	.938893
		.177300	-.470479	.011662	.009617	.344208
	2	.500000	1.221483	1.221289	.999841	0.000000
		1.735000	1.492020	-.016098	-.013179	.672591
		.477300	-.492020	.014632	.011979	.740014

FOLDOUT FRAME /

DCX DCY DCZ	NX NY NZ	VN SIG
.945091	.324553	.000000
.186943	-.447006	-.024030
.266651	-.833577	
.957309	.288009	.000000
.110935	-.287154	-.014970
.266931	-.913561	
.962478	.270929	.000000
.061631	-.163401	-.010137
.264268	-.948629	
.965212	.261384	.000000
.021167	-.052527	-.007697
.260612	-.963805	
.965235	.261384	.000000
-.015183	.052527	-.007196
.260944	-.963805	
.962560	.270929	.000000
-.054863	.163401	-.008545
.265457	-.948629	
.957488	.288009	.000000
-.102645	.287154	-.012085
.269593	-.913561	
.945549	.324553	.000000
-.176183	.447006	-.019350
.273671	-.833577	
.920396	.390089	.000000
-.296481	.652170	-.032050
.254891	-.650004	
.900112	.435365	.000000
-.419079	.855263	-.041587
.119039	-.281038	
.999948	0.000000	.000000
-.003526	.938893	.009526
.009617	.344208	
.999841	0.000000	.000000
-.013179	.672591	.009772
.011979	.740014	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX	VT	VX	DCX	NX
		NPY	VTSQ	VY	DCY	NY
		NPZ	CP	VZ	DCZ	NZ
3	3	.500000	1.232356	1.232207	.999879	0.000000
		1.400000	1.518701	-.017153	-.013919	.447214
		.700000	-.518701	.008577	.006960	.894427
	4	.500000	1.237037	1.236932	.999955	0.000000
		1.000000	1.530261	-.011243	-.009088	.279631
		.858250	-.530261	.003274	.002647	.960107
	5	.500000	1.234013	1.234011	.999998	0.000000
		.600000	1.522789	-.002482	-.002011	.156305
		.948150	-.522789	.000393	.000318	.987709
	6	.500000	1.220064	1.220020	.999964	0.000000
		.200000	1.488557	.010370	.008500	.050436
		.989900	-.488557	-.000524	-.000429	.998727
	7	.500000	1.206541	1.206516	.999979	0.000000
		-.200000	1.455742	-.007029	-.005826	-.447214
		.900000	-.455742	-.003515	-.002913	.894427
	8	.500000	1.196347	1.196331	.999986	0.000000
		-.600000	1.431247	.005573	.004659	-.447214
		.700000	-.431247	.002787	.002329	.894427
	9	.500000	1.185439	1.185352	.999927	0.000000
		-1.000000	1.405265	.012836	.010828	-.447214
		.500000	-.405265	.006418	.005414	.894427
	10	.500000	1.175488	1.175237	.999829	0.000000
		-1.400000	1.381772	.019439	.016537	-.447214
		.300000	-.381772	.009719	.008268	.894427
	11	.500000	1.164000	1.163439	.999519	0.000000
		-1.800000	1.354895	.032302	.027751	-.447214
		.100000	-.354895	.016151	.013876	.894427
	12	.500000	1.168003	1.167855	.999873	0.000000
		-1.935000	1.364231	.006398	.005477	-.938893
		-.177300	-.364231	-.017450	-.014940	-.344206
	13	.500000	1.195403	1.195120	.999763	0.000000
		-1.735000	1.428989	.019253	.016106	-.672591
		-.477300	-.428989	-.017439	-.014638	-.740014
	14	.500000	1.218760	1.218532	.999813	0.000000
		-1.400000	1.485377	.021080	.017296	-.447214
		-.700000	-.485377	-.010540	-.008648	-.894427

FOLDOUT FRAME 1

X-FLOW

VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
1.232207	.999879	0.000000	.000000
-.017153	-.013919	.447214	.010857
.008577	.006960	.894427	
1.236932	.999955	0.000000	.000000
-.011243	-.009088	.279631	.011576
.003274	.002647	.960107	
1.234011	.999998	0.000000	.000000
-.002482	-.002011	.156305	.011805
.000393	.000318	.987709	
1.220020	.999964	0.000000	.000000
.010370	.008500	.050436	.010980
-.000524	-.000429	.998727	
1.206516	.999979	0.000000	.000000
-.007029	-.005826	-.447214	.011147
-.003515	-.002913	.894427	
1.196331	.999986	0.000000	.000000
.005573	.004659	-.447214	.011654
.002787	.002329	.894427	
1.185352	.999927	0.000000	.000000
.012836	.010828	-.447214	.010632
.006418	.005414	.894427	
1.175237	.999829	0.000000	.000000
.019439	.016537	-.447214	.008609
.009719	.008268	.894427	
1.163439	.999519	0.000000	.000000
.032302	.027751	-.447214	.004981
.016151	.013876	.894427	
.167855	.999873	0.000000	.000000
.006398	.005477	-.938893	.006411
.017450	-.014940	-.344208	
.195120	.999763	0.000000	.000000
.019253	.016106	-.672591	.007340
.017499	-.014638	-.740314	
.218532	.999813	0.000000	.000000
.021080	.017296	-.447214	.008960
.010540	-.008648	-.894427	

FOLDOUT FRAME 2

PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
3	15	.500000	1.234579	1.234462	.999905	0.000000
		-1.000000	1.524186	.016316	.013216	-.279631
		-.858250	-.524186	-.004752	-.003849	-.960107
	16	.500000	1.244132	1.244037	.999964	0.000000
		-.600000	1.547863	.010366	.008332	-.156305
		-.948150	-.547863	-.001640	-.001319	-.987709
	17	.500000	1.249397	1.249390	.999994	0.000000
		-.200000	1.560993	.004210	.003369	-.050436
		-.989900	-.560993	-.000213	-.000170	-.998727
	18	.500000	1.251259	1.251258	.999999	0.000000
		.200000	1.565650	-.001969	-.001573	.050436
		-.989900	-.565650	-.000099	-.000079	-.998727
	19	.500000	1.249969	1.249942	.999979	0.000000
		.600000	1.562422	-.008063	-.006451	.156305
		-.948150	-.562422	-.001276	-.001021	-.987709
	20	.500000	1.245269	1.245135	.999933	0.000000
		1.000000	1.550694	-.013864	-.011133	.279631
		-.858250	-.550694	-.004038	-.003242	-.960107
	21	.500000	1.236471	1.236305	.999866	0.000000
		1.400000	1.528862	-.018128	-.014661	.447214
		-.700000	-.528862	-.009064	-.007331	-.894427
	22	.500000	1.223413	1.223215	.999838	0.000000
		1.735000	1.496738	-.016278	-.013306	.672591
		-.477300	-.496738	-.014795	-.012093	-.740314
	23	.500000	1.213215	1.213153	.999949	0.000000
		1.935000	1.471890	-.004220	-.003478	.938893
		-.177300	-.471890	-.011510	-.009487	-.344208
4	1	-.246068	1.156990	1.155568	.998771	-.049532
		1.923092	1.338626	.053200	.045981	.939127
		.174052	-.338626	.021401	.018497	.339980
	2	-.249477	1.161134	1.160040	.999058	-.043145
		1.726269	1.348232	.029883	.025736	.675151
		.470688	-.348232	.040558	.034938	.736411
	3	-.249169	1.165449	1.164708	.999364	-.034875
		1.395016	1.358272	.010548	.009051	.449471
		.692774	-.358272	.040195	.034489	.892614

FOLDOUT FRAME 1

ODY

X-FLOW

VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
1.234452	.999905	0.000000	.000000
.016316	.013216	-.279631	.010302
-.004752	-.003849	-.960107	
1.244037	.999964	0.000000	.000000
.010366	.008332	-.156305	.011310
-.001640	-.001319	-.987709	
1.249390	.999994	0.000000	.000000
.004210	.003369	-.050436	.011924
-.000213	-.000170	-.998727	
1.251258	.999999	0.000000	.000000
-.001969	-.001573	.050436	.012193
-.000099	-.000079	-.998727	
1.249942	.999979	0.000000	.000000
-.008063	-.006451	.156305	.012128
-.001276	-.001021	-.987709	
1.245195	.999933	0.000000	.000000
-.013864	-.011133	.279631	.011760
-.004038	-.003242	-.960107	
1.236305	.999866	0.000000	.000000
-.018128	-.014661	.447214	.010921
-.009064	-.007331	-.894427	
1.223215	.999838	0.000000	.000000
-.016278	-.013306	.672591	.009613
-.014795	-.012093	-.740014	
1.213153	.999949	0.000000	.000000
-.004220	-.003478	.938893	.009545
-.011510	-.009487	-.344208	
1.155568	.998771	-.049532	.000000
.053200	.045981	.939127	.004922
.021401	.018497	.339980	
1.160040	.999058	-.043145	.000000
.029883	.025736	.675151	.004422
.040558	.034938	.736411	
1.164708	.999364	-.034875	.000000
.010548	.006051	.449471	.004010
.040195	.034489	.892614	

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	V1 VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
4	4	-.249537	1.166421	1.165810	.999476	-.031043
		.998756	1.360539	-.000124	-.000106	.281449
		.850538	-.360539	.037770	.032381	.959074
	5	-.250016	1.163090	1.162505	.999497	-.029218
		.600001	1.352777	-.008797	-.007555	.157442
		.940749	-.352777	.035812	.030790	.987096
	6	-.250002	1.152040	1.151345	.999397	-.028252
		.200000	1.327196	-.021558	-.018722	.050769
		.982825	-.327196	.033680	.029235	.998310
	7	-.249496	1.135124	1.134800	.999714	-.012608
		-.199997	1.288507	-.026978	-.023767	-.434526
		.896503	-.288507	.002870	.002529	.900571
	8	-.250000	1.119936	1.119873	.999944	0.000000
		-.600000	1.254256	-.010588	-.009454	-.447214
		.700000	-.254256	-.005294	-.004727	.894427
	9	-.250000	1.111342	1.111342	.999999	0.000000
		-1.000000	1.235082	.001286	.001157	-.447214
		.500000	-.235082	.000643	.000578	.894427
	10	-.250000	1.108832	1.108740	.999917	0.000000
		-1.400000	1.229508	.012740	.011489	-.447214
		.300000	-.229508	.006370	.005745	.894427
	11	-.247831	1.115217	1.114799	.999625	-.012880
		-1.793015	1.243710	.017342	.015550	-.460010
		.100024	-.243710	.025159	.022559	.887820
	12	-.248068	1.128924	1.126893	.998201	-.049532
		-1.923092	1.274468	-.065545	-.058060	-.939127
		-.174052	-.274468	.016879	.014951	-.339980
	13	-.249477	1.147986	1.146858	.999018	-.043145
		-1.726269	1.317872	-.042024	-.036607	-.675158
		-.470688	-.317872	-.028665	-.024969	-.736411
	14	-.249169	1.160735	1.160026	.999389	-.034875
		-1.395016	1.347306	-.020453	-.017620	-.449471
		-.692774	-.347306	-.035024	-.030174	-.892614
	15	-.249537	1.169028	1.168465	.999518	-.031043
		-.998756	1.366627	-.009974	-.008532	-.281449
		-.850538	-.366627	-.034893	-.029848	-.959074

FOLDOUT FRAME 1

W

DCX DCY DCZ	NX NY NZ	VN SIG
.999476	-.031043	.000000
-.000106	.281449	.004083
.032381	.959074	
.999497	-.029218	.000000
-.007555	.157442	.004254
.030790	.987096	
.999397	-.028252	.000000
-.018722	.050789	.004249
.029235	.998310	
.999714	-.012608	.000000
-.023767	-.434526	.000604
.002529	.900571	
.999944	0.000000	.000000
-.009454	-.447214	-.001173
-.004727	.894427	
.999999	0.000000	.000000
.001157	-.447214	-.001694
.000578	.894427	
.999917	0.000000	.000000
.011489	-.447214	-.002980
.005745	.894427	
.999625	-.012880	.000000
.015550	-.460010	-.003264
.022559	.887820	
.998201	-.049532	.000000
-.058060	-.939127	.007805
.014951	-.339980	
.999018	-.043145	.000000
-.036607	-.675158	.006628
-.024969	-.736411	
.999389	-.034875	.000000
-.017620	-.449471	.005602
-.030174	-.892614	
.999518	-.031043	.000000
-.008532	-.281449	.005201
-.029848	-.959074	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
4	16	-.250016	1.174210	1.173709	.999573	-.029218
		-.600001	1.378769	-.005058	-.004308	-.157442
		-.940749	-.378769	-.033935	-.028900	-.987096
	17	-.250002	1.177071	1.176601	.999601	-.028252
		-.200000	1.385497	-.002132	-.001854	-.050789
		-.982825	-.385497	-.033187	-.028194	-.998310
	18	-.250002	1.177939	1.177467	.999600	-.028252
		.200000	1.387539	-.000154	-.000131	.050789
		-.982825	-.387539	-.033330	-.028295	-.998310
	19	-.250016	1.176983	1.176476	.999569	-.029218
		.600001	1.385288	.002284	.001940	.157442
		-.940749	-.385288	-.034459	-.029278	-.987096
	20	-.249537	1.174127	1.173553	.999511	-.031043
		.998756	1.378574	.006152	.005248	.281449
		-.850538	-.378574	-.036176	-.030811	-.959074
	21	-.249169	1.169520	1.168800	.999384	-.034875
		1.395016	1.367777	.014296	.012223	.449471
		-.692774	-.367777	-.038458	-.032892	-.892614
	22	-.249477	1.163098	1.162013	.999067	-.043145
		1.726269	1.352797	.032273	.027748	.675158
		-.470688	-.352797	-.038492	-.033094	-.736411
	23	-.248068	1.157588	1.156167	.998772	-.049532
		1.923092	1.340010	.054224	.046842	.939127
		-.174052	-.340010	-.018660	-.016120	-.339980
5	1	-.743334	1.160425	1.146655	.988142	-.153543
		1.874150	1.346587	.168493	.145199	.934141
		.161626	-.346587	.057936	.049927	.322188
	2	-.747389	1.166631	1.156305	.991149	-.132740
		1.690281	1.361028	.104989	.089994	.683173
		.444215	-.361028	.113860	.097597	.718091
	3	-.747752	1.171864	1.164831	.994042	-.108809
		1.373892	1.373264	.051909	.044296	.457325
		.663304	-.373264	.219710	.099593	.882618
	4	-.747958	1.173024	[illegible]167569	.995350	-.095703
		.992572	1.375986	.020130	.017212	.288525
		.819383	-.375986	.111176	.094777	.952677

FOLDOUT FRAME

DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
.999573	-.029218	.000000
-.004308	-.157442	.005076
-.028900	-.987096	
.999601	-.028252	.000000
-.001854	-.050789	.004937
-.028194	-.998310	
.999600	-.028252	.000000
-.000131	.050789	.004786
-.028295	-.998310	
.999569	-.029218	.000000
.001940	.157442	.004603
-.029278	-.987096	
.999511	-.031043	.000000
.005248	.281449	.004347
-.030811	-.959074	
.999384	-.034875	.000000
.012223	.449471	.004212
-.032892	-.892614	
.999067	-.043145	.000000
.027748	.675158	.004566
-.033094	-.736411	
.998772	-.049532	.000000
.046842	.939127	.004987
-.016120	-.339980	
.988142	-.153543	-.000000
.145199	.934141	.015792
.049927	.322188	
.991149	-.132740	-.000000
.089994	.683173	.013445
.097597	.716091	
.994042	-.108809	-.000000
.044296	.457325	.010893
.099593	.882618	
.995350	-.095703	-.000000
.017212	.288525	.009621
.094777	.952677	

PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
5	5	-.750055	1.170769	1.165817	.995771	-.089915
		.600009	1.370699	-.004751	-.004067	.162020
		.910468	-.370699	.107457	.091784	.982682
	6	-.750005	1.161565	1.156220	.995398	-.086851
		.200003	1.349234	-.041883	-.036057	.052106
		.953924	-.349234	.103132	.088787	.994858
	7	-.748551	1.145511	1.143638	.998365	-.039925
		-.199961	1.312195	-.060743	-.053027	-.379842
		.882279	-.312195	.024440	.021335	.924189
	8	-.750000	1.124601	1.124251	.999689	0.000000
		-.600000	1.264728	-.025092	-.022312	-.447214
		.700000	-.264728	-.012546	-.011156	.894427
	9	-.750000	1.114870	1.114851	.999992	0.000000
		-1.000000	1.242934	-.004028	-.003613	-.447214
		.500000	-.242934	-.002014	-.001807	.894427
	10	-.750000	1.115443	1.115255	.999831	0.000000
		-1.400000	1.244214	.018316	.016420	-.447214
		.300000	-.244214	.009158	.008210	.894427
	11	-.741375	1.132611	1.130300	.997960	-.044855
		-1.764760	1.282807	.017624	.015560	-.519160
		.100234	-.282807	.070123	.061913	.853499
	12	-.743334	1.132236	1.115714	.985408	-.153543
		-1.874150	1.281958	-.191336	-.168990	-.934141
		-.161626	-.281958	.023044	.020353	-.322188
	13	-.747389	1.151358	1.140735	.990816	-.132740
		-1.690281	1.325626	-.126978	-.110286	-.683173
		-.444215	-.325626	-.090072	-.078231	-.718091
	14	-.747752	1.165286	1.158299	.994004	-.108869
		-1.373892	1.357891	-.069581	-.059712	-.457325
		-.663304	-.357891	-.106741	-.091601	-.882618
	15	-.747958	1.173015	1.167615	.995397	-.095703
		-.992572	1.375964	-.038301	-.032652	-.288525
		-.819383	-.375964	-.105695	-.090106	-.952677
	16	-.750055	1.177768	1.172992	.995944	-.089915
		-.600009	1.387138	-.020972	-.017807	-.162020
		-.910468	-.387138	-.103871	-.088193	-.982682

FOLDOUT FRA...

DCX DCY DCZ	NX NY NZ	VN SIG
95771	-.089915	.000000
84067	.162020	.009344
91784	.982682	
95398	-.086851	-.000000
36057	.052106	.009411
88787	.994858	
98365	-.039925	.000000
53027	-.379842	-.000416
21335	.924189	
99689	0.000000	.000000
22312	-.447214	-.007092
11156	.894427	
99992	0.000000	.000000
03613	-.447214	-.007455
01807	.894427	
99831	0.000000	.000000
16420	-.447214	-.009000
08210	.894427	
97960	-.044855	.000000
5560	-.519160	-.005237
61913	.853499	
35408	-.153543	-.000000
68990	-.934141	.022641
20353	-.322188	
00816	-.132740	-.000000
10286	-.683173	.016214
78231	-.718091	
04004	-.138809	-.000000
59712	-.457325	.014426
01601	-.882618	
05397	-.095703	-.000000
32652	-.288525	.012115
00106	-.952677	
05944	-.089915	.000000
17807	-.162020	.011020
08193	-.982682	

PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
5	17	-.750005	1.180390	1.175928	.996219	-.086851
		-.200003	1.393322	-.007814	-.006620	-.052106
		-.953924	-.393322	-.102249	-.086623	-.994858
	18	-.750005	1.181278	1.176812	.996220	-.086851
		.200003	1.395417	.003321	.002812	.052106
		-.953924	-.395417	-.102562	-.086823	-.994858
	19	-.750055	1.180608	1.175825	.995949	-.089915
		.600009	1.393835	.015707	.013304	.162020
		-.910468	-.393835	-.104938	-.088936	-.982682
	20	-.747958	1.178349	1.172939	.995409	-.095703
		.992572	1.388506	.031346	.026601	.288525
		-.819383	-.388506	-.108337	-.091940	-.952677
	21	-.747752	1.174632	1.167657	.994063	-.108809
		1.373892	1.379760	.058416	.049732	.457325
		-.663304	-.379760	-.113680	-.096779	-.882618
	22	-.747389	1.167891	1.157552	.991148	-.132740
		1.690281	1.363969	.108970	.093305	.683173
		-.444215	-.363969	-.110304	-.094447	-.718091
	23	-.743334	1.160774	1.146999	.988133	-.153543
		1.874150	1.347396	.170110	.146548	.934141
		-.161626	-.347396	-.053408	-.046011	-.322188
6	1	-1.229655	1.132362	1.090828	.963321	-.268347
		1.773614	1.282243	.291169	.257134	.921489
		.134912	-.282243	.086937	.076775	.280799
	2	-1.245329	1.144713	1.111521	.971003	-.239[illegible]65
		1.614691	1.310369	.197828	.172819	.702123
		.336555	-.310369	.189089	.165185	.670724
	3	-1.245068	1.158983	1.136725	.980795	-.194936
		1.329324	1.343242	.102834	.088779	.475316
		.600627	-.343242	.201273	.173663	.857948
	4	-1.245783	1.165866	1.148618	.985205	-.170981
		.979004	1.359244	.048514	.041612	.304683
		.753512	-.359244	.193825	.166250	.936981
	5	-1.250120	1.169561	1.154226	.986888	-.159881
		.600034	1.367873	.006877	.005880	.172638
		.846449	-.367873	.188649	.161299	.971923

DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
.996219	-.086851	.000000
-.006620	-.052106	.010240
-.086623	-.994858	
.996220	-.086851	.000000
.002812	.052106	.009850
-.086823	-.994858	
.995949	-.069915	.000000
.013304	.162020	.009820
-.088936	-.982682	
.995409	-.095703	-.000000
.026601	.288525	.010025
-.091940	-.952677	
.994063	-.108809	-.000000
.049732	.457325	.011212
-.096779	-.882618	
.991148	-.132740	-.000000
.093305	.683173	.013668
-.094447	-.718091	
.988133	-.153543	-.000000
.146548	.934141	.015888
-.046011	-.322188	
.963321	-.268347	-.000000
.257134	.921489	.027232
.076775	.280799	
.971003	-.239[illegible]65	-.000000
.172819	.702123	.024419
.165185	.670724	
.980795	-.194936	-.000000
.088779	.475316	.019161
.173663	.857948	
.985205	-.170981	-.000000
.041612	.304683	.016512
.166250	.936981	
.986888	-.159881	-.000000
.005880	.172638	.015703
.161299	.971923	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX	VT	VX	DCX	NX
		NPY	VTSQ	VY	DCY	NY
		NPZ	CP	VZ	DCZ	NZ
6	6	-1.250012	1.170850	1.155253	.986679	-.153515
		.200010	1.370889	-.053638	-.045811	.055250
		.893198	-.370889	.162761	.156093	.986601
	7	-1.248100	1.174562	1.168781	.995078	-.074106
		-.199835	1.379597	-.096906	-.082504	-.251846
		.852389	-.379597	.064470	.054888	.964926
	8	-1.250000	1.154940	1.154001	.999187	0.000000
		-.600000	1.333886	-.041635	-.036050	-.447214
		.700000	-.333886	-.020818	-.018025	.894427
	9	-1.250000	1.138016	1.137954	.999954	0.000000
		-1.000000	1.295081	-.009750	-.008568	-.447214
		.500000	-.295081	-.004875	-.004284	.894427
	10	-1.250000	1.143892	1.143401	.999571	0.000000
		-1.400000	1.308488	.029956	.026188	-.447214
		.300000	-.308488	.014978	.013094	.894427
	11	-1.225923	1.161360	1.150415	.990576	-.105654
		-1.707445	1.348756	-.011041	-.009507	-.687853
		.100626	-.348756	.158631	.136634	.718119
	12	-1.229655	1.118520	1.069951	.956586	-.268347
		-1.773614	1.251088	-.323600	-.289310	-.921489
		-.134912	-.251088	.039432	.035254	-.280799
	13	-1.245329	1.130909	1.097016	.970030	-.239065
		-1.614691	1.278956	-.230259	-.203614	-.702123
		-.386555	-.278956	-.149950	-.132601	-.670724
	14	-1.245068	1.151328	1.129039	.980641	-.194936
		-1.329324	1.325556	-.127739	-.110993	-.475316
		-.600627	-.325556	-.185734	-.161321	-.857948
	15	-1.245783	1.162543	1.145364	.985223	-.170981
		-.979004	1.351506	-.072753	-.062581	-.304683
		-.753512	-.351506	-.185350	-.159435	-.936981
	16	-1.250120	1.169385	1.154316	.987114	-.159881
		-.600034	1.367462	-.040457	-.034597	-.172638
		-.846449	-.367462	-.182699	-.156235	-.971923
	17	-1.250012	1.172927	1.159016	.988140	-.153515
		-.200010	1.375757	-.014301	-.012192	-.055250
		-.893198	-.375757	-.179542	-.153072	-.986601

FOLDOUT FRAME

X / Y / Z	NX / NY / NZ	VN / SIG
X	NX	VN
Y	NY	SIG
Z	NZ	
679	-.153515	-.000000
811	.055250	.015444
093	.986601	
078	-.074106	.000000
504	-.251846	.000059
888	.964926	
187	0.000000	.000000
050	-.447214	-.013633
025	.894427	
954	0.000000	.000000
568	-.447214	-.013916
284	.894427	
571	0.000000	.000000
188	-.447214	-.016569
094	.894427	
576	-.105654	.000000
507	-.687853	-.002403
634	.718119	
586	-.268347	-.000000
310	-.921489	.036006
254	-.280799	
030	-.239065	-.000000
614	-.702123	.031398
601	-.670724	
641	-.194936	-.000000
993	-.475316	.024287
321	-.857948	
223	-.170981	-.000000
581	-.304683	.020145
435	-.936981	
114	-.159881	-.000000
597	-.172638	.018139
235	-.971923	
140	-.153515	-.000000
192	-.055250	.016626
072	-.986601	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
6	18	-1.250012	1.173694	1.159779	.986144	-.153515
		.200010	1.377557	.007690	.006552	.055250
		-.893198	-.377557	-.180031	-.153388	-.986601
	19	-1.250120	1.171902	1.156827	.987136	-.159881
		.600034	1.373354	.032565	.027788	.172638
		-.846449	-.373354	-.184514	-.157448	-.971923
	20	-1.245783	1.167332	1.150142	.985274	-.170981
		.979004	1.362663	.062430	.053481	.304683
		-.753512	-.362663	-.189579	-.162403	-.936981
	21	-1.245068	1.159668	1.137419	.980815	-.194936
		1.329324	1.344829	.111184	.095876	.475316
		-.610627	-.344829	-.196837	-.169736	-.857948
	22	-1.245329	1.144845	1.111627	.970984	-.239065
		1.614691	1.310671	.202859	.177193	.702123
		-.386555	-.310671	-.183850	-.160598	-.670724
	23	-1.229655	1.132343	1.090782	.963296	-.268347
		1.773614	1.282201	.293104	.258848	.921489
		-.134912	-.282201	-.080540	-.071127	-.280799
7	1	-1.699678	1.071793	.975394	.910058	-.414479
		1.611865	1.148740	.431871	.402943	.885208
		.096576	-.148740	.104085	.097113	.211244
	2	-1.733772	1.092781	1.014192	.928083	-.372374
		1.484752	1.194171	.318158	.291155	.725701
		.297994	-.194171	.253683	.232145	.578529
	3	-1.738932	1.121965	1.066664	.950711	-.310024
		1.250730	1.258805	.179768	.160226	.507279
		.497910	-.258805	.297852	.265474	.804085
	4	-1.738266	1.142165	1.099857	.962958	-.269527
		.954054	1.304542	.097975	.085780	.335023
		.644837	-.304542	.291988	.255644	.902837
	5	-1.750276	1.158627	1.121590	.968034	-.250229
		.600104	1.342417	.037906	.032716	.193980
		.739306	-.342417	.288124	.248677	.948555
	6	-1.750025	1.174333	1.139526	.970360	-.237694
		.200030	1.379059	-.034967	-.029776	.061556
		.792992	-.379059	.281632	.239823	.969388

FOLDOUT FRAME

DCX DCY DCZ	NX NY NZ	VN SIG
.986144	-.153515	-.000030
.006552	.055250	.016044
-.153388	-.986601	
.987136	-.159881	-.000030
.027788	.172638	.016340
-.157448	-.971923	
.985274	-.170981	-.000030
.053481	.304683	.017048
-.162403	-.936981	
.980815	-.194936	.000000
.095876	.475316	.019582
-.169736	-.857948	
.970984	-.239065	-.000000
.177193	.702123	.024706
-.160598	-.670724	
.963296	-.268347	-.000000
.256848	.921489	.027344
-.071127	-.280799	
.910058	-.414479	-.000030
.402943	.885202	.041810
.097113	.211244	
.926083	-.372374	-.000000
.291155	.725701	.037841
.232145	.578529	
.950711	-.310024	-.000000
.160226	.507279	.030138
.265474	.804085	
.962958	-.269527	-.000000
.085780	.335023	.025359
.255644	.902837	
.968034	-.250229	-.000030
.032716	.193980	.023756
.248677	.948555	
.970360	-.237694	-.000030
.029776	.061556	.022518
.239823	.969388	

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ	VN SIG
7	7	-1.749550	1.205607	1.178688	.977672	-.197278	.000000
		-.199759	1.453488	-.115921	-.096152	-.113683	.015226
		.782469	-.453488	.225266	.186851	.973734	
	8	-1.747311	1.230972	1.225355	.995437	-.075980	.000000
		-.599857	1.515291	-.100709	-.081813	-.368319	-.008677
		.679777	-.515291	.060447	.049105	.926589	
	9	-1.750000	1.227380	1.227221	.999871	0.000000	.000000
		-1.000000	1.506461	-.017632	-.014365	-.447214	-.024519
		.500000	-.506461	-.008816	-.007183	.894427	
	10	-1.720409	1.218753	1.215655	.997458	-.050629	.000000
		-1.352829	1.485359	.022100	.018133	-.496741	-.018933
		.314114	-.485359	.083989	.068914	.866409	
	11	-1.762537	1.166416	1.083066	.928542	-.348626	-.000000
		-1.550513	1.360526	-.292335	-.250627	-.842191	.034454
		.113943	-.360526	.319428	.273854	.411307	
	12	-1.699678	1.081512	.977211	.903560	-.414479	0.000000
		-1.611865	1.169668	-.462855	-.427970	-.885202	.049562
		-.096576	-.169668	.022186	.020514	-.211244	
	13	-1.733772	1.086144	1.006208	.926404	-.372374	-.000000
		-1.484752	1.179709	-.356337	-.328121	-.725701	.045341
		-.297994	-.179709	-.200604	-.184693	-.578529	
	14	-1.738932	1.114650	1.059335	.950374	-.310024	-.000000
		-1.250730	1.242445	-.210056	-.188450	-.507279	.035901
		-.497910	-.242445	-.275918	-.247538	-.804085	
	15	-1.738266	1.136204	1.093988	.962844	-.269527	-.000000
		-.954054	1.290960	-.125252	-.110237	-.335023	.029572
		-.644837	-.290960	-.280114	-.246534	-.902837	
	16	-1.750276	1.151282	1.114573	.968114	-.250229	-.000000
		-.600104	1.325451	-.071497	-.062102	-.193980	.026698
		-.739306	-.325451	-.279403	-.242689	-.948555	
	17	-1.750025	1.158015	1.124810	.971326	-.237694	-.000000
		-.200030	1.340998	-.023565	-.020350	-.061556	.024180
		-.792992	-.340998	-.274307	-.236877	-.969388	
	18	-1.750025	1.158514	1.125308	.971338	-.237694	-.000000
		.200030	1.342154	.015083	.013019	.061556	.023503
		-.792992	-.342154	-.274958	-.237345	-.969388	

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ	VN SIG
7	19	-1.750276	1.152916	1.116233	.966183	-.250229	-.000000
		.600104	1.329215	.060952	.052876	.193980	.024579
		-.739306	-.329215	-.281936	-.244593	-.948555	
	20	-1.738266	1.139416	1.097239	.962984	-.269527	-.000000
		.954054	1.298269	.111503	.097859	.335023	.026002
		-.644837	-.298269	-.286136	-.251169	-.902837	
	21	-1.738932	1.120131	1.064935	.950724	-.310024	-.000000
		1.250730	1.254694	.188418	.168210	.507279	.030634
		-.497910	-.254694	-.291729	-.260442	-.804085	
	22	-1.733772	1.091523	1.012990	.928052	-.372374	-.000000
		1.464752	1.191423	.323365	.296251	.725701	.038158
		-.297994	-.191423	-.246391	-.225731	-.578529	
	23	-1.699678	1.071357	.974973	.910036	-.414479	-.000000
		1.611865	1.147806	.433686	.404800	.885202	.041913
		-.096576	-.147806	-.095654	-.089283	-.211244	
		************		************		************	
8	1	-2.218024	.953089	.763560	.801143	-.597981	-.000000
		1.240723	.908378	.521127	.546777	.747834	.065691
		.149617	.091622	.231907	.243322	.288382	
	2	-2.214445	1.078634	.975907	.904762	-.425912	-.000000
		.990269	1.163451	.237422	.220114	.463200	.039168
		.411287	-.163451	.393304	.364631	.777203	
	3	-2.250969	1.127743	1.034668	.917468	-.397801	-.000000
		.600392	1.271805	.117301	.104014	.246251	.036269
		.560379	-.271805	.433021	.383971	.883807	
	4	-2.250072	1.160877	1.079656	.930043	-.366809	-.000000
		.200101	1.347636	.007608	.006554	.075569	.032128
		.632913	-.347636	.426436	.367391	.927222	
	5	-2.250072	1.187823	1.104142	.929551	-.366809	-.000000
		-.200101	1.410923	-.082736	-.069654	-.075569	.032261
		.632913	-.410923	.430056	.362054	.927222	
	6	-2.250383	1.215486	1.127038	.927273	-.372805	-.000000
		-.600126	1.477407	-.178891	-.147176	-.278586	.031772
		.553499	-.477407	.418424	.344244	.885102	

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
8	7	-2.218355	1.206050	1.107315	.918133	-.396212	-.000000
		-.956945	1.454557	-.246493	-.204380	-.458473	.033983
		.416059	-.454557	.409454	.339500	.795499	
	8	-2.212088	1.083768	.912264	.841752	-.537231	-.000000
		-1.209729	1.174554	-.477735	-.440855	-.740960	.058742
		.166619	-.174554	.337711	.311608	.402941	
	9	-2.218024	.965398	.772784	.800483	-.597981	-.000000
		-1.240723	.931993	-.555522	-.575433	-.747834	.069724
		-.149617	.068007	-.161841	-.167642	-.288382	
	10	-2.214445	1.074426	.971402	.904113	-.425912	.000000
		-.990269	1.154391	-.269128	-.250485	-.463200	.043639
		-.411287	-.154391	-.371939	-.346175	-.777203	
	11	-2.250969	1.117305	1.024801	.917209	-.397801	-.000000
		-.600392	1.248370	-.145030	-.129804	-.246251	.039174
		-.560379	-.248370	-.420854	-.376669	-.883807	
	12	-2.250074	1.138957	1.059640	.930360	-.366578	-.000000
		-.200104	1.297223	-.042453	-.037274	-.075231	.033966
		-.632837	-.297223	-.415432	-.364748	-.927341	
	13	-2.250074	1.139033	1.059741	.930387	-.366578	-.000000
		.200104	1.297395	.032406	.028451	.075231	.033347
		-.632837	-.297395	-.416287	-.365474	-.927341	
	14	-2.250969	1.117486	1.025131	.917408	-.397801	.000000
		.600392	1.248774	.131954	.118082	.246251	.037211
		-.560379	-.248774	-.424672	-.380025	-.883807	
	15	-2.214445	1.073381	.971068	.904682	-.425912	.000000
		.990269	1.152146	.246456	.229607	.463200	.039860
		-.411287	-.152146	-.385268	-.358930	-.777203	
	16	-2.218024	.950934	.762055	.801375	-.597981	-.000000
		1.240723	.904276	.524166	.551212	.747834	.065833
		-.149617	.095724	-.220904	-.232302	-.288382	
		************		************		************	
9	1	-2.626833	.660120	.326828	.495104	-.868756	.000000
		.687692	.435759	.468030	.709007	.411733	.104713
		.149145	.564241	.331497	.502177	.275208	

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
9	2	-2.629150	.835434	.526675	.630421	-.776209	-.000000
		.434170	.697949	.195323	.233798	.200002	.088646
		.336208	.302051	.618394	.740208	.597912	
	3	-2.635472	.679817	.591517	.672319	-.740175	.000000
		.141262	.774078	.046040	.052329	.062764	.086147
		.389779	.225922	.649655	.738410	.669478	
	4	-2.635472	.890766	.598838	.672273	-.740175	-.000000
		-.141262	.793463	-.079632	-.089465	-.062764	.086400
		.389779	.206537	.654604	.734878	.669478	
	5	-2.629150	.869668	.548218	.630376	-.776209	.000000
		-.434170	.756323	-.228735	-.263014	-.200002	.089534
		.336208	.243677	.635135	.730376	.597912	
	6	-2.626833	.703717	.348373	.495047	-.868756	.000000
		-.687692	.495218	-.497144	-.706454	-.411733	.106041
		.149145	.504782	.355953	.505818	.275208	
	7	-2.626833	.664268	.328750	.494906	-.868756	.000000
		-.687692	.441252	-.493026	-.742209	-.411733	.106522
		-.149145	.558748	-.300168	-.451879	-.275208	
	8	-2.629150	.620631	.517237	.630352	-.776209	.000000
		-.434170	.673435	-.217408	-.264928	-.200002	.090273
		-.336208	.326565	-.598819	-.729705	-.597912	
	9	-2.635472	.857280	.576419	.672381	-.740175	-.000000
		-.141262	.734930	-.067674	-.078941	-.062764	.087213
		-.389779	.265070	-.630944	-.735984	-.669478	
	10	-2.635472	.856967	.576233	.672410	-.740175	-.000000
		.141262	.734392	.056429	.065847	.062764	.086864
		-.389779	.265608	-.631733	-.737244	-.669478	
	11	-2.629150	.819951	.516958	.630475	-.776209	.000000
		.434170	.672319	.203153	.247763	.200002	.089184
		-.336208	.327681	-.603150	-.735605	-.597912	
	12	-2.626833	.653104	.323443	.495240	-.868756	-.000000
		.687692	.426545	.471156	.721410	.411733	.104895
		-.149145	.573455	-.316135	-.484050	-.275208	

************ ************ ************

LEAVING FRINT1

LEAVING MAIN

C-2

FLOPNT

BODY IDENTIFIER IS TEST   NUMBER CF SYMMETRY PLANES= 0   NUMBER OF QUADRALA

= 0   NUMBER OF QUADRALATERALS= 189   MACH NUMBER= 0.

[illegible] FRAME 2

```
FLOPNT RUN ID -
     TEST PROBLEM WITH TEST BODY


INPUT DATA -

     INITIAL X=-4.5000E+00  INCREMENT= 1.0000E+00  NUMBER OF VALUES=   4
     INITIAL Y= 0.          INCREMENT= 0.          NUMBER OF VALUES=   1
     INITIAL Z= 1.0000E+00  INCREMENT=-5.0000E-01  NUMBER OF VALUES=   5


     X AXIS IS INCREMENTED FIRST
     Y AXIS IS INCREMENTED THIRD
     Z AXIS IS INCREMENTED SECOND

               * INDICATES THE POINT IS INSIDE THE BODY


     X            Y            Z              VX           VY           VZ
 -4.5000000   0.0000000   1.0000000      9.4274E-01  -1.8463E-03   3.1225E-02
 -3.5000000   0.0000000   1.0000000      8.9363E-01  -5.2665E-03   1.0830E-01
 -2.5000000   0.0000000   1.0000000      9.8504E-01  -2.1047E-02   2.8638E-01
 -1.5000000   0.0000000   1.0000000      1.1528E+00  -7.7206E-02   1.6956E-01


     X            Y            Z              VX           VY           VZ
 -4.5000000   0.0000000    .5000000      9.2699E-01  -1.8687E-03   2.0175E-02
 -3.5000000   0.0000000    .5000000      8.0239E-01  -5.3770E-03   1.0116E-01
     INSIDE QUAD   179         I2=   1
     ZNP,ROSQ,TSQ,H=   -8.9149E-02   2.2821E-01   1.0355E+00   1.0000E-01
     INSIDE QUAD   180         I2=   1
     ZNP,ROSQ,TSQ,H=   -3.5348E-02   6.6282E-02   6.7553E-01   1.0000E-01
     INSIDE QUAD   181         I2=   1
     ZNP,ROSQ,TSQ,H=   -3.5348E-02   6.6282E-02   6.7553E-01   1.0000E-01
     INSIDE QUAD   182         I2=   1
     ZNP,ROSQ,TSQ,H=   -8.9149E-02   2.2821E-01   1.0355E+00   1.0000E-01
 -2.5000000   0.0000000    .5000000      1.4449E+00  -2.2314E-02   1.2787E-01
 -1.5000000   0.0000000    .5000000      1.2122E+00  -6.2494E-02   3.9898E-02


     X            Y            Z              VX           VY           VZ
 -4.5000000   0.0000000   0.0000000      9.1975E-01  -1.7342E-03   1.5068E-03
 -3.5000000   0.0000000   0.0000000      7.3093E-01  -4.4575E-03   4.6059E-03
 -2.5000000   0.0000000   0.0000000      1.2744E+00  -1.3880E-02   1.8615E-02
 -1.5000000   0.0000000   0.0000000      1.2164E+00  -3.0605E-02   3.3288E-02


     X            Y            Z              VX           VY           VZ
 -4.5000000   0.0000000   -.5000000      9.2565E-01  -1.4964E-03  -1.7501E-02
 -3.5000000   0.0000000   -.5000000      7.9717E-01  -3.3034E-03  -9.4089E-02
     INSIDE QUAD   185         I2=   1
     ZNP,ROSQ,TSQ,H=   -8.9149E-02   2.2821E-01   1.0355E+00   1.0000E-01
     INSIDE QUAD   186         I2=   1
     ZNP,ROSQ,TSQ,H=   -3.5348E-02   6.6282E-02   6.7553E-01   1.0000E-01
     INSIDE QUAD   187         I2=   1
     ZNP,ROSQ,TSQ,H=   -3.5348E-02   6.6282E-02   6.7553E-01   1.0000E-01
     INSIDE QUAD   188         I2=   1
     ZNP,ROSQ,TSQ,H=   -8.9149E-02   2.2821E-01   1.0355E+00   1.0000E-01
 -2.5000000   0.0000000   -.5000000      1.4261E+00  -4.1937E-03  -1.0065E-01
 -1.5000000   0.0000000   -.5000000      1.2105E+00  -1.1531E-02   1.9700E-02
```

+00 NUMBER OF VALUES= 4
NUMBER OF VALUES= 1
-01 NUMBER OF VALUES= 5

E THE BODY

	VY	VZ	V
-01	-1.8463E-03	3.1225E-02	9.4326E-01
-01	-5.2665E-03	1.0830E-01	9.0019E-01
-01	-2.1047E-02	2.8638E-01	1.0260E+00
+00	-7.7206E-02	1.6956E-01	1.1678E+00

	VY	VZ	V
-01	-1.8687E-03	2.0175E-02	9.2720E-01
-01	-5.3770E-03	1.0116E-01	8.0876E-01

1.0355E+00 1.0000E-01

6.7553E-01 1.0000E-01

6.7553E-01 1.0000E-01

1.0355E+00 1.0000E-01

+00	-2.2314E-02	1.2787E-01	1.4506E+00	*
+00	-6.2494E-02	3.9898E-02	1.2145E+00	

	VY	VZ	V
-01	-1.7342E-03	1.5068E-03	9.1975E-01
-01	-4.4575E-03	4.6059E-03	7.3096E-01
+00	-1.3680E-02	1.8615E-02	1.2746E+00
+00	-3.0605E-02	3.3288E-02	1.2173E+00

	VY	VZ	V
01	-1.4964E-03	-1.7501E-02	9.2582E-01
01	-3.3034E-03	-9.4089E-02	8.0271E-01

1.0355E+00 1.0000E-01

6.7553E-01 1.0000E-01

6.7553E-01 1.0000E-01

1.0355E+00 1.0000E-01

00	-4.1937E-03	-1.0065E-01	1.4297E+00	*
00	-1.1531E-02	1.9700E-02	1.2108E+00	

FOLDOUT FRAME 2

X	Y	Z	VX	VY	VZ	V
-4.5000000	0.0000000	-1.0000000	9.4052E-01	-1.2184E-03	-2.9389E-02	9.4098E-01
-3.5000000	0.0000000	-1.0000000	8.8645E-01	-2.3480E-03	-1.0521E-01	8.9268E-01
-2.5000000	0.0000000	-1.0000000	9.6251E-01	-3.3361E-03	-2.8834E-01	1.0048E+00
-1.5000000	0.0000000	-1.0000000	1.1359E+00	-2.5233E-03	-2.0899E-01	1.1550E+00

* INDICATES THE POINT IS INSIDE THE BODY

ARYTRJ

BODY IDENTIFIER IS TEST   NUMBER CF SYMMETRY PLANES= 0   NUMBER OF QUADRAL

PLANES= 0 NUMBER OF QUADRALATERALS= 189 MACH NUMBER= 0.

FOLDOUT FRAME 2

```
ARYTRJ RUN ID -
   TEST PROBLEM WITH TEST BOCY

PHYSICAL INPUT DATA -
 AIR SPEED= 9.000000E+01   CHARACTERISTIC DIMENSION OF THE BODY= 1.000000E+00
 DENSITY AND TEMPERATURE OF AIR ARE  9.092500E-01 AND  2.686590E+02   AIR VISCOS

NUMERICAL INTEGRATOR INPUTS -
 TIME STEP= 1.0000E-01   MINIMUM TIME STEP= 5.0000E-03   PRINT TIME INTERVAL= 1.

 LOCAL ERROR TOLERANCES FOR DVDQ -    1.0000E-05    1.0000E-05    1.0000E-05
```


FOLDOUT FRAME

IMENSION OF THE BODY= 1.000000E+00
0E-01 AND 2.686590E+02 AIR VISCOSITY IS 1.693764E-05

5.0000E-03 PRINT TIME INTERVAL= 1.0000E+00 X COORD. OF FINAL PLANE= 0.

E-05 1.0000E-05 1.0000E-05

FOLDOUT FRAME 2

```
WATER DROP DIAMETER = 3.00000E+02 MICROMETERS

             PARTICLE SETTLING SPEED= 1.27827E+00 M/SEC
INITIAL X=-5.0000E+00   INCREMENT= 0.              NUMBER OF VALUES=   1
INITIAL Y=-1.0000E+00   INCREMENT= 2.0000E+00     NUMBER OF VALUES=   2
INITIAL Z= 1.0000E+00   INCREMENT=-2.0000E+00     NUMBER OF VALUES=   2


X AXIS IS INCREMENTED THIRD
Y AXIS IS INCREMENTED FIRST
Z AXIS IS INCREMENTED SECOND


* * * * * * *  INITIAL COORDINATES  X=-5.00000E+00   Y=-1.00000E+00   Z= 1.00000
     IFLAG= 7 FOR KSTEP=     27   NEVAL=     49             HMIN IS SET TO 3.1250E-03


KSTEP       T               X            Y            Z             VPX          VPY
    0  0.             -5.0000E+00 -1.0000E+00  1.0000E+00  9.6596E-01 -1.4267E-02  1
         H= 1.0000E-01   R= 2.0586E+01   AC= 0.          NEVAL=     1
   10  1.0000E+00 -4.0344E+00 -1.0145E+00  1.0021E+00  9.6478E-01 -1.5232E-02  3
         H= 1.0000E-01   R= 6.8363E+01   AC= 7.6445E-04  NEVAL=    12
   11  1.0000E+00 -4.0344E+00 -1.0145E+00  1.0021E+00  9.6478E-01 -1.5232E-02  3
         H= 1.0000E-01   R= 7.6138E+01   AC= 6.1630E-04  NEVAL=    13
   21  2.0000E+00 -3.0718E+00 -1.0325E+00  1.0094E+00  9.5991E-01 -2.2680E-02  1
         H= 1.0000E-01   R= 1.8029E+02   AC= 5.1929E-04  NEVAL=    31
   31  2.3125E+00 -2.7720E+00 -1.0404E+00  1.0151E+00  9.5930E-01 -2.7841E-02  2
         H= 3.1250E-03   R= 2.0134E+02   AC= 5.1575E-04  NEVAL=    57
   41  2.4000E+00 -2.6881E+00 -1.0429E+00  1.0172E+00  9.5956E-01 -2.9385E-02  2
         H= 1.2500E-02   R= 2.0860E+02   AC= 5.0905E-04  NEVAL=    77
   51  2.8000E+00 -2.3035E+00 -1.0561E+00  1.0293E+00  9.6440E-01 -3.6556E-02  3
         H= 1.0000E-01   R= 2.2229E+02   AC= 4.9929E-04  NEVAL=    97
   54  3.0000E+00 -2.1101E+00 -1.0637E+00  1.0379E+00  9.6916E-01 -3.9522E-02  4
         H= 1.0000E-01   R= 2.0962E+02   AC= 5.3730E-04  NEVAL=   104
   64  3.2500E+00 -1.8670E+00 -1.0739E+00  1.0492E+00  9.7641E-01 -4.2069E-02  4
         H= 1.2500E-02   R= 1.9778E+02   AC= 5.6999E-04  NEVAL=   130
   74  3.5000E+00 -1.6219E+00 -1.0846E+00  1.0613E+00  9.8411E-01 -4.3370E-02  4
         H= 5.0000E-02   R= 1.7680E+02   AC= 5.9854E-04  NEVAL=   150
   81  4.0000E+00 -1.1265E+00 -1.1064E+00  1.0860E+00  9.9693E-01 -4.3131E-02  4
         H= 2.0000E-01   R= 1.4402E+02   AC= 6.9847E-04  NEVAL=   164
   86  5.0000E+00 -1.1968E-01 -1.1471E+00  1.1313E+00  1.0160E+00 -3.7496E-02  4
         H= 2.0000E-01   R= 1.5173E+02   AC= 6.0359E-04  NEVAL=   175
   86  5.1177E+00  0.             -1.1515E+00  1.1361E+00  1.0181E+00 -3.6517E-02  3
         H= 2.0000E-01   R= 1.5173E+02   AC= 6.2904E-04  NEVAL=   175

              INITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
                ALPHA0=     -.8462      BETA0=       .0988
                ALPHAR=    -2.0542      BETAR=      2.2413

     DRAG VECTOR AT FINAL  POINT -
      DIRECTION COSINES-   8.2179E-01   3.8626E-01  -4.1888E-01   ANGLES A AND GA
     AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.10221E+00    1.01954E+00


* * * * * * *  INITIAL COORDINATES  X=-5.00000E+00   Y= 1.00000E+00   Z=-1.00000E
     IFLAG= 7 FOR KSTEP=     28   NEVAL=     60             HMIN IS SET TO 3.1250E-03
```


FOLDOUT FRAM

```
ROMETERS

27827E+00 M/SEC
          NUMBER OF VALUES=    1
000E+00   NUMBER OF VALUES=    2
000E+00   NUMBER OF VALUES=    2



E+00    Y=-1.00000E+00    Z= 1.00000E+00
          HMIN IS SET TO 3.1250E-03


  Z             VPX           VPY           VPZ           VX            VY            VZ
000E+00   9.6596E-01 -1.4267E-02  1.6667E-03  9.6596E-01 -1.4267E-02  1.5870E-02
          NEVAL=     1
021E+00   9.6478E-01 -1.5232E-02  3.1541E-03  9.4392E-01 -3.4403E-02  4.0864E-02
445E-04   NEVAL=    12
021E+00   9.6478E-01 -1.5232E-02  3.1541E-03  9.4151E-01 -3.7761E-02  4.5294E-02
630E-04   NEVAL=    13
094E+00   9.5991E-01 -2.2680E-02  1.4476E-02  9.4637E-01 -8.7974E-02  1.2261E-01
923E-04   NEVAL=    31
151E+00   9.5930E-01 -2.7841E-02  2.2740E-02  9.6591E-01 -9.7990E-02  1.4245E-01
575E-04   NEVAL=    57
172E+00   9.5956E-01 -2.9385E-02  2.5288E-02  9.7691E-01 -1.0088E-01  1.4898E-01
905E-04   NEVAL=    77
293E+00   9.6440E-01 -3.6556E-02  3.7613E-02  1.0420E+00 -9.9754E-02  1.5379E-01
923E-04   NEVAL=    97
373E+00   9.6916E-01 -3.9522E-02  4.2861E-02  1.0858E+00 -8.3119E-02  1.2343E-01
730E-04   NEVAL=   104
492E+00   9.7641E-01 -4.2069E-02  4.7262E-02  1.0977E+00 -7.2147E-02  1.0213E-01
393E-04   NEVAL=   130
513E+00   9.8411E-01 -4.3370E-02  4.9320E-02  1.1037E+00 -5.4774E-02  7.0318E-02
354E-04   NEVAL=   150
160E+00   9.9693E-01 -4.3131E-02  4.8716E-02  1.0957E+00 -2.2761E-02  2.4140E-02
347E-04   NEVAL=   164
113E+00   1.0160E+00 -3.7496E-02  4.1078E-02  1.1046E+00  5.6844E-03 -6.0732E-03
153E-04   NEVAL=   175
161E+00   1.0161E+00 -3.6517E-02  3.9872E-02  1.1046E+00  5.6844E-03 -6.0732E-03
104E-04   NEVAL=   175

 ANGLES (DEGREES) -
0=      .0988
R=     2.2413


01  -4.1888E-01   ANGLES A AND GAMMA-   2.5175E+01   1.1476E+02
 ARE     1.10221E+00     1.01954E+00


+00    Y= 1.00000E+00    Z=-1.00000E+00
          HMIN IS SET TO 3.1250E-03
```

FOLDOUT FRAME 2

```
KSTEP       T           X           Y           Z             VPX         VPY
  0   0.          -5.0000E+00  1.0000E+00 -1.0000E+00   9.6340E-01  1.2975E-02 -2.
        H= 1.0000E-01  R= 1.5173E+02  AC= 0.            NEVAL=    1
 10   1.0000E+00 -4.0369E+00  1.0132E+00 -1.0295E+00   9.6232E-01  1.3708E-02 -3.
        H= 1.0000E-01  R= 4.5689E+01  AC= 1.2573E-03   NEVAL=   16
 11   1.0000E+00 -4.0369E+00  1.0132E+00 -1.0295E+00   9.6232E-01  1.3708E-02 -3.
        H= 1.0000E-01  R= 5.2997E+01  AC= 9.3450E-04   NEVAL=   18
 21   2.0000E+00 -3.0769E+00  1.0291E+00 -1.0623E+00   9.5692E-01  1.9735E-02 -3.
        H= 1.0000E-01  R= 1.5349E+02  AC= 5.8890E-04   NEVAL=   38
 31   2.7656E+00 -2.3454E+00  1.0485E+00 -1.0985E+00   9.5602E-01  3.1574E-02 -5.
        H= 3.1250E-03  R= 2.0016E+02  AC= 5.4970E-04   NEVAL=   66
 41   2.9000E+00 -2.2168E+00  1.0529E+00 -1.1065E+00   9.5733E-01  3.3578E-02 -6.
        H= 5.0000E-02  R= 2.0280E+02  AC= 5.4600E-04   NEVAL=   86
 44   3.0000E+00 -2.1210E+00  1.0563E+00 -1.1130E+00   9.5864E-01  3.4974E-02 -6.
        H= 5.0000E-02  R= 2.0340E+02  AC= 5.4493E-04   NEVAL=   92
 54   3.3875E+00 -1.7482E+00  1.0707E+00 -1.1405E+00   9.6613E-01  3.9311E-02 -7.
        H= 6.2500E-03  R= 1.9948E+02  AC= 5.8877E-04   NEVAL=  117
 64   3.5500E+00 -1.5909E+00  1.0772E+00 -1.1532E+00   9.7046E-01  4.0630E-02 -8.
        H= 5.0000E-02  R= 1.9617E+02  AC= 5.9103E-04   NEVAL=  137
 71   4.0000E+00 -1.1512E+00  1.0960E+00 -1.1910E+00   9.8418E-01  4.2377E-02 -8.
        H= 1.0000E-01  R= 1.8893E+02  AC= 5.9535E-04   NEVAL=  152
 80   5.0000E+00 -1.5051E-01  1.1371E+00 -1.2785E+00   1.0170E+00  3.8245E-02 -8.
        H= 5.0000E-02  R= 2.0139E+02  AC= 5.5777E-04   NEVAL=  172
 84   5.1477E+00  1.3878E-17  1.1427E+00 -1.2909E+00   1.0214E+00  3.6966E-02 -8.
        H= 2.5000E-02  R= 2.0627E+02  AC= 5.1777E-04   NEVAL=  181

                  INITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
                     ALPHA0=      .7716      BETA0=     -1.7363
                     ALPHAR=     2.0727      BETAR=     -4.5852

    DRAG VECTOR AT FINAL  POINT -
     DIRECTION COSINES-   8.4447E-01  -2.5705E-01   4.6989E-01   ANGLES A AND GAM
    AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.14163E+00    1.02538E+00
```

```
Z            VPX            VPY            VPZ              VX             VY             VZ
0E+00    9.6340E-01  1.2975E-02 -2.9207E-02   9.6340E-01  1.2975E-02 -1.5004E-02
         NEVAL=       1
5E+00    9.6232E-01  1.3708E-02 -3.0100E-02   9.3841E-01  3.1623E-02 -4.0163E-02
3E-03    NEVAL=      16
5E+00    9.6232E-01  1.3708E-02 -3.0100E-02   9.3552E-01  3.4700E-02 -4.4642E-02
0E-04    NEVAL=      18
3E+00    9.5692E-01  1.9735E-02 -3.8095E-02   9.2806E-01  7.9368E-02 -1.2368E-01
0E-04    NEVAL=      38
5E+00    9.5602E-01  3.1574E-02 -5.8414E-02   9.6771E-01  9.4036E-02 -1.7743E-01
0E-04    NEVAL=      66
6E+00    9.5733E-01  3.3578E-02 -6.2513E-02   1.0045E+00  9.1879E-02 -1.8064E-01
0E-04    NEVAL=      86
0E+00    9.5864E-01  3.4974E-02 -6.5529E-02   1.0231E+00  8.7796E-02 -1.8064E-01
9E-04    NEVAL=      92
5E+00    9.6613E-01  3.9311E-02 -7.6149E-02   1.0615E+00  7.4554E-02 -1.6886E-01
7E-04    NEVAL=     117
2E+00    9.7046E-01  4.0630E-02 -8.0008E-02   1.0775E+00  6.7191E-02 -1.5845E-01
3E-04    NEVAL=     137
0E+00    9.8418E-01  4.2377E-02 -8.7065E-02   1.1159E+00  4.1874E-02 -1.1020E-01
5E-04    NEVAL=     152
6E+00    1.0170E+00  3.8245E-02 -8.4091E-02   1.1389E+00  3.9491E-03 -2.2823E-02
7E-04    NEVAL=     172
9E+00    1.0214E+00  3.6966E-02 -8.1971E-02   1.1416E+00  3.2180E-04 -1.4954E-02
7E-04    NEVAL=     181

ANGLES (DEGREES) -
=    -1.7363
=    -4.5852


1    4.6989E-01    ANGLES A AND GAMMA-   -1.6930E+01    6.1973E+01
ARE      1.14163E+00      1.02538E+00
```

FOLDOUT FRAME 2

CONFAC

BODY IDENTIFIER IS TEST   NUMBER OF SYMMETRY PLANES= 0   NUMBER OF QUADRAL

FOLDOUT FRA

ETRY PLANES= 0   NUMBER OF QUADRALATERALS= 189   MACH NUMBER= 0.

FOLDOUT FRAME 2

CONFAC RUN ID -
TEST PROBLEM WITH TEST BODY

PHYSICAL INPUT DATA -
AIR SPEED= 9.000000E+01   CHARACTERISTIC DIMENSION OF THE BODY= 1.000000E+0
DENSITY AND TEMPERATURE OF AIR ARE 9.092500E-01 AND 2.686590E+02   AIR VI

NUMERICAL INTEGRATOR INPUTS -
TIME STEP= 1.0000E-0 :   MINIMUM TIME STEP= 5.0000E-03   PRINT TIME INTERVAL=

LOCAL ERROR TOLERANCES FOR DVDQ -   1.0000E-05   1.0000E-05   1.0000E-05

PARTICLE FLUX TUBE SPECIFICATIONS -
NUMBER OF TRAJECTORIES ON FLUX TUBE PERIPHERY= 4   FLUX TUBE RADIUS AT TAR

TARGET AND INITIAL COORDINATE ESTIMATES-

JGUESS	YT	ZT	YI	ZI
1	0.00000	0.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	0.00000

TERISTIC DIMENSION OF THE BODY= 1.000000E+00
RE 9.092500E-01 AND 2.686590E+02 AIR VISCOSITY IS 1.693764E-05

TIME STEP= 5.00000E-03 PRINT TIME INTERVAL= 1.0000E+00 UPSTREAM START DISTANCE=-5.0000E

- 1.0000E-05 1.0000E-05 1.0000E-05

-
UEE PERIPHERY= 4 FLUX TUBE RADIUS AT TARGET= .00328 TOLERANCE= .5000

INATES-

ZT	YI	ZI
0000	0.00000	0.00000
0000	0.00000	0.00000

FOLDOUT FRAME 2

WATER DROP DIAMETER = 3.00000E+02 MICROMETERS

PARTICLE SETTLING SPEED= 1.27327E+00 M/SEC

TARGET COORDINATES X=-1.50000E+00 Y= 1.10000E+00 Z= 8.00000E-01

TRAJECTORY NUMBER 0 TARGET COORDINATES - XPSTAR = -1.500000 YPSTAR = 1.
YPSTARP= 1.

YFINAL	ZFINAL	ITERATIONS	YINIT	ZINIT	ERRO
.1209E+01	.8803E+00	1	.1101E+01	.8012E+00	.1352E
.1210E+01	.8813E+00	2	.1102E+01	.8024E+00	.1367E
.1097E+01	.8052E+00	3	.9795E+00	.7039E+00	.5981E
.1102E+01	.7993E+00	4	.9834E+00	.6981E+00	.2112E
.1099E+01	.7979E+00	5	.9800E+00	.6961E+00	.2383E
.1100E+01	.7998E+00	6	.9811E+00	.6983E+00	.4269E

KSTEP	T	X	Y	Z	VPX	VPY	
0	0.	-5.0000E+00	9.8110E-01	6.9829E-01	9.6002E-01	1.3571E-02	-1.
	H= 1.0000E-01	R= 2.7725E+02	AC= 0.		NEVAL= 1		
10	7.0000E-01	-4.3281E+00	9.9068E-01	6.9725E-01	9.5929E-01	1.3983E-02	-1.
	H= 1.0000E-01	R= 5.2057E+01	AC= 8.3495E-04		NEVAL= 13		
14	1.0000E+00	-4.0405E+00	9.9497E-01	6.9705E-01	9.5819E-01	1.4671E-02	-2.
	H= 1.0000E-01	R= 8.7192E+01	AC= 5.9458E-04		NEVAL= 17		
24	1.8625E+00	-3.2173E+00	1.0101E+00	6.9995E-01	9.4867E-01	2.2660E-02	9.
	H= 6.2500E-03	R= 2.0038E+02	AC= 5.2003E-04		NEVAL= 42		
34	2.0000E+00	-3.0870E+00	1.0134E+00	7.0151E-01	9.4620E-01	2.5388E-02	1.
	H= 5.0000E-02	R= 2.2830E+02	AC= 4.9527E-04		NEVAL= 62		
35	2.0000E+00	-3.0870E+00	1.0134E+00	7.0151E-01	9.4620E-01	2.5388E-02	1.
	H= 5.0000E-02	R= 2.3878E+02	AC= 4.5273E-04		NEVAL= 64		
45	2.8000E+00	-2.3352E+00	1.0437E+00	7.2664E-01	9.3723E-01	5.2614E-02	5.
	H= 5.0000E-02	R= 3.3778E+02	AC= 4.3878E-04		NEVAL= 86		
49	3.0000E+00	-2.1475E+00	1.0549E+00	7.3913E-01	9.4051E-01	5.9150E-02	6.
	H= 1.0000E-01	R= 3.2750E+02	AC= 4.4993E-04		NEVAL= 94		
59	3.6804E+00	-1.5000E+00	1.0996E+00	7.9973E-01	9.6535E-01	6.9304E-02	1.0
	H= 5.0000E-02	R= 2.7658E+02	AC= 4.7412E-04		NEVAL= 117		

DRAG VECTOR AT FINAL POINT -
DIRECTION COSINES- 8.1247E-01 4.2971E-02 5.8142E-01 ANGLES A AND GAMM
AIR AND PARTICLE SPEEDS AT THE FINAL POINT ARE 1.14461E+00 9.73484E-01

INITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
ALPHA0= .8099 BETA0= -.0973
ALPHAR= 4.1063 BETAR= 6.1774

TRAJECTORY NUMBER 1 TARGET COORDINATES - XPSTAR = -1.500352 YPSTAR = 1.0
YPSTARP= 0.0

YFINAL	ZFINAL	ITERATIONS	YINIT	ZINIT	ERROR
-.3022E-03	.3611E-02	1	.7256E-03	.4269E-02	.4483E-

KSTEP	T	X	Y	Z	VPX	VPY	
0	0.	-5.0000E+00	9.8182E-01	7.0256E-01	9.6008E-01	1.3563E-02	-1.5
	H= 1.0000E-01	R= 2.7658E+02	AC= 0.		NEVAL= 1		
10	7.0000E-01	-4.3281E+00	9.9140E-01	7.0157E-01	9.5935E-01	1.3974E-02	-1.0
	H= 1.0000E-01	R= 5.2019E+01	AC= 8.3454E-04		NEVAL= 15		
14	1.0000E+00	-4.0404E+00	9.9568E-01	7.0133E-01	9.5825E-01	1.4660E-02	-1.5

FOLDOUT FRAM

```
S

00 M/SEC

10000E+00      Z= 8.00000E-01


 = -1.500000    YPSTAR =   1.100000     ZPSTAR =    .800000 (FLOW SYSTEM)
                YPSTARP=   1.100000     ZPSTARP=    .800000 (FLUX TUBE SYSTEM)

 YINIT         ZINIT        ERROR  (FLUX TUBE SYSTEM)
1101E+01    .8012E+00    .1352E+00
1102E+01    .8024E+00    .1367E+00
0795E+00    .7039E+00    .5981E-02
0834E+00    .6981E+00    .2112E-02
0800E+00    .6961E+00    .2383E-02
0811E+00    .6983E+00    .4269E-03

       VPX          VPY          VPZ          VX           VY           VZ
  9.6002E-01  1.3571E-02 -1.6308E-03  9.6002E-01  1.3571E-02  1.2572E-02
  NEVAL=      1
  9.5929E-01  1.3983E-02 -1.0880E-03  9.3821E-01  2.6512E-02  2.5151E-02
  NEVAL=     13
  9.5819E-01  1.4671E-02 -2.0919E-04  9.1998E-01  4.0543E-02  3.9618E-02
  NEVAL=     17
  9.4867E-01  2.2660E-02  9.6867E-03  8.7914E-01  9.4479E-02  1.0518E-01
  NEVAL=     42
  9.4620E-01  2.5388E-02  1.3176E-02  8.7511E-01  1.0894E-01  1.2621E-01
  NEVAL=     62
  9.4620E-01  2.5388E-02  1.3176E-02  8.7450E-01  1.1444E-01  1.3473E-01
  NEVAL=     64
  9.3723E-01  5.2614E-02  5.5791E-02  9.6531E-01  1.5681E-01  2.6234E-01
  NEVAL=     86
  9.4051E-01  5.9150E-02  6.9614E-02  1.0177E+00  1.4009E-01  2.7029E-01
  NEVAL=     94
  9.6535E-01  6.9304E-02  1.0475E-01  1.1213E+00  7.7552E-02  2.1635E-01
  NEVAL=    117

.8142E-01   ANGLES A AND GAMMA-    3.0275E+00    5.4450E+01
  1.14461E+00    9.73484E-01


ES (DEGREES) -
 -.0973
 6.1774


 = -1.500352    YPSTAR =   1.099975     ZPSTAR =    .803261 (FLOW SYSTEM)
                YPSTARF=   0.000000     ZPSTARP=    .003280 (FLUX TUBE SYSTEM)

 YINIT         ZINIT        ERROR  (FLUX TUBE SYSTEM)
7256E-03    .4269E-02    .4483E-03

       VPX          VPY          VPZ          VX           VY           VZ
  9.6008E-01  1.3563E-02 -1.5749E-03  9.6008E-01  1.3563E-02  1.2628E-02
  NEVAL=      1
  9.5935E-01  1.3974E-02 -1.0309E-03  9.3835E-01  2.6478E-02  2.5248E-02
  NEVAL=     15
  9.5825E-01  1.4660E-02 -1.5069E-04  9.2023E-01  4.0463E-02  3.9745E-02
```

FOLDOUT FRAME 2

FOLDOUT FRAME

```
         H= 1.0000E-01  R= 8.7056E+01  AC= 5.9484E-04  NEVAL=      23
   24  1.8688E+00 -3.2112E+00  1.0110E+00  7.0439E-01  9.4870E-01  2.2724E-02
         H= 6.2500E-03  R= 2.0090E+02  AC= 5.1944E-04  NEVAL=     48
   34  1.9750E+00 -3.1105E+00  1.0135E+00  7.0557E-01  9.4682E-01  2.4783E-02
         H= 2.5000E-02  R= 2.2224E+02  AC= 5.0001E-04  NEVAL=     68
   36  2.0000E+00 -3.0869E+00  1.0141E+00  7.0590E-01  9.4636E-01  2.5322E-02
         H= 2.5000E-02  R= 2.3257E+02  AC= 4.7405E-04  NEVAL=     72
   46  2.4750E+00 -2.6395E+00  1.0293E+00  7.1651E-01  9.3803E-01  3.9867E-02
         H= 5.0000E-02  R= 3.1803E+02  AC= 4.4628E-04  NEVAL=     92
   53  3.0000E+00 -2.1471E+00  1.0554E+00  7.4345E-01  9.4066E-01  5.8707E-02
         H= 2.0000E-01  R= 3.2760E+02  AC= 4.4565E-04  NEVAL=   106
   63  3.6250E+00 -1.5528E+00  1.0959E+00  7.9793E-01  9.6301E-01  6.8579E-02
         H= 5.0000E-02  R= 2.8288E+02  AC= 4.6314E-04  NEVAL=   129
   65  3.6794E+00 -1.5004E+00  1.0997E+00  8.0359E-01  9.6549E-01  6.8798E-02
         H= 5.0000E-02  R= 2.7205E+02  AC= 4.8639E-04  NEVAL=   133
  DRAG VECTOR AT FINAL POINT -
   DIRECTION COSINES-   8.2736E-01    3.1554E-02    5.6078E-01    ANGLES A AND
  AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE      1.14496E+00      9.73520E


TRAJECTORY NUMBER  2     TARGET COORDINATES -  XPSTAR = -1.500235     YPSTAR =
                                                                      YPSTARF=

           YFINAL        ZFINAL       ITERATIONS       YINIT        ZINIT         E
         .3951E-02   -.1236E-02           1          .4128E-02  -.3891E-03    .14

KSTEP          T            X            Y            Z            VPX          VPY
    0  0.          -5.0001E+00  9.8523E-01  6.9791E-01  9.6007E-01  1.3617E-02
         H= 1.0000E-01  R= 2.7205E+02  AC= 0.                  NEVAL=      1
   10  7.0000E-01 -4.3282E+00  9.9484E-01  6.9686E-01  9.5934E-01  1.4030E-02
         H= 1.0000E-01  R= 5.1988E+01  AC= 8.3522E-04  NEVAL=     15
   14  1.0000E+00 -4.0405E+00  9.9914E-01  6.9664E-01  9.5824E-01  1.4719E-02
         H= 1.0000E-01  R= 8.7042E+01  AC= 5.9501E-04  NEVAL=     23
   24  1.8688E+00 -3.2113E+00  1.0145E+00  6.9955E-01  9.4666E-01  2.2828E-02
         H= 6.2500E-03  R= 2.0108E+02  AC= 5.1932E-04  NEVAL=     48
   34  1.9750E+00 -3.1106E+00  1.0170E+00  7.0074E-01  9.4677E-01  2.4901E-02
         H= 2.5000E-02  R= 2.2250E+02  AC= 4.9985E-04  NEVAL=     68
   36  2.0000E+00 -3.0870E+00  1.0176E+00  7.0105E-01  9.4630E-01  2.5444E-02
         H= 2.5000E-02  R= 2.3288E+02  AC= 4.7383E-04  NEVAL=     72
   46  2.6250E+00 -2.4990E+00  1.0393E+00  7.1739E-01  9.3677E-01  4.6008E-02
         H= 5.0000E-02  R= 3.3341E+02  AC= 4.4043E-04  NEVAL=     93
   52  3.0000E+00 -2.1473E+00  1.0592E+00  7.3850E-01  9.4062E-01  5.9214E-02
         H= 1.0000E-01  R= 3.2871E+02  AC= 4.4545E-04  NEVAL=   105
   62  3.6250E+00 -1.5532E+00  1.1001E+00  7.9309E-01  9.6281E-01  6.9236E-02
         H= 5.0000E-02  R= 2.8409E+02  AC= 4.6253E-04  NEVAL=   128
   64  3.6800E+00 -1.5002E+00  1.1039E+00  7.9877E-01  9.6534E-01  6.9463E-02
         H= 5.0000E-02  R= 2.7313E+02  AC= 4.8587E-04  NEVAL=   132
  DRAG VECTOR AT FINAL POINT -
   DIRECTION COSINES-   8.2653E-01    3.2372E-02    5.6197E-01    ANGLES A AND
  AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE      1.14547E+00      9.73446E


TRAJECTORY NUMBER  3     TARGET COORDINATES -  XPSTAR = -1.499648     YPSTAR =
                                                                      YPSTARP=

           YFINAL        ZFINAL       ITERATIONS       YINIT        ZINIT         E
         .3971E-03   -.2022E-02           1          .4452E-03  -.1895E-02    .13

KSTEP          T            X            Y            Z            VPX          VPY
    0  0.          -5.0000E+00  9.8154E-01  6.9640E-01  9.6000E-01  1.3583E-02
         H= 1.0000E-01  R= 2.7313E+02  AC= 0.                  NEVAL=      1
   10  7.0000E-01 -4.3282E+00  9.9114E-01  6.9535E-01  9.5927E-01  1.3995E-02
         H= 1.0000E-01  R= 5.2060E+01  AC= 8.3513E-04  NEVAL=     13
   14  1.0000E+00 -4.0405E+00  9.9542E-01  6.9513E-01  9.5817E-01  1.4684E-02
```

65

ORIGINAL PAGE IS OF POOR QUALITY

```
      23
70E-01  2.2724E-02  9.8952E-03  8.7962E-01  9.4692E-02  1.0612E-01
=     48
02E-01  2.4783E-02  1.2530E-02  8.7645E-01  1.0571E-01  1.2211E-01
=     68
66E-01  2.5322E-02  1.3231E-02  8.7562E-01  1.1110E-01  1.3036E-01
=     72
03E-01  3.9867E-02  3.3994E-02  9.0337E-01  1.5468E-01  2.1774E-01
=     92
86E-01  5.8707E-02  6.9232E-02  1.0128E+00  1.4126E-01  2.6912E-01
=    106
11E-01  6.8579E-02  1.0215E-01  1.1111E+00  8.4626E-02  2.2827E-01
=    129
99E-01  6.8798E-02  1.0407E-01  1.1229E+00  7.4802E-02  2.1077E-01
=    133

-01   ANGLES A AND GAMMA-   2.1841E+00   5.5890E+01
96E+00     9.73520E-01


00235      YPSTAR =  1.103272      ZPSTAR =    .800000 (FLOW SYSTEM)
           YPSTARF=   .003280      ZPSTARP=  -.000000 (FLUX TUBE SYSTEM)

      ZINIT        ERROR  (FLUX TUBE SYSTEM)
2  -.3891E-03   .1406E-02

PX          VPY         VPZ           VX          VY          VZ
07E-01  1.3617E-02 -1.6521E-03  9.6007E-01  1.3617E-02  1.2551E-02
=      1
34E-01  1.4030E-02 -1.1109E-03  9.3831E-01  2.6589E-02  2.5095E-02
=     15
24E-01  1.4719E-02 -2.3501E-04  9.2016E-01  4.0642E-02  3.9509E-02
=     23
66E-01  2.2828E-02  9.7640E-03  8.7928E-01  9.5240E-02  1.0563E-01
=     48
07E-01  2.4901E-02  1.2396E-02  8.7602E-01  1.0636E-01  1.2160E-01
=     68
00E-01  2.5444E-02  1.3095E-02  8.7515E-01  1.1181E-01  1.2984E-01
=     72
67E-01  4.6008E-02  4.3395E-02  9.2909E-01  1.6091E-01  2.4252E-01
=     93
22E-01  5.9214E-02  6.9218E-02  1.0123E+00  1.4274E-01  2.6969E-01
=    105
11E-01  6.9236E-02  1.0236E-01  1.1112E+00  8.5586E-02  2.2938E-01
=    128
44E-01  6.9463E-02  1.0433E-01  1.1232E+00  7.5645E-02  2.1166E-01
=    132

01   ANGLES A AND GAMMA-   2.2429E+00   5.5808E+01
47E+00     9.73446E-01


99648      YPSTAR =  1.100025      ZFSTAR =    .796739 (FLOW SYSTEM)
           YPSTARP=  -.000000      ZFSTARP=  -.003280 (FLUX TUBE SYSTEM)

      ZINIT        ERROR  (FLUX TUBE SYSTEM)
  -.1895E-02   .1319E-02

PX          VPY         VPZ           VX          VY          VZ
0E-01  1.3583E-02 -1.6586E-03  9.6000E-01  1.3583E-02  1.2544E-02
       1
7E-01  1.3995E-02 -1.1167E-03  9.3816E-01  2.6541E-02  2.5099E-02
      13
E-01  1.4684E-02 -2.3900E-04  9.1991E-01  4.0595E-02  3.9543E-02
```

FOLDOUT FRAME 2

```
     H= 1.0000E-01  R= 8.7222E+01  AC= 5.9455E-04   NEVAL=    17
 24  1.8625E+00 -3.2174E+00  1.0106E+00  6.9800E-01  9.4863E-01  2.2692E-02
     H= 6.2500E-03  R= 2.0058E+02  AC= 5.1985E-04   NEVAL=    42
 34  2.0000E+00 -3.0871E+00  1.0139E+00  6.9955E-01  9.4614E-01  2.5428E-02
     H= 5.0000E-02  R= 2.2856E+02  AC= 4.9509E-04   NEVAL=    62
 35  2.0000E+00 -3.0871E+00  1.0139E+00  6.9955E-01  9.4614E-01  2.5428E-02
     H= 5.0000E-02  R= 2.3908E+02  AC= 4.5250E-04   NEVAL=    64
 45  2.8000E+00 -2.3354E+00  1.0443E+00  7.2468E-01  9.3711E-01  5.2784E-02
     H= 5.0000E-02  R= 3.3842E+02  AC= 4.3855E-04   NEVAL=    86
 49  3.0000E+00 -2.1477E+00  1.0555E+00  7.3724E-01  9.4038E-01  5.9353E-02
     H= 1.0000E-01  R= 3.2808E+02  AC= 4.4975E-04   NEVAL=    94
 59  3.6500E+00 -1.5296E+00  1.0983E+00  7.9477E-01  9.6385E-01  6.9443E-02
     H= 5.0000E-02  R= 2.8269E+02  AC= 4.6343E-04   NEVAL=   117
 60  3.6808E+00 -1.4998E+00  1.1004E+00  7.9793E-01  9.6528E-01  6.9554E-02
     H= 5.0000E-02  R= 2.7710E+02  AC= 4.7361E-04   NEVAL=   119
 DRAG VECTOR AT FINAL POINT -
  DIRECTION COSINES-   8.1238E-01   4.2836E-02   5.8156E-01   ANGLES A AND G
 AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.14489E+00    9.73459E-


TRAJECTORY NUMBER  4     TARGET COORDINATES -  XPSTAR = -1.499765    YPSTAR =
                                                                      YPSTARP=

            YFINAL      ZFINAL      ITERATIONS      YINIT      ZINIT       ER
          -.4310E-02   .7579E-04         1       -.3891E-02  -.3977E-03   .103

KSTEP       T             X            Y            Z           VPX          VPY
  0  0.            -4.9999E+00  9.7721E-01  6.9790E-01  9.5996E-01  1.3530E-02 -
     H= 1.0000E-01  R= 2.7710E+02  AC= 0.            NEVAL=     1
 10  7.0000E-01 -4.3281E+00  9.8676E-01  6.9687E-01  9.5923E-01  1.3941E-02 -
     H= 1.0000E-01  R= 5.2125E+01  AC= 8.3479E-04   NEVAL=    13
 14  1.0000E+00 -4.0405E+00  9.9104E-01  6.9667E-01  9.5813E-01  1.4628E-02 -
     H= 1.0000E-01  R= 8.7353E+01  AC= 5.9414E-04   NEVAL=    17
 24  1.8625E+00 -3.2174E+00  1.0061E+00  6.9959E-01  9.4856E-01  2.2624E-02
     H= 6.2500E-03  R= 2.0095E+02  AC= 5.1945E-04   NEVAL=    42
 34  2.0000E+00 -3.0871E+00  1.0094E+00  7.0116E-01  9.4606E-01  2.5356E-02
     H= 5.0000E-02  R= 2.2900E+02  AC= 4.9474E-04   NEVAL=    62
 35  2.0000E+00 -3.0871E+00  1.0094E+00  7.0116E-01  9.4606E-01  2.5356E-02
     H= 5.0000E-02  R= 2.3953E+02  AC= 4.5218E-04   NEVAL=    64
 45  2.8000E+00 -2.3355E+00  1.0398E+00  7.2645E-01  9.3704E-01  5.2642E-02
     H= 5.0000E-02  R= 3.3867E+02  AC= 4.3847E-04   NEVAL=    86
 49  3.0000E+00 -2.1478E+00  1.0510E+00  7.3908E-01  9.4034E-01  5.9173E-02
     H= 1.0000E-01  R= 3.2816E+02  AC= 4.4983E-04   NEVAL=    94
 59  3.6500E+00 -1.5297E+00  1.0935E+00  7.9682E-01  9.6387E-01  6.9148E-02
     H= 5.0000E-02  R= 2.8240E+02  AC= 4.6359E-04   NEVAL=   116
 60  3.6811E+00 -1.4997E+00  1.0957E+00  8.0003E-01  9.6531E-01  6.9255E-02
     H= 5.0000E-02  R= 2.7685E+02  AC= 4.7364E-04   NEVAL=   118
 DRAG VECTOR AT FINAL POINT -
  DIRECTION COSINES-   8.1378E-01   4.0887E-02   5.7973E-01   ANGLES A AND G
 AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.14496E+00    9.73502E-
```


FOLDOUT FRAME 1

```
E-04  NEVAL=    17
E-01  9.4863E-01  2.2692E-02  9.6505E-03  8.7890E-01  9.4679E-02  1.0508E-01
E-04  NEVAL=    42
E-01  9.4614E-01  2.5428E-02  1.3140E-02  8.7412E-01  1.0920E-01  1.2612E-01
E-04  NEVAL=    62
E-01  9.4614E-01  2.5428E-02  1.3140E-02  8.7418E-01  1.1472E-01  1.3465E-01
E-04  NEVAL=    64
E-01  9.3711E-01  5.2784E-02  5.5842E-02  9.6504E-01  1.5739E-01  2.6271E-01
E-04  NEVAL=    86
E-01  9.4038E-01  5.9353E-02  6.9706E-02  1.0176E+00  1.4059E-01  2.7074E-01
E-04  NEVAL=    94
E-01  9.6385E-01  6.9443E-02  1.0389E-01  1.1154E+00  8.2849E-02  2.2593E-01
E-04  NEVAL=   117
E-01  9.6528E-01  6.9554E-02  1.0497E-01  1.1215E+00  7.7790E-02  2.1679E-01
E-04  NEVAL=   119

2   5.8156E-01   ANGLES A AND GAMMA-   3.0184E+00   5.4440E+01
RE     1.14489E+00    9.73459E-01


PSTAR = -1.499765     YPSTAR =  1.096728      ZPSTAR =    .800000 (FLOW SYSTEM)
                      YPSTARP=  -.003280      ZPSTARP=    .000000 (FLUX TUBE SYSTEM)

    YINIT        ZINIT        ERROR  (FLUX TUBE SYSTEM)
  -.3891E-02  -.3977E-03   .1033E-02

              VPX          VPY          VPZ          VX          VY          VZ
E-01  9.5996E-01  1.3530E-02 -1.6213E-03  9.5996E-01  1.3530E-02  1.2582E-02
      NEVAL=     1
E-01  9.5923E-01  1.3941E-02 -1.0773E-03  9.3808E-01  2.6448E-02  2.5186E-02
E-04  NEVAL=    13
E-01  9.5813E-01  1.4628E-02 -1.9607E-04  9.1978E-01  4.0466E-02  3.9694E-02
E-04  NEVAL=    17
E-01  9.4856E-01  2.2624E-02  9.7440E-03  8.7866E-01  9.4430E-02  1.0556E-01
E-04  NEVAL=    42
E-01  9.4606E-01  2.5356E-02  1.3253E-02  8.7459E-01  1.0891E-01  1.2671E-01
E-04  NEVAL=    62
E-01  9.4606E-01  2.5356E-02  1.3253E-02  8.7396E-01  1.1442E-01  1.3528E-01
E-04  NEVAL=    64
E-01  9.3704E-01  5.2642E-02  5.6158E-02  9.6537E-01  1.5667E-01  2.6346E-01
E-04  NEVAL=    86
E-01  9.4034E-01  5.9173E-02  7.0049E-02  1.0180E+00  1.3981E-01  2.7122E-01
E-04  NEVAL=    94
E-01  9.6387E-01  6.9148E-02  1.0418E-01  1.1156E+00  8.2154E-02  2.2576E-01
E-04  NEVAL=   116
E-01  9.6531E-01  6.9255E-02  1.0526E-01  1.1216E+00  7.7109E-02  2.1662E-01
E-04  NEVAL=   118

    5.7973E-01   ANGLES A AND GAMMA-   2.8763E+00   5.4568E+01
RE     1.14496E+00    9.73502E-01
```

FOLDOUT FRAME 2

FLUX TUBE CROSS SECTION COORCINATES IN THE -

IP	INITIAL PLANE XP	YP	ZP	TARGET PLAN XP	YP
CENTER	-5.0000E+00	9.8110E-01	6.9829E-01	-1.5000E+00	1.1000E+00
1	1.5884E-14	7.2555E-04	4.2635E-03	-5.2934E-15	-3.0215E-04
2	1.1492E-14	4.1278E-03	-3.8912E-04	-1.0963E-15	3.9506E-03
3	2.8054E-14	4.4517E-04	-1.8950E-03	-2.9064E-15	3.9710E-04
4	9.7370E-15	-3.8913E-03	-3.9756E-04	1.6757E-15	-4.3100E-03

FLUX TUBE CROSS SECTICN AREA IN THE INITIAL PLANE= 2.47114E-05

CONCENTRATION FACTOR= 1.08337

AT THE POINT (X,Y,Z)= -1.50000 1.10000 .80000
FOR A PARTICLE OF DIAMETER= 300.00000 WITH DIAMETER TO LENGTH RATIO= 1
NORMALIZED AIR SPEED AT FINAL POINT= 1.14339
PARTICLE CONCENTRATION RATIO= 1.11288

FOLDOUT FRA

ROSS SECTION COORCINATES IN THE -

TARGET PLANE

ZP	XP	YP	ZP	
9829E-01	-1.5000E+00	1.1000E+00	8.0000E-01	(FLOW SYSTEM)
2635E-03	-5.2934E-15	-3.0215E-04	3.6111E-03	(FLUX TUBE SYSTEM)
8912E-04	-1.0963E-15	3.9506E-03	-1.2361E-03	(FLUX TUBE SYSTEM)
8950E-03	-2.9064E-15	3.9710E-04	-2.0225E-03	(FLUX TUBE SYSTEM)
9756E-04	1.6757E-15	-4.3100E-03	7.5786E-05	(FLUX TUBE SYSTEM)

THE INITIAL PLANE= 2.47114E-05 IN THE TARGET PLANE= 2.28097E-05

1.10000 .80000
00 WITH DIAMETER TO LENGTH RATIO= 1.00000E+00 AND DENSITY= 1.00000E+03
1.14339
.1288

FOLDOUT FRAME 2

TANTRA

BODY IDENTIFIER IS TEST   NUMBER CF SYMMETRY PLANES= 0   NUMBER OF QUADRAL

FOLDOUT FRA

MMETRY PLANES= 0 NUMBER OF QUADRALATERALS= 189 MACH NUMBER= 0.

FOLDOUT FRAME 2

```
TANGENT TRAJECTORY CODE RUN ID -
   TEST PROBLEM WITH TEST BODY

PHYSICAL INPUT DATA -
 AIR SPEED= 9.000000E+01   CHARACTERISTIC DIMENSION OF THE BODY= 1.000000
 DENSITY AND TEMPERATURE OF AIR ARE  9.092500E-01 AND  2.686590E+02   AIR

NUMERICAL INTEGRATOR INPUTS -
 TIME STEP= 1.0000E-01   MINIMUM TIME STEP= 5.0000E-03   PRINT TIME INTER

 LOCAL ERROR TOLERANCES FOR DVDQ -    1.0000E-05    1.0000E-05    1.0000E


TRAJECTORY DATA ARE WRITTEN ON UNIT 10 FOR PLOTTING
```

C DIMENSION OF THE BODY= 1.000000E+00
92500E-01 AND 2.686590E+02 AIR VISCOSITY IS 1.493764E-05

EP= 5.0000E-03 PRINT TIME INTERVAL= 1.0000E+00 X COORD. OF FINAL PLANE= 0.

0000E-05 1.0000E-05 1.0000E-05

OR PLOTTING

FOLDOUT FRAME 2

```
        WATER DROP DIAMETER = 2.00000E+02 MICROMETERS

                       PARTICLE SETTLING SPEED= 7.69093E-01 M/SEC



     TRAJECTORIES ARE TO BEGIN ALONG A LINE DEFINED BY THE POINTS (X1,Y1,Z1,) AND
        (     -5.00000E+00     0.              -4.50000E-01 )    AND     (     -5.00000E
     WITH DIRECTION COSINES -(COS(ALPHA),COS(BETA),COS(GAMMA)) -        0.

     STARTING POINT INCREMENTS ARE - COARSE INCREMENT= 5.00000E-02   FINE INCREMEN


  *   *    *    *  INITIAL COORDINATES  X=-5.00000E+00     Y= 0.              Z=-4.50000E
     IFLAG= 7 FOR KSTEP=      27  NEVAL=     58             HMIN IS SET TO 3.1250E-03
     IFLAG= 7 FOR KSTEP=      27  NEVAL=     59             HMIN IS SET TO 1.5625E-03
         INSIDE QUAD  185        I2=  1
         ZNP,ROSQ,TSQ,H=  -5.4665E-03   2.4343E-01   1.0355E+00   2.5000E-02
         INSIDE QUAD  188        I2=  1
         ZNP,ROSQ,TSQ,H=  -7.1977E-03   2.5035E-01   1.0355E+00   2.5000E-02
         THE BODY SURFACE IS PENETRATED.  PARTICLE COORDINATES ARE (X,Y,Z)-2.552
         TRIAL INITIAL COORDINATES ARE (YINIT,ZINIT)  0.          -4.5000E-01

             AFTER   0 ATTEMPTS PARTICLE STILL PENETRATES THE BODY.


  KSTEP        T           X          Y           Z          VPX         VPY
      0  0.          -5.0000E+00  0.         -4.5000E-01  9.4971E-01 -1.0353E-03 -1.
         H= 1.0000E-01  R= 8.2573E+00  AC= 1.9004E-17  NEVAL=     1
     10  5.0000E-01 -4.5253E+00 -5.2030E-04 -4.5857E-01  9.4886E-01 -1.0526E-03 -1.
         H= 5.0000E-02  R= 2.1823E+01  AC= 1.6453E-03  NEVAL=    17
     19  1.0000E+00 -4.0517E+00 -1.0637E-03 -4.6742E-01  9.4439E-01 -1.1384E-03 -1.
         H= 1.0000E-01  R= 6.8350E+01  AC= 6.6054E-04  NEVAL=    35
     29  1.8406E+00 -3.2695E+00 -2.2201E-03 -4.8800E-01  9.0566E-01 -1.7706E-03 -3.
         H= 1.5625E-03  R= 2.0070E+02  AC= 4.9969E-04  NEVAL=    63
     39  1.8750E+00 -3.2385E+00 -2.2817E-03 -4.8936E-01  9.0255E-01 -1.8174E-03 -4.
         H= 1.2500E-02  R= 2.1011E+02  AC= 4.9009E-04  NEVAL=    83
     47  2.0000E+00 -3.1264E+00 -2.5204E-03 -4.9505E-01  8.8980E-01 -2.0074E-03 -5.
         H= 5.0000E-02  R= 2.6029E+02  AC= 4.1124E-04  NEVAL=    99
     57  2.5750E+00 -2.6346E+00 -3.9965E-03 -5.5196E-01  8.2481E-01 -3.1898E-03 -1.
         H= 2.5000E-02  R= 3.9701E+02  AC= 3.9795E-04  NEVAL=   121


  *   *    *    *  INITIAL COORDINATES  X=-5.00000E+00     Y= 0.              Z=-5.00000E
     IFLAG= 7 FOR KSTEP=      28  NEVAL=     60             HMIN IS SET TO 3.1250E-03
     IFLAG= 7 FOR KSTEP=      29  NEVAL=     63             HMIN IS SET TO 1.5625E-03
     IFLAG= 7 FOR KSTEP=     108  NEVAL=    235             HMIN IS SET TO 7.8125E-04


  KSTEP        T           X          Y           Z          VPX         VPY
      0  0.          -5.0000E+00  0.         -5.0000E-01  9.5022E-01 -1.0211E-03 -1.
         H= 1.0000E-01  R= 3.9701E+02  AC= 8.2209E-21  NEVAL=     1
     10  5.0000E-01 -4.5250E+00 -5.1313E-04 -5.0905E-01  9.4939E-01 -1.0379E-03 -1.
         H= 5.0000E-02  R= 2.1255E+01  AC= 1.6923E-03  NEVAL=    17
     20  1.0000E+00 -4.0512E+00 -1.0485E-03 -5.1842E-01  9.4510E-01 -1.1204E-03 -1.
         H= 1.0000E-01  R= 6.6581E+01  AC= 6.7263E-04  NEVAL=    37
     30  1.8797E+00 -3.2321E+00 -2.2468E-03 -5.4173E-01  9.0617E-01 -1.7668E-03 -4.
         H= 1.5625E-03  R= 1.9997E+02  AC= 5.3975E-04  NEVAL=    65
```

(X1,Y1,Z1,) AND (X2,Y2,Z2) -
(-5.00000E+00 0. 0.)
0. 0. 1.00000E+00

2 FINE INCREMENT= 5.00000E-03

Z=-4.50000E-01 FOR TRAJECTORY NUMBER 1
ET TO 3.1250E-03
ET TO 1.5625E-03

2.5000E-02

2.5000E-02
RE (X,Y,Z)-2.55232E+00-4.32804E-03-5.70585E-01
-4.5000E-01 ATTEMPT NUMBER 0

ODY.

	VPY	VPZ	VX	VY	VZ
1	-1.0353E-03	-1.7077E-02	9.4971E-01	-1.0353E-03	-8.5312E-03
1					
1	-1.0526E-03	-1.7267E-02	9.2635E-01	-1.5046E-03	-1.5595E-02
17					
1	-1.1384E-03	-1.8462E-02	8.7433E-01	-2.4196E-03	-3.7486E-02
35					
1	-1.7706E-03	-3.8358E-02	7.3501E-01	-4.3441E-03	-1.5675E-01
63					
.	-1.8174E-03	-4.0613E-02	7.2694E-01	-4.4526E-03	-1.6882E-01
83					
.	-2.0074E-03	-5.1080E-02	6.9105E-01	-4.9664E-03	-2.4430E-01
99					
:	-3.1898E-03	-1.6851E-01	7.4570E-01	-6.1109E-03	-5.7168E-01
21					

ORIGINAL PAGE IS
OF POOR QUALITY

Z=-5.00000E-01 FOR TRAJECTORY NUMBER 0
T TO 3.1250E-03
T TO 1.5625E-03
T TO 7.8125E-04

	VPY	VPZ	VX	VY	VZ
	-1.0211E-03	-1.8037E-02	9.5022E-01	-1.0211E-03	-9.4917E-03
1					
	-1.0379E-03	-1.8253E-02	9.2743E-01	-1.4781E-03	-1.7214E-02
17					
	-1.1204E-03	-1.9572E-02	8.7764E-01	-2.3594E-03	-4.0720E-02
37					
	-1.7668E-03	-4.2684E-02	7.4593E-01	-4.2808E-03	-1.7362E-01
65					

FOLDOUT FRAME 2

```
 48  1.9063E+00 -3.2081E+00 -2.2942E-03 -5.4294E-01  9.0593E-01 -1.8018E-03
        H= 6.2500E-03  R= 2.0666E+02  AC= 4.9383E-04  NEVAL=    85
 49  2.0000E+00 -3.1237E+00 -2.4692E-03 -5.4747E-01  8.9545E-01 -1.9350E-03
        H= 2.5000E-02  R= 2.3735E+02  AC= 4.4684E-04  NEVAL=   103
 59  2.5250E+00 -2.6674E+00 -3.7260E-03 -5.9541E-01  8.4667E-01 -2.8990E-03
        H= 5.0000E-02  R= 3.5235E+02  AC= 4.1138E-04  NEVAL=   124
 69  2.7125E+00 -2.5091E+00 -4.3054E-03 -6.2775E-01  8.4692E-01 -3.2768E-03
        H= 1.2500E-02  R= 3.6565E+02  AC= 4.0703E-04  NEVAL=   147
 79  2.8750E+00 -2.3701E+00 -4.8572E-03 -6.6329E-01  8.6379E-01 -3.4910E-03
        H= 2.5000E-02  R= 2.7019E+02  AC= 4.4649E-04  NEVAL=   167
 84  3.0000E+00 -2.2614E+00 -5.3004E-03 -6.9339E-01  8.7616E-01 -3.5962E-03
        H= 2.5000E-02  R= 2.2479E+02  AC= 4.9517E-04  NEVAL=   178
 94  3.2687E+00 -2.0226E+00 -6.2920E-03 -7.6277E-01  9.0165E-01 -3.7829E-03
        H= 6.2500E-03  R= 2.2802E+02  AC= 4.7372E-04  NEVAL=   202
104  3.3750E+00 -1.9261E+00 -6.6963E-03 -7.9143E-01  9.1405E-01 -3.8160E-03
        H= 2.5000E-02  R= 2.0274E+02  AC= 4.9549E-04  NEVAL=   222
114  3.3937E+00 -1.9089E+00 -6.7679E-03 -7.9655E-01  9.1608E-01 -3.8177E-03
        H= 1.5625E-03  R= 1.9867E+02  AC= 5.3852E-04  NEVAL=   247
124  3.4500E+00 -1.8572E+00 -6.9827E-03 -8.1193E-01  9.2214E-01 -3.8205E-03
        H= 1.2500E-02  R= 1.8939E+02  AC= 5.4795E-04  NEVAL=   267
134  3.8000E+00 -1.5285E+00 -8.3154E-03 -9.0780E-01  9.5632E-01 -3.7791E-03
        H= 5.0000E-02  R= 1.9086E+02  AC= 5.4461E-04  NEVAL=   288
144  4.0000E+00 -1.3352E+00 -9.0641E-03 -9.6181E-01  9.7643E-01 -3.7025E-03
        H= 5.0000E-02  R= 1.8499E+02  AC= 5.4930E-04  NEVAL=   311
145  4.0000E+00 -1.3352E+00 -9.0641E-03 -9.6181E-01  9.7643E-01 -3.7025E-03
        H= 2.5000E-02  R= 1.8398E+02  AC= 5.5533E-04  NEVAL=   314
155  4.3500E+00 -9.8803E-01 -1.0328E-02 -1.0523E+00  1.0069E+00 -3.5092E-03
        H= 2.5000E-02  R= 1.9043E+02  AC= 5.4239E-04  NEVAL=   335
165  4.7750E+00 -5.5306E-01 -1.1753E-02 -1.1520E+00  1.0387E+00 -3.1772E-03
        H= 5.0000E-02  R= 1.8739E+02  AC= 5.4448E-04  NEVAL=   356
170  5.0000E+00 -3.1772E-01 -1.2444E-02 -1.1993E+00  1.0526E+00 -2.9619E-03
        H= 5.0000E-02  R= 1.8378E+02  AC= 5.5173E-04  NEVAL=   367
175  5.2995E+00  1.1102E-16 -1.3284E-02 -1.2559E+00  1.0682E+00 -2.6446E-03
        H= 1.0000E-01  R= 1.7534E+02  AC= 5.5777E-04  NEVAL=   377


* * * * * * * * * * * * * * * * * * * * * * * * * * SWITCH TO FINE STEPSIZE * *


*    *    *    *  INITIAL COORDINATES  X=-5.00000E+00    Y= 0.            Z=-4.9500
  IFLAG= 7 FOR KSTEP=    30  NEVAL=     57              HMIN IS SET TO 3.1250E-03
  IFLAG= 7 FOR KSTEP=    30  NEVAL=     58              HMIN IS SET TO 1.5625E-03
     INSIDE QUAD  187        I2=  1
     ZNP,ROSQ,TSQ,H=  -3.2026E-04   1.6737E-01   6.7553E-01   2.5000E-02
     THE BODY SURFACE IS PENETRATED.  PARTICLE COORDINATES ARE (X,Y,Z)-2.41
     TRIAL INITIAL COORDINATES ARE (YINIT,ZINIT)  0.           -4.9500E-01

           AFTER   0 ATTEMPTS PARTICLE STILL PENETRATES THE BODY.


KSTEP          T             X            Y             Z          VPX          VPY
  0  0.              -5.0000E+00  0.             -4.9500E-01  9.5017E-01 -1.0226E-03
        H= 1.0000E-01  R= 1.7534E+02  AC= 4.2147E-20  NEVAL=     1
 10  5.0000E-01 -4.5250E+00 -5.1385E-04 -5.0401E-01  9.4934E-01 -1.0394E-03
        H= 5.0000E-02  R= 2.1313E+01  AC= 1.6874E-03  NEVAL=    13
 20  1.0000E+00 -4.0512E+00 -1.0501E-03 -5.1333E-01  9.4502E-01 -1.1222E-03
        H= 1.0000E-01  R= 5.6799E+01  AC= 9.2763E-04  NEVAL=    31
 21  1.0000E+00 -4.0512E+00 -1.0501E-03 -5.1333E-01  9.4502E-01 -1.1222E-03
        H= 1.0000E-01  R= 6.6762E+01  AC= 6.7141E-04  NEVAL=    33
 31  1.8766E+00 -3.2352E+00 -2.2457E-03 -5.3643E-01  9.0602E-01 -1.7688E-03
        H= 1.5625E-03  R= 2.0029E+02  AC= 5.0046E-04  NEVAL=    60
 41  1.9063E+00 -3.2083E+00 -2.2988E-03 -5.3772E-01  9.0350E-01 -1.8081E-03
        H= 6.2500E-03  R= 2.0786E+02  AC= 4.9260E-04  NEVAL=    80
```

71

FOLDOUT FRAME

```
E-01 -1.8018E-03 -4.4579E-02  7.4182E-01 -4.3961E-03 -1.8313E-01
     85
E-01 -1.9350E-03 -5.2476E-02  7.2203E-01 -4.6783E-03 -2.3124E-01
    103
7E-01 -2.8990E-03 -1.4541E-01  7.7503E-01 -5.6161E-03 -5.0306E-01
    124
2E-01 -3.2768E-03 -2.0033E-01  9.5347E-01 -5.6300E-03 -5.6342E-01
    147
9E-01 -3.4910E-03 -2.3312E-01  1.0317E+00 -5.0500E-03 -4.5671E-01
    167
5E-01 -3.5962E-03 -2.4746E-01  1.0474E+00 -4.9247E-03 -4.0973E-01
    178
5E-01 -3.7829E-03 -2.6766E-01  1.1074E+00 -5.0931E-03 -3.8329E-01
    202
5E-01 -3.8160E-03 -2.7199E-01  1.1195E+00 -4.0114E-03 -3.1470E-01
    222
8E-01 -3.8177E-03 -2.7241E-01  1.1183E+00 -3.9671E-03 -3.0931E-01
    247
4E-01 -3.8205E-03 -2.7338E-01  1.1168E+00 -3.8600E-03 -2.9616E-01
    267
2E-01 -3.7791E-03 -2.7288E-01  1.1511E+00 -3.2909E-03 -2.4028E-01
    288
5E-01 -3.7025E-03 -2.6648E-01  1.1507E+00 -2.8540E-03 -1.8720E-01
    311
3E-01 -3.7025E-03 -2.6648E-01  1.1506E+00 -2.8140E-03 -1.8361E-01
=   314
9E+00 -3.5092E-03 -2.4919E-01  1.1656E+00 -2.2839E-03 -1.3240E-01
=   335
7E+00 -3.1772E-03 -2.1923E-01  1.1649E+00 -1.4809E-03 -7.1961E-02
=   356
8E+00 -2.9619E-03 -2.0115E-01  1.1603E+00 -1.0059E-03 -4.1299E-02
=   367
2E+00 -2.6446E-03 -1.7707E-01  1.1631E+00 -4.1830E-04 -1.9720E-02
=   377


O FINE STEPSIZE * * * * * * * * * * * * * * * * * * * * * * * * * * *


          Z=-4.95000E-01    FOR TRAJECTORY NUMBER    1
IS SET TO 3.1250E-03
IS SET TO 1.5625E-03

-01    2.5000E-02
ES ARE (X,Y,Z)-2.41459E+00-4.70245E-03-6.47195E-01
     -4.9500E-01       ATTEMPT NUMBER    0

HE BODY.

PX           VPY          VPZ           VX           VY           VZ
7E-01 -1.0226E-03 -1.7943E-02  9.5017E-01 -1.0226E-03 -9.3971E-03
=     1
4E-01 -1.0394E-03 -1.8156E-02  9.2731E-01 -1.4808E-03 -1.7056E-02
=    13
2E-01 -1.1222E-03 -1.9463E-02  8.8821E-01 -2.1833E-03 -3.4500E-02
=    31
2E-01 -1.1222E-03 -1.9463E-02  8.7730E-01 -2.3654E-03 -4.0409E-02
=    33
2E-01 -1.7688E-03 -4.2313E-02  7.4457E-01 -4.2901E-03 -1.7230E-01
=    60
0E-01 -1.8081E-03 -4.4423E-02  7.3895E-01 -4.3748E-03 -1.8295E-01
=    80
```

ORIGINAL PAGE IS
OF POOR QUALITY

FOLDOUT FRAME 2

```
  48  2.0000E+00 -3.1240E+00 -2.4745E-03 -5.4224E-01  8.9498E-01 -1.9425E-03
         H= 2.5000E-02  R= 2.3887E+02  AC= 4.4563E-04  NEVAL=   94
  58  2.4750E+00 -2.7105E+00 -3.5943E-03 -5.8330E-01  8.4764E-01 -2.8141E-03
         H= 5.0000E-02  R= 3.4415E+02  AC= 4.1415E-04  NEVAL=   115
  68  2.7125E+00 -2.5103E+00 -4.3208E-03 -6.2285E-01  8.4491E-01 -3.3024E-03
         H= 1.2500E-02  R= 3.7292E+02  AC= 4.0480E-04  NEVAL=   137


* * * * * * * * * * * * * * * * * * * * * * * * * * TANGENT TRAJECTORY IS AS FOLL


*    *    *    *   INITIAL COORDINATES  X=-5.00000E+00     Y= 0.              Z=-5.0000
     IFLAG= 7 FOR KSTEP=    28  NEVAL=    60                HMIN IS SET TO 3.1250E-0
     IFLAG= 7 FOR KSTEP=    29  NEVAL=    63                HMIN IS SET TO 1.5625E-0
     IFLAG= 7 FOR KSTEP=   108  NEVAL=   235                HMIN IS SET TO 7.8125E-0

KSTEP         T            X           Y             Z              VPX         VPY
   0  0.          -5.0000E+00  0.          -5.0000E-01  9.5022E-01 -1.0211E-03
         H= 1.0000E-01  R= 3.7292E+02  AC= 9.3174E-21  NEVAL=    1
  10  5.0000E-01 -4.5250E+00 -5.1313E-04 -5.0905E-01  9.4939E-01 -1.0379E-03
         H= 5.0000E-02  R= 2.1255E+01  AC= 1.6923E-03  NEVAL=   17
  20  1.0000E+00 -4.0512E+00 -1.0485E-03 -5.1842E-01  9.4510E-01 -1.1204E-03
         H= 1.0000E-01  R= 6.6581E+01  AC= 6.7269E-04  NEVAL=   37
  30  1.8797E+00 -3.2321E+00 -2.2468E-03 -5.4179E-01  9.0617E-01 -1.7668E-03
         H= 1.5625E-03  R= 1.9997E+02  AC= 5.3975E-04  NEVAL=   65
  40  1.9063E+00 -3.2081E+00 -2.2942E-03 -5.4294E-01  9.0393E-01 -1.8018E-03
         H= 6.2500E-03  R= 2.0666E+02  AC= 4.9383E-04  NEVAL=   85
  49  2.0000E+00 -3.1237E+00 -2.4692E-03 -5.4747E-01  8.9545E-01 -1.9350E-03
         H= 2.5000E-02  R= 2.3735E+02  AC= 4.4684E-04  NEVAL=   103
  59  2.5250E+00 -2.6674E+00 -3.7260E-03 -5.9541E-01  8.4607E-01 -2.8990E-03
         H= 5.0000E-02  R= 3.5235E+02  AC= 4.1138E-04  NEVAL=   124
  69  2.7125E+00 -2.5091E+00 -4.3054E-03 -6.2775E-01  8.4692E-01 -3.2768E-03
         H= 1.2500E-02  R= 3.6565E+02  AC= 4.0703E-04  NEVAL=   147
  79  2.8750E+00 -2.3701E+00 -4.8572E-03 -6.6329E-01  8.6379E-01 -3.4910E-03
         H= 2.5000E-02  R= 2.7019E+02  AC= 4.4649E-04  NEVAL=   167
  84  3.0000E+00 -2.2614E+00 -5.3004E-03 -6.9339E-01  8.7616E-01 -3.5962E-03
         H= 2.5000E-02  R= 2.2479E+02  AC= 4.9517E-04  NEVAL=   178
  94  3.2687E+00 -2.0226E+00 -6.2920E-03 -7.6277E-01  9.0165E-01 -3.7829E-03
         H= 6.2500E-03  R= 2.2802E+02  AC= 4.7372E-04  NEVAL=   202
 104  3.3750E+00 -1.9261E+00 -6.6963E-03 -7.9149E-01  9.1405E-01 -3.8160E-03
         H= 2.5000E-02  R= 2.0274E+02  AC= 4.9549E-04  NEVAL=   222
 114  3.3937E+00 -1.9089E+00 -6.7679E-03 -7.9659E-01  9.1608E-01 -3.8177E-03
         H= 1.5625E-03  R= 1.9867E+02  AC= 5.3852E-04  NEVAL=   247
 124  3.4500E+00 -1.8572E+00 -6.9827E-03 -8.1193E-01  9.2214E-01 -3.8205E-03
         H= 1.2500E-02  R= 1.8939E+02  AC= 5.4795E-04  NEVAL=   267
 134  3.8000E+00 -1.5285E+00 -8.3154E-03 -9.0780E-01  9.5632E-01 -3.7791E-03
         H= 5.0000E-02  R= 1.9086E+02  AC= 5.4461E-04  NEVAL=   288
 144  4.0000E+00 -1.3352E+00 -9.0641E-03 -9.6181E-01  9.7643E-01 -3.7025E-03
         H= 5.0000E-02  R= 1.8499E+02  AC= 5.4930E-04  NEVAL=   311
 145  4.0000E+00 -1.3352E+00 -9.0641E-03 -9.6181E-01  9.7643E-01 -3.7025E-03
         H= 2.5000E-02  R= 1.8398E+02  AC= 5.5533E-04  NEVAL=   314
 155  4.3500E+00 -9.8803E-01 -1.0328E-02 -1.0523E+00  1.0069E+00 -3.5092E-03
         H= 2.5000E-02  R= 1.9043E+02  AC= 5.4239E-04  NEVAL=   335
 165  4.7750E+00 -5.5306E-01 -1.1753E-02 -1.1520E+00  1.0387E+00 -3.1772E-03
         H= 5.0000E-02  R= 1.8739E+02  AC= 5.4449E-04  NEVAL=   356
 170  5.0000E+00 -3.1772E-01 -1.2444E-02 -1.1993E+00  1.0528E+00 -2.9619E-03
         H= 5.0000E-02  R= 1.8378E+02  AC= 5.5173E-04  NEVAL=   367
 175  5.2995E+00  1.1102E-16 -1.3284E-02 -1.2559E+00  1.0662E+00 -2.6446E-03
         H= 1.0000E-01  R= 1.7534E+02  AC= 5.5777E-04  NEVAL=   377
```


FOLDOUT FRAME

```
. -1.9425E-03 -5.2353E-02  7.1946E-01 -4.6997E-03 -2.3140E-01
94
. -2.8141E-03 -1.3307E-01  7.4906E-01 -5.5837E-03 -4.7531E-01
.15
. -3.3024E-03 -2.0236E-01  9.5275E-01 -5.7009E-03 -5.7291E-01
.37


'ORY IS AS FOLLOWS * * * * * * * * * * * * * * * * * * * * * * *


     Z=-5.00000E-01    FOR TRAJECTORY NUMBER    0
IT TO 3.1250E-03
IT TO 1.5625E-03
IT TO 7.8125E-04


     VPY         VPZ          VX          VY          VZ
. -1.0211E-03 -1.8037E-02  9.5022E-01 -1.0211E-03 -9.4917E-03
 1
. -1.0379E-03 -1.8253E-02  9.2743E-01 -1.4781E-03 -1.7214E-02
17
. -1.1204E-03 -1.9572E-02  8.7764E-01 -2.3594E-03 -4.0720E-02
37
. -1.7668E-03 -4.2684E-02  7.4593E-01 -4.2808E-03 -1.7362E-01
65
. -1.8018E-03 -4.4579E-02  7.4102E-01 -4.3561E-03 -1.8313E-01
85
. -1.9350E-03 -5.2476E-02  7.2203E-01 -4.6783E-03 -2.3124E-01
03
. -2.8990E-03 -1.4541E-01  7.7503E-01 -5.6161E-03 -5.0306E-01
24
  -3.2768E-03 -2.0033E-01  9.5347E-01 -5.6300E-03 -5.6342E-01
47
  -3.4910E-03 -2.3312E-01  1.0317E+00 -5.0500E-03 -4.5671E-01
67
  -3.5962E-03 -2.4746E-01  1.0474E+00 -4.9247E-03 -4.0973E-01
78
  -3.7829E-03 -2.6766E-01  1.1074E+00 -5.0931E-03 -3.8329E-01
02
  -3.8160E-03 -2.7199E-01  1.1195E+00 -4.0114E-03 -3.1470E-01
22
  -3.8177E-03 -2.7241E-01  1.1183E+00 -3.9671E-03 -3.0931E-01
47
  -3.8205E-03 -2.7338E-01  1.1168E+00 -3.8600E-03 -2.9616E-01
67
  -3.7791E-03 -2.7286E-01  1.1511E+00 -3.2909E-03 -2.4028E-01
88
  -3.7025E-03 -2.6648E-01  1.1507E+00 -2.8540E-03 -1.8720E-01
11
  -3.7025E-03 -2.6648E-01  1.1506E+00 -2.8140E-03 -1.8361E-01
14
  -3.5092E-03 -2.4919E-01  1.1656E+00 -2.2839E-03 -1.3240E-01
35
  -3.1772E-03 -2.1923E-01  1.1649E+00 -1.4809E-03 -7.1961E-02
56
  -2.9619E-03 -2.0115E-01  1.1603E+00 -1.0059E-03 -4.1299E-02
67
  -2.6446E-03 -1.7707E-01  1.1631E+00 -4.1830E-04 -1.9720E-02
77
```

STEREO

PLOT TANGENT TRAJECTORY TO THE TEST BODY

NUMBER OF SYMMETRY PLANES= 0   NUMBER OF TRAJECTORIES= 1   XSTART

MINIMUM AND MAXIMUM COORDINATES -

X AXIS=	-5.00000E+00	2.00000E+00
Y AXIS=	-2.00000E+00	2.00000E+00
Z AXIS=	-1.25593E+00	1.00000E+00

COORDINATE TRANSLATIONS USED TO CENTER THE PLOTS - DELX, DELY, DELZ -
-1.50000E+00   0.   -1.27964E-01

CRT PLOTS

THETA = 0.00   PSI = 160.00   DELTA = 3.50
PLOT LABEL - THETA=0, PSI=160, DELTA=3.5
PEMSF = 1.5466E+00

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.2158E+01	-.5754E+00
-.5000E+01	0.	-.5000E+00	-.2158E+01	-.5754E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1865E+01	-.5894E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1572E+01	-.6039E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.1065E+01	-.6400E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.1050E+01	-.6418E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.9978E+00	-.6488E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.7146E+00	-.7229E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.6162E+00	-.7729E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.5297E+00	-.8279E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.4620E+00	-.8744E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.3133E+00	-.9818E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.2533E+00	-.1026E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.2426E+00	-.1034E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.2104E+00	-.1058E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.5772E-02	-.1206E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1145E+00	-.1290E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1145E+00	-.1290E+01
-.9880E+00	-.1033E-01	-.1052E+01	.3304E+00	-.1429E+01
-.5531E+00	-.1175E-01	-.1152E+01	.6006E+00	-.1584E+01
-.3177E+00	-.1244E-01	-.1199E+01	.7468E+00	-.1657E+01
.1110E-15	-.1328E-01	-.1256E+01	.9439E+00	-.1744E+01

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.1537E+01	-.5754E+00
-.5000E+01	0.	-.5000E+00	-.1537E+01	-.5754E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1328E+01	-.5894E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1119E+01	-.6039E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.7575E+00	-.6400E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.7469E+00	-.6418E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.7096E+00	-.6488E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.5073E+00	-.7229E+00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1 XSTART=-5.00000E+00

DELY, DELZ -
27964E-01

YPLOT

-.5754E+00
-.5754E+00
-.5894E+00
-.6039E+00
-.6400E+00
-.6418E+00
-.6488E+00
-.7229E+00
-.7729E+00
-.8279E+00
-.8744E+00
-.9818E+00
-.1026E+01
-.1034E+01
-.1058E+01
-.1206E+01
-.1290E+01
-.1290E+01
-.1429E+01
-.1584E+01
-.1657E+01
-.1744E+01

YPLOT

-.5754E+00
-.5754E+00
-.5894E+00
-.6039E+00
-.6400E+00
-.6418E+00
-.6488E+00
-.7229E+00

FOLDOUT FRAME 2

-.2509E+01	-.4305E-02	-.6277E+00	-.4369E+00	-.7729E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.3750E+00	-.8279E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.3266E+00	-.8744E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.2202E+00	-.9818E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.1772E+00	-.1026E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.1696E+00	-.1034E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.1466E+00	-.1058E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.1809E-03	-.1206E+01
-.1335E+01	-.9064E-02	-.9618E+00	.8585E-01	-.1290E+01
-.1335E+01	-.9064E-02	-.9618E+00	.8585E-01	-.1290E+01
-.9880E+00	-.1033E-01	-.1052E+01	.2402E+00	-.1429E+01
-.5531E+00	-.1175E-01	-.1152E+01	.4334E+00	-.1584E+01
-.3177E+00	-.1244E-01	-.1199E+01	.5378E+00	-.1657E+01
.1110E-15	-.1328E-01	-.1256E+01	.6786E+00	-.1744E+01

THETA = 0.00 PSI = 160.00 DELTA = 3.00

PLOT LABEL - THETA=0, PSI=160, DELTA=3.0

PEMSF = 1.5568E+00

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.2129E+01	-.5792E+00
-.5000E+01	0.	-.5000E+00	-.2129E+01	-.5792E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1839E+01	-.5933E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1550E+01	-.6079E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.1050E+01	-.6442E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.1036E+01	-.6460E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.9841E+00	-.6531E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.7048E+00	-.7277E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.6076E+00	-.7780E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.5223E+00	-.8334E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.4555E+00	-.8802E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.3088E+00	-.9882E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.2496E+00	-.1033E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.2390E+00	-.1041E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.2073E+00	-.1065E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.5410E-02	-.1214E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1133E+00	-.1298E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1133E+00	-.1298E+01
-.9880E+00	-.1033E-01	-.1052E+01	.3262E+00	-.1439E+01
-.5531E+00	-.1175E-01	-.1152E+01	.5923E+00	-.1594E+01
-.3177E+00	-.1244E-01	-.1199E+01	.7370E+00	-.1668E+01
.1110E-15	-.1328E-01	-.1256E+01	.9315E+00	-.1756E+01

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.1593E+01	-.5792E+00
-.5000E+01	0.	-.5000E+00	-.1593E+01	-.5792E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1376E+01	-.5933E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1160E+01	-.6079E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.7850E+00	-.6442E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.7740E+00	-.6460E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.7354E+00	-.6531E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.5258E+00	-.7277E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.4529E+00	-.7780E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.3888E+00	-.8334E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.3387E+00	-.8802E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.2285E+00	-.9882E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.1840E+00	-.1033E+01
-.1909E+01	-.6768E-02	-.7966E+00	[illegible]	[illegible]

-.1909E+01	-.6768E-02	-.7966E+00	-.1761E+00	-.1041E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.1522E+00	-.1065E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.5852E-03	-.1214E+01
-.1335E+01	-.9064E-02	-.9618E+00	.8853E-01	-.1298E+01
-.1335E+01	-.9064E-02	-.9618E+00	.8853E-01	-.1298E+01
-.9880E+00	-.1033E-01	-.1052E+01	.2464E+00	-.1439E+01
-.5531E+00	-.1175E-01	-.1152E+01	.4485E+00	-.1594E+01
-.3177E+00	-.1244E-01	-.1199E+01	.5566E+00	-.1668E+01
.1110E-15	-.1328E-01	-.1256E+01	.7025E+00	-.1756E+01

THETA = 0.00 PSI = 160.00 DELTA = 2.50
PLOT LABEL - THETA=0, PSI=160, DELTA=2.5
PEMSF = 1.5672E+00

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.2099E+01	-.5831E+00
-.5000E+01	0.	-.5000E+00	-.2099E+01	-.5831E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1814E+01	-.5973E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1529E+01	-.6119E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.1036E+01	-.6485E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.1021E+01	-.6504E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.9703E+00	-.6575E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.6948E+00	-.7326E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.5990E+00	-.7833E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.5148E+00	-.8390E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.4490E+00	-.8861E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.3043E+00	-.9949E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.2459E+00	-.1040E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.2355E+00	-.1048E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.2041E+00	-.1072E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.5043E-02	-.1222E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1120E+00	-.1307E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1120E+00	-.1307E+01
-.9880E+00	-.1033E-01	-.1052E+01	.3220E+00	-.1449E+01
-.5531E+00	-.1175E-01	-.1152E+01	.5849E+00	-.1605E+01
-.3177E+00	-.1244E-01	-.1199E+01	.7271E+00	-.1679E+01
.1110E-15	-.1328E-01	-.1256E+01	.9189E+00	-.1768E+01

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.1649E+01	-.5831E+00
-.5000E+01	0.	-.5000E+00	-.1649E+01	-.5831E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1425E+01	-.5973E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1201E+01	-.6119E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.8129E+00	-.6485E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.8015E+00	-.6504E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.7615E+00	-.6575E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.5446E+00	-.7326E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.4691E+00	-.7833E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.4028E+00	-.8390E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.3509E+00	-.8861E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.2369E+00	-.9949E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.1908E+00	-.1040E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.1826E+00	-.1048E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.1579E+00	-.1072E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.9949E-03	-.1222E+01
-.1335E+01	-.9064E-02	-.9618E+00	.9124E-01	-.1307E+01
-.1335E+01	-.9064E-02	-.9618E+00	.9124E-01	-.1307E+01
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	-.1449E+01
-.5531E+00	-.1175E-01	-.1152E+01	.4638E+00	-.1605E+01
-.3177E+00	-.1244E-01	-.1199E+01	.5758E+00	-.1679E+01
.1110E-15	-.1328E-01	-.1256E+01	.7268E+00	-.1768E+01

CODE LISTINGS

```
      PROGRAM PBOXC(INPUT,TAPE6, TAPE5=INPUT, OUTPUT,
     1 TAPE8 , TAPE9, TAPE39, PUNCH, TAPE1=PUNCH)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     THIS CODE HAS THREE PRINCIPAL USES -
C          1. DEBUG HESS-SMITH CODE INPUT DATA.
C          2. PLOT 3-DIMENSIONAL BODY SURFACE DESCRIPTION.
C          3. TRANSFER QUADRALATERAL ELEMENT DATA TO UNIT 9 FOR LATER
C             USE BY PROGRAM STEREO.
C
C     PERFORMS  PRELIMINARY PROCESSING (IPROS=TRUE) (SCALING,
C     TRANSLATING, ROTATING) OF INPUT DATA FOR THE HESS-SMITH
C     NON-LIFTING CODE (RPT. E.S. 40622).   PRELIMINARY PROCESSED DATA
C     MAY BE PUNCHED (IPUNCH=TRUE).   AFTER PRELIMINARY PROCESSING, DATA
C     ALSO MAY BE PROCESSED INTO QUADRALATERAL ELEMENTS AND THE HESS-
C     SMITH FIRST OUTPUT (E.S. 40622 SEC. 9.4) MAY BE PRINTED (IPRNT=
C     TRUE).    DATA ALSO MAY BE PLOTTED (IPICT=TRUE).    IN ANY CASE THE
C     DATA ARE WRITTEN ON TO UNIT 9, WHICH MAY BE SAVED FOR USE LATER
C     BY SR STEREO WHICH PLOTS THE BODY ALONG WITH TRAJECTORIES.
C
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IPRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      REAL MACH
      LOGICAL IPROS, IPUNCH, IPRNT, IPICT, ICRT
      COMMON /M/ MACH, BETA, RBETA
C     READ IN CONTROL DATA
    1 READ ( 5, 9000 )(HEDR(I),I=1,15),IFLAG,NSYM, KMACH, KASE
 9000 FORMAT( 15A4, I1, 10X,I1, 1X, I1, 2X, A4)
      MACH = 0.0
      IF(KMACH .NE. 0) READ(5,6) MACH
    6 FORMAT (F10.6)
      BETA = SQRT(1.0 - MACH * MACH)
      RBETA = 1.0 / BETA
      READ(5,8000)IPROS, IPUNCH, IPRNT, IPICT, ICRT
 8000 FORMAT(5L1)
      IF( IPROS ) READ(5,7000) ANGLE, XSCALE, YSCALE, ZSCALE,XTRANS,
     1  YTRANS, ZTRANS
 7000 FORMAT( 7F 10.0)
      IF(.NOT. IPROS) GO TO 50
      IF(XSCALE .EQ. 0.0) XSCALE=1.0
      IF(YSCALE .EQ. 0.0) YSCALE=1.0
      IF(ZSCALE .EQ. 0.0) ZSCALE=1.0
      COSA = COS(  0.0174533 * ANGLE)
      SINA = SIN(  0.0174533 * ANGLE)
   50 REWIND 8
      REWIND 9
      CALL PINPUT
      IF(IPICT ) CALL PICTUR
      IF( ICRT ) CALL FRAME(0.5,0.5)
      IF(IPICT .AND.  .NOT. ICRT) CALL PLOT(15.0, 0.0,-3)
      IF(IPICT .AND.  .NOT. ICRT) CALL ENDCC
      IF(IPICT .AND.ICRT) CALL ENDPLT
      REWIND 9
      STOP
      END
```

```
*DECK,PEADER
      SUBROUTINE PEADER
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IPRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      LOGICAL IPROS, IPUNCH, IPRNT, IPICT, ICRT
      DATA IPAGE/0/
    1 FORMAT( 1H1, 4X, 14H PROGRAM PBOXC, 15X, 30HATMOSPHERIC SCIENCE AS
     1SOCIATES/            38X, 22HBEDFORD, MASSACHUSETTS, 22X, 4HPAGEI5/
     2 7X, 8HBODY ID., 2X, A4/ 30X, 15A4)
   10 IPAGE = IPAGE + 1
      WRITE (6,1) IPAGE, KASE, (HEDR(I),I=1,15)
      RETURN
      END
```

```
*DECK,PATPROS
      SUBROUTINE PATPROS( X, Y, Z, XX, YY, ZZ )
C
C     THIS IS A SIMPLE SCALING AND ORIGIN TRANSLATION CODE FOR THE
C     DOUGLAS BOXC POTENTIAL FLOW  CODE DATA INPUT
C        XTRANS, YTRANS, ZTRANS ARE ORIGIN TRANSLATIONS
C        XSCALE, YSCALE, ZSCALE ARE SCALE FACTORS
C     THE CODE ALSO ALLOWS FOR ROTATION IN THE X - Z PLANE TO ADJUST
C     FOR ARBITRARY ANGLE OF ATTACK
C        SINA, COSA ARE SINE AND COSINE OF ANGLE
C        ANGLE IS THE ANGLE( INPUT IN DEGREES)  THAT THE AIRPLANE AXIS
C        MAKES WITH THE NEGATIVE X AXIS (POSITIVE COUNTERCLOCKWISE
C        FROM THE-X AXIS) AFTER SCALING ( NOTE - AFTER SCALING THE
C        AIRPLANE NOSE POINTS DOWN THE NEGATIVE X AXIS)
C
C     THIS VERSION FOR USE WITH PBOXC
C
C
      LOGICAL IPROS, IPUNCH, IPRNT, IPICT, ICRT
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IPRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      X = ( X - XTRANS ) * XSCALE
      Y = ( Y - YTRANS ) * YSCALE
      Z = ( Z - ZTRANS ) * ZSCALE
      XX= ( XX- XTRANS ) * XSCALE
      YY= ( YY- YTRANS ) * YSCALE
      ZZ= ( ZZ- ZTRANS ) * ZSCALE
      XP = X
      X = XP * COSA - Z * SINA
      Z = XP * SINA + Z * COSA
      XP = XX
      XX= XP * COSA - ZZ* SINA
      ZZ= XP * SINA + ZZ* COSA
      RETURN
      END
```

```
*DECK,PINPUT
      SUBROUTINE PINPUT
C
C     PROCESSES THE HESS-SMITH CODE INPUT DATA
C
      REAL NX, NY, NZ , MACH
      LOGICAL IPROS, IPUNCH, IFRNT, IPICT, ICRT, RFLAG, AFLAG, BFLAG
      INTEGER  STAT, STATT, CCNV
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IFRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      COMMON /M/ MACH, BETA, RBETA
      DIMENSION  SPH ( 200 ),  CPH ( 200 ), XINP ( 200 ), ZINP ( 200 )
      DIMENSION LAXIS(8), RAXIS(6), L45(6), L(5)
      DIMENSION XA (  500 ), XB (  500 ), YA (  500 ), YB (  500 ),
     1  ZA (  500 ), ZB (  500 ), NLINE(500 ), NLT (  500 ), CFLAG(3),
     2  XI (4), ETA (4), XIN (4), YIN (4),  ZIN (4),
     4                              RX (4), R (4), RY (4)
      EQUIVALENCE (NULL,NQUAD)
      DATA   CFLAG                  / 2H 1, 2H 2, 2H   /
      DATA PI/3.141593E0/, HAFPI/1.570796E0/, EPS/.0001/
      DATA LAXIS / 4HVIEW, 4H CF , 4HBODY, 4H LOO, 4HKING, 4H DOW,
     1 4HN TH, 1HE/
      DATA RAXIS/ 4H AXI, 4HS TO, 4HWARD,4H THE, 4H ORI,  4HGIN /
      DATA L45/ 4H45-D, 4HEGRE, 4HE VI, 4HEW F, 4HROM , 4HTHE /
      DATA R45/ 4HSIDE/, L/5*4H    /
      DATA PLUSX, MINUSX, PLUSY, MINUSY, PLUSZ, MINUSZ
     1  / 4H +X , 4H -X , 4H +Y , 4H -Y , 4H +Z , 4H -Z /
    1 FORMAT (      3E10.0, I2 / 3F10.0, I2)
 4002 FORMAT ( 1H0, 6X 5HN   M, 7X, 4 ( 1HX, 11X ), 2HNX, 11X, 3HNPX,
     1  11X, 1HD / 19X, 4 ( 1HY, 11X ), 2HNY, 11X, 3HNPY, 11X, 1HT /
     2  19X, 4(1HZ, 11X ), 2HNZ, 11X, 3HNPZ, 11X, 1HA        )
 4005 FORMAT ( 1H0, 7X, I4, 4F12.6, 2F13.6, E14.4,A2/(12X,4F12.6,
     1  2F13.6, E14.4 )  )
 4010 FORMAT ( 1H0, 3X, 2I4, 4F12.6, 2F13.6, E14.4,A2/(12X, 4F12.6,
     1  2F13.6,  E14.4  )  )
 4015 FORMAT ( 1H0, 3 ( 20X,  12H************ ))

C  INPUT -- SECTION 9.1  INPUT SCHEME
      KLCT = 0
      NULL = 0
      NPRT = 13
      CALL READER
      WRITE (6, 40)
   40 FORMAT (1H0,16X,44HP A R A M E T R I C    I N F O R M A T I O N//)
      IF (NSYM - 1) 54, 56, 58
   54 WRITE (6, 55)
   55 FORMAT (1H0,16X,21HNO SYMMETRY SPECIFIED)
      GO TO 61
   56 WRITE (6, 57)
   57 FORMAT (1H0,16X,30HTHERE IS ONE PLANE OF SYMMETRY)
      GO TO 61
   58 WRITE (6, 59) NSYM
   59 FORMAT (1H0,16X,9HTHERE ARE,I2, 13H PLANES OF SYMMETRY)
   61 IF ( MACH .NE. 0.0 ) WRITE (6, 21) MACH
   21 FORMAT (1H0,16X,13HMACH NUMBER =,F10.5)
      IF (IFLAG .EQ. 0) GO TO 29
      READ (5, 20) NLM1, MMIN, B, C
      IF (B .EQ. 0.0) B = 1.0
      IF (C .EQ. 0.0) C = 1.0
```

```
20 FORMAT ( 2I5, 2F10.5 )
 4 FORMAT ( 8F10.0 )
   WRITE (6, 62) NLM1, MMIN, B, C
62 FORMAT (1H0,16X,10HGENERATE A,I3, 2H X,I3, 12H SPHERE. B =,F10.5,
  1 4X,3HC =,F10.5 )
   MLINES = MMIN + 1
   NLINES = NLM1 + 1
   N = 0
   IF ( NSYM .EQ. 0 ) GO TO 2
   IF ( NSYM - 2 ) 3, 5, 6
 2 PITH = PI
   PIPHI = PI + PI
   GO TO 7
 3 PITH = PI
   PIPHI = PI
   GO TO 7
 5 PITH = PI
   PIPHI = HAFPI
   GO TO 7
 6 PITH = HAFPI
   PIPHI = PITH
 7 SPH ( MLINES ) = SIN ( PIPHI )
   SPH ( 1 ) = 0.0
   CPH ( MLINES ) = COS ( PIPHI )
   CPH ( 1 ) = 1.0
   EKM = MMIN
   EKN = NLM1
   EMM = 0.0
   DO 8  I = 2, MMIN
   EMM = EMM + 1.0
   PHI = EMM / EKM * PIPHI
   SPH ( I ) = SIN ( PHI )
 8 CPH ( I ) = COS ( PHI )
   IF ( IFLAG .EQ. 2 ) GO TO 10
   ENN = 1.0
   DO 9  I = 1, MLINES
   XA ( I ) = 1.0
   YA ( I ) = 0.0
 9 ZA ( I ) = 0.0
   GO TO 18
10 READ ( 5, 4 ) ( XINP ( I ), ZINP ( I ), I = 1, NLINES )
   DO 11 I = 1, MLINES
   XA ( I ) = XINP ( 1 )
   YA ( I ) = B * ZINP ( 1 ) * SPH ( I )
   ZA ( I ) = - C * ZINP ( 1 ) * CPH ( I )
   XB ( I ) = XINP ( 2 )
   YB ( I ) = B * ZINP ( 2 ) * SPH ( I )
11 ZB ( I ) = - C * ZINP ( 2 ) * CPH ( I )
   NLCT = 2
   GO TO 250
12 DO 14 I = 1, MLINES
   XA ( I ) = XB ( I )
   YA ( I ) = YB ( I )
14 ZA ( I ) = ZB ( I )
   IF ( IFLAG .EQ. 1 ) GO TO 16
   NLCT = NLCT + 1
   DO 15  I = 1, MLINES
   XB ( I ) =  XINP ( NLCT )
   YB ( I ) =  B * ZINP ( NLCT ) * SPH ( I )
15 ZB ( I ) =  - C * ZINP ( NLCT ) * CPH ( I )
```

```
      GO TO 250
   16 ENN = ENN + 1.0
   18 THETA = ENN / EKN * PITH
      STH = SIN ( THETA )
      CTH = COS ( THETA )
      DO 17  I = 1, MLINES
      XB ( I ) = CTH
      YB ( I ) =     B * STH * SPH ( I )
   17 ZB ( I ) =   - C * STH * CPH ( I )
      GO TO 250
   29 N = -1
      IF(IPROS) WRITE(6,101)
      IF(IPROS) WRITE(6,102) XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     1 ZTRANS, COSA, SINA
      IF(IPICT) WRITE(6,103)
      IF(IPUNCH) WRITE(6,104)
C
  101 FORMAT( 1H0, 16X, 61HINPLT DATA ARE PROCESSED BY SCALING, ROTATING
     1 AND TRANSLATING)
  102 FORMAT( 18X, 58HXSCALE, YSCALE, ZSCALE, XTRANS, YTRANS, ZTRANS, CO
     1SA, SINA/ 15X, 8(1PE14.4))
  103 FORMAT( 1H0, 16X,18HPLOTS ARE PREPARED)
  104 FORMAT( 1H0, 16X, 16HDATA ARE PUNCHED)
      XMIN =  1.0E6
      XMAX = -1.0E6
      YMIN =  1.0E6
      YMAX = -1.0E6
      ZMIN =  1.0E6
      ZMAX = -1.0E6
      GO TO 50
   30 IF ( RFLAG ) GO TO 50
      RFLAG = .TRUE.
      X = XX
      Y = YY
      Z = ZZ
      STAT = STATT
      GO TO 66
   50 RFLAG = .FALSE.
   51 READ ( 5, 1 )  X, Y, Z, STAT, XX, YY, ZZ, STATT
      IF ( IPROS ) CALL FATPROS( X, Y, Z, XX, YY, ZZ )
      IF(IPUNCH ) WRITE(1,5100) X, Y, Z, STAT, XX, YY, ZZ, STATT
 5100 FORMAT( 3(  F10.7), I2/ 3(  F10.7), I2)
      WRITE (9) X,Y,Z,STAT,XX,YY,ZZ,STATT
C
   64 XMIN = AMIN1(XMIN, X * RBETA)
      YMIN = AMIN1(YMIN,Y)
      ZMIN = AMIN1(ZMIN,Z)
      XMAX = AMAX1(XMAX, X * RBETA)
      YMAX = AMAX1(YMAX,Y)
      ZMAX = AMAX1(ZMAX,Z)
      IF(STAT .EQ. 3) GO TO 164
      XMIN = AMIN1(XMIN, XX* RBETA)
      YMIN = AMIN1(YMIN,YY)
      ZMIN = AMIN1(ZMIN,ZZ)
      XMAX = AMAX1(XMAX, XX* RBETA)
      YMAX = AMAX1(YMAX,YY)
      ZMAX = AMAX1(ZMAX,ZZ)
  164 IF( NSYM .EQ. 0 ) GO TO 65
      YMIN = AMIN1( YMIN, -Y)
      YMAX = AMAX1( YMAX, -Y)
```

```
      IF(STAT .EQ. 3) GO TO 165
      YMIN = AMIN1( YMIN, -YY)
      YMAX = AMAX1( YMAX, -YY)
  165 IF( NSYM .EQ. 1 ) GO TO 65
      ZMIN = AMIN1( ZMIN, -Z)
      ZMAX = AMAX1( ZMAX, -Z)
      IF(STAT .EQ. 3) GO TO 65
      ZMIN = AMIN1( ZMIN, -ZZ)
      ZMAX = AMAX1( ZMAX, -ZZ)
   65 IF (N .EQ.(-1))GO TO 80
   66 IF (STAT .EQ. 0 .OR. STAT .EQ. 3) GO TO 180
      IF ( STAT .EQ. 2 ) GO TO 200
      IF ( .NOT. AFLAG ) GO TO 200
      MC = M
   80 M = 1
      IF ( STAT .EQ. 2 )  GO TO 150
      IF ( .NOT. BFLAG ) GO TO 84
   75 DO 81 J = 1, MC
      XA ( J ) = XB ( J )
      YA ( J ) = YB ( J )
   81 ZA ( J ) = ZB ( J )
   83 XB ( 1 ) = X
      YB ( 1 ) = Y
      ZB ( 1 ) = Z
      GO TO 30
   84 IF ( AFLAG ) GO TO 85
      BFLAG = .TRUE.
      GO TO 75
   85 AFLAG = .FALSE.
      GO TO 83
  150 AFLAG = .TRUE.
      BFLAG = .FALSE.
      IF (N .EQ.(-1))N = 0
  160 XA ( M ) = X
      YA ( M ) = Y
      ZA ( M ) = Z
      GO TO 30
  180 M = M + 1
      IF ( AFLAG ) GO TO 160
      XB (M ) = X
      YB ( M ) = Y
      ZB ( M ) = Z
      IF ( STAT .NE. 3 )  GO TO 30
  200 MMIN = MIN0(M, MC) - 1
      MC = M
  250 N = N + 1
      KLCT = KLCT + 1
      IF( .NOT. IPRNT) GO TO 2100

C  BEGIN COMPUTATION OF NULL POINTS AND 28 QUANTITIES

      DO 2000 I = 1, MMIN
      NULL = NULL + 1
      XIN(1) = XA( I ) * RBETA
      XIN(2) = XA(I+1) * RBETA
      XIN(3) = XB(I+1) * RBETA
      XIN(4) = XB( I ) * RBETA
      YIN(1) = YA(I)
      YIN(2) = YA(I+1)
      YIN(3) = YB(I+1)
```

```
      YIN(4) = YB(I)
      ZIN(1) = ZA(I)
      ZIN(2) = ZA(I+1)
      ZIN(3) = ZB(I+1)
      ZIN(4) = ZB(I)

C  FORM DIAGONAL VECTORS
C  EQUATION  ( 64 )

      T1X = XIN(3) - XIN(1)
      T2X = XIN(4) - XIN(2)
      T1Y = YIN(3) - YIN(1)
      T2Y = YIN(4) - YIN(2)
      T1Z = ZIN(3) - ZIN(1)
      T2Z = ZIN(4) - ZIN(2)

C  FORM CROSS PRODUCT  N = T2 X T1
C  EQUATION  ( 65 )

      NX = T2Y*T1Z - T1Y*T2Z
      NY = T1X*T2Z - T2X*T1Z
      NZ = T2X*T1Y - T1X*T2Y
      VN = SQRT (  NX* NX +  NY* NY +  NZ* NZ )

C  FORM UNIT NORMAL VECTOR
C  EQUATION  ( 66 )

      NX = NX / VN
      NY = NY / VN
      NZ = NZ / VN

C  COMPUTE AVERAGE POINT
C  EQUATION  ( 68 )

      AVX = .25 * ( XIN(1) + XIN(2) + XIN(3) + XIN(4) )
      AVY = .25 * ( YIN(1) + YIN(2) + YIN(3) + YIN(4) )
      AVZ = .25 * ( ZIN(1) + ZIN(2) + ZIN(3) + ZIN(4) )

C  COMPUTE PROJECTION DISTANCE
C  EQUATIONS ( 69 ) AND ( 71 )

      D =  NX*( AVX - XIN(1) ) +  NY*( AVY - YIN(1) ) +  NZ*(AVZ-ZIN(1))
      PD = ABS( D )

C  EQUATIONS ( 73 ) AND ( 74 )

      T = SQRT ( T1X*T1X + T1Y*T1Y + T1Z*T1Z )
      T1X = T1X / T
      T1Y = T1Y / T
      T1Z = T1Z / T

C  EQUATION  ( 75 )

      T2X = NY*T1Z - NZ*T1Y
      T2Y = NZ*T1X - NX*T1Z
      T2Z = NX*T1Y - NY*T1X

C  COMPUTE COORDINATES OF CORNER POINTS IN REFERENCE COORD. SYSTEM
C  EQUATION  ( 72 )

```

```
      DO 1000 J = 1, 4
      XP = XIN(J) + NX * D
      YP = YIN(J) + NY * D
      ZP = ZIN(J) + NZ * D
      D =  - D
      XDIF = XP - AVX
      YDIF = YP - AVY
      ZDIF = ZP - AVZ

C  TRANSFORM CORNER POINTS TO ELEMENT COORDINATE SYSTEM  ( XI, ETA )
C  WITH AVERAGE POINT AS ORIGIN
C  EQUATION  ( 80 )

      XI(J) = T1X*XDIF + T1Y*YDIF + T1Z*ZDIF
 1000 ETA(J) = T2X*XDIF + T2Y*YDIF + T2Z*ZDIF

C  COMPUTE CENTROID
C  EQUATION  ( 81 )

      XI0 = .3333333E0 * ( XI (4) * ( ETA (1) - ETA (2) ) + XI ( 2 )
     1  * ( ETA (4) - ETA ( 1) ) ) / ( ETA (2 )  - ETA (4) )
      ETA0 = -.3333333E0 * ETA(1)


C  OBTAIN CORNER POINTS IN SYSTEM WITH CENTROID AS ORIGIN
C  EQUATION  ( 82 )

      DO 1020 J = 1, 4
      XI(J) = XI(J) - XI0
 1020 ETA(J) = ETA(J) - ETA0

C  COMPUTATION AIDS
      ETA2M1 = ETA ( 2 ) - ETA ( 1 )
      ETA3M2 = ETA ( 3 ) - ETA ( 2 )
      ETA4M3 = ETA ( 4 ) - ETA ( 3 )
      ETA1M4 = ETA ( 1 ) - ETA ( 4 )
      XI1M2 = XI ( 1 ) - XI ( 2 )
      XI2M3 = XI ( 2 ) - XI ( 3 )
      XI3M4 = XI ( 3 ) - XI ( 4 )
      XI4M1 = XI ( 4 ) - XI ( 1 )
      ETA2P4 = ETA ( 2 ) + ETA ( 4 )
      XI3M1 = XI ( 3 ) - XI ( 1 )
      XI4M2 = XI ( 4 ) - XI ( 2 )
      ETA2M4 = ETA ( 2 ) - ETA ( 4 )
      XI1234 = XI ( 1 ) + XI ( 2 ) + XI ( 3 ) + XI ( 4 )

C  TRANSFORM CENTROID TO REFERENCE COORDINATE SYSTEM
C  EQUATION  ( 83 )
      XCENT = AVX + T1X*XI0 + T2X*ETA0
      YCENT = AVY + T1Y*XI0 + T2Y*ETA0
      ZCENT = AVZ + T1Z*XI0 + T2Z*ETA0

C  COMPUTE LARGER DIAGONAL VECTOR
C  EQUATION  ( 84 )
      TSQ = AMAX1 ( XI3M1 ** 2, XI4M2 ** 2 + ETA2M4 ** 2  )
      T = SQRT ( TSQ )


C  COMPUTE AREA
C  EQUATION  ( 85 )
```

```
      AREA             = .5 * XI3M1 * ETA2M4

C  COMPUTE CONSTANTS FOR EQUATIONS ( 42 ) AND ( 43 )
C  EQUATION  ( 45 )
      D12SQ = XI1M2 ** 2 + ETA2M1 ** 2
      D12 = SQRT ( D12SQ )
      D23SQ = XI2M3 **2  + ETA3M2 ** 2
      D23 = SQRT ( D23SQ )
      D34SQ = XI3M4 ** 2 + ETA4M3 ** 2
      D34 = SQRT ( D34SQ )
      D41SQ = XI4M1 ** 2 + ETA1M4 ** 2
      D41 = SQRT ( D41SQ )
      C1 = 0.0
      C2 = 0.0
      C3 = 0.0
      C4 = 0.0
      C5 = 0.0
      C6 = 0.0
      C7 = 0.0
      C8 = 0.0
      XNP = 0.0
      YNP = 0.0
      IF ( D12 ) 1030, 1040, 1030
 1030 C1 = ETA2M1 / D12
      C5 = XI1M2 / D12
 1040 IF ( D23 ) 1050, 1060, 1050
 1050 C2 = ETA3M2 / D23
      C6 = XI2M3 / D23
 1060 IF ( D34 ) 1070, 1080, 1070
 1070 C3 = ETA4M3 / D34
      C7 = XI3M4 / D34
 1080 IF ( D41 ) 1090, 1100, 1090
 1090 C4 = ETA1M4 / D41
      C8 = XI4M1 / D41
 1100 CONV = 3


C BEGIN NULL POINT ITERATICN

      DO 1590  ITR = 1, 30
      DO 1580  K = 1,4
C  EQUATION  ( 47 )
      R ( K ) = SQRT ( ( XNP - XI ( K ) ) ** 2 + ( YNP - ETA(K))** 2 )
      RX (K ) = ( XNP - XI ( K ) ) / R ( K )
 1580 RY (K ) = ( YNP - ETA ( K ) ) / R ( K )
      R1PR2   =  R ( 1 )  + R ( 2 )
      R2PR3   =  R ( 2 )  + R ( 3 )
      R3PR4   =  R ( 3 )  + R ( 4 )
      R4PR1   =  R ( 4 )  + R ( 1 )
      ARG1 = ALOG ( ( R1PR2 - D12 ) / ( R1PR2 + D12 ) )
      ARG2 = ALOG ( ( R2PR3 - D23 ) / ( R2PR3 + D23 ) )
      ARG3 = ALOG ((R3PR4 - D34 ) / ( R3PR4 + D34 ) )
      ARG4 = ALOG ((R4PR1 - D41 ) / ( R4PR1 + D41 ) )


C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 42 ) AND ( 43 )
      VX = C1 * ARG1 + C2 * ARG2 + C3 * ARG3 + C4 * ARG 4
      VY = C5 * ARG1 + C6 * ARG2 + C7 * ARG 3 + C8 * ARG4

```

```
C  COMPUTE PARTIAL DERIVATIVES OF INDUCED VELOCITIES
C  EQUATION ( 90 ), USING EQUATIONS ( 91 ) - ( 93 )


      D12P=  ( R1PR2 ** 2 - D12 SQ   ) * .5
      D23P=  ( R2PR3 ** 2 - D23 SQ   ) * .5
      D34P=  ( R3PR4 ** 2 - D34 SQ   ) * .5
      D41P=  ( R4PR1 ** 2 - D41 SQ   ) * .5
      C1P  = ETA2M1 / D12P
      C2P  = ETA3M2 / D23P
      C3P  = ETA4M3 / D34P
      C4P  = ETA1M4 / D41P
      C5P  = XI1M2 / D12P
      C6P  = XI2M3 / D23P
      C7P  = XI3M4 / D34P
      C8P  = XI4M1 / D41P
      R12Y = RY ( 1 ) + RY ( 2 )
      R23Y = RY ( 2 ) + RY ( 3 )
      R34Y = RY ( 3 ) + RY ( 4 )
      R41Y = RY ( 4 ) + RY ( 1 )
      VXX = C1P* ( RX ( 1 ) + RX ( 2 ) ) + C2P* ( RX ( 2 ) + RX ( 3 )) +
     1      C3P* ( RX ( 3 ) + RX ( 4 ) ) + C4P* ( RX ( 4 ) + RX ( 1 ) )
      VXY = C1P* R12Y + C2P* R23Y + C3P* R34Y + C4P* R41Y
      VYY = C5P* R12Y + C6P* R23Y + C7P* R34Y + C8P* R41Y


C  COMPUTE NEW NULL POINT ( XNP, YNP )
C  EQUATION ( 94 )

      XMXP = ( VY * VXY - VX * VYY ) / ( VXX * VYY - VXY ** 2 )
      XNP  = XMXP + XNP
      YNP  = YNP - ( VX + VXX * XMXP ) / VXY

C     TEST NULL POINT CONVERGENCE
      IF ( ABS ( VX ) .LT. EPS .AND. ABS ( VY ) .LT. EPS ) GO TO 1600
 1590 CONTINUE
C     NO CONVERGENCE , USE 30TH ITERATION
      CONV = 2

C     TEST IF THIS POINT IS OUTSIDE THE ELEMENT
 1600 IF ( XNP ** 2 + YNP ** 2  .LE. TSQ )  GO TO 1620

C     CONVERGES TO POINT AT INFINITY
      CONV = 1
      XNULL           = XCENT
      YNULL           = YCENT
      ZNULL           = ZCENT
      GO TO 1700

C     TRANSFORM NULL POINT TO REFERENCE COORDINATE SYSTEM
C  EQUATION ( 79 )  NOTE THAT Z - COORDINATE IS ZERO
 1620 XNULL           = XCENT + T1X * XNP + T2X * YNP
      YNULL           = YCENT + T1Y * XNP + T2Y * YNP
      ZNULL           = ZCENT + T1Z * XNP + T2Z * YNP


C  PRINT RESULTS -- SECTION 9.4 THE FIRST OUTPUT

 1700 IF ( NPRT .GE. 11 ) GO TO 1750
      NPRT = NPRT + 1
```

```
      IF ( I .EQ. 1 ) GO TO 1760
      WRITE (6, 4005) I, XIN, NX, XNULL        , PD, CFLAG (CONV),
     1  YIN, NY, YNULL        , T, ZIN, NZ, ZNULL          , AREA
      GO TO 1770
 1750 NPRT = 0
      CALL PEADER
      WRITE ( 6, 4002 )
 1760 WRITE ( 6, 4010) N   , I, XIN, NX, XNULL          , PD, CFLAG (CONV
     1    ), YIN, NY, YNULL        , T, ZIN, NZ, ZNULL           , AREA
 1770 CONTINUE
 2000 CONTINUE
 2100 NLT ( KLCT ) = MMIN
      NLINE ( KLCT ) = N
      IF ( IFLAG .EQ. 0 ) GO TO 2001
      IF ( N .LT. NLM1 ) GO TO 12
      IF( IPRNT ) WRITE(6,4015)
      GO TO 2025
 2001 IF ( STAT .LT. 2 ) GO TO 80
      NLT(KLCT) = -NLT(KLCT)
      NPRT = NPRT + 1
      IF( IPRNT ) WRITE(6,4015)

C  TEST FOR END OF CASE
 2020 IF ( STAT .NE. 3 ) GO TO 80
 2025 NN1 = MOD ( 3 * NQUAD, 255 )
      NQNN1 = NQUAD
      IF ( NN1 .LT. 5 .AND. NN1 .GT. 0  ) NQNN1 = NQUAD + 2
      DELX = -0.5 * (XMIN + XMAX)
      DELY = -0.5 * (YMIN + YMAX)
      DELZ = -0.5 * (ZMIN + ZMAX)
      WRITE (9) XMIN, XMAX, YMIN, YMAX, ZMIN, ZMAX, DELX, DELY, DELZ,
     1 NSYM
      ENDFILE 9
      REWIND 9
      IF ( .NOT. IPICT ) GO TO 8500
C     SET UP PERSPECTIVE ANGLES FOR PLOTS
      WRITE (8) XMIN, XMAX, YMIN, YMAX, ZMIN, ZMAX, DELX, DELY, DELZ
      LAST = 0
      PHI = 0.0
C     THE OPERATION OF ANGLES THETA AND PSI ARE AS FOLLOWS FOR A RIGHT
C     HANDED COORDINATE SYSTEM WITH THE Z AXIS DIRECTED UPWARD.  FIRST
C     ROTATE THE COORDINATE SYSTEM BY ANGLE THETA ABOUT THE Y AXIS SUCH
C     THAT FOR POSITIVE THETA THE POSITIVE X AXIS TILTS UPWARD.  THEN
C     ROTATE BY ANGLE PSI ABOUT THE NEW Z AXIS SUCH THAT FOR POSITIVE
C     PSI THE ROTATION IS CLOCKWISE WHEN VIEWED FROM ABOVE.
      IF (NSYM .GT. 0) IF (NSYM - 2) 2028, 2029, 2030
 2027 PSI = 90.
      THETA = 0.0
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, MINUSY, RAXIS
      PSI = 45.
      THETA = 45.
      WRITE (8) PSI, THETA, PHI, LAST, L45, PLUSX, MINUSY, PLUSZ, R45 ,L
      THETA = -45.
      WRITE (8) PSI, THETA, PHI, LAST, L45, PLUSX, MINUSY, MINUSZ, R45,L
      PSI = 135.
      WRITE (8) PSI, THETA, PHI, LAST, L45, MINUSX, MINUSY, PLUSZ, R45,L
      THETA = 45.
      WRITE (8) PSI, THETA, PHI, LAST, L45, MINUSX, MINUSY, MINUSZ,R45,L
 2028 PSI = 0.
      THETA = -90.
```

```
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, MINUSZ, RAXIS
      THETA= 45.
      PSI=-135.
      WRITE (8) PSI, THETA, PHI, LAST, L45, MINUSX, PLUSY,MINUSZ, R45,L
      THETA=-45.
      PSI=-45.
      WRITE (8) PSI, THETA, PHI, LAST, L45,  PLUSX, PLUSY,MINUSZ, R45,L
 2029 PSI = 180.
      THETA = 0.
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, MINUSX, RAXIS
      PSI = -135.
      THETA =-45.
      WRITE (8) PSI, THETA, PHI, LAST, L45, MINUSX, PLUSY, PLUSZ, R45,L
 2030 THETA = 0.0
      PSI = 0.
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, PLUSX, RAXIS
      THETA = 0.0
      PSI = -90.
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, PLUSY, RAXIS
      THETA = 90.
      PSI = 0.
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, PLUSZ, RAXIS
      THETA = 45.
      PSI =-45.
      LAST = 1
      WRITE (8) PSI, THETA, PHI, LAST, L45, PLUSX, PLUSY, PLUSZ, R45, L
 8500 REWIND 8
C
      IF(IPRNT) WRITE(6,9999) NQUAD
 9999 FORMAT( 1H0, 16X, I5, 26H BASIC ELEMENTS WERE INPUT)
      RETURN
      END
```

```
*DECK,PICTURE
      SUBROUTINE PICTUR
C
C     PLOTS SURFACE ELEMENTS ON A 3-DIMENSIONAL BODY

      LOGICAL IPROS, IPUNCH, IFRNT, IPICT, ICRT, RFLAG, AFLAG, BFLAG
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IFRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      DIMENSION  XA(250),XB(250),YA(250),YB(250),ZA(250),ZB( 250),
     1                 XIN(4),YIN(4),ZIN(4),HLABEL(15), PROGID( 3),
     2 YIN2(4),ZIN2(4),             YPLTSC( 4), ZPLTSC( 4),HLINE2(7),
     3 HLINE1(7), XM(2), YM(2), ZM(2)
      REAL  NX,NY,NZ,NXO
      INTEGER  STAT,STATT
      DATA PROGID/ 7HNORMENT, 4H3840, 3HLYC/
      DATA          ISHAD,IFRAME/0,0/  ,  XSC,YSC,ZSC/3*1.0/

      FIRST(QX,QY,QZ,Q1,Q2,Q3) = QX*Q1 + QY*Q2 + QZ*Q3

      THIRD(QX,QY,QZ,QPSI,QTHETA,QPHI) = QX*(COS(QTHETA)*COS(QPSI)) +
     1  QY*(-SIN(QPSI)*COS(QPHI)+SIN(QTHETA)*COS(QPSI)*SIN(QPHI)) +
     2  QZ*(SIN(QPSI)*SIN(QPHI)+SIN(QTHETA)*COS(QPSI)*COS(QPHI))

      IREFL = NSYM
      IF( IREFL .GT. 2 ) IREFL = 2
      IPIC = 1
      IF( ICRT ) GO TO 750
      CALL PLOTID
C     CALL PLTID3( PROGID, 200.0, 11.0, 1.0)
      CALL PLOT( 5.0, 0.0, -3 )
      GO TO 2
  750 CALL  MICRO(PROGID, 1.0, 14.0)
      READ(5,3000) HLINE1, HLINE2
 3000 FORMAT(7A6/7A6)
      CALL TITL(HLINE1,HLINE2)
      WRITE( 6, 5201 )
 5201 FORMAT( 1H-, 12H   CRT PLOTS)
    2 REWIND 9
  301 READ (8) XM(1),XM(2),YM(1),YM(2),ZM(1),ZM(2),DELX,DELY,DELZ
      WRITE(6,7400) XM(1),XM(2),YM(1),YM(2),ZM(1),ZM(2)
      WRITE(6,7500)
      WRITE(6,7700) DELX,DELY,DELZ
 7400 FORMAT( 1H0, 9X, 81HMINIMUM AND MAXIMUM COORDINATES IN THE   SCALE
     1D,   TRANSLATED,   ROTATED SYSTEM -/12X,   7HX AXIS=2(1PE15.5)/
     2 12X, 7HY AXIS=2(1PE15.5)/ 12X, 7HZ AXIS=2(1PE15.5))
 7500 FORMAT(1H0, 9X, 69HCOORDINATE TRANSLATIONS USED TO CENTER THE PLOT
     1S - DELX, DELY, DELZ -)
 7700 FORMAT(12X,39H AFTER SCALING, TRANSLATING, ROTATING -3(1PE15.5)/)
    4 IPIC = IPIC + 1

C  READ PLOTTING INSTRUCTIONS
      READ ( 8 ) PSI,THETA,PHI,LAST, HLABEL
      WRITE(6,5205)HLABEL
 5205 FORMAT(5X, 15A4)

    8 IF( IPIC .GT. 2 .AND.  .NOT.  ICRT ) CALL PLOT( 10.0, -5.5, -3 )
      IF( IPIC .GT. 2 .AND.         ICRT ) CALL FRAME( 0.5, 0.5 )

C     SET UP STARTING CONSTANTS
```

```
      IFADV = 1
      PSI   =  PSI   / 57.29578E0
      THETA = THETA / 57.29578E0
      PHI   =  PHI   / 57.29578E0
      SINTH = SIN(THETA)
      COSTH = COS(THETA)
      SINPSI= SIN(PSI)
      COSPSI= COS(PSI)
      SINPHI= SIN(PHI)
      COSPHI= COS(PHI)
      A1 = COSTH * SINPSI
      A2 = COSPSI*COSPHI + SINTH*SINPSI*SINPHI
      A3 =-COSPSI*SINPHI + SINTH*SINPSI*COSPHI
      A4 =-SINTH
      A5 = COSTH*SINPHI
      A6 = COSTH*COSPHI
      A7 = COSTH*COSPSI
      A8 =-SINPSI*COSPHI + SINTH*COSPSI*SINPHI
      A9 = SINPSI*SINPHI + SINTH*COSPSI*COSPHI
C     SET SCALE FACTOR FOR THE PLOT
      YSM= 1.E50
      ZSM= 1.E50
      YLG=-1.E50
      ZLG=-1.E50
      DO 20 I=1,2
      X=XM(I)+DELX
      DO 20 J=1,2
      Y=YM(J)+DELY
      DO 20 K=1,2
      Z=ZM(K)+DELZ
      YNR=FIRST(X,Y,Z,A1,A2,A3)
      ZNR=FIRST(X,Y,Z,A4,A5,A6)
      YSM=AMIN1(YSM,YNR)
      ZSM=AMIN1(ZSM,ZNR)
      YLG=AMAX1(YLG,YNR)
   20 ZLG=AMAX1(ZLG,ZNR)
      PENSF=9.99/AMAX1(YLG-YSM,ZLG-ZSM)
       N = -1
      NN = - 1


C     READ IN     SURFACE DATA
   29 READ (9) X,Y,Z,STAT, XX,YY,ZZ,STATT
      IF (STAT .EQ. 3 .OR. STATT .EQ. 3) REWIND 9
       RFLAG = .FALSE.
       GO TO 80
   30 IF (RFLAG) GO TO 50
       RFLAG = .TRUE.
       X = XX
       Y = YY
       Z = ZZ
       STAT = STATT
       GO TO 60
   50 RFLAG = .FALSE.
      READ (9) X,Y,Z,STAT, XX,YY,ZZ,STATT
      IF (STAT .EQ. 3 .OR. STATT .EQ. 3) REWIND 9
   60 IF (STAT .EQ. 0 .OR. STAT .EQ. 3) GO TO 180
      IF (STAT .EQ. 2) GO TO 200
   70 IF (.NOT. AFLAG) GO TO 200
       MC = M
```

```
 80  M = 1
      IF (STAT .EQ. 2) GO TO 150
      IF (.NOT. BFLAG) GO TO 84
 75  DO 81 J =1,MC
       XA(J) = XB(J)
       YA(J) = YB(J)
 81    ZA(J) = ZB(J)
 83  XB(1) = X
     YB(1) = Y
     ZB(1) = Z
     GO TO 30
 84  IF (AFLAG) GO TO 85
      BFLAG = .TRUE.
      GO TO 75
 85  AFLAG = .FALSE.
      GO TO 83
150  AFLAG = .TRUE.
      BFLAG = .FALSE.
      N = N+1
160  XA(M) = X
     YA(M) = Y
     ZA(M) = Z
     GO TO 30
180  M = M + 1
     IF (AFLAG) GO TO 160
      XB(M) = X
      YB(M) = Y
      ZB(M) = Z
     IF (STAT .NE. 3) GO TO 30
200  MMIN = MIN0 (M,MC) - 1
      MC = M
250  N = N + 1
     NN = NN + 1

C  BEGIN COMPUTATION OF SURFACE ELEMENT CHARACTERISTICS

450  DO 2000 I= 1,MMIN
       XIN(1) = XA(I) * XSC + DELX
       XIN(2) = XA(I+1) * XSC + DELX
       XIN(3) = XB(I+1) * XSC + DELX
       XIN(4) = XB(I) * XSC + DELX
       YIN(1) = YA(I) * YSC + DELY
       YIN(2) = YA(I+1) * YSC + DELY
       YIN(3) = YB(I+1) * YSC + DELY
       YIN(4) = YB(I) * YSC + DELY
       ZIN(1) = ZA(I) * ZSC + DELZ
       ZIN(2) = ZA(I+1) * ZSC + DELZ
       ZIN(3) = ZB(I+1) * ZSC + DELZ
       ZIN(4) = ZB(I) * ZSC + DELZ
       IRFLG = 0

C  FORM DIAGONAL VECTORS - EQUATION (64)
      T1X = XIN(3) - XIN(1)
      T2X = XIN(4) - XIN(2)
      T1Y = YIN(3) - YIN(1)
      T2Y = YIN(4) - YIN(2)
      T1Z = ZIN(3) - ZIN(1)
      T2Z = ZIN(4) - ZIN(2)
```

```
C  FORM CROSS PRODUCT  N=T2 X  T1  - EQUATION (65)
       NX = T2Y*T1Z - T1Y*T2Z
       NY = T1X*T2Z - T2X*T1Z
       NZ = T2X*T1Y - T1X*T2Y
       VN = SQRT ( NX*NX + NY*NY + NZ*NZ )

C  FORM UNIT NORMAL VECTOR - EQUATION (66)
       NX = NX / VN
       NY = NY / VN
       NZ = NZ / VN

      IF (IFADV .EQ. 0) GO TO 471

C     A NEW VIEW OF THE BODY IS TO BE PLOTTED.  PLOT THE LEGEND AND
C     INITIALIZE FOR THE BODY PLOT.
      IF( ICRT ) GO TO 524
      CALL PLOT( 2.5, 0.0, 3 )
      CALL SYMBOL( 2.5, 0.0, 0.150, HLABEL, 0.0, 60)
      CALL PLOT( 7.5, 5.5, -3)
      GO TO 525
  524 CALL STBEAM(24)
      CALL SYMBOL( 3.0, 0.0, 0.150, HLABEL, 0.0, 60)
      CALL STBEAM(18)
      CALL PLOT( 8.0, 5.5, -3)
 525  IFADV = 0

 471  NXO = THIRD(NX,NY,NZ,PSI,THETA,PHI)
      IF (NXO.LE.0.0 .AND. ISHAD.EQ.0) GO TO 571


C  CALCULATE POINTS TO BE PLOTTED
 530  YO1 = FIRST(XIN(1),YIN(1),ZIN(1),A1,A2,A3)
      YO2 = FIRST(XIN(2),YIN(2),ZIN(2),A1,A2,A3)
      YO3 = FIRST(XIN(3),YIN(3),ZIN(3),A1,A2,A3)
      YO4 = FIRST(XIN(4),YIN(4),ZIN(4),A1,A2,A3)
      ZO1 = FIRST(XIN(1),YIN(1),ZIN(1),A4,A5,A6)
      ZO2 = FIRST(XIN(2),YIN(2),ZIN(2),A4,A5,A6)
      ZO3 = FIRST(XIN(3),YIN(3),ZIN(3),A4,A5,A6)
      ZO4 = FIRST(XIN(4),YIN(4),ZIN(4),A4,A5,A6)

      YIN2(1) = YO1
      YIN2(2) = YO2
      YIN2(3) = YO3
      YIN2(4) = YO4
      ZIN2(1) = ZO1
      ZIN2(2) = ZO2
      ZIN2(3) = ZO3
      ZIN2(4) = ZO4

C     SCALE AND PLOT A SINGLE QUADRALATERAL
      DO 540 II=1,4
      YPLTSC(II) = YIN2(II) * PENSF
      ZPLTSC(II) = ZIN2(II) * PENSF
      IF(                              ABS(ZPLTSC(II)) .LE. 5.000)
     1                  GO TO 540
      WRITE(6,5000) N, M
 5000 FORMAT( 1H0, 10X, 21HSCALE TROUBLE FOR N =I4, 3X, 3HM =I4)
      GO TO 2000
  540 CONTINUE
      CALL PLOT( YPLTSC( 1), ZPLTSC( 1), 3)
```

```
      DO 550 II=2,4
  550 CALL PLOT( YPLTSC(II), ZPLTSC(II), 2)
      CALL PLOT( YPLTSC( 1), ZPLTSC( 1), 2)

  571 IF (IREFL .EQ. 0 .OR. IRFLG .EQ. 3) GO TO 2000
      IF (IREFL .EQ. 2 .AND. IRFLG .EQ. 1) GO TO 600
      IF (IREFL .EQ. 2 .AND. IRFLG .EQ. 2) GO TO 602
C
C     REFLECT QUADRANT I ELEMENTS TO QUADRANT II
      DO 580 II = 1,4
  580  YIN(II) = -YIN(II)
       NY = -NY
       GO TO 604
C
C     REFLECT QUADRANT II ELEMENTS TO QUADRANT IV
  600 DO 601 II = 1,4
       YIN(II) = -YIN(II)
  601  ZIN(II) = -ZIN(II)
       NY = -NY
       NZ = -NZ
       GO TO 604
C
C     REFLECT QUADRANT IV ELEMENTS TO QUADRANT III
  602 DO 603 II = 1,4
  603  YIN(II) = -YIN(II)
       NY = -NY
C
C
  604 IRFLG = IRFLG + 1
      IF (IREFL .EQ. 1) IRFLG = 3
      GO TO 471


 2000 CONTINUE
 2001 IF (STAT .LT. 2) GO TO 480
      NN = NN - 1
      N = - 1
  475 IF (IFRAME .EQ. 2) IFADV = 1
  480 IF (IFRAME .EQ. 1) IFADV = 1
  485 IF (IFADV .EQ. 1) CALL PLOT(10.0,-5.5, -3)


C  TEST FOR END OF CASE
 2020 IF (STAT .NE. 3) GO TO 80
      IF (LAST .EQ. 1) RETURN
      GO TO 4
      END
```

```
      OVERLAY(BOXC,0,0)
      PROGRAM MAIN( INPUT,TAPE6, TAPE5=INPUT, OUTPUT,
     1 TAPE1, TAPE3, TAPE8, TAPE9, TAPE11, TAPE12, TAPE13,
     2              TAPE4, TAPE10, TAPE14)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - DECEMBER 1979
C
C     THIS IS ESSENTIALLY THE NON-LIFTING POTENTIAL FLOW CODE OF HESS
C     AND SMITH AS DESCRIBED IN DOUGLAS AIRCRAFT CO. RPT. E.S. 40622
C     (15 MARCH 1962), AD-282 255.   THAT REPORT SHOULD BE CONSULTED FOR
C     DETAILS OF THE METHOD AND COMPUTATION.
C
C     EIGHT OVERLAYS ARE USED.   THE FINAL OVERLAY WRITES THE 28
C     QUANTITIES ON UNIT 14 FOR USE BY SR FLOVEL IN CALCULATING FLOW
C     VELOCITIES.
C
C     ALSO REQUIRED, IN ADDITION TO THE SYSTEM INPUT, OUTPUT AND PUNCH
C     UNITS, ARE THE FOLLOWING UNITS - 1,3,8,9,10,11,12,13.
C
      LOGICAL IPROS
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      REAL MACH
      COMMON /SPACER/ DUMMY (14000)
      COMMON / ATAPE / NATAPE
      COMMON /M/ MACH, BETA, RBETA
      LOGICAL  AFLOW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      COMMON/SOLVE/ N1,N2,N3,KORE,NFL
      COMMON /INPT/ LIST, IPROS
      COMMON /PROS/      SINA,COSA, XSCALE, YSCALE, ZSCALE, XTRANS,
     1 YTRANS, ZTRANS
      COMMON /FLOWP/ NU,NNON
      COMMON /SIG/ NFLCOM
      COMMON /TAPES/ MN
      COMMON /FRINTO/ KMAT,NSEQ,KTP14
      COMMON /CLEAK/ LEAK, FRACT
    6 FORMAT (F10.6)
 7000 FORMAT( 7F10.0)
 7500 FORMAT(    18X, 55HANGLE, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS, Z
     1TRANS =/ 16X, 7(1PE13.4))
 8000 FORMAT(  L1)
 9000 FORMAT (15A4,2I1,3L1,4I1,I2,4I1,1X,A4)
 9300 FORMAT( I4, F10.0 )
 9400 FORMAT( 1H0, 17X,31HNUMBER OF LEAKY QUADRALATERALS=I4, 3X,
     1 40HFRACTION OF FREE-STREAM VELOCITY LEAKED=1PE11.4)
 9500 FORMAT( 1H0, 17X, 61HINPUT DATA ARE PROCESSED BY SCALING, ROTATING
     1 AND TRANSLATING)
      DATA KORE /14000/
      NSEQ = 0
C     READ IN CONTROL DATA
    1 READ ( 5, 9000 ) HEDR, IFLAG, LIST, AFLOW, BFLOW, CFLOW, ISIG,
     1 IPRS, MPR, NCODE, NNON, NSYM, NOFF, KMACH, KTP14, KASE
      READ(5,8000) IPROS
      IF( IPROS ) READ(5,7000) ANGLE, XSCALE, YSCALE, ZSCALE,XTRANS,
     1  YTRANS, ZTRANS
      IF(.NOT. IPROS) GO TO 2
```

```
      IF(XSCALE .EQ. 0.0) XSCALE=1.0
      IF(YSCALE .EQ. 0.0) YSCALE=1.0
      IF(ZSCALE .EQ. 0.0) ZSCALE=1.0
    2 CONTINUE
      READ( 5,9300 ) LEAK, FRACT
      REWIND 1
      REWIND 3
      REWIND 8
      REWIND 9
      REWIND 10
      REWIND 11
      REWIND 12
      REWIND 13
      IF (LIST .EQ. 0) REWIND 4
      MACH = 0.0
      IF (KMACH .LE. 0) GO TO 7
      NNON = 0
      READ (5, 6) MACH
      AFLOW = .TRUE.
      BFLOW = .FALSE.
      CFLOW = .FALSE.
    7 BETA = SQRT(1.0 - MACH * MACH)
      RBETA = 1.0 / BETA
      NU = 0
      CALL HEADER
      WRITE(6,9200) IFLAG, LIST, ISIG, IPRS, MPR, NCODE, NNON,
     1 NOFF, KMACH, KTP14
 9200 FORMAT( 1H0, 17X, 17HINPUT PARAMETERS-// 20X, 6HIFLAG=I2, 5X,
     1 5HLIST=I2, 5X, 5HISIG=I3, 6X, 5HIPRS=I2, 7X, 4HMPR=I2//
     2 20X, 6HNCODE=I2, 5X, 5HNNON=I2, 5X, 5HNOFF=I3, 5X, 6HKMACH=I2,
     3 5X, 6HKTP14=I2)
      IF( .NOT. IPROS) GO TO 40
      WRITE(6,9500)
      WRITE(6,7500) ANGLE,XSCALE,YSCALE,ZSCALE,XTRANS,YTRANS,ZTRANS
   40 WRITE( 6,9400 ) LEAK, FRACT
      IF(.NOT. IPROS) GO TO 50
      COSA = COS(  0.0174533 * ANGLE)
      SINA = SIN(  0.0174533 * ANGLE)
   50 IF (AFLOW .OR. BFLOW .OR. CFLOW)  NU = 1
C     CALL INPUT (LIST)
      CALL OVERLAY(4HBOXC,1,0)
      IF (LIST .NE. 0) GO TO 10
C     CALL FLOWS (NU, NNON)
      CALL OVERLAY(4HBOXC,1,1)
      IF(KTP14 .EQ. 1) CALL OVERLAY(4HBOXC,8,0)
      GO TO 1000
   10 CONTINUE
      GO TO 5000
C
C     FORM  XIJ , YIJ , AND  ZIJ MATRICES
C
C1000 CALL VFORM
 1000 CALL OVERLAY(4HBOXC,2,0)
      IF (NCODE) 5000, 1500, 2000
 1500 NCODE = 1
      IF (NQUAD .GT. 500 ) NCODE = 2
 2000 IF (NMAT .EQ. 3) NCODE = 2
```

```
C     CALL  AFCRM
      CALL OVERLAY(4HBOXC,3,0)
      IF ( NAFLOW ) 2100, 2100, 2050
 2050 KMAT = 1
      NFL = NAFLOW
      GO TO 2300
 2100 IF ( NBFLOW ) 2200, 2200, 2150
 2150 KMAT = 2
      NFL = NBFLOW
      GO TO 2300
 2200 IF ( NCFLOW ) 5000, 5000, 2250
 2250 KMAT = 3
      NFL = NCFLOW
 2300 NQ = NQUAD + 1
      MN = 1
      NM = MOD ( NQ, 255 )
      IF ( NM .LT. 5 .AND. NM .GT. 0 ) NQ = NQ + 5
      NFLCOM = 0
      NSOL = MIN0( 6000 / NQUAD, 100)
      IF (NCODE .NE. 1) GO TO 2500
 2400 N1 = 8
      N2 = 9
      N3 = 13
 2450 NCFLG = NFL
C     CALL SCLVIT (DUMMY(1), NQUAD, NFL, KORE, N1, N2, N3, 3, &2475)
      CALL OVERLAY(4HBOXC,4,0)
      REWIND 3
C     IF (MN .EQ. 1) CALL ATAPES (MN)
      IF (MN .EQ. 1)
     1CALL OVERLAY(4HBOXC,6,0)
      GO TO 3300
C2500 CALL ATAPES (MN)
 2500 CALL OVERLAY(4HBOXC,6,0)
      NSKIP = 0
 2900 NCFLG = MIN0 (NSOL, NFL - NSKIP)
C     CALL SIGMA (NFLCOM )
      CALL OVERLAY(4HBOXC,5,0)
      ITER = 0
C3300 CALL PRINT1 (NFLCOM, MN, KMAT, NSEC)
 3300 CALL OVERLAY(4HBOXC,7,0)
      NFLCOM = NFLCOM + NCFLG
      NSKIP = NSKIP + NCFLG
      IF (NCODE .EQ. 1) GO TO 3700
      IF( NSKIP .NE. NFL  ) GO TO 2900
      MN = MN + 1
      IF ( KMAT -  2 ) 3500, 3600, 5000
 3500 IF ( NBFLOW ) 3600, 3600, 3550
 3550 NFL = NBFLOW
      KMAT = 2
      GO TO 2500
 3600 IF ( NCFLOW ) 5000, 5000, 3650
 3650 NFL = NCFLOW
      KMAT = 3
      GO TO 2500
 3700 IF (MN .EQ. 2 .OR. NMAT .EQ. 1) GO TO 5000
      N1 = 10
      N2 = 13
```

```
      N3 = 8
      MN = 2
C **   POSITION THE TAPE FOR THE SIGMAS.
      JJ = 2
      IF (ISIG .NE. 0) JJ = 3
      JJ = NFLOW * JJ  + NFL
      DO 3750 J = 1, JJ
 3750 READ (3)
      NFL = NFLOW - NFL
     1   (KMAT - 2) 3800, 3900, 5000
 3800 IF (NBFLOW) 3900, 3900, 3850
 3850 KMAT = 2
      GO TO 2450
 3900 KMAT = 3
      GO TO 2450
 5000 CONTINUE
      WRITE (6, 5100)
 5100 FORMAT(1H0, 10X, 12HLEAVING MAIN)


      CALL EXIT
C     IF (LIST .NE. 0) STOP
      GO TO 1
      END
```

```
*DECK, HEADER
      SUBROUTINE HEADER
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      DATA IPAGE/0/
    1 FORMAT( 1H1, 5X, 13HPROGRAM BOXC , 15X, 30HATMOSPHERIC SCIENCE ASS
     1OCIATES/  38X, 22HBEDFORD, MASSACHUSETTS, 22X, 4HPAGE, I5/
     2 7X, 8HBODY ID., 2X, A4/ 30X, 15A4)
   10 IPAGE = IPAGE + 1
      WRITE (6,1) IPAGE, KASE,HEDR
      RETURN
      END
```

```
*DECK, ROWV
      SUBROUTINE ROWV( XIJ, YI., ZIJ, III, KSKIP )
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      LOGICAL AFLOW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
       DIMENSION XIJ(1), YIJ(1), ZIJ(1)
      INTEGER CKFLG
      DIMENSION NT(3)
      DATA  NT                 / 1, 11, 12 /
    5 CKFLG = 0
      N1 = 1
      N2 = NQUAD/ 3
      N3 = NQUAD - N2 - N2
      NN = N2
C        READ IN ONE ROW OF THE VX, VY, VZ
      DO 50 I1 = 1, 3
      NTAPE = NT(I1)
   10 READ(NTAPE)          (XIJ(I2) , YIJ(I2) , ZIJ(I2) , I2 = N1 , NN )
      N1 = NN + 1
      IF( I1 .EQ. 2 ) GO TO 35
      NN = NN + N2
      GO TO 50
   35 NN = NN + N3
   50 CONTINUE
      NER = 0
      IF ( III .NE. (NQUAD + NOFF))  IF ( KSKIP ) 80, 80, 100
      REWIND 1
      REWIND 11
      REWIND 12
   80 RETURN
  100 IF ( NMATM1 .EQ. 0 ) RETURN
      DO 110 N1 = 1, NMATM1
      READ ( 1 )
      READ ( 11 )
  110 READ ( 12 )
      RETURN
      END
```

```
*DECK,INPUT
      SUBROUTINE INPUT
C     SUBROUTINE INPUT (LIST)
      LOGICAL IPROS
      COMMON /INPT/ LIST, IPROS
      REAL NX, NY, NZ , IXX, IXY, IYY, MACH
      LOGICAL AFLOW, BFLOW, CFLOW, RFLAG, AFLAG, BFLAG
      INTEGER  STAT, STATT, CONV
      DIMENSION  SPH ( 200 ),  CPH ( 200 ), XINP ( 200 ), ZINP ( 200 )
      DIMENSION  XOFF(1000), YOFF (1000), ZOFF (1000)
      DIMENSION XA (   500 ), XB (   500 ), YA (   500 ), YB (   500 ),
     1  ZA (   500 ), ZB (   500 ), NLINE(500 ), NLT (   500 ), CFLAG(3),
     2  XI (4), ETA (4), XIN (4), YIN (4),  ZIN (4), XNULL (1000),
     3  YNULL(1000), ZNULL (1000),          XNORM(1000),
     4  YNORM ( 1000), ZNORM (1000),  RX (4), R (4), RY (4)
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /M/ MACH, BETA, RBETA
       COMMON /NORMS/ XNORM, YNORM, ZNORM
      EQUIVALENCE (XNULL,          XOFF), ( YNULL,        YOFF),
     1 (ZNULL, ZOFF), (NULL, NQUAD)
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      DATA   CFLAG                    / 2H 1, 2H 2, 2H   /
      DATA PI/3.141593E0/, HAFPI/1.570796E0/, EPS/.0001/
 3030 FORMAT (1H1)
    1 FORMAT (      3E10.0, I2 / 3F10.0, I2)
 4002 FORMAT ( 1H0, 6X,5HN   M, 7X, 4 ( 1HX, 11X ), 2HNX, 11X, 3HNPX,
     1  11X, 1HD / 19X, 4 ( 1HY, 11X ), 2HNY, 11X, 3HNPY, 11X, 1HT /
     2  19X, 4(1HZ, 11X ), 2HNZ, 11X, 3HNPZ, 11X, 1HA        )
 4005 FORMAT ( 1H0, 7X, I4, 4F12.6, 2F13.6, E14.4,A2/(12X,4F12.6,
     1  2F13.6, E14.4 )  )
 4010 FORMAT ( 1H0, 3X, 2I4, 4F12.6, 2F13.6, E14.4,A2/(12X, 4F12.6,
     1  2F13.6,  E14.4  )  )
 4015 FORMAT ( 1H0, 3 ( 20),  12H************ ))

C  INPUT -- SECTION 9.1  INPUT SCHEME
      KLCT = 0
      NULL = 0
      NPRT = 13
      WRITE (6, 40)
   40 FORMAT (1H0,16X,44HP A R A M E T R I C   I N F O R M A T I O N
     1 /// 38X,23HGENERATED UNIFORM FLOWS //)
      IF ( AFLOW ) WRITE (6, 41)
   41 FORMAT (46X,6HX-FLOW)
      IF ( BFLOW ) WRITE (6, 42)
   42 FORMAT (46X,6HY-FLOW)
      IF ( CFLOW ) WRITE (6, 43)
   43 FORMAT (46X,6HZ-FLOW)
      IF (IPRS .NE. 0) WRITE (6, 44)
   44 FORMAT (1H0,16X,22HPRINT SIGMA ITERATIONS )
      IF (MPR .EQ. 0) GO TO 52
      IF (MPR - 2) 45, 47, 49
   45 WRITE (6, 46)
   46 FORMAT (1H0,16X,18HPRINT VIJ MATRICES)
      GO TO 52
   47 WRITE (6, 48)
   48 FORMAT (1H0,16X,18HPRINT AIJ MATRICES )
      GO TO 52
   49 WRITE (6, 51)
   51 FORMAT (1H0,16X,31HPRINT BOTH VIJ AND AIJ MATRICES )
```

```
52 IF (ISIG .NE. 0) WRITE (6, 53)                                      INPU  61
53 FORMAT (1H0,16X,19HINPUT SIGMA GUESSES )                            INPU  62
   IF (NSYM - 1) 54, 56, 58                                            INPU  63
54 WRITE (6, 55)                                                       INPU  64
55 FORMAT (1H0,16X,21HNC SYMMETRY SPECIFIED )                          INPU  65
   GO TO 61                                                            INPU  66
56 WRITE (6, 57)                                                       INPU  67
57 FORMAT (1H0,16X,30HTHERE IS ONE PLANE OF SYMMETRY )                 INPU  68
   GO TO 61                                                            INPU  69
58 WRITE (6, 59) NSYM                                                  INPU  70
59 FORMAT (1H0,16X,9HTHERE ARE,I2, 19H PLANES OF SYMMETRY )            INPU  71
61 IF ( MACH .NE. 0.0 ) WRITE (6, 21) MACH                             INPU  72
21 FORMAT (1H0,16X,13HMACH NUMBER =,F10.5)                             INPU  73
   IF (IFLAG .EQ. 0) GO TO 29                                          INPU  74
   READ (5, 20) NLM1, MMIN, B, C                                       INPU  75
   IF (B .EQ. 0.0) B = 1.0                                             INPU  76
   IF (C .EQ. 0.0) C = 1.0                                             INPU  77
20 FORMAT ( 2I5, 2F10.5 )                                              INPU  78
 4 FORMAT ( 8F10.0 )                                                   INPU  79
   WRITE (6, 62) NLM1, MMIN, B, C                                      INPU  80
62 FORMAT (1H0,16X,10HGENERATE A,I3, 2H X,I3, 12H SPHERE. B =,F10.5,   INPU  81
  1 4X,3HC =,F10.5 )                                                   INPU  82
   MLINES = MMIN + 1                                                   INPU  83
   NLINES = NLM1 + 1                                                   INPU  84
   N = 0                                                               INPU  85
   IF ( NSYM .EQ. 0 ) GO TO 2                                          INPU  86
   IF ( NSYM - 2 ) 3, 5, 6                                             INPU  87
 2 PITH = PI                                                           INPU  88
   PIPHI = PI + PI                                                     INPU  89
   GO TO 7                                                             INPU  90
 3 PITH = PI                                                           INPU  91
   PIPHI = PI                                                          INPU  92
   GO TO 7                                                             INPU  93
 5 PITH = PI                                                           INPU  94
   PIPHI = HAFPI                                                       INPU  95
   GO TO 7                                                             INPU  96
 6 PITH = HAFPI                                                        INPU  97
   PIPHI = PITH                                                        INPU  98
 7 SPH ( MLINES ) = SIN ( PIPHI )                                      INPU  99
   SPH ( 1 ) = 0.0                                                     INPU 100
   CPH ( MLINES ) = CCS ( PIPHI )                                      INPU 101
   CPH ( 1 ) = 1.0                                                     INPU 102
   EKM = MMIN                                                          INPU 103
   EKN = NLM1                                                          INPU 104
   EMM = 0.0                                                           INPU 105
   DO 8  I = 2, MMIN                                                   INPU 106
   EMM = EMM + 1.0                                                     INPU 107
   PHI = EMM / EKM * PIFHI                                             INPU 108
   SPH ( I ) = SIN ( PHI )                                             INPU 109
 8 CPH ( I ) = COS ( PHI )                                             INPU 110
   IF ( IFLAG .EQ. 2 ) GO TO 10                                        INPU 111
   ENN = 1.0                                                           INPU 112
   DO 9  I = 1, MLINES                                                 INPU 113
   XA ( I ) = 1.0                                                      INPU 114
   YA ( I ) = 0.0                                                      INPU 115
 9 ZA ( I ) = 0.0                                                      INPU 116
   GO TO 18                                                            INPU 117
10 READ ( 5, 4 ) ( XINP ( I ), ZINP ( I ), I = 1, NLINES )             INPU 118
   DO 11 I = 1, MLINES                                                 INPU 119
   XA ( I ) = XINP ( 1 )                                               INPU 120
```

```
      YA ( I ) = B * ZINP ( 1 ) * SPH ( I )
      ZA ( I ) = - C * ZINP ( 1 ) * CPH ( I )
      XB ( I ) = XINP ( 2 )
      YB ( I ) = B * ZINP ( 2 ) * SPH ( I )
   11 ZB ( I ) = - C * ZINP ( 2 ) * CPH ( I )
      NLCT = 2
      GO TO 250
   12 DO 14 I = 1, MLINES
      XA ( I ) = XB ( I )
      YA ( I ) = YB ( I )
   14 ZA ( I ) = ZB ( I )
      IF ( IFLAG .EQ. 1 ) GO TO 16
      NLCT = NLCT + 1
      DO 15  I = 1, MLINES
      XB ( I ) =  XINP ( NLCT )
      YB ( I ) =  B * ZINP ( NLCT ) * SPH ( I )
   15 ZB ( I ) =  - C * ZINP ( NLCT ) * CPH ( I )
      GO TO 250
   16 ENN = ENN + 1.0
   18 THETA = ENN / EKN * PITH
      STH = SIN ( THETA )
      CTH = COS ( THETA )
      DO 17  I = 1, MLINES
      XB ( I ) = CTH
      YB ( I ) =     B * STH * SPH ( I )
   17 ZB ( I ) =  - C * STH * CPH ( I )
      GO TO 250
   29 N = -1
      IF (LIST .EQ. 0) GO TO 50
      WRITE (6, 19)
   19 FORMAT (1H0 16X 28HBASIC DATA CALCULATIONS ONLY)
      GO TO 50
   30 IF ( RFLAG ) GO TO 50
      RFLAG = .TRUE.
      X = XX
      Y = YY
      Z = ZZ
      STAT = STATT
      IF (LIST) 66, 66, 65
   50 RFLAG = .FALSE.
      READ ( 5, 1 )  X, Y, Z, STAT, XX, YY, ZZ, STATT
      IF ( IPROS ) CALL DATPROS( X, Y, Z, XX, YY, ZZ )
   65 IF (N .EQ.(-1))GO TO 80
   66 IF (STAT .EQ. 0 .OR. STAT .EQ. 3) GO TO 180
      IF ( STAT .EQ. 2 ) GO TO 200
      IF ( .NOT. AFLAG ) GO TO 200
      MC = M
   80 M = 1
      IF ( STAT .EQ. 2 )  GO TO 150
      IF ( .NOT. BFLAG ) GO TO 84
   75 DO 81 J = 1, MC
      XA ( J ) = XB ( J )
      YA ( J ) = YB ( J )
   81 ZA ( J ) =  ZB ( J )
   83 XB ( 1 ) = X
      YB ( 1 ) = Y
      ZB ( 1 ) = Z
      GO TO 30
   84 IF ( AFLAG ) GO TO 85
      BFLAG = .TRUE.
```

```
      GO TO 75
   85 AFLAG = .FALSE.
      GO TO 83
  150 AFLAG = .TRUE.
      BFLAG = .FALSE.
      IF (N .EQ.(-1))N = 0
  160 XA ( M ) = X
      YA ( M ) = Y
      ZA ( M ) = Z
      GO TO 30
  180 M = M + 1
      IF ( AFLAG ) GO TO 160
      XB (M ) = X
      YB ( M ) = Y
      ZB ( M ) = Z
      IF ( STAT .NE. 3 )  GO TO 30
  200 MMIN = MIN0(M, MC) - 1
      MC = M
  250 N = N + 1
      KLCT = KLCT + 1

C  BEGIN COMPUTATION OF NULL POINTS AND 28 QUANTITIES

      DO 2000 I = 1, MMIN
      NULL = NULL + 1
      XIN(1) = XA( I ) * RBETA
      XIN(2) = XA(I+1) * RBETA
      XIN(3) = XB(I+1) * RBETA
      XIN(4) = XB( I ) * RBETA
      YIN(1) = YA(I)
      YIN(2) = YA(I+1)
      YIN(3) = YB(I+1)
      YIN(4) = YB(I)
      ZIN(1) = ZA(I)
      ZIN(2) = ZA(I+1)
      ZIN(3) = ZB(I+1)
      ZIN(4) = ZB(I)

C  FORM DIAGONAL VECTORS
C  EQUATION  ( 64 )

      T1X = XIN(3) - XIN(1)
      T2X = XIN(4) - XIN(2)
      T1Y = YIN(3) - YIN(1)
      T2Y = YIN(4) - YIN(2)
      T1Z = ZIN(3) - ZIN(1)
      T2Z = ZIN(4) - ZIN(2)

C  FORM CROSS PRODUCT  N = T2 X T1
C  EQUATION  ( 65 )

      NX = T2Y*T1Z - T1Y*T2Z
      NY = T1X*T2Z - T2X*T1Z
      NZ = T2X*T1Y - T1X*T2Y
      VN = SQRT (  NX* NX +  NY* NY +  NZ* NZ )

C  FORM UNIT NORMAL VECTOR
C  EQUATION  ( 66 )

      NX = NX / VN
```

```
      NY = NY / VN
      NZ = NZ / VN

C   COMPUTE AVERAGE POINT
C   EQUATION  ( 68 )

      AVX = .25 * ( XIN(1) + XIN(2) + XIN(3) + XIN(4) )
      AVY = .25 * ( YIN(1) + YIN(2) + YIN(3) + YIN(4) )
      AVZ = .25 * ( ZIN(1) + ZIN(2) + ZIN(3) + ZIN(4) )

C   COMPUTE PROJECTION DISTANCE
C   EQUATIONS ( 69 ) AND ( 71 )

      D =  NX*( AVX - XIN(1) ) +  NY*( AVY - YIN(1) ) +  NZ*(AVZ-ZIN(1))
      PD = ABS( D )

C   EQUATIONS ( 73 ) AND ( 74 )

      T = SQRT ( T1X*T1X + T1Y*T1Y + T1Z*T1Z )
      T1X = T1X / T
      T1Y = T1Y / T
      T1Z = T1Z / T

C   EQUATION  ( 75 )

      T2X = NY*T1Z - NZ*T1Y
      T2Y = NZ*T1X - NX*T1Z
      T2Z = NX*T1Y - NY*T1X

C   COMPUTE COORDINATES OF CORNER POINTS IN REFERENCE COORD. SYSTEM
C   EQUATION  ( 72 )

      DO 1000 J = 1, 4
      XP = XIN(J) + NX * D
      YP = YIN(J) + NY * D
      ZP = ZIN(J) + NZ * D
      D =  - D
      XDIF = XP - AVX
      YDIF = YP - AVY
      ZDIF = ZP - AVZ

C   TRANSFORM CORNER POINTS TO ELEMENT COORDINATE SYSTEM  ( XI, ETA )
C   WITH AVERAGE POINT AS ORIGIN
C   EQUATION  ( 80 )

      XI(J) = T1X*XDIF + T1Y*YDIF + T1Z*ZDIF
 1000 ETA(J) = T2X*XDIF + T2Y*YDIF + T2Z*ZDIF

C   COMPUTE CENTROID
C   EQUATION  ( 81 )

      XI0 = .3333333E0 * ( XI (4) * ( ETA (1) - ETA (2) ) + XI ( 2 )
     1  * ( ETA (4) - ETA ( 1) ) ) / ( ETA (2 )  - ETA (4) )
      ETA0 = -.3333333E0 * ETA(1)


C   OBTAIN CORNER POINTS IN SYSTEM WITH CENTROID AS ORIGIN
C   EQUATION  ( 82 )

      DO 1020 J = 1, 4
```

```
      XI(J) = XI(J) - XI0
 1020 ETA(J) = ETA(J) - ETA0

C  COMPUTATION AIDS
      ETA2M1 = ETA ( 2 ) - ETA ( 1 )
      ETA3M2 = ETA ( 3 ) - ETA ( 2 )
      ETA4M3 = ETA ( 4 ) - ETA ( 3 )
      ETA1M4 = ETA ( 1 ) - ETA ( 4 )
      XI1M2 = XI ( 1 ) - XI ( 2 )
      XI2M3 = XI ( 2 ) - XI ( 3 )
      XI3M4 = XI ( 3 ) - XI ( 4 )
      XI4M1 = XI ( 4 ) - XI ( 1 )
      ETA2P4 = ETA ( 2 ) + ETA ( 4 )
      XI3M1 = XI ( 3 ) - XI ( 1 )
      XI4M2 = XI ( 4 ) - XI ( 2 )
      ETA2M4 = ETA ( 2 ) - ETA ( 4 )
      XI1234 = XI ( 1 ) + XI ( 2 ) + XI ( 3 ) + XI ( 4 )

C  TRANSFORM CENTROID TO REFERENCE COORDINATE SYSTEM
C  EQUATION  ( 83 )
      XCENT = AVX + T1X*XI0 + T2X*ETA0
      YCENT = AVY + T1Y*XI0 + T2Y*ETA0
      ZCENT = AVZ + T1Z*XI0 + T2Z*ETA0

C  COMPUTE LARGER DIAGONAL VECTOR
C  EQUATION  ( 84 )
      TSQ = AMAX1 ( XI3M1 ** 2, XI4M2 ** 2 + ETA2M4 ** 2  )
      T = SQRT ( TSQ )


C  COMPUTE AREA
C  EQUATION  ( 85 )
      AREA             = .5 * XI3M1 * ETA2M4

C  COMPUTE 2ND MOMENTS  IXX, IXY, IYY
C  EQUATIONS ( 86 ) - ( 88 )
      IXX =                8.333333E-2 * XI3M1 * ( ETA ( 1 ) * XI4M2 *
     1  XI1234 + ETA2M4 * ( XI (1) * ( XI(1) + XI (3 )  )  +
     2  XI ( 3 ) ** 2 ) + XI ( 2 ) * ETA ( 2 ) * ( XI1234 - XI ( 4 ) )
     3  - XI ( 4 ) *  ETA ( 4 ) * ( XI1234 - XI ( 2 ) )   )
      IXY =                4.166667E-2 * XI3M1 * ( 2. * XI ( 4 ) * ( ETA (1)
     1  ** 2 - ETA ( 4 ) ** 2  ) - 2. * XI ( 2 ) * ( ETA ( 1 ) ** 2  -
     2  ETA ( 2 ) ** 2 ) + ( XI ( 1 ) + XI ( 3 ) ) * ETA2M4 * ( 2. *
     3  ETA ( 1 ) + ETA2P4 ) )
      IYY =                8.333333E-2 * XI3M1 * ETA2M4 * ((ETA ( 1 ) +
     1  ETA2P4 ) ** 2 - ETA ( 1 ) * ETA2P4 - ETA ( 2 ) * ETA ( 4 )  )

C  COMPUTE CONSTANTS FOR EQUATIONS ( 42 ) AND ( 43 )
C  EQUATION  ( 45 )
      D12SQ = XI1M2 ** 2 + ETA2M1 ** 2
      D12 = SQRT ( D12SQ )
      D23SQ = XI2M3 **2  + ETA3M2 ** 2
      D23 = SQRT ( D23SQ )
      D34SQ = XI3M4 ** 2 + ETA4M3 ** 2
      D34 = SQRT ( D34SQ )
      D41SQ = XI4M1 ** 2 + ETA1M4 ** 2
      D41 = SQRT ( D41SQ )
      C1 = 0.0
      C2 = 0.0
      C3 = 0.0
```

```
      C4 = 0.0
      C5 = 0.0
      C6 = 0.0
      C7 = 0.0
      C8 = 0.0
      XNP = 0.0
      YNP = 0.0
      IF ( D12 ) 1030, 1040, 1030
 1030 C1 = ETA2M1 / D12
      C5 = XI1M2 / D12
 1040 IF ( D23 ) 1050, 1060, 1050
 1050 C2 = ETA3M2 / D23
      C6 = XI2M3 / D23
 1060 IF ( D34 ) 1070, 1080, 1070
 1070 C3 = ETA4M3 / D34
      C7 = XI3M4 / D34
 1080 IF ( D41 ) 1090, 1100, 1090
 1090 C4 = ETA1M4 / D41
      C8 = XI4M1 / D41
 1100 CONV = 3


C BEGIN NULL POINT ITERATION

      DO 1591  ITR = 1, 30
      DO 1580  K = 1,4
C  EQUATION  ( 47 )
      R ( K ) = SQRT ( ( XNP - XI ( K ) ) ** 2 + ( YNP - ETA(K))** 2 )
      RX (K ) = ( XNP - XI ( K ) ) / R ( K )
 1580 RY (K ) = ( YNP - ETA ( K ) ) / R ( K )
      R1PR2  =  R ( 1 )  + R ( 2 )
      R2PR3  =  R ( 2 )  + R ( 3 )
      R3PR4  =  R ( 3 )  + R ( 4 )
      R4PR1  =  R ( 4 )  + R ( 1 )
      ARG1 = ALOG ( ( R1PR2 - D12 ) / ( R1PR2 + D12 ) )
      R4PR1  =  R ( 4 )  + R ( 1 )
      ARG1 = ALOG ( ( R1PR2 - D12 ) / ( R1PR2 + D12 ) )
      ARG2 = ALOG ( ( R2PR3 - D23 ) / ( R2PR3 + D23 ) )
      ARG3 = ALOG ((R3PR4 - D34 ) / ( R3PR4 + D34 ) )
      ARG4 = ALOG ((R4PR1 - D41 ) / ( R4PR1 + D41 ) )

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 42 ) AND ( 43 )
      VX = C1 * ARG1 + C2 * ARG2 + C3 * ARG3 + C4 * ARG 4
      VY = C5 * ARG1 + C6 * ARG2 + C7 * ARG 3 + C8 * ARG4

C  COMPUTE PARTIAL DERIVATIVES OF INDUCED VELOCITIES
C  EQUATION ( 90 ), USING EQUATIONS ( 91 ) - ( 93 )


      D12P=  ( R1PR2 ** 2 - D12 SQ   ) * .5
      D23P=  ( R2PR3 ** 2 - D23 SQ   ) * .5
      D34P=  ( R3PR4 ** 2 - D34 SQ   ) * .5
      D41P=  ( R4PR1 ** 2 - D41 SQ   ) * .5
      C1P = ETA2M1 / D12P
      C2P = ETA3M2 / D23P
      C3P = ETA4M3 / D34P
      C4P = ETA1M4 / D41P
      C5P = XI1M2 / D12P
```

```
      C6P = XI2M3 / D23P
      C7P = XI3M4 / D34P
      C8P = XI4M1 / D41P
      R12Y = RY ( 1 ) + RY ( 2 )
      R23Y = RY ( 2 ) + RY ( 3 )
      R34Y = RY ( 3 ) + RY ( 4 )
      R41Y = RY ( 4 ) + RY ( 1 )
      VXX = C1P* ( RX ( 1 ) + RX ( 2 ) ) + C2P* ( RX ( 2 ) + RX ( 3 )) +
     1      C3P* ( RX ( 3 ) + RX ( 4 ) ) + C4P* ( RX ( 4 ) + RX ( 1 ) )
      VXY = C1P* R12Y + C2P* R23Y + C3P* R34Y + C4P* R41Y
      VYY = C5P* R12Y + C6P* R23Y + C7P* R34Y + C8P* R41Y


C  COMPUTE NEW NULL POINT ( XNP, YNP )
C  EQUATION ( 94 )

      XMXP = ( VY * VXY - VX * VYY ) / ( VXX * VYY - VXY ** 2 )
      XNP = XMXP + XNP
      YNP = YNP - ( VX + VXX * XMXP ) / VXY

C     TEST NULL POINT CONVERGENCE
 1590 IF ( ABS ( VX ) .LT. EPS .AND. ABS ( VY ) .LT. EPS ) GO TO 1600
 1591 CONTINUE
C     NO CONVERGENCE , USE 30TH ITERATION
      CONV = 2

C     TEST IF THIS POINT IS OUTSIDE THE ELEMENT
 1600 IF ( XNP ** 2 + YNP ** 2  .LE. TSQ )  GO TO 1620

C     CONVERGES TO POINT AT INFINITY
      CONV = 1
      XNULL ( NULL ) = XCENT
      YNULL ( NULL ) = YCENT
      ZNULL ( NULL ) = ZCENT
      GO TO 1700

C     TRANSFORM NULL POINT TO REFERENCE COORDINATE SYSTEM
C  EQUATION ( 79 )  NOTE THAT Z - COORDINATE IS ZERO
 1620 XNULL ( NULL ) = XCENT + T1X * XNP + T2X * YNP
      YNULL ( NULL ) = YCENT + T1Y * XNP + T2Y * YNP
      ZNULL ( NULL ) = ZCENT + T1Z * XNP + T2Z * YNP


C  PRINT RESULTS -- SECTION 9.4 THE FIRST OUTPUT

 1700 IF ( NPRT .GE. 11 ) GO TO 1750
      NPRT = NPRT + 1
      IF ( I .EQ. 1 ) GO TO 1760
      WRITE (6, 4005) I, XIN, NX, XNULL ( NULL), PD, CFLAG (CONV),
     1  YIN, NY, YNULL (NULL), T, ZIN, NZ, ZNULL ( NULL ), AREA
      GO TO 1770
 1750 NPRT = 0
      CALL HEADER
      WRITE ( 6, 4002 )
 1760 WRITE ( 6, 4010) N   , I, XIN, NX, XNULL ( NULL ), PD, CFLAG (CONV
     1   ), YIN, NY, YNULL (NULL), T, ZIN, NZ, ZNULL ( NULL ), AREA
 1770 XNORM ( NULL ) = NX
      YNORM ( NULL ) = NY
      ZNORM ( NULL ) = NZ
```

```
C  WRITE 28 QUANTITIES ON TAPE 4 AS ONE LOGICAL RECORD

 2000 IF (LIST .EQ. 0) WRITE (4) XCENT, YCENT, ZCENT, T1X, T1Y, T1Z,
     1 T2X, T2Y, T2Z, NX, NY, NZ, XI(1), ETA(1), XI(2), ETA(2), XI(3),
     2 XI(4), ETA(4), TSQ, AREA, IXX, IXY, IYY, D12, D23, D34, D41
      NLT ( KLCT ) = MMIN
      NLINE ( KLCT ) = N
      IF ( IFLAG .EQ. 0 ) GO TO 2001
      IF ( N .LT. NLM1 ) GO TO 12
      WRITE ( 6, 4015 )
      GO TO 2025
 2001 IF ( STAT .LT. 2 ) GO TO 80
      NLT(KLCT) = -NLT(KLCT)
      NPRT = NPRT + 1
      WRITE ( 6, 4015  )

C  TEST FOR END OF CASE
 2020 IF ( STAT .NE. 3 ) GO TO 80
 2025 NN1 = MOD ( 3 * NQUAD, 255 )
      NQNN1 = NQUAD
      IF ( NN1 .LT. 5 .AND. NN1 .GT. 0  ) NQNN1 = NQUAD + 2
      IF (LIST.NE. 0) GO TO 8500
C     WRITE UNIT NORMALS ON TAPE 4 AS ONE LOGICAL RECORD
 2031 WRITE (4) (XNORM(J), YNORM(J), ZNORM(J), J = 1, NQNN1)
C  WRITE CONTROL TABLES ON TAPE 4 AS ONE LOGICAL RECORD
      WRITE ( 4 ) KLCT, ( NLINE (J), NLT(J), J = 1, KLCT )
C  **  WRITE NULL POINTS AND NORMALS (1 RECORD)
 3032 WRITE (4)(XNULL(J), YNULL(J), ZNULL(J),XNORM(J), YNORM(J),ZNORM(J)
     1 , J = 1, NQUAD)
      WRITE ( 6, 3030 )
C  WRITE ALL NULL POINTS ON TAPE 8 (1 LOGICAL RECORD / POINT)
      DO 2058 I = 1, NQUAD
 2058 WRITE  (8)  XNULL (I), YNULL(I), ZNULL(I)
C
C     READ IN OFF-BODY POINTS
C
      IF ( NOFF .LE. 0 ) GO TO 8000
      NOFF = 0
 5000 NOFF = NOFF + 1
      READ (5, 1) XOFF(NOFF), YOFF(NOFF),ZOFF(NOFF),STAT, X,Y,Z,STATT
      IF (STAT .EQ. 3) GO TO 5100
      NOFF = NOFF + 1
      XOFF(NOFF) = X
      YOFF(NOFF) = Y
      ZOFF(NOFF) = Z
      IF (STATT .NE. 3) GO TO 5000

C     WRITE OFF-BODY POINTS ON  8  ( 1 RECORD / POINT )

 5100 DO 7020 I = 1, NOFF
      XOFF(I) = XOFF(I) * RBETA
 7020 WRITE ( 8) XOFF(I), YOFF(I), ZOFF(I)

C     WRITE OFF-BODY POINTS ON 4 (1 RECORD)
C
      WRITE (4)(XOFF(I), YOFF(I), ZOFF(I), I = 1, NOFF)

      WRITE (6, 63) NOFF
   63 FORMAT (1H0,16X,9HTHERE ARE,I4, 15H OFF-BODY POINTS )
 8000 REWIND 4
```

```
 8500 REWIND 8
C
      WRITE(6, 9999) NQUAD
 9999 FORMAT( 1H0 , 5X, I5,  26H BASIC ELEMENTS WERE INPUT)
C     RETURN
      END
```

```
*DECK,DATPR
      SUBROUTINE DATPROS( X, Y, Z, XX, YY, ZZ )
C
C     THIS IS A SIMPLE SCALING AND ORIGIN TRANSLATION CODE FOR THE
C     DOUGLAS BOXC POTENTIAL FLOW  CODE DATA INPUT
C        XTRANS, YTRANS, ZTRANS ARE ORIGIN TRANSLATIONS
C        XSCALE, YSCALE, ZSCALE ARE SCALE FACTORS
C     THE CODE ALSO ALLOWS FOR ROTATION IN THE X - Z PLANE TO ADJUST
C     FOR ARBITRARY ANGLE OF ATTACK
C        SINA, COSA ARE SINE AND COSINE OF ANGLE
C        ANGLE IS THE ANGLE( INPUT IN DEGREES)  THAT THE AIRPLANE AXIS
C        MAKES WITH THE NEGATIVE X AXIS (POSITIVE COUNTERCLOCKWISE
C        FROM THE-X AXIS) AFTER SCALING ( NOTE - AFTER SCALING THE
C        AIRPLANE NOSE POINTS DOWN THE NEGATIVE X AXIS)
C
C     THIS VERSION FOR USE WITH BOXC
C
C
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /PROS/      SINA,COSA, XSCALE, YSCALE, ZSCALE, XTRANS,
     1 YTRANS, ZTRANS
      X = ( X - XTRANS ) * XSCALE
      Y = ( Y - YTRANS ) * YSCALE
      Z = ( Z - ZTRANS ) * ZSCALE
      XX= ( XX- XTRANS ) * XSCALE
      YY= ( YY- YTRANS ) * YSCALE
      ZZ= ( ZZ- ZTRANS ) * ZSCALE
      XP = X
      X = XP * COSA - Z * SINA
      Z = XP * SINA + Z * COSA
      XP = XX
      XX= XP * COSA - ZZ* SINA
      ZZ= XP * SINA + ZZ* COSA
      RETURN
      END
```

```
*DECK, FLOWS
      SUBROUTINE FLOWS
C     SUBROUTINE FLOWS (NU, NNON )
      COMMON /FLOWP/ NU,NNON
      COMMON HEDR(15),MPR,IER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      LOGICAL  AFLOW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      COMMON / FLOW / NQ, NL, KFLOW, VX(2000), VY(2000), VZ(2000),
     1                                       VNC(1000)
       COMMON /NORMS/ XNORM(1000),YNORM(1000),ZNORM(1000)
   31 FORMAT ( 3I1 )
   40 FORMAT( 6F10.8 )
 9999 FORMAT (1H0,5X 16HFLOWS HAS SET UP,
     1 I3, 11H  X  FLOWS, I3, 15H  Y  FLOWS, AND I3, 11H  Z  FLOWS. )
      NAFLOW = 0
      NBFLOW = 0
      NCFLOW = 0
      NMAT = 0
      NQ = NQUAD + NOFF
      NL = NQUAD
      NN = MOD(3* NQ    , 255)
      IF ( NN .LT. 5 .AND. NN .GT. 0 ) NQ = NQ + 5
      KFLOW = 0
      NN = MOD( NQUAD, 255)
      IF ( NN .LT. 5 .AND. NN .GT. 0) NL = NL + 5
      IF (NNON .GT. 0) GO TO 140
      IF (NU .GT. 0) GO TO 50
      WRITE (6, 115)
  115 FORMAT (1H1,6X,24HNO ONSET FLOWS SPECIFIED )
      STOP
   50 IF ( .NOT. AFLOW ) GO TO 60
      KFLOW = 1
      GO TO 100
   60 IF ( .NOT. BFLOW ) GO TO 70
      KFLOW = 2
      GO TO 100
   70 IF ( CFLOW ) GO TO 90
      IF (KFLOW .NE. 0) GO TO 4000
      WRITE ( 6, 80 )
   80 FORMAT ( 1H1,6X,12HINPUT ERROR.,5X,25HNO FLOW MATRIX SPECIFIED. )
      STOP
   90 KFLOW = 3
  100 CALL UNIFRM
      IF (KFLOW - 2) 60, 70, 4000

C     THIS SECTION SETS UP THE NON-UNIFORM ONSET FLOWS

  140 DO 3000 N = 1, NNON
      IERR = 0
C
C - - THE FLAGS READ IN HERE HAVE THE FOLLOWING VALUES...
C
C         FLAG                         MEANING
C        ------                       ---------
C
C         KFL        . . . .          FLOW MATRIX-ASSOCIATION FLAG
C                                     1 X-FLOW, 2 Y-FLOW, 3 Z-FLOW
C
C         KUN        . . . .          0 NON-UNIFORM FLOW, 1 UNIFORM FLOW
```

```
C
C         KTYPE     . . . .         0 INPUT FLOW VELOCITY COMPONENTS,
C                                   1 INPUT FLOW NORMAL VELOCITY
C
      READ ( 5, 31 ) KFL, KUN, KTYPE
      KTEST = KFL - KFLOW
      IF (KTEST) 145, 220, 150
  145 WRITE (6, 146) KFLOW, KFL
  146 FORMAT (15H1*****NOTE***** / 25H0AN INPUT FLOW FOR MATRIX,I3,
     1 38H PHYSICALLY PRECEDED A FLOW FOR MATRIX,I3 /
     2 26H0THIS FLOW MUST BE SKIPPED //)
      IERR = 1
      GO TO 220
  150 IF (NU) 155, 155, 152
  152 IF (KTEST - 2) 170, 153, 160
  153 IF (KFL - 2) 145, 160, 161
  155 KFLOW = KFL
  156 IF (KFLOW - 2) 157, 158, 159
  157 AFLOW = .TRUE.
      GO TO 220
  158 BFLOW = .TRUE.
      GO TO 220
  159 CFLOW = .TRUE.
      GO TO 220
  160 IF (.NOT. AFLOW) GO TO 161
      KFLOW = 1
      CALL UNIFRM
  161 IF (.NOT. BFLOW) GO TO 162
      KFLOW = 2
      CALL UNIFRM
  162 KFLOW = KFL
      IF (KFLOW .EQ. 2) GO TO 158
      IF (CFLOW) GO TO 200
      GO TO 159
  170 KFLOW = KFL
      IF (NU .EQ. 0) GO TO 156
      IF (KFLOW - 2) 175, 180, 185
  175 IF (AFLOW) GO TO 200
      GO TO 157
  180 IF (BFLOW) GO TO 200
      GO TO 158
  185 IF (CFLOW) GO TO 200
      GO TO 159
  200 CALL UNIFRM
  220 NVREAD = NQUAD
      IF (KUN .GT. 0) NVREAD = 1
      IF ( KTYPE .NE. 0 ) GO TO 222
      READ ( 5, 40 ) ( VX(I), VY(I), VZ(I), I = 1, NVREAD )
      GO TO 224
  222 READ ( 5, 40 ) ( VNC(I), I = 1, NVREAD )
      DO 223 I = 1, NQUAD
      VX(I) = 0.0
      VY(I) = 0.0
  223 VZ(I) = 0.0
  224 IF ( IERR .NE. 0 ) GO TO 1200
      NVREAD = NQUAD + NOFF
      IF (KUN .LE. 0) IF (NOFF) 240, 240, 230
      DO 225 NV = 2, NVREAD
      VX(NV) = VX(1)
      VY(NV) = VY(1)
```

```
  225 VZ(NV) = VZ(1)
      GO TO 240
  230 NQP1 = NQUAD + 1
      DO 235 NV = NQP1, NVREAD
      VX(NV) = 0.0
      VY(NV) = 0.(
  235 VZ(NV) = 0.0
  240 IF ( KFLOW - 2 ) 600, 700, 800
  600 NAFLOW = NAFLOW + 1
      GO TO 900
  700 NBFLOW = NBFLOW + 1
      GO TO 900
  800 NCFLOW = NCFLOW + 1
  900 IF ( KTYPE .NE. 0 ) GO TO 1075
      DO 1050 J = 1, NQUAD
 1050 VNC (J) = VX(J)*XNORM(J) + VY(J)*YNORM(J) + VZ(J)*ZNCRM(J)
 1075 WRITE ( 3 ) KFLOW, (VX(K), VY(K), VZ(K), K = 1, NQ)
 1100 WRITE (3) ( VNC(K), K = 1, NL )

C     READ IN FIRST GUESSES FOR THE SIGMAS
 1200 IF ( ISIG )  3000, 3000, 1600
 1600 READ (5, 40) ( VNC(K), K = 1, NQUAD )

C     WRITE SIGMA GUESSES ON TAPE 3 AS ONE LOGICAL RECORD

      IF (IERR .EQ. 0) WRITE (3) (VNC(J), J = 1, NL)
 3000 CONTINUE
      IF (NU .NE. 0) IF (KFLOW - 2) 60, 70, 4000
 4000 REWIND 3
      IF ( AFLOW ) NMAT = 1
      IF ( BFLOW ) NMAT = NMAT + 1
      IF ( CFLOW ) NMAT = NMAT + 1
      NMATM1 = NMAT - 1
      NFLOW = NAFLOW + NBFLOW + NCFLOW
      WRITE(6, 9999)     NAFLOW, NBFLOW, NCFLOW
C     RETURN
      END
```

```
*DECK,UNIFRM
      SUBROUTINE UNIFRM
C
C *****  SPECIAL FOR LEAKY QUADS  ******
C
      COMMON / FLOW / NQ, NL, KFLOW, VX(2000), VY(2000), VZ(2000),
     1 VNC(1000)
      LOGICAL AFLOW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      COMMON /NORMS/ XNORM(1000),YNORM(1000),ZNORM(1000)
      COMMON HEDR(15),MPR,IER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /QLEAK/ LEAK, FRACT

C     THIS ROUTINE SETS UP THE UNIFORM ONSET FLOWS.  FOR THESE FLOWS IT
C     IS ONLY NECESSARY TO HAVE TWO VELOCITY MATRICES, ONE ALL ZEROES
C     AND THE OTHER ALL ONES. WE SHALL FILL VX WITH 0'S AND VY WITH 1'S.

      DO 10 I = 1, NQ
      VX(I) = 0.0
   10 VY(I) = 1.0

C     NOW WE'LL TEST 'KFLOW' TO DETERMINE WHAT FLOW TO SET UP FOR.

      IF ( KFLOW - 2 ) 20, 30, 40

C     THIS PORTION SETS UP FOR 'A' FLOW.

   20 NAFLOW = 1
      WRITE (  3 ) KFLOW, ( VY(I), VX(I), VX(I), I = 1, NQ )
C
C     THIS IS A PATCH TO PROVIDE FOR LEAKY QUADS.  THESE MUST BE THE
C     FIRST QUADS IN THE TABLE.  THEY LEAK AT A FRACTION FRACT OF THE
C     FREE-STREAM RATE.  ONLY THE A FLOW IS PROVIDED FOR HERE.
C
C     LEAK = NO. OF LEAKY QUADS
C
      IF( LEAK .GT. 0 ) GO TO 21
      WRITE( 3) ( XNORM(I), I=1,NL )
      GO TO 50
   21 DO 22 I=1,LEAK
   22 VZ(I) = XNORM(I) + FRACT
      IF( LEAK .GE. NL ) GO TO 25
      LEAKP = LEAK + 1
      DO 24 I=LEAKP,NL
   24 VZ(I) = XNORM(I)
   25 WRITE( 3 ) ( VZ(I), I=1,NL )
      DO 26 I=1,NL
   26 VZ(I) = 0.0
      GO TO 50

C     THIS PORTION SETS UP FOR 'B' FLOW.

   30 NBFLOW = 1
      WRITE (  3 ) KFLOW, ( VX(I), VY(I), VX(I), I = 1, NQ )
      WRITE ( 3 ) ( YNORM(I), I = 1, NL )
      GO TO 50

C     THIS PORTION SETS UP FOR "C" FLOW.

```

```
   40 NCFLOW = 1
      WRITE (  3 ) KFLOW, ( VX(I), WX(I), VY(I), I = 1, NQ )
      WRITE ( 3 ) ( ZNORM(I), I = 1, NL )

C     CHECK FOR INPUT SIGMAS.

   50  IF ( ISIG .EQ. 0 ) RETURN

C     READ THE SIGMA GUESSES INTO VZ.

      READ ( 5, 60 ) ( VZ(I), I = 1, NQUAD )
   60 FORMAT ( 6F10.8 )

C     WRITE SIGMAS ON TAPE 3 AS ONE LOGICAL RECORD AND HANG IT UP. *TMR*

      WRITE ( 3 ) ( VZ(I), I = 1, NL )
      RETURN
      END
```

```
*DECK,VFORM
      SUBROUTINE VFORM
      REAL M12, M23, M34, M41 , IXX, IXY, IYY
      INTEGER TAPES
C
      LOGICAL  AFLOW, BFLOW, CFLOW
      DIMENSION NTAPE(3), D41(335),
     1 XIJ1 (335), XIJ2 (335), XIJ3 (335), YIJ1 (335), YIJ2 (335),
     2 YIJ3 (335), ZIJ1 (335), ZIJ2 (335), ZIJ3 (335), XX1 ( 1340),
     3 XX2 (1340), XX3(1340), YY1(1340),YY2(1340),YY3(1340),ZZ1(1340),
     4 ZZ2(1340), ZZ3(1340 ), X(8),Y(8),Z(8), XC(335), YC(335), ZC(335),
     5 A11(335), A12 (335), A13 (335), A21(335), A22(335), A23(335),
     6 A31(335), A32 (335), A33 (335), XI1(335), XI2(335), XI3(335),
     7 XI4(335), ETA1(335),ETA2 (335), ETA4(335),TSQ(335), A (335),
     8 IXX(335), IXY (335), IYY (335), D12 (335), D23(335), D34(335)
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      EQUIVALENCE  ( XIJ1, YY1 (1) ), ( XC, YY1 (336) ), ( YC,YY1(671)),
     1  ( ZC, YY1(1006) ), ( ETA4, XX1 ( 1 ) ), ( YIJ1, XX1 ( 336 ) ),
     2  ( XIJ2, YY2 (1) ), ( YIJ2, YY2 ( 336 )), ( A11, YY2 ( 671)),
     3  ( A12 , YY2 (1006)),  ( A13, XX1 (671)), ( TSQ, XX1 ( 1006 )),
     4  ( A21, YY3 (1) )   ,  ( A22, YY3 ( 336)), ( A23, YY3 ( 671)),
     5  ( A   ,  YY3 (1006)),  (XIJ3, XX2 ( 1)), ( YIJ3, XX2 ( 336) ),
     6  (ZIJ1,  ZZ1 (1) )  ,  (A31 , ZZ1 (336 )), (A32 , ZZ1 ( 671)),
     7  ( A33,  ZZ1 (1006)),  ( IXX, XX2 ( 671)), (  D12, XX2 (1006) ),
     8  (ZIJ2,  ZZ2 (1)  ) ,  ( XI1, ZZ2 (336 )), ( XI2, ZZ2 ( 671)),
     9  (XI3,   ZZ2 (1006)),  ( IXY, XX3 ( 1 )), ( D23, XX3 ( 336 )),
     A  (D34,  ZZ3 ( 1 ) ) ,  ( ZIJ3, ZZ3(336 )), (XI4, ZZ3 (  671)),
     B  ( ETA1,ZZ3 ( 1006)),  ( ETA2, XX3 (671)), ( IYY, XX3 ( 1006))
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLO
      DATA  RHO1SQ, RHO2SQ / 6.0, 16.0 /
       DATA   NTAPE                       / 1 , 11 , 12 /
 4004 FORMAT ( 1H0, 3HROW,I5,5X, 6HX-FLOW)
 4005 FORMAT ( 1H0, 3HROW,I5,5X, 6HY-FLOW)
 4006 FORMAT ( 1H0, 3HROW,I5,5X, 6HZ-FLOW)
      INEAR = 0
      INTERM = 0
```

```
      IFAR = 0
   10 IF ( NSYM - 1 ) 58, 52, 54
   52 ASSIGN  2100 TO I29
      ASSIGN  910 TO I19
      GO TO 60
   54 ASSIGN 2200 TO I29
      IF ( NSYM .EQ. 3 ) GO TO 56
      ASSIGN  920 TO I19
      GO TO 60
   56 ASSIGN 930  TO I19
      GO TO 60
   58 ASSIGN 2000 TO I19
   60 LOOP = 2 ** NSYM + 1
      NEL = NQUAD / 3
      NELL = NEL
      NELP = NEL
      NREM = MOD ( 3 * NEL + 1, 255 )
      IF ( NREM .LT. 5 .AND. NREM .GT. 0 ) NELP = NEL + 5
      NON = NQUAD + NOFF
      DO 8000  M = 1, 3
      KROW = 0
  201 NT = NTAPE ( M )
  202 IF (M .NE. 3)    GO TO 300
      NEL = NQUAD - 2 * NEL
      NELP = NEL
      NREM = MOD ( 3 * NEL + 1 , 255 )
      IF ( NREM .LT. 5 .AND. NREM .GT. 0) NELP = NEL + 5

C  READ 28 QUANTITIES

  300 DO 500  J = 1, NEL
  500 READ (4) XC(J), YC (J), ZC(J), A11(J), A12(J), A13(J), A21(J),
     1 A22(J), A23(J), A31(J), A32(J), A33(J),       XI1(J),ETA1(J),XI2(
     2 J), ETA2(J), XI3(J), XI4(J), ETA4(J), TSQ(J), A (J), IXX (J),
     3 IXY (J), IYY(J), D12(J), D23(J), D34(J), D41(J)
  800 KROW = KROW + 1
      READ ( 8  ) XNPP, YNPP, ZNPP
      DO 2300 I1 = 1,  NEL
      DO 1700  I2 = 1, LOOP
      IF ( I2 .EQ. LOOP ) GO TO I19,( 2000, 910, 920, 930  )
      GO TO (1000, 910, 920, 910, 930, 910, 920, 910 ), I2
  910 YC ( I1 ) = - YC ( I1 )
      A12 ( I1 ) = - A12 ( I1 )
      A22 ( I1 ) = - A22 ( I1 )
      A31 ( I1 ) = - A31 ( I1 )
      A33 ( I1 ) = - A33 ( I1 )
      GO TO 932
  920 ZC ( I1 ) = - ZC ( I1 )
      A13 ( I1 ) = - A13 ( I1 )
      A23 ( I1 ) = - A23 ( I1 )
      A31 ( I1 ) = - A31 ( I1 )
      A32 ( I1 ) = - A32 ( I1 )
      GO TO 932
  930 XC ( I1 ) = - XC ( I1 )
      A11 ( I1 ) = - A11 ( I1 )
      A21 ( I1 ) = - A21 ( I1 )
      A32 ( I1 ) = - A32 ( I1 )
      A33 ( I1 ) = - A33 ( I1 )
  932 IF ( I2 .EQ. LOOP ) GO TO I29, (       2100, 2200    )
 1000 XDIF = XNPP- XC ( I1 )
```

```
      YDIF = YNPP- YC ( I1 )
      ZDIF = ZNPP- ZC ( I1 )

C  COMPUTE DISTANCE FROM NULL POINT TO ORIGIN OF J-TH ELEMENT COORDINATE
C     SYSTEM  ( J CORRESPONDS TO THE INDEX I1 )

C  INEQUALITY  ( 98 )

      ROSQ = XDIF ** 2 + YDIF ** 2 + ZDIF ** 2
      IF ( ROSQ .LT. RHO2SQ * TSQ ( I1 ) ) GO TO 1400

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATION  ( 97 )

      IFAR = IFAR + 1
      ARG1 = A ( I1) / SQRT ( ROSQ ) ** 3
      X   ( I2) = ARG1 * XDIF
      Y   ( I2 ) = ARG1 * YDIF
      Z   ( I2 ) = ARG1 * ZDIF
      GO TO 1700

C  TRANSFORM NULL POINT TO J - ELEMENT COORDINATE SYSTEM
C  EQUATION  ( 78 )


 1400 XNP = A11 ( I1 ) * XDIF + A12 ( I1 ) * YDIF + A13 ( I1 ) * ZDIF
      YNP =  A21 ( I1 ) * XDIF + A22 ( I1) * YDIF + A23 (I1)*ZDIF
      ZNP = A31 ( I1 ) * XDIF + A32 (I1) * YDIF + A33 (I1) * ZDIF

C  INEQUALITIES  ( 99) AND ( 100 )
      IF ( ROSQ .LT. RHO1SQ * TSQ ( I1 ) ) GO TO 1410

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 57 ) - ( 62 )

      INTERM = INTERM + 1
      P = YNP **2     + ZNP ** 2 - 4.0 * XNP ** 2
      QP= XNP **2     + ZNP ** 2 - 4.0 * YNP ** 2
      RO = SQRT ( ROSQ )
      ROP = RO ** (- 7)
      WXXX = XNP * ( 9.0 * P + 30.0 * XNP ** 2 ) * ROP
      WXXY = 3.0 * P * ROP * YNP
      WXYY = 3.0 * XNP * QP * ROP
      W YYY = YNP * ( 9.0 * QP + 30.0 * YNP ** 2 ) * ROP
      WXXZ = 3.0 * ZNP * P * ROP
      WXYZ       = - 15.0 * XNP * YNP * ZNP * ROP
      WYYZ = 3.0 * ZNP * QP * ROP
      ROP = - RO ** ( - 3)
      WX = ROP * XNP
      WY = ROP * YNP
      WZ = ROP * ZNP
      HIXX = .5 * IXX ( I1 )
      HIYY = .5 * IYY ( I1 )
      VX = - WXYY*HIYY - WXXY*IXY( I1) - WXXX*HIXX - WX*A( I1)
      VY = - WYYY*HIYY - WXYY*IXY( I1) - WXXY*HIXX - WY*A( I1)
      VZ = - WYYZ*HIYY - WXYZ*IXY( I1) - WXXZ*HIXX - WZ*A( I1)
      GO TO 1600

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 42 ) - ( 49 )
```

```
1410 ETA4M3 = ETA4 ( I1) - ETA1 ( I1 )
     INEAR = INEAR + 1
     RO = SQRT ( ROSQ )
     ETA2M1 = ETA2 ( I1 ) - ETA1 ( I1 )
     XI4M3 = XI4 ( I1 ) - XI 3 ( I1 )
     XI2M1 = XI2 (I1 ) - XI1 ( I1 )
     XI3M2 = XI3 ( I1 ) - XI2 ( I1 )
     XI1M4 = XI1 ( I1 ) - XI4 ( I1 )
     XMXI 1 = XNP - XI1 ( I1 )
     XMXI2 = XNP - XI2 ( I1 )
     XMXI3 = XNP - XI3 ( I1 )
     XMXI4 = XNP - XI4 ( I1 )
     YMETA1= YNP -  ETA1 ( I1 )
     YMETA 2 = YNP - ETA2 ( I1 )
     YMETA 4 = YNP - ETA4 ( I1 )
       ZNPSQ = ZNP * ZNP
     IF ( ZNPSQ .LT. TSQ ( I1 ) * 1.0E-6 ) ZNPSQ = 0.0
     E1 = ZNPSQ + XMXI1 **2
     E2 = ZNPSQ + XMXI2 **2
     E3 = ZNPSQ + XMXI3 **2
     E4 = ZNPSQ + XMXI4 **2
     H1 = YMETA1 * XMXI1
     H2 = YMETA2 * XMXI2
     H3 = YMETA1 * XMXI3
     H4 = YMETA4 * XMXI4
     M12 = 0.0
     IF ( XI2M1 .NE. 0.0) M12 = ETA2M1 / XI2M1
     M23 = 0.0
     IF ( XI3M2 .NE.0.0) M23 = - ETA2M1 / XI3M2
     M34 = 0.0
     IF ( XI4M3 .NE. 0.0) M34 = ETA4M3 / XI4M3
     M41 = 0.0
     IF ( XI1M4 .NE. 0.0) M41 = - ETA4M3 / XI1M4
     ANUM1 =  M12 * E1 - H1
     ANUM2 =  M12 * E2 - H2
     ANUM3 =  M23 * E2 - H2
     ANUM4 =  M23 * E3 - H3
     ANUM5 =  M34 * E3 - H3
     ANUM6 =  M34 * E4 - H4
     ANUM7 =  M41 * E4 - H4
     ANUM8 =  M41 * E1 - H1
     R 1 = SQRT ( XMXI1  ** 2 + YMETA1 ** 2 + ZNPSQ)
     R2  = SQRT ( XMXI2  ** 2 + YMETA2 ** 2 + ZNPSQ)
     R3  = SQRT ( XMXI3  ** 2 + YMETA1 ** 2 + ZNPSQ)
     R4  = SQRT ( XMXI4  ** 2 + YMETA4 ** 2 + ZNPSQ)
     Q25 = D12 ( I1 )
     Q26 = D23 ( I1 )
     Q27 = D34 ( I1 )
     Q28 = D41 ( I1 )
     VX = 0.0
     VY = 0.0
     VZ = 0.0
     IF ( Q25 ) 1420, 1430, 1420
1420 TEMP = R1 + R2
     TEMP1 = TEMP - Q25
     TEMP2 = TEMP + Q25
     ARG1 = 1.0
     IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG1=ALOG(TEMP1/TEMP2)
     TEMP = ARG1 / Q25
```

```
      VX = ETA2M1 * TEMP
      VY = - XI2M1 * TEMP
 1430 IF ( Q26 ) 1435, 1440, 1435
 1435 TEMP = R2 + R3
      TEMP1 = TEMP - Q26
      TEMP2 = TEMP + Q26
      ARG2 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG2=ALOG(TEMP1/TEMP2)
      TEMP = ARG2 / Q26
      VX = VX - ETA2M1 * TEMP
      VY = VY - XI3M2 * TEMP
 1440 IF ( Q27 ) 1450, 1460, 1450
 1450 TEMP = R3 + R4
      TEMP1 = TEMP - Q27
      TEMP2 = TEMP + Q27
      ARG3 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG3=ALOG(TEMP1/TEMP2)
      TEMP = ARG3 / Q27
      VX = VX + ETA4M3 * TEMP
      VY = VY - XI4M3 * TEMP
 1460 IF ( Q28 ) 1470, 1480, 1470
 1470 TEMP = R4 + R1
      TEMP1 = TEMP - Q28
      TEMP2 = TEMP + Q28
      ARG4 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG4=ALOG(TEMP1/TEMP2)
      TEMP = ARG4 / Q28
      VX = VX - ETA4M3 * TEMP
      VY = VY - XI1M4 * TEMP
 1480 IF ( ZNPSQ .NE. 0.0 ) GO TO 1510
      TEST = SQRT(TSQ(I1)* 1.0E-3)
      IF(Q25.GT.TEST) IF((XMXI1*ETA2M1-YMETA1*XI2M1)/Q25) 1600,1502,1502
 1502 IF(Q26.GT.TEST) IF((-XMXI2*ETA2M1-YMETA2*XI3M2)/Q26)1600,1504,1504
 1504 IF(Q27.GT.TEST) IF((XMXI3*ETA4M3-YMETA1*XI4M3)/Q27) 1600,1506,1506
 1506 IF(Q28.GT.TEST) IF((-XMXI4*ETA4M3-YMETA4*XI1M4)/Q28)1600,1508,1508
 1508 VZ = 6.28318531E0
      GO TO 1600
 1510 IF (XI2M1 .NE. 0.0) VZ = ATAN(ANUM1/(ZNP*R1))-ATAN(ANUM2/(ZNP*R2))
      IF (XI3M2 .NE. 0.0)VZ=VZ+ATAN(ANUM3/(ZNP*R2))-ATAN(ANUM4/(ZNP*R3))
      IF (XI4M3 .NE. 0.0)VZ=VZ+ATAN(ANUM5/(ZNP*R3))-ATAN(ANUM6/(ZNP*R4))
      IF (XI1M4 .NE. 0.0)VZ=VZ+ATAN(ANUM7/(ZNP*R4))-ATAN(ANUM8/(ZNP*R1))
C
C  TRANSFORM INDUCED VELOCITY COMPONENTS TO REFERENCE COORDINATE SYSTEM
C  EQUATION   ( 79 )

 1600 X    ( I2) = A11 (I1) * VX + A21 (I1) * VY + A31 (I1) * VZ
      Y    ( I2) = A12 (I1) * VX + A22 (I1) * VY + A32 (I1) * VZ
      Z    ( I2) = A13 (I1) * VX  + A23 (I1) * VY + A33 (I1) * VZ
 1700 CONTINUE

 2000 IF (.NOT. AFLOW) GO TO 2010
      XIJ1(I1) = X(1)
      YIJ1(I1) = Y(1)
      ZIJ1(I1) = Z(1)
 2010 IF (.NOT. BFLOW) GO TO 2020
      XIJ2(I1) = X(1)
      YIJ2(I1) = Y(1)
      ZIJ2(I1) = Z(1)
 2020 IF (.NOT. CFLOW) GO TO 2300
      XIJ3(I1) = X(1)
```

```
      YIJ3(I1) =  Y(1)
      ZIJ3(I1) = Z(1)
      GO TO 2300
 2100 IF ( .NOT. AFLOW) GO TO 2101
      XIJ1 ( I1 ) = X ( 1 ) + X ( 2 )
      YIJ1 ( I1 ) = Y ( 1 ) + Y ( 2 )
      ZIJ1 ( I1 ) = Z ( 1 ) + Z ( 2 )
 2101 IF (.NOT. BFLOW) GO TO 2102
      XIJ2 ( I1 ) = X ( 1 ) - X ( 2 )
      YIJ2 ( I1 ) = Y ( 1 ) - Y ( 2 )
      ZIJ2 ( I1 ) = Z ( 1 ) - Z ( 2 )
 2102 IF (.NOT. CFLOW) GO TO 2300
      XIJ3 ( I1 ) = X ( 1 ) + X ( 2 )
      YIJ3 ( I1 ) = Y ( 1 ) + Y ( 2 )
      ZIJ3 ( I1 ) = Z ( 1 ) + Z ( 2 )
      GO TO 2300
 2200 IF (.NOT. AFLOW ) GO TO 2201
      XIJ1 (I1) = X ( 1 ) + X ( 2 ) + X ( 3 ) + X ( 4 )
      YIJ1 (I1) = Y ( 1 ) + Y ( 2 ) + Y ( 3 ) + Y ( 4 )
      ZIJ1 (I1) = Z ( 1 ) + Z ( 2 ) + Z ( 3 ) + Z ( 4 )
 2201 IF (.NOT. BFLOW ) GO TO 2202
      XIJ2 (I1) = X ( 1 ) - X ( 2 ) - X ( 3 ) + X ( 4 )
      YIJ2 (I1) = Y ( 1 ) - Y ( 2 ) - Y ( 3 ) + Y ( 4 )
      ZIJ2 (I1) = Z ( 1 ) - Z ( 2 ) - Z ( 3 ) + Z ( 4 )
 2202 IF (.NOT. CFLOW ) GO TO 2204
      XIJ3 (I1) = X ( 1 ) + X ( 2 ) - X ( 3 ) - X ( 4 )
      YIJ3 (I1) = Y ( 1 ) + Y ( 2 ) - Y ( 3 ) - Y ( 4 )
      ZIJ3 (I1) = Z ( 1 ) + Z ( 2 ) - Z ( 3 ) - Z ( 4 )
 2204 IF ( NSYM .EQ. 2 ) GC TC 2300
      IF (.NOT. AFLOW ) GO TO 2205
      XIJ1 ( I1 ) = XIJ1 (I1) - X ( 5 ) - X ( 6 ) - X ( 7 ) - X ( 8 )
      YIJ1 ( I1 ) = YIJ1 (I1) - Y ( 5 ) - Y ( 6 ) - Y ( 7 ) - Y ( 8 )
      ZIJ1 ( I1 ) = ZIJ1 (I1) - Z ( 5 ) - Z ( 6 ) - Z ( 7 ) - Z ( 8 )
 2205 IF (.NOT. BFLOW ) GO TO 2206
      XIJ2 ( I1 ) = XIJ2 (I1) + X ( 5 ) - X ( 6 ) - X ( 7 ) + X ( 8 )
      YIJ2 ( I1 ) = YIJ2 (I1) + Y ( 5 ) - Y ( 6 ) - Y ( 7 ) + Y ( 8 )
      ZIJ2 ( I1 ) = ZIJ2 (I1) + Z ( 5 ) - Z ( 6 ) - Z ( 7 ) + Z ( 8 )
 2206 IF ( .NOT. CFLOW ) GO TO 2300
      XIJ3 (I1) = XIJ3 (I1) - X ( 5 ) - X ( 6 ) + X ( 7 ) + X ( 8 )
      YIJ3 (I1) = YIJ3 (I1) - Y ( 5 ) - Y ( 6 ) + Y ( 7 ) + Y ( 8 )
      ZIJ3 (I1) = ZIJ3 (I1) - Z ( 5 ) - Z ( 6 ) + Z ( 7 ) + Z ( 8 )
 2300 CONTINUE
C  WRITE ONE ROW ON TAPE
C
      IF(AFLOW)WRITE(NT)       (XIJ1(J),YIJ1(J),ZIJ1(J),J=1, NELP)
      IF(BFLOW) WRITE(NT)        (XIJ2(J),YIJ2(J),ZIJ2(J),J=1,NELP)
      IF(CFLOW)WRITE(NT)       (XIJ3(J),YIJ3(J),ZIJ3(J),J=1, NELP)

      IF ( KROW .LT. NON    ) GC TO 800
      REWIND 8
 8000 REWIND NT
   42 FORMAT ( 1H0, 5X, 13HXIJ COMPONENT / ( 1H , 7F15.8))
   43 FORMAT ( 1H0, 5X, 13HYIJ COMPONENT / ( 1H [illegible]5.8))
   44 FORMAT ( 1H0, 5X, 13HZIJ COMPONENT / ( 1H [illegible]5.8))
      IF ( MPR .EQ. 0 .OR. MPR .EQ. 2 ) GO TO 907
      CALL HEADER
      DO 9060  K = 1, KRCW
      IND1 = 1 - NELL
      IND2 = 0
      I = 0
```

```
9003 IND1 = IND1 + NELL
     IND2 = IND2 + NELL
9002 I = I + 1
     NT = NTAPE ( I )
 004 IF(AFLOW)READ(NT)       (XX1(J), YY1(J), ZZ1(J),J = IND1, INC2 )
     IF(BFLOW) READ(NT)          (XX2(J),YY2(J), ZZ2(J),J=IND1,IND2)
     IF(CFLOW) READ (NT)         (XX3(J),YY3(J),ZZ3(J), J=IND1, INC2)
     IF ( I -  2   ) 9003, 9008, 9050
9008 IND1 = IND2 + 1
     IND2 = IND2 + NEL
     GO TO 9002
9050 IF (.NOT. AFLOW) GO TO 9051
     WRITE ( 6, 4004 ) K
     WRITE ( 6,  42 )   ( XX1 (J), J = 1, NQUAD)
     WRITE ( 6,  43 )   ( YY1 (J), J = 1, NQUAD)
     WRITE ( 6,  44 )   ( ZZ1 (J), J = 1, NQUAD)
9051 IF (.NOT. BFLOW ) GO TO 9052
     WRITE ( 6, 4005 ) K
     WRITE ( 6,  42 ) ( XX2 (J), J = 1, NQUAD )
     WRITE ( 6,  43 ) ( YY2 (J), J = 1, NQUAD )
     WRITE ( 6,  44 ) ( ZZ2 (J), J = 1, NQUAD )
9052 IF ( .NOT. CFLOW ) GO TO 9060
     WRITE ( 6, 4006 ) K
     WRITE ( 6,  42 ) ( XX3 (J), J = 1, NQUAD )
     WRITE ( 6,  43 ) ( YY3 (J), J = 1, NQUAC )
     WRITE ( 6,  44 ) ( ZZ3 (J), J = 1, NQUAD )
9060 CONTINUE
9070 REWIND 1
     REWIND 11
     REWIND 12
9075 WRITE ( 6, 4999 ) INEAR, INTERM, IFAR
4999 FORMAT ( 1H0,//16H0NEAR ELEMENTS =,I7/ 24H0INTERMEDIATE ELEMENTS =
    1, I7   / 15H0FAR ELEMENTS =, I7  )
     WRITE(6, 9999)
9999 FORMAT( 1H0 , 5X, 13HLEAVING VFORM)
C    RETURN
     END
```

```
*DECK,AFORM
      SUBROUTINE  AFORM
      REAL NX , NY , NZ
       LOGICAL           AFLCW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLCW,BFLCW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      DIMENSION C(6000)
      DIMENSION NX( 1000), NY( 1000), NZ( 1000), NTAPE(3)
      DIMENSION A( 1000), XIJ( 1000), YIJ( 1000), ZIJ( 1000)
      DATA  NTAPE                   / 9, 10, 13 /
   42 FORMAT ( 1H0, 5X, 13HXIJ COMPONENT / ( 1H , 7F15.8))
   43 FORMAT ( 1H0, 5X, 13HYIJ COMPONENT / ( 1H , 7F15.8))
   44 FORMAT ( 1H0, 5X, 13HZIJ COMPONENT / ( 1H , 7F15.8))
   45 FORMAT ( 1H0, 3HROW, I6 )
   46 FORMAT(1H0, 5X,  3HAIJ / (1H , 7F15.8 ))
      IF (MPR .NE. 0) CALL HEADER
      NQNN1 = NQUAD + 2
      NQNN = MOD(NQNN1, 255)
      IF (NQNN  .LT. 5 .AND. NCNN   .GT. 0) NQNN1 = NQUAD + 5
      IF (NCODE .NE. 1) GO TO 20
      IF (NAFLOW) 2, 2, 1
    1 NF1 = NAFLOW
      GO TO 5
    2 IF (NBFLOW) 4, 4, 3
    3 NF1 = NBFLOW
      GO TO 5
    4 NF1 = NCFLOW
    5 NF2 = NFLOW - NF1
      L2 = 0
      DO 6 KK = 1, NF1
      L1 = L2 + 1
      L2 = L2 + NQUAD
      READ (3)
    6 READ (3) (C(K), K = L1, L2)
      LAST1 = L2
      IF (NF2 .EQ. 0) GO TO 8
      DO 7 KK = 1, NF2
      L1 = L2 + 1
      L2 = L2 + NQUAD
      READ (3)
    7 READ (3) (C(K), K = L1, L2)
    8 DO 10 KK = 1, L2
   10 C(KK) = -C(KK)
C  **  READ IN UNIT NORMAL VECTORS
   20 READ(4) (NX(I), NY(I), NZ(I), I = 1, NQUAD)
C  FORM NORMAL VELOCITIES - EQUATION 102
   30 DO 1000 KK = 1, NQUAD
      DO 1000 NM = 1, NMAT
      CALL ROWV (XIJ, YIJ, ZIJ, (KK * NM) / NMAT + NOFF, 0)
      DO 60 K= 1, NQUAD
   60 A  (K) = NX(KK)*XIJ(K) + NY(KK)* YIJ(K) + NZ(KK)*ZIJ(K)
      IF( MPR.EQ. 0 ) GO TO 70
      WRITE(6,45) KK
      IF ( MPR .EQ. 2 ) GO TO 65
      WRITE(6,42) ( XIJ(I4), I4 = 1,NQUAD )
      WRITE(6,43) ( YIJ(I4), I4 = 1,NQUAD )
      WRITE(6,44) ( ZIJ(I4), I4 = 1,NQUAD )
      IF ( MPR - 2 ) 70, 65, 65
   65 WRITE (6, 46) (A(I4), I4 = 1, NQUAD)
```

```
   70 IF (NCODE .NE. 1) GO TO 500
      IF (NM .NE. 1) GO TO 100
      WRITE(8 )              (A(I),I=1,NQUAD),(C(I),I=KK,LAST1,NQUAD)
      GO TO 1000
  100 NT = KK + LAST1
      WRITE (10)              (A(I),I=1,NQUAD),(C(I),I=NT,L2,NQUAD)
      GO TO 1000
  500 NT = NTAPE(NM)
      IF (NM .EQ. 1) WRITE (8) NQNN1,          (A(I), I = 1, NQNN1)
      WRITE ( NT ) NQNN1,          (A(I), I = 1, NQNN1)
 1000 CONTINUE
      REWIND 8
      REWIND 9
      REWIND 10
      REWIND 13
      WRITE(6, 9999)
 9999 FORMAT( 1H0 , 5X, 13HLEAVING AFOR1)
C     RETURN
      END
```

```
*DECK,SOLVT
      SUBROUTINE SOLVIT
C     SUBROUTINE  SOLVIT (A, N[, MD, KD, NI, MM, NO, NW, *)
      COMMON/SOLVE/ NI,MM,NO,KD,MD
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,ND,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /SPACER/ A(14000)
C
C
C                 ****         ***/     *******       *****      *           ***/                  *
C                 *      *   *    /*         *        *          *          *   /*             ******
C        ****     ****       *  /   *        *        ***        *          *  /  *   ****          *    *
C                 *          */     *        *        *          *          */    *                 ***
C                 *          /***            *        *          *****      /***                    *    *
C
C             D I R E C T   M A T R I X   S O L U T I O N
C
C     WRITTEN BY J. L. HESS * PROGRAMMED BY T. M. RIDDELL
C*****LANGUAGE
C
C           FORTRAN IV
C
C*****FUNCTIONAL DESCRIPTION
C
C           THIS ROUTINE SOLVES THE REAL MATRIX EQUATION
C
C                           --      --        --      --        --      --
C                           I        I        I        I        I        I
C                           I    A   I    *   I    B   I    =   I    C   I
C                           I        I        I        I        I        I
C                           --      --        --      --        --      --
C
C                                -1
C     FOR 'B' ( B = A   * C ) .  IF 'A' IS THE REAL COEFFICIENT MATRIX
C
C     FOR A SET OF SIMULTANEOUS EQUATIONS AND 'C' IS THE MATRIX OF
```

```
C
C     CONSTANTS ( RIGHT-SIDES ), THEN 'B' WILL BE THE SOLUTIONS OF THE
C
C     SET OF SIMULTANEOUS EQUATIONS.  NOTE THAT IF 'C' IS A UNIT MATRIX,
C
C     'B' WILL BE THE INVERSE OF 'A'.
C
C*****CALL STATEMENT
C
C         CALL SOLVIT ( AREA, N, M, KORE, NT1, NT2, NT3, NOUT, &NNN )
C
C     WHERE
C
C       'AREA' IS AN ARRAY ( DIMENSIONED FOR AT LEAST 'KORE' WORDS )
C              THAT IS USED BY 'SOLVIT' FOR SCRATCH PURPOSES.
C              AFTER A NORMAL RETURN FROM 'SOLVIT', THIS ARRAY WILL
C              CONTAIN THE 'B' MATRIX STORED IN COLUMNAR ORDER.
C
C       'N'    IS THE ORDER OF THE 'A' MATRIX
C
C       'M'    IS THE NUMBER OF COLUMNS IN 'B' AND 'C'
C
C       'KORE' IS THE DIMENSIONED SIZE OF 'AREA' IN WORDS
C
C       'NT1'  IS THE LOGICAL FILE NUMBER OF THE INPUT DATA SET
C              (THIS UNIT IS ALSO USED BY 'SOLVIT' AS A SCRATCH TAPE)
C              SEE BELOW FOR THE DESCRIPTION OF THE INPUT FORMAT
C
C       'NT2'  IS THE LOGICAL FILE NUMBER OF AN AVAILABLE SCRATCH UNIT
C
C       'NT3'  IS THE LOGICAL FILE NUMBER OF AN AVAILABLE SCRATCH UNIT
C              (NT1, NT2, AND NT3 MUST ALL HAVE DIFFERENT VALUES)
C
C       'NOUT' IS THE LOGICAL FILE NUMBER OF THE OUTPUT DATA SET
C              THE 'B' MATRIX IS WRITTEN ON 'NOUT' IN COLUMNAR ORDER,
C              ONE LOGICAL RECORD PER COLUMN
C              ('NOUT' MAY EQUAL NT1, NT2, OR NT3)
C
C       '&NNN' IS THE FORTRAN STATEMENT NUMBER WHERE CONTROL IS TO BE
C              TRANSFERRED IF 'SOLVIT' DETERMINES THAT THE VALUE OF
C              'KORE' IS TOO SMALL TO ALLOW THE COMPUTATION TO CONTINUE
C              (A FORTRAN VARIABLE RETURN)
C
C*****OUTPUT
C              -1
C         B = A   C        WRITTEN IN COLUMNAR ORDER (ONE LOGICAL RECORD
C                          PER COLUMN) ON 'NOUT' AND STORED IN 'AREA'
C
C*****STORAGE REQUIRED
C
C         F5E HEXADECIMAL BYTES
C
C*****METHOD
C
C         GAUSSIAN ELIMINATION
C              NOTE...THE ROWS ARE NOT NORMALIZED
C                     THE PIVOT IS ASSUMED TO BE THE DIAGONAL ELEMENT
C
C*****GENERAL NOTES
C
```

```
C         THE VALUE OF 'KORE' MUST BE SUFFICIENT TO STORE
C               MAX0 ( 3 * (N + M), N * M ) REAL VALUES
C
C         THE 'A' AND 'C' MATRICES MUST BE INPUT IN ROW ORDER . . . .
C               ONE LOGICAL RECORD PER ROW OF THE 'A' AND 'C' MATRICES
C               I.E.,
C
C         .                               .                               .
C         .   1 ROW OF THE 'A' MATRIX     .   1 ROW OF THE 'C' MATRIX     .
C         .................................................................
C         .      ('N' REAL VALUES)        .      ('M' REAL VALUES)        .
C         *                                                               *
C         *****************************************************************
C         *                     ONE LOGICAL RECORD                        *
C         *                   ('N' + 'M' REAL VALUES)                     *
C
C
C         'NOUT' IS NOT POSITIONED PRIOR TO THE WRITING OF 'B'
C
C
C     DIMENSION  A ( KD )
C
      LOGICAL  LAST
C
      NW=3
      N = ND
      M = MD
      KORE = KD
      NPM = N + M
      IF (MAX0(3 * NPM, M * N) .LE. KORE) GO TO 5
 2475 WRITE (6, 2480) NQUAD, MD , KORE
 2480 FORMAT (4H1THE,I4, 2H X,I3, 15H MATRIX EXCEEDS,I6, 7H WORDS. )
      CALL EXIT
    5 MT = MM
      REWIND MT
      NIN = NI
      REWIND NIN
      NOUT = NO
      REWIND NOUT
      MP1 = M + 1
      NN = N
      NEL = NPM
C
C - - CALCULATE THE MAXIMUM NO. OF ROWS, 'K'
C
   10 K = (KORE - NEL) / NEL
C
C - - TEST TO SEE IF THE REST OF THE MATRIX WILL FIT IN CORE
C
      LAST = K .GE. NN
      IF (LAST) K = NN
C
C - - READ 'K' ROWS OF THE AUGMENTED 'A' MATRIX
C
   30 NT = 0
      DO 40 IB = 1, K
      NS = NT + 1
      NT = NT + NEL
   40 READ (NIN) (A(IO), IO = NS, NT)
C
```

```
C - - CHECK TO SEE IF WE WERE UNLUCKY ENOUGH TO END UP WITH ONLY ONE ROW
C
      IF (K .EQ. 1) GO TO 90
C
C - - 'K' IS GREATER THAN "1" SO WE CAN START THE TRIANGULARIZATION
C
      NELP1 = NEL + 1
      NS = - NEL
      NELP2 = NELP1 + 1
C
C - - FORM THE 'TRAPEZOICAL' ARRAY  (8)
C
      DO 50 IB = 2, K
      NP = NELP2 - IB
      NS = NS + NELP1
      NT = NS
      DO 50 IO = IB, K
      NT = NT + NEL
      MN = NT
      NB = NS
      A(NT) = (-A(NT)) / A(NS)
      DO 50 NF = 2, NP
      MN = MN + 1
      NB = NB + 1
   50 A(MN) = A(MN) + A(NT) * A(NB)
      IF (LAST) GO TO 90
C
C - - WRITE THE 'TRAPEZOIDAL' MATRIX ON TAPE
C
      NT = 0
      NP = NEL
      NS = - NEL
      DO 60 IO = 1, K
      NS = NS + NELP1
      NT = NT + NEL
      WRITE (MT) NP, (A(IB), IB = NS, NT)
   60 NP = NP - 1
      NP = NP - M
      NS = KORE - NEL + 1
C
C - - READ ANOTHER ROW
C
      DO 80 IO = 1, NP
      READ (NIN) (A(IB), IB = NS, KORE)
C
C - - MODIFY THIS ROW BY THE 'TRAPEZOIDAL' ARRAY
C
      NT = 1
      MN = NS
      DO 70 IB = 1, K
      NB = NT
      NF = MN + 1
      A(MN) = (-A(MN)) / A(NT)
      DO 65 NN = NF, KORE
      NB = NB + 1
   65 A(NN) = A(NN) + A(MN) * A(NB)
      MN = NF
   70 NT = NT + NELP1
C
C - - WRITE THE MODIFIED ROW ON TAPE
```

```
C
   80 WRITE (NOUT)      (A(NT), NT = MN, KORE)
      REWIND NOUT
      REWIND NIN
C
C - - SWITCH THE TAPES
C
      NT = NIN
      NIN = NOUT
      NOUT = NT
C
C - - RE-CALCULATE ROW LENGTH AND LOOP BACK
C
      NEL = NEL - K
      NN = NEL - M
      GO TO 10
C
C - - REWIND ALL TAPES
C
   90 REWIND MT
      REWIND NIN
      REWIND NOUT
C
C - - CONDENSE THE MATRIX
C
      NN = NEL
      NL = NELP1
      IF (K .EQ. 1) GO TO 105
      NS = 1
      NT = NEL
      DO 100 IB = 2, K
      NS = NS + NELP1
      NT = NT + NEL
      DO 100 IO = NS, NT
      A(NL) = A(IO)
  100 NL = NL + 1
  105 N1 = KORE - K * M + 1
C
C - - THERE, NOW WE CAN START THE BACK-SOLUTION
C * * NOTE..THE FIRST AVAILABLE LOCATION FOR THE SOLUTIONS IS A(N1)
C
      NREM = N
      NEL = NPM
      LAST = K .EQ. N
      NPASS = 0
C
C - - SOLVE FOR THE ANSWERS CORRESPONDING TO 'K' ROWS
C
  110 KM1 = K - 1
      KP1 = K + 1
      NS = NL - MP1
      NPASS = NPASS + 1
      DO 130 MN = 1, M
      NF = NS + MN
      A(NF) = A(NF) / A(NS)
      NT = NS
      IF (KM1 .EQ. 0) GO  TO 130
      DO 125 IB = 1, KM1
      NF = NF - IB - M
      NT = NT - MP1 - IB
```

```
      SUM = 0.0
      NP = NF
      N2 = MP1 + IB
      DO 120 IO = 1, IB
      NN = NT + IO
      NP = NP + N2 - IO
  120 SUM = SUM + A(NN) * A(NP)
  125 A(NF) = (A(NF) - SUM) / A(NT)
  130 CONTINUE
C
C - - MOVE THE SOLUTIONS TO CONTIGUOUS LOCATIONS STARTING AT A(N1)
C
      N1 = KORE + 1
      DO 140 NN = 1, K
      DO 135 MN = 1, M
      NL = NL - 1
      N1 = N1 - 1
  135 A(N1) = A(NL)
  140 NL = NL - NM
C
C - - WRITE THE SOLUTIONS ON TAPE
C
      WRITE (NIN) K
      NS = N1 - 1
      DO 145 MN = 1, M
      NT = NS + MN
  145 WRITE ( NIN ) (A(IO), IO = NT, KORE, M)
C
C - - TEST IF THIS IS THE LAST PASS
C
      IF (LAST) GO TO 200
C
C - - WE MUST NOW MODIFY THE TRIANGULAR MATRIX TO REFLECT THE EFFECT OF
C     THE SOLUTIONS OBTAINED SO FAR  (EQ 21)
C * * NOTE..LOCATIONS A(1) TO A(N1-1) ARE NOW FREE TO USE
C
C - - CALCULATE THE NEXT VALUES OF 'NEL' AND 'NREM'
C
      NELOLD = NEL
      KOLD = K
      NEL = NEL - K
      NREM = NREM - K
C
C - - NOW APPLY THE INCREDIBLE FORMULA FOR THE NEW 'K'
C
      K = (-4 * M - 1) / 2 + IFIX(SQRT(0.25 + FLOAT((4 * M + 2) * M +
     1 2 * (KORE - NELOLD))))
      NROW = NREM - K + 1
      IF (K .LT. NREM) GO TO 150
      LAST = .TRUE.
      NROW = 1
      K = NREM
  150 NS = 1
      NT = NELOLD + 1
C
C - - READ IN THE ROWS TO BE MODIFIED
C
      DO 190 IB = 1, NREM
      NT = NT - 1
      IF (IB .LE. NROW) GO TO 160
```

```
      NS = NS + NN
      NT = NT + NN
  160 READ ( MT ) NN, (A(IO), IO = NS, NT)
      NP = N1 - 1
      NF = NT - M - KM1
      NN = NN - KOLD
      DO 170 MN = 1, M
      N2 = NF
      NA = NP + MN
      NB = NA
      SUM = 0.0
      DO 165 IO = 1, KOLD
      SUM = SUM + A(N2) * A(NA)
      N2 = N2 + 1
  165 NA = NA + M
      N2 = N2 + MN - 1
  170 A(N2) = A(N2) - SUM
C
C - - WRITE THE MODIFIED ROW ON TAPE OR CONDENSE THE ROW
C
      NL = NT - M + 1
      IF (IB .GE. NROW) GO TO 175
      NF = NL - KP1
      WRITE (NOUT) NN, (A(IO), IO = NS, NF), (A(IO), IO = NL, NT)
      GO TO 190
  175 NF = NL - KOLD
      DO 180 MN = NL, NT
      A(NF) = A(MN)
  180 NF = NF + 1
  190 CONTINUE
      REWIND MT
      REWIND NOUT
C
C - - SWITCH THE TAPES
C
      NT = MT
      MT = NOUT
      NOUT = NT
C
C - - LOOP BACK THRU THE SOLUTION
C
      NL = NF
      GO TO 110
C
C - - START TO WRAP IT UP
C
  200 REWIND NIN
      N2 = N
C
C * * NOTE.. AT THIS POINT ALL LOCATIONS A(1) THRU A(KORE) ARE FREE
C
      DO 220 IB = 1, NPASS
      READ (NIN) K
      N1 = N2 - K + 1
      NS = N1
      NT = N2
C
C - - READ IN THE SOLUTIONS
C
      DO 210 IO = 1, M
```

```
      READ (NIN) (A(NN), NN = NS, NT)
      NT = NT + N
  210 NS = NS + N
  220 N2 = N1 - 1
C
C - - WRITE THE SOLUTIONS CN TAPE
C
      NT = 0
      DO 230 IO = 1, M
      NS = NT + 1
      NT = NT + N
  230 WRITE (NW) (A(NN), NN = NS, NT)
C
      WRITE (6, 300) N, N, M
  300 FORMAT (4H0THE,I5, 2H X,I5, 12H MATRIX WITH,I4, 33H RIGHT SIDES WA
     1S SOLVED DIRECTLY.)
C     RETURN
      END
```

```
*DECK,SIGMA
      SUBROUTINE SIGMA
C     SUBROUTINE SIGMA ( NSKIP )
      COMMON /SIG/ NSKIP
      DIMENSION L(100), C( 6000), DSIG1(100)
      DIMENSION A(1000)
      DIMENSION SIG(6000)
      COMMON HEDR(15),MPR,MER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON / ATAPE / NCOPY
       NT = NCOPY + 8
      NTAPE = NCOPY
      IF ( ISIG .NE. 0 ) GO TO 1
      M = 2
      GO TO 2
    1 M = 3
    2 IF (NSKIP .EQ. 0) GO TO 11
      N  = M * NSKIP
      DO 3 K = 1, N
    3 READ(3)
   11 N1 = 1
      N2 = NQUAD
      DO 5 I = 1, NCFLG
      READ (3)
      READ(3) ( C(K), K = N1, N2)
      IF( ISIG .NE. 0) READ (3) (SIG(K), K = N1, N2)
      N1 = N2 +1
    5 N2 = N2 + NQUAD
      N = (NFLOW - NSKIP - NCFLG) * M + NSKIP
      IF ( N .EQ. 0 ) GO TO 67
      DO 66 K = 1, N
   66 READ (3)
   67 ITER = 0
      NCONV = 0
      DO 12 J = 1, NCFLG
      L(J) = 0
      JN = NQUAD * ( J - 1 )
```

```
      DO 12  I = 1, NQUAD
      K1 = I + JN
   12 IF( ISIG .EQ. 0) SIG(K1) = 0.0
   20 DO 22 I = 1, NCFLG
   22 DSIG1 ( I ) = 0.0
      DO 80 I= 1, NQUAD
      READ ( NTAPE ) NQ, ( A(J), J = 1, NQUAD )
      DO 80 J = 1, NCFLG
      IF(    L(J)  .NE. 0) GO TO 80
      SUM = 0.0
      JN = NQUAD * ( J - 1 )
      DO 60 K = 1, NQUAD
      K2 = K + JN
   60 SUM = SUM + A(K) * SIG(K2)
      K1 = I + JN
      DSIG2 =(-C(K1) - SUM) / A(I)
      SIG(K1) = SIG(K1) + DSIG2
      DSIG1(J) = AMAX1(ABS(DSIG2), DSIG1(J))
   80 CONTINUE
       ITER = ITER + 1
      REWIND NTAPE
      IF( IPRS .EQ. 0) GO TO 85
       WRITE(6,9998) ITER
 9998 FORMAT(1H , 5X, 17H ITERATION NOS.    , I3)
      DO 82 K = 1, NCFLG
      K1 = NQUAD * ( K-1) + 1
      K2 = K1 + NQUAD
   82 WRITE(6, 10) K , (     SIG(I), I = K1, K2)
   10 FORMAT ( 1H , 5X, 12H FLOW NUMBER    , I4 / ( 5X, 6F15.8))
   85 DO 400 J = 1 , NCFLG
      IF( L(J) .NE. 0) GO TO 400
      IF(DSIG1(J) .GE. 1.0E-4) GO TO 400
      L ( J ) = ITER
      NCONV = NCONV + 1
      IF ( NCONV .EQ. NCFLG )  GO TO 500
  400 CONTINUE
      NTAPE = NT - NTAPE
      IF ( ITER - 100) 20, 500, 20
  500 DO 650 J = 1, NCFLG
      IF ( L ( J ) .EQ. 0 )  GO TO 550
      WRITE ( 6, 6 )  L ( J )
    6 FORMAT (1H0, 5X, I5, 2X, 35HITERATIONS REQUIRED FOR CONVERGENCE )
      GO TO 650
  550 WRITE ( 6, 7 )
    7 FORMAT (1H0, 8X, 35HNO CONVERGENCE AFTER 100 ITERATIONS )
      K1 = NQUAD * ( J-1) + 1
      K2 = K1 + NQUAD
      WRITE(6,8) (SIG(I), I = K1,K2)
    8 FORMAT( 1H , 5X, 8F12.7)
  650 CONTINUE
      NN = NQUAD
      M = MOD(NN, 255)
      IF (M .LT. 5 .AND. M .GT. 0)  NN = NN + 5
      N1 = 1
      DO 675 J = 1, NCFLG
      WRITE (3) (SIG(K), K = N1, NN)
      N1 = N1 + NQUAD
  675 NN = NN + NQUAD
      REWIND 3
      WRITE(6, 9999)
```

```
 9999 FORMAT( 1H0 , 5X, 13HLEAVING SIGMA)
C     RETURN
      END




*DECK,ATAPS
      SUBROUTINE ATAPES
C     SUBROUTINE ATAPES ( KFLOW )
      COMMON /TAPES/ KFLOW

C- - -DEFINITION OF ARGUMENTS

C     NQ              NUMBER OF VALUES OF 'A' PER RECORD
C     KFLOW           FLOW-FLAG, 1 = A-FLOW, 2 = B-FLOW, 3 = C-FLOW
C     NCOPY           TAPE NUMBER TO BE USED BY 'ROWA'

      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON / ATAPE / NCOPY
      DIMENSION A(1000),NLINE(500),NLT(500),XNULL(1000),YNULL(1000),
     1 ZNULL(1000),XNORM(1000),YNORM(1000),ZNORM(1000),XOFF(1000),
     2 YOFF(1000),ZOFF(1000)
      IF ( KFLOW - 2 ) 100, 200, 300
  100 NCOPY = 9
      GO TO 1000
  200 NCOPY = 10
      GO TO 400
  300 NCOPY = 13

C- - -START OF LOOP

  400 DO 900 N = 1, NQUAD
      NTRY = 0
  500 CKSUM = 0.0

C- - -READ THE 'A' MATRIX FROM THE APPROPRIATE TAPE

      READ ( NCOPY ) NQ,          (A(I), I = 1, NQ)

  900 WRITE ( 8 ) NQ,          (A(I), I = 1, NQ)
      GO TO 1400
C- - -THE PURPOSE OF THE FOLLOWING 'MICKEY MOUSE' IS TO RE-POSITION THE
C     CONTROL TABLES, NULL POINTS, AND UNIT NORMALS AT THE BEGINNING OF
C     THE TAPE.  THIS ELIMINATES SKIPPING THE '28 QUANTITIES' EACH TIME.
 1000 READ (4) KLCT, (NLINE(J),NLT(J), J = 1, KLCT)
      READ (4) (XNULL(J),YNULL(J),ZNULL(J),XNORM(J),YNORM(J),ZNORM(J),
     1 J = 1, NQUAD)
      IF (NOFF .GT. 0) READ (4) (XOFF(J), YOFF(J), ZOFF(J), J=1, NOFF)
      REWIND 4
      WRITE (4) KLCT, (NLINE(J), NLT(J), J = 1, KLCT)
      DO 1100 J = 1, NQUAD
 1100 WRITE (4) XNULL(J),YNULL(J),ZNULL(J),XNORM(J),YNORM(J),ZNORM(J)
      IF (NOFF .EQ. 0) GO TO 1300
      DO 1200 J = 1, NOFF
 1200 WRITE (4) XOFF(J),YOFF(J),ZOFF(J),XOFF(J),YOFF(J),ZOFF(J)
 1300 REWIND 4
 1400 REWIND 8
```

```
      REWIND NCOPY
      WRITE (6, 1500)
 1500 FORMAT (1H0, 5X, 14HLEAVING ATAPES)
C     RETURN
      END
```

```
*DECK,PRINT
      SUBROUTINE PRINT1
C     SUBROUTINE PRINT1( NSKIP, MN, KMAT, NSEQ)
      COMMON /PRINT0/ KMAT,NSEQ,KTP14
      COMMON /TAPES/ MN
      COMMON /SIG/ NSKIP
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      REAL NX , NY , NZ, MACH
      LOGICAL PUNCHV
      COMMON /M/ MACH, BETA, RBETA
      DIMENSION              FLOWID(3),
     1 VX(2000), VY(2000), VZ(2000),
     4 NST(500), NCL(500)
      DIMENSION SIG(1000), XIJ(1000), YIJ(1000), ZIJ(1000)
      DATA FLOWID / 2HX-, 2HY-, 2HZ- /, PROG / 4HBOXC /
      PUNCHV = .FALSE.
      NTIME = NQUAD + NOFF
      LCMAX = 12
C     READ IN IDENTIFYING INTEGERS
C
      READ(4) INSECT, ( NST(J) , NCL(J) , J = 1, INSECT)
      DO 2000 L = 1, NCFLG
      IF( ISIG .NE. 0) GO TO 1
      M = 2
      GO TO 2
    1 M = 3
    2 N = M * (NSKIP + L - 1)
      IF (N .EQ. 0) GO TO 4
      DO 3 J = 1, N
    3 READ (3)
    4 READ ( 3) KFLOW, (VX(IJ), VY(IJ), VZ(IJ), IJ = 1, NTIME )
      IF ( KFLOW .EQ. KMAT ) GO TO 9
      CALL HEADER
      WRITE (6, 8) KFLOW, KMAT
    8 FORMAT ( 1H0,6X,48HAN APPARENT FLOW MIS-MATCH HAS OCCURRED. KFLOW
     1=, I2, 7H KMAT =, I2 )
      CALL EXIT
    9 N = (NFLOW - NSKIP - L + 1) * M + NSKIP + L - 2
      DO 5 J = 1, N
    5 READ (3)
      READ (3) (SIG(J), J = 1, NQUAD)
      REWIND 3
      IF(KTP14 .EQ. 1) WRITE(14) (SIG(J), J=1,NQUAD)
      IF(KTP14 .EQ. 1) ENDFILE 14
      REWIND 14
      IF (MN .EQ. 1) GO TO 15
      NRSKIP = MN - 1
      DO 10 JM = 1, NRSKIP
      READ (1)
```

```
      READ (11)
   10 READ (12)
   15 LC = LCMAX
      INSECT  = 1
      M = 0
      IF (L .GT. 1) READ (4)
      DO  1000  IS  = 1, NTIME
      READ(4) XN, YN, ZN, NX, NY, NZ
      IF ( MACH .EQ. 0.0 ) GO TO 17
      CORR = 1.0 / SQRT(NX * NX + BETA * BETA * (NY * NY + NZ * NZ))
      NX = NX * CORR
      NY = NY * BETA * CCRR
      NZ = NZ * BETA * CORR
      XN = XN * BETA
   17 VIX = 0.0
      VIY =  0.0
      VIZ =  0.0
      CALL ROWV(XIJ, YIJ, ZIJ, IS, 1)
      DO  20 I1 =  1, NQUAD
C
C     VELOCITY COMPONENTS   EQ. (135) OR EQ. (140)
C
      VIX  = VIX  + XIJ( I1 ) *  SIG(I1)
      VIY  = VIY  + YIJ( I1 ) *  SIG(I1)
   20 VIZ  = VIZ  + ZIJ( I1 ) *  SIG(I1)
      VIX = VIX * RBETA * RBETA + VX(IS)
      VIY = VIY * RBETA + VY(IS)
      VIZ = VIZ * RBETA + VZ(IS)
C     IF ( PUNCHV ) GO TO 26
      IF ( IS .EQ. NQUAD .OR. IS .EQ. NTIME ) GO TO 22
      VIXT = VIX
      VIYT = VIY
      VIZT = VIZ
C     PUNCHV = .TRUE.
      GO TO 30
   22 NSEQ = NSEQ + 1
      IF(PUNCHV)
     1WRITE ( 7, 24 ) VIX, VIY, VIZ, KASE, PROG, NSEQ
   24 FORMAT ( 3F10.7, 36X,A4, 2X,A4, I4)
      GO TO 28
   26 NSEQ = NSEQ + 1
      WRITE ( 7, 27 ) VIXT, VIYT, VIZT, VIX, VIY, VIZ, KASE, PROG, NSEQ
   27 FORMAT ( 6F10.7, 6X,A4, 2X,A4, I4)
   28 PUNCHV = .FALSE.
C           TOTAL VELOCITY MAGNITUDE        EQ. ( 136 )
C
   30 VTSQ = VIX * VIX + VIY * VIY + VIZ * VIZ
      VT = SQRT ( VTSQ)
C
C     PRESSURE COEFFICIENT  EQ. (137)
C
      CPI =  1.0  -  VTSQ
C
C     DIRECTION COSINES OF THE TOTAL VELOCITY VECTOR  EQ. (138)
      GIX = VIX / VT
      GIY = VIY / VT
      GIZ = VIZ / VT
      LC = LC +1
      IF (IS .GT. NQUAD) GO TO 50
C     TOTAL NORMAL VELOCITY   EQ.  (139)
```

C-3

```
C
      VNI = VIX * NX + VIY * NY + VIZ * NZ
      N = NST ( INSECT )
      MMAX = IABS ( NCL ( INSECT ) )
      M = M + 1
      IF( LC .LT. LCMAX) IF (M - 1) 40, 35, 40
      WRITE (6, 3000)
 3000 FORMAT ( 1H0,  4X,1H.,84X,1H. )
      CALL HEADER
      LC  = 0
      WRITE (6, 4030) FLOWID(KFLOW)
 4030 FORMAT (1H0, 45X, A2, 4HFLOW)
      WRITE(6,4000)
   35 WRITE(6, 4005) N, M, XN, VT, VIX, GIX, NX, VNI
      GO TO 45
 4015 FORMAT(1H0, 3(17X , 2( 6H****** ) ) )
 4000 FORMAT(1H0, 6X ,5HN    M,8X, 3HNPX,10X, 2HVT , 12X, 2HVX , 10X ,
     1 3HDCX, 11X, 2HNX ,10X, 2HVN  /
     21H ,19X, 3HNPY , 9X, 4HVTSQ ,11X, 2HVY ,10X, 3HDCY,11X, 2HNY ,10X,
     33HSIG/
     41H ,19X, 3HNPZ ,10X, 4HCF   , 10X, 2HVZ ,10X, 3HDCZ,11X, 2HNZ     )
 4005 FORMAT(1H0,3X, 2I4 , 6F13.6)
 4010 FORMAT(1H0,7X, I4  , 6F13.6)
 4020 FORMAT( 1H , 11X, 6F13.6)
   40 WRITE(6,4010) M, XN, VT, VIX, GIX, NX, VNI
   45 WRITE(6, 4020) YN, VTSQ, VIY, GIY, NY, SIG(IS), ZN,
     1 CPI , VIZ, GIZ, NZ
      IF( M .LT. MMAX) GC TO 1000
      IF (NCL(INSECT) .GT. 0) GO TO 48
      WRITE (6, 4015)
      LC = LC + 1
   48 M = 0
      INSECT = INSECT + 1
      GO TO 1000
   50 IF ( LC .LT. LCMAX .AND. IS .NE. (NQUAD + 1))  GO TO 60
      WRITE (6, 3000)
      CALL HEADER
      LC = 0
      WRITE (6, 4030) FLOWID(KFLOW)
      WRITE (6, 55)
   55 FORMAT (1H0,6X,5HPCINT,13X,2HX ,19X,2HVT,18X,2HVX,17X,3HDCX, /,
     125X,2HY ,17),4HVTSQ,17X,2HVY,17X,3HDCY, /,
     225X,2HZ ,18X,2HCP,18X,2HVZ,17X,3HDCZ, // )
C
C     WRITE THE OFF-BODY ANSWERS
C
   60 N = IS - NQUAD
      WRITE (6,65) N,XN,VT,VIX,GIX,YN,VTSQ,VIY,GIY,ZN,CPI,VIZ,GIZ
   65 FORMAT (1H0, I9, 4F20.6, / (10X, 4F20.6))
C
 1000 CONTINUE
      REWIND 4
      IF (NOFF .GT. 0) WRITE (6, 4015)
 2000 CONTINUE
      WRITE(6, 9999)
 9999 FORMAT( 1H1 , 5X, 14HLEAVING PRINT1)
C     RETURN
      END
```

```
*DECK,WTAP14
      SUBROUTINE WTAP14
C
C     WRITES 28 QUANTITIES ON TAPE14 FOR USE BY THE PARTICLE TRAJECTORY
C     CODES.  REVISED 3/22/77.
C
      COMMON HEDR(15),MPF,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /SPACER/ DUMMY (14000)
      REAL IXX,IXY,IYY,MACH
      COMMON /M/ MACH, BETA, RBETA
      DIMENSION                D41(1000),     XC(1000),YC(1000),ZC(1000),
     1 A11(1000),A12 (1000),A13 (1000),A21(1000),A22(1000),A23(1000),
     2 A31(1000),A32 (1000),A33 (1000),XI1(1000),XI2(1000),XI3(1000),
     3 XI4(1000),ETA1(1000),ETA2(1000),ETA4(1000),TSQ(1000),A(1000),
     4 IXX(1000),IXY (1000),IYY (1000),D12 (1000),D23(1000),D34(1000)
      EQUIVALENCE (DUMMY(1), D41), (DUMMY(1001), XC), (DUMMY(2001), YC),
     1  (DUMMY(3001), ZC), (DUMMY(4001),  A11), (DUMMY(5001), A12),
     2  (DUMMY(6001),  A13), (DUMMY(7001),  A21), (DUMMY(8001), A22),
     3  (DUMMY(9001), A23), (DUMMY(10001),  A31), (DUMMY(11001), A32),
     4  (DUMMY(12001), A33), (DUMMY(13001), XI1)
C
      REWIND 14
      WRITE(14) KASE,NSYM,NQUAD,RBETA, MACH
      DO 100 J=1,NQUAD
  100 READ (4) XC(J), YC (J), ZC(J), A11(J), A12(J), A13(J), A21(J),
     1 A22(J), A23(J), A31(J), A32(J), A33(J),       XI1(J),ETA1(J),XI2(
     2 J), ETA2(J), XI3(J), XI4(J), ETA4(J), TSQ(J), A (J), IXX (J),
     3 IXY (J), IYY(J), D12(J), D23(J), D34(J), D41(J)
      WRITE(14)(XC(J),YC (J), ZC(J), A11(J), A12(J), A13(J), A21(J),
     1 A22(J), A23(J), A31(J), A32(J), A33(J),       XI1(J),ETA1(J),XI2(
     2 J), ETA2(J), XI3(J), XI4(J), ETA4(J), TSQ(J), A (J), IXX (J),
     3 IXY (J), IYY(J), D12(J), D23(J), D34(J), D41(J) ,J=1,NQUAD)
      REWIND 4
      END
```

```
      PROGRAM FLOPNT( INPUT, TAPE6, TAPE5=INPUT, TAPE14, OUTPUT)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     CALLS FLOVEL TO COMPUTE AND PRINT FLOW VELOCITIES AT SPECIFIED
C     POINTS IN SPACE.  INPUT INTEGERS M(3) SPECIFY THE ORDER IN WHICH
C     INCREMENTING IS DONE - ALLOWED VALUES OF M ARE 1,2,3.  FOR EXAMPLE
C     SUPPOSE M(1)=2, M(2)=1, M(3)=3, THEN Y IS INCREMENTED FIRST, X IS
C     INCREMENTED SECOND AND Z IS INCREMENTED LAST.
C     OTHER INPUT DATA ARE (IN ORDER OF X AXIS FIRST, Y AXIS SECOND,
C     Z AXIS THIRD)- INITIAL COORDINATE, INCREMENT, NUMBER OF INCREMENTS
C     DESIRED (INCLUDING THE INITIAL COORDINATE VALUE).
C
C     NOTE - POINTS THAT ARE INSIDE THE BODY ARE MARKED WITH AN ASTERIX
C     IN THE PRINTOUT.
C
      DIMENSION HOLL(18), X(3), D(3), N(3), M(3), SX(3), SD(3), NS(3),
     1 SXI(3), SEQ(6)
      DATA SEQ/ 4HFIRS, 4HT   , 4HSECO, 4HND  , 4HTHIR, 4HD   /
      DATA STAR, BLNK / 3H  *, 3H   /
      READ( 5, 2600) KASE
      CALL SETFLO( KASE )
      READ( 5, 1300 ) HOLL
      WRITE( 6, 1400) HOLL
    5 READ(5,1100)M
      IF(IABS(M(1))+IABS(M(2))+IABS(M(3)).EQ. 0) STOP
      IF(M(1)+M(2)+M(3) .EQ. 6) GO TO 10
      WRITE(6,1200)
      STOP
   10 DO 20 L=1,3
   20 READ(5,1000) X(L), D(L), N(L)
      WRITE( 6, 1700)
      WRITE(6,2000) X(1), D(1), N(1)
      WRITE(6,3000) X(2), D(2), N(2)
      WRITE(6,4000) X(3), D(3), N(3)
      WRITE(6,9000)
      WRITE(6,5000) SEQ(2*M(1)-1), SEQ(2*M(1))
      WRITE(6,6000) SEQ(2*M(2)-1), SEQ(2*M(2))
      WRITE(6,7000) SEQ(2*M(3)-1), SEQ(2*M(3))
      WRITE( 6, 1600 )
      DO 40 L=1,3
      LL=4-M(L)
      SD(LL)=D(L)
      SXI(LL)=X(L)-D(L)
   40 NS(LL)=N(L)
      N1=NS(1)
      N2=NS(2)
      N3=NS(3)
      SX(1)=SXI(1)
      DO 500 I=1,N1
      SX(1)=SX(1)+SD(1)
      SX(2)=SXI(2)
      DO 500 J=1,N2
      WRITE( 6,1900)
      SX(2)=SX(2)+SD(2)
      SX(3)=SXI(3)
      DO 500 K=1,N3
```

FOLDOUT FRAME

```
PROGRAM FLOPNT( INPUT, TAPE6, TAPE5=INPUT, TAPE14, OUTPUT)

H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979

CALLS FLOVEL TO COMPUTE AND PRINT FLOW VELOCITIES AT SPECIFIED
POINTS IN SPACE.  INPUT INTEGERS M(3) SPECIFY THE ORDER IN WHICH
INCREMENTING IS DONE - ALLOWED VALUES OF M ARE 1,2,3.  FOR EXAMPLE
SUPPOSE M(1)=2, M(2)=1, M(3)=3, THEN Y IS INCREMENTED FIRST, X IS
INCREMENTED SECOND AND Z IS INCREMENTED LAST.
OTHER INPUT DATA ARE (IN ORDER OF X AXIS FIRST, Y AXIS SECOND,
Z AXIS THIRD)- INITIAL COORDINATE, INCREMENT, NUMBER OF INCREMENTS
DESIRED (INCLUDING THE INITIAL COORDINATE VALUE).

NOTE - POINTS THAT ARE INSIDE THE BODY ARE MARKED WITH AN ASTERIX
IN THE PRINTOUT.

DIMENSION HOLL(18), X(3), D(3), N(3), M(3), SX(3), SD(3), NS(3),
 SXI(3), SEQ(6)
DATA SEQ/ 4HFIRS, 4HT   , 4HSECO, 4HND  , 4HTHIR, 4HD   /
DATA STAR, BLNK / 3H  *, 3H   /
READ( 5, 2600) KASE
CALL SETFLO( KASE )
READ( 5, 1300 ) HOLL
WRITE( 6, 1400) HOLL
READ(5,1100)M
IF(IABS(M(1))+IABS(M(2))+IABS(M(3)).EQ. 0) STOP
IF(M(1)+M(2)+M(3) .EQ. 6) GO TO 10
WRITE(6,1200)
STOP
DO 20 L=1,3
READ(5,1000) X(L), D(L), N(L)
WRITE( 6, 1700)
WRITE(6,2000) X(1), D(1), N(1)
WRITE(6,3000) X(2), D(2), N(2)
WRITE(6,4000) X(3), D(3), N(3)
WRITE(6,9000)
WRITE(6,5000) SEQ(2*M(1)-1), SEQ(2*M(1))
WRITE(6,6000) SEQ(2*M(2)-1), SEQ(2*M(2))
WRITE(6,7000) SEQ(2*M(3)-1), SEQ(2*M(3))
WRITE( 6, 1600 )
DO 40 L=1,3
LL=4-M(L)
SD(LL)=D(L)
SXI(LL)=X(L)-D(L)
NS(LL)=N(L)
N1=NS(1)
N2=NS(2)
N3=NS(3)
SX(1)=SXI(1)
DO 500 I=1,N1
SX(1)=SX(1)+SD(1)
SX(2)=SXI(2)
DO 500 J=1,N2
WRITE( 6,1900)
SX(2)=SX(2)+SD(2)
SX(3)=SXI(3)
DO 500 K=1,N3
```

```
      SX(3)=SX(3)+SD(3)
      DO 50 L=1,3
      LL=4-M(L)
   50 X(L)=SX(LL)
      CALL FLOVEL( X(1), X(2), X(3), VX, VY, VZ, 0.10, INBDY)
      V = SQRT( VX**2 + VY**2 + VZ**2 )
      IF( INBDY ) 100, 200, 100
  100 WRITE(6,1500) X(1), X(2), X(3), VX, VY, VZ, V, STAR
      GO TO 500
  200 WRITE(6,1500) X(1), X(2), X(3), VX, VY, VZ, V, BLNK
  500 CONTINUE
      WRITE( 6, 1600 )
      GO TO 5
 1000 FORMAT( 2E10.0,I4)
 1100 FORMAT(3I2)
 1200 FORMAT(///10X, 47HINCREMENTING SEQUENCE IS ERRONIOUS.  TRY AGAIN.)
 1300 FORMAT( 18A4)
 1400 FORMAT( 1H1, 9X, 15HFLOPNT RUN ID -/ 15X, 18A4//)
 1500 FORMAT( 3X, 3F12.7, 2X, 4(1PE13.4),A3)
 1600 FORMAT(1H0,20X,40H* INDICATES THE POINT IS INSIDE THE BODY)
 1700 FORMAT( 1H0, 5X, 12HINPUT DATA -/)
 1900 FORMAT(  // 10X, 1HX, 11X, 1HY, 11X, 1HZ, 13X, 2HVX, 11X, 2HVY,
     1 11X, 2HVZ, 11X, 1HV)
 2600 FORMAT( A4)
 2000 FORMAT( 10X, 10HINITIAL X=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 3000 FORMAT( 10X, 10HINITIAL Y=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 4000 FORMAT( 10X, 10HINITIAL Z=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 5000 FORMAT( 10X, 22HX AXIS IS INCREMENTED 2A4)
 6000 FORMAT( 10X, 22HY AXIS IS INCREMENTED 2A4)
 7000 FORMAT( 10X, 22HZ AXIS IS INCREMENTED 2A4)
 9000 FORMAT(1H0)
      END
```

```
*DECK,PRFUN
      FUNCTION PRFUN(R, DLR, COF)
C
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     RETURNS THE COEFFICIENT WHICH WHEN MULTIPLIED BY FLUID VELOCITY
C     RELATIVE TO THE PARTICLE YIELDS THE PARTICLE ACCELERATION.
C
C     FOR WATER DROPS IN AIR
C
C     FOR REYNOLDS NUMBERS LARGER THAN 200 USE CORR VS R DATA OF GUNN
C     AND KINZER FOR WATER DROPS IN AIR.   FOR SMALLER REYNOLDS NUMBERS
C     USE DATA FOR RIGID SPHERES.
C
      IF( R .LE. 200. ) GO TO 100
      PRFUN = WCORR(R)/R/COF
      RETURN
  100 PRFUN =  CORR(R)/R/COF
      RETURN
      END
```

```
*DECK,IMPACT
      SUBROUTINE IMPACT(YI,ZI)
C
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES       APRIL 1979
C ****************************************************************
C
C     CALLED BY S.R. TRAJECT AFTER IMPACT ON THE BODY.   ADJUSTS INITIAL
C     Y AND Z COORDINATES OF PARTICLE TRAJECTORY TO AVOID FURTHER IMPACT
C     THE ADJUSTMENT IS CASE DEPENDENT SO THIS S.R. SHOULD BE REVISED
C     FOR EACH STUDY.
C
C ****************************************************************
C
      RETURN
      END
```

```
*DECK,PARTCL
      SUBROUTINE PARTCL(V,ELL,RHO,VIS,TEMP,DIAM,DLR,RHOP,VT,RF,PT,ACC,N)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     CALLED BY CONFAC, ARYTRJ OR TANTRA  TO READ PARTICLE SPECS, AND
C     COMPUTE GRAVITY SETTLING SPEED AND OTHER PARAMETERS.  SEE CONFAC
C
C     FOR WATER DROPS IN AIR
C
C     CALLS FALWAT TO COMPUTE SETTLING SPEED VIA BEARDS EQUATIONS.
C
C     REYNOLDS NUMBER(R)-DAVIES NUMBER(CORR) RELATIONS ARE AS FOLLOWS -
C     FOR REYNOLDS NUMBERS LARGER THAN 200 USE CORR VS R DATA OF GUNN
C     AND KINZER FOR WATER DROPS IN AIR.   FOR SMALLER REYNOLDS NUMBERS
C     USE DATA FOR RIGID SPHERES.
C
C                            GLOSSARY
C     ACC      DIAM/ELL - USED TO COMPUTE ACCELERATION MODULUS
C     DIAM     DIAMETER OF A WATER DROP
C     DLR      NOT RELEVANT TO WATER DROPS
C     ELL      CHARACTERISTIC DIMENSION OF THE BODY ( METERS )
C     PT       DRAG COEFFICIENT*ABS(REYNOLDS NUMBER) FOR GRAVITY SETTLING
C              OF PARTICLES
C     RF       FACTOR TO CONVERT VELOCITY DIFFERENCE TO REYNOLDS NUMBER
C     RHO      AIR DENSITY (SI)
C     RHOP     PARTICLE DENSITY (SI)
C     TEMP     AIR TEMPERATURE (DEG. KELVIN)
C     V        AIR SPEED (SI)
C     VIS      AIR VISCOSITY (SI)
C     VT       GRAVITY SETTLING SPEED OF PARTICLE
C
      READ (5,1100) DIAM
      IF(DIAM .NE. 0.0) GO TO 6
      N = 1
      RETURN
    6 WRITE (6,2500) DIAM
      RHOP = 1.0E3
      DLR=1.0
      RF = DIAM*RHO /VIS * 1.0E-6
      ACC = DIAM/ELL * 1.0E-6
C     COMPUTE GRAVITY SETTLING SPEED OF PART.AND PARAMETERS DERIVED
C     FROM IT
      CALL FALWAT(DIAM*1.0E-6,RHO,VIS,TEMP,287.04*RHO*TEMP,VT)
      R = RF*VT
      PT = CORR(R)/R
      IF(R .GT. 200.) PT = WCORR( R )/R
    7 WRITE(6, 3500) VT
      VT = VT/V
      RF = RF*V
      RETURN
 1100 FORMAT(7F10.0)
 2500 FORMAT( 1H1, 9X, 21HWATER DROP DIAMETER =1PE12.5,12H MICROMETERS/)
 3500 FORMAT(     20X, 24HPARTICLE SETTLING SPEED=1PE12.5, 6H M/SEC)
      END
```

```
*DECK,CONFAC
      SUBROUTINE CONFAC
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     EXECUTIVE FOR COMPUTATION OF CONCENTRATION FACTORS FOR PARTICLES
C     IN A FLOW ABOUT A 3-DIMENSIONAL BODY.  CROSS SECTIONAL AREAS OF A
C     PARTICLE FLUX TUBE ARE CALCULATED ABOUT THE POINT OF INTEREST AND
C     ABOUT A POINT FAR UPSTREAM.  CONCENTRATION FACTOR IS THE RATIO OF
C     THESE AREAS.
C     SINGLE TRAJECTORIES TO A TARGET POINT MAY BE COMPUTED (NW=0)
C     FLOW DATA PREPARED BY THE HESS-SMITH CODE ARE READ FROM UNIT 14
C     VIA SR SETF10.
C     UNIT 9 IS A SCRATCH UNIT USED FOR TRAJECTORY DATA STORAGE.
C     UNIT 10 IS USED FOR TRAJECTORY DATA OUTPUT FOR PLOTTING.
C     SR PARTCL IS CALLED TO READ, PROCESS AND PRINT PARTICLE DATA.
C     THIS SR CAN BE ONE OF SEVERAL THAT TREATS WATER DROPS OR ONE OF
C     VARIOUS TYPES OF ICE CRYSTALS.
C
C     GLOSSARY
C
C  DISTINGUISH TWO COORDINATE SYSTEMS - 1. THE FLOW SYSTEM IS THE SYSTEM
C  IN WHICH THE AIRCRAFT AND FLOW ARE DEFINED, AND 2. THE FLUX TUBE
C  SYSTEM WHICH HAS ITS Y-Z PLANE IN THE PLANE OF A FLUX TUBE CROSS
C  SECTION WITH ORIGIN AT THE FLUX TUBE CENTER.
C
C     ALL COORDINATES AND TIMES ARE NORMALIZED (DIMENSIONLESS)
C
C     ACC     DIAM/ELL - USED TO COMPUTE ACCELERATION MODULUS
C     ALPHA0  ANGLE BETWEEN PROJECTION OF INITIAL VELOCITY VECTOR IN
C             X-Y PLANE AND X AXIS
C     ALPHAR  ANGLE BETWEEN PROJECTION OF FINAL VELOCITY VECTOR IN X-Y
C             PLANE AND X AXIS
C     BETA0   ANGLE BETWEEN INITIAL VELOCITY VECTOR AND ITS PROJECTION
C             IN THE X-Y PLANE
C     BETAR   ANGLE BETWEEN FINAL VELOCITY VECTOR AND ITS PROJECTION
C             IN THE X-Y PLANE
C     CONRTO  RATIO OF PARTICLE CONCENTRATION AT TARGET POINT TO CONC.
C             AT INITIAL POINT
C     DIAM    DIAMETER OF A WATER DROP OR ICE AGGREGATE
C             BASE DIAMETER FOR A PLATE OR CYLINDER (MICROMETERS)
C     DLR     BASE DIAMETER TO LENGTH (CYLINDER) OR THICKNESS (PLATE)
C             RATIO
C     ELL     CHARACTERISTIC DIMENSION OF THE BODY ( METERS )
C     EPSI( ) PARAMETERS USED TO CONTROL LOCAL ERROR IN THE NUMERICAL
C             INTEGRATION (SEE DVDQ GLOSSARY)
C     FN      FROUDE NUMBER
C     FNR     RECIPROCAL OF THE FROUDE NUMBER
C     HI      INITIAL TIME STEP FOR NUMERICAL INTEGRATION (SEE DVDQ)
C     HMAX    MAXIMUM TIME STEP (SEE DVDQ)
C     HMIN    MINIMUM ALLOWED TIME STEP (SEE DVDQ)
C     IPLOT   IF TRUE, TRAJECTORY DATA ARE COPIED TO UNIT 10 FOR PLOTTNG
C     NW      NUMBER OF TRAJECTORIES USED TO DEFINE THE FLUX TUBE
C             PERIPHERY.  IF(NW .EQ. 0) SINGLE TRAJECTORIES ARE COMPUTED
C     P( )    CURRENT VALUES OF INDEPENDENT VARIABLES -
C                 P(1) = X
C                 P(2) = DX/DT
C                 P(3) = Y
C                 P(4) = DY/DT
C                 P(5) = Z
```

```
C                P(6) = DZ/DT
C     PACT    (SPARE)
C     PT      DRAG COEFFICIENT*ABS(REYNOLDS NUMBER) FOR GRAVITY SETTLING
C             OF PARTICLES
C     RF      FACTOR TO CONVERT VELOCITY DIFFERENCE TO REYNOLDS NUMBER
C     RHO     AIR DENSITY (KG/M**3)
C     RHOP    PARTICLE DENSITY (KG/M**3)
C     RW      RADIUS OF PARTICLE FLUX TUBE IN TARGET PLANE (NORMALIZED)
C     TEMP    AIR TEMPERATURE (DEG. KELVIN)
C     TOL     TOLERANCE FOR REACHING A POINT ON TARGET PLANE WINDOW
C             (FRACTION OF RW)
C     TPRINT  OUTPUT TIME INTERVAL
C     V       AIR SPEED (M/SEC)
C     VIS     AIR VISCOSITY (KG/(M-SEC))
C     VPGT    PARTICLE SPEED AT TARGET POINT
C     VT      GRAVITY SETTLING SPEED OF PARTICLE
C     VTGT    AIR SPEED AT TARGET POINT
C     XI3P,YI3P,ZI3P   INITIAL PLANE FLUX TUBE CENTER COORDINATES IN
C                      THE FLOW SYSTEM
C     XSTART  TRAJECTORY INITIAL X COORDINATE
C     XP,YP,ZP  TARGET POINT COORDINATES IN THE FLUX TUBE SYSTEM
C     XW,YW,ZW  COORDINATES OF CENTER OF FLUX TUBE AT THE TARGET PLANE
C               IN THE FLOW SYSTEM
C     YE(),ZE()     TARGET POINT COORDINATES OF THE LAST THREE GUESSES
C                   (FLOW SYSTEM)
C     YI(),ZI()     INITIAL POINT COORDINATES OF THE LAST THREE GUESSES
C                   (FLOW SYSTEM)
C     YPSTAR, ZPSTAR   TARGET POINT COORDINATES (FLOW SYSTEM)
C     YPSTARP, ZPSTARP   TARGET POINT COORDINATES (FLUX TUBE SYSTEM)
      COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
     1RF,REO,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHAO,BETAO,IREC,
     2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
     3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XWP,XPP,ACC,DLR,JLIM
      DIMENSION HOLL(18),XINIT(100), XEXIT(100)
      DIMENSION YINIT(100), ZINIT(100),YEXIT(100),ZEXIT(100)
       DIMENSION YI(3), ZI(3), YE(3), ZE(3)
      LOGICAL      IPLOT
      DATA PI/3.1415926536/
      NFIN=0
C                      READ AND WRITE DATA
      READ (5,2600) KASE
      CALL SETFLO(KASE)
      READ(5,1000)HOLL,        IPLOT
      READ(5,1100)V, ELL, RHO, TEMP, XSTART
      READ(5,1100) TPRINT, HI, HMINI, EPSI
C     SET DEFAULT VALUES FOR NUMERICAL INTEGRATION AND PRINT PARAMETERS
      IF(TPRINT .EQ. 0.0) TPRINT=0.1
      IF(HI .EQ. 0.0) HI=0.1
      IF(HMINI .EQ. 0.0) HMINI=0.005
      IF(EPSI(1) .EQ. 0.0) EPSI(1)=1.0E-5
      IF(EPSI(2) .EQ. 0.0) EPSI(2)=1.0E-5
      IF(EPSI(3) .EQ. 0.0) EPSI(3)=1.0E-5
      READ (5,1150) NW, RW, TOL
      JLIM=25
      IF(NW .EQ. 0) JLIM=0
      DO 3 J=2,3
    3 READ (5,1100) YE(J), ZE(J), YI(J), ZI(J)
      VIS = 145.8E-8 * TEMP**(3.0/2.0)/(110.4 + TEMP)
      WRITE(6,1200) HOLL
      WRITE(6,1300) V, ELL, RHO, TEMP, VIS
```

```
      WRITE(6,1400) HI,HPRINT,TPRINT, XSTART
      WRITE(6,1500) EPSI(1), EPSI(2), EPSI(3)
      WRITE (6,1520) NW, RW, TOL
      WRITE (6,1540)
      DO 4 J=2,3
      I=J-1
    4 WRITE (6,1550) I, YE(J), ZE(J), YI(J) ,ZI(J)
C     INITIALIZE
      FN = V**2/(9.8*ELL)
      FNR = 1.0/FN
       IF (.NOT. IPLOT) GO TO 5
      REWIND 10
      WRITE (6,1800)
C     ENTER TRAJECTORY CALCULATION LOOP
    5 CALL PARTCL(V,ELL,RHC,VIS,TEMP,DIAM,DLK,RHOP,VT,RF,PT,ACC,NFIN)
      IF(NFIN .EQ. 0) GO TO 6
      IF( .NOT. IPLOT) RETURN
      ENDFILE 10
      REWIND 10
      RETURN
    6 READ(5,1100) XW, YW, ZW
      WRITE(6,3500) XW, YW, ZW
C     IF NECESSARY SET DEFAULT VALUES FOR INITIAL AND FINAL TRAJECTORY
C     POINT GUESSES
      IF(ABS(YE(2))+ABS(YE(3))+ABS(ZE(2))+ABS(ZE(3))+ABS(YI(2))+
     1 ABS(YI(3))+ABS(ZI(2))+ABS(ZI(3)) .NE. 0.0) GO TO 7
      YE(2) = YW + SIGN(1.5*RW*TOL, YW)
      ZE(2) = ZW + SIGN(1.5*RW*TOL, ZW)
      YE(3) = YW - SIGN(1.5*RW*TOL, YW)
      ZE(3) = ZW - SIGN(1.5*RW*TOL, ZW)
      YI(2) = YW
      ZI(2) = ZW
      YI(3) = YE(2)
      ZI(3) = ZE(2)
    7 COF = PT*VT*FN
      R = RF * VT
      XPSTAR = XW
      YPSTAR = YW
      ZPSTAR = ZW
      YPSTARP=YW
      ZPSTARP=ZW
      XI3P = 0.0
      YI3P = 0.0
      ZI3P = 0.0
      XWP=XSTART
      XPP = XW
      XP = 0.0
      YP = 0.0
      ZP = 0.0
      IP = 0
C
C     COMPUTE TRAJECTORY THAT PASSES THROUGH THE CENTER OF THE FLUX TUBE
C
      ALPHA0 = 0.0
      BETA0 = 0.0
      ALPHAR=0.0
      BETAR=0.0
      WRITE (6,2800) IP,XPSTAR,YPSTAR, ZPSTAR, YPSTARP, ZPSTARP
      CALL MAP (YI,ZI,TCL,RW,YE,ZE)
      IF( IT .LT. 0 ) GO TO 5
```

```
C           COMPUTE INITIAL AND FINAL TRAJECTORY ANGLES
      CALL FLOVEL(XI3,YI3,ZI3,VX,VY,VZ,HI,INBODY)
      ALPHA0 = ATAN(VY/VX) * 180./PI
      BETA0 = ATAN((VZ-VT)/SQRT(VX**2 + VY**2)) * 180./PI
      ALPHAR = ATAN(P(4)/P(2))*180./PI
      BETAR = ATAN(P(6)/SQRT(P(2)**2+P(4)**2))*180./PI
      WRITE (6,2000) ALPHA0, BETA0, ALPHAR, BETAR
      IF(NW .EQ. 0) GO TO 5
      ALPHA0 = ALPHA0*PI/180.
      BETA0 = BETA0*PI/180.
      ALPHAR = ALPHAR*PI/180.
      BETAR = BETAR*PI/180.
C     COMPUTE AIR AND PARTICLE SPEEDS AT FINAL POINT OF TRAJECTORY
      CALL FLOVEL( P(1), P(3), P(5), VX, VY, VZ, HI, INBODY)
      VTGT = SQRT( VX**2 + VY**2 + VZ**2 )
      VPGT = SQRT(P(2)**2 + P(4)**2 + P(6)**2)
      XI3P = XI3
      YI3P = YI3
      ZI3P = ZI3
      CALL TRANSFM( 0.0, YI(2) - YI3, ZI(2) - ZI3, ALPHA0, BETA0,
     1 XP, YP, ZP, 1)
      YI(2) = YP
      ZI(2) = ZP
      CALL TRANSFM(P(1) - XPSTAR, YE(2) - YPSTAR, ZE(2) - ZPSTAR,
     1 ALPHAR, BETAR, XP, YP, ZP, 1)
      YE(2) = YP
      ZE(2) = ZP
      YI(3) = 0.0
      ZI(3) = 0.0
      CALL TRANSFM(P(1) - XPSTAR, YE(3) - YPSTAR, ZE(3) - ZPSTAR,
     1 ALPHAR, BETAR, XP, YP, ZP, 1)
      YE(3) = YP
      ZE(3) = ZP
      XP = XW
      YP = YW
      ZP = ZW
      XWP=0.0
C                 LOOP FOR EACH POINT ON FLUX TUBE PERIPHERY
      DO 500 IP=1,NW
      THETA = FLOAT(IP-1)/FLOAT(NW)  *3.1415926536 *2.
C            CALCULATE TARGET  COORDINATES IN FLUX TUBE SYSTEM
      YPSTARP = RW * SIN(THETA)
      ZPSTARP = RW * COS(THETA)
        IPSTAR = IP
C           TRANSFORM TARGET COORDINATES TO FLOW SYSTEM
      CALL TRANSFM(0.0,YPSTARP, ZPSTARP, ALPHAR, BETAR,XPSTAR,YPSTAR,
     1 ZPSTAR,-1)
      XPSTAR = XW + XPSTAR
      YPSTAR = YW + YPSTAR
      ZPSTAR = ZW + ZPSTAR
C           GUESS INITIAL COORDINATES AND COMPUTE TRAJECTORY
      WRITE (6,2800) IP,XPSTAR,YPSTAR, ZPSTAR, YPSTARP, ZPSTARP
      CALL MAP (YI,ZI,TOL,RW,YE,ZE)
      IF( IT .LT. 0 ) GO TC 5
C           TRANSFORM FINAL AND INITIAL COORDINATES TO FLUX TUBE SYS.
      CALL TRANSFM (P(1) - XW , P(3) - YW  ,P(5) - ZW  ,ALPHAR,BETAR,
     1XEXIT(IP),YEXIT(IP),ZEXIT(IP),1)
      CALL TRANSFM (XI3-XI3P,YI3-YI3P,ZI3-ZI3P,ALPHA0,BETA0,XINIT(IP),
     1YINIT(IP),ZINIT(IP),1)
      IF ( ABS(XINIT(IP)) . LE . RW * TOL ) GO TO 500
```

```
      WRITE (6, 2900) XINIT(IP),XI3P
  500 CONTINUE
C     COMPUTE  FLUX TUBE CROSS SECTION AREAS IN THE INITIAL AND TARGET
C     PLANES, AND COMPUTE CONCENTRATION FACTOR, ETC.
      WRITE (6,2200) XI3P,YI3P,ZI3P,XW,YW,ZW
      DO 600  IP=1,NW
  600 WRITE (6,2300) IP, XINIT(IP), YINIT(IP), ZINIT(IP), XEXIT(IP),
     1 YEXIT(IP), ZEXIT(IP)
      CALL POLYGON (YINIT,ZINIT, NW, AREA)
      CALL POLYGON (YEXIT,ZEXIT,NW,DENOM)
      CONFAK = AREA/DENOM
      CONRTO = CONFAK / VPGT
      WRITE (6,3000) AREA, DENOM, CONFAK, XW, YW, ZW, DIAM
      WRITE(6,3400)DLR,RHOP
      WRITE( 6, 3200 ) VTGT, CONRTO
C
C
C
C     SET UP TRIAL COORDINATES FOR NEXT PARTICLE
C
      YI(3) = YI3
      ZI(3) = ZI3
      YE(3) = P(3)
      ZE(3) = P(5)
      CALL TRANSFM( 0.0, YI(2), ZI(2),  ALPHA0, BETA0, XI3,YI3, ZI3, -1)
      YI(2) = YI3 + YI3P
      ZI(2) = ZI3 + ZI3P
      CALL TRANSFM( 0.0, YE(2), ZE(2),  ALPHAR, BETAR, XI3,YI3, ZI3, -1)
      YE(2) = YI3 + YW
      ZE(2) = ZI3 + ZW
      GO TO 5
 1000 FORMAT(18A4, 7X,L1)
 1100 FORMAT(8F10.5)
 1150 FORMAT (I10,7F10.5)
 1200 FORMAT(1H1,5X,  15HCONFAC RUN ID -/ 8X, 18A4)
 1300 FORMAT(1H0, 5X, 21HPHYSICAL INPUT DATA -/7X,10HAIR SPEED=1PE13.6,
     1 3X, 37HCHARACTERISTIC DIMENSION OF THE BODY=1PE13.6/ 7X,35HDENSIT
     2Y AND TEMPERATURE OF AIR ARE 1PE13.6, 5H AND 1PE13.6,20H   AIR VIS
     3COSITY IS 1PE13.6)
 1400 FORMAT( 1H0, 5X, 29HNUMERICAL INTEGRATOR INPUTS -/ 7X, 10HTIME STE
     1P=1PE11.4, 3X, 18HMINIMUM TIME STEP=1PE11.4, 3X, 20HPRINT TIME INT
     2ERVAL=1PE11.4, 3X, 24HUPSTREAM START DISTANCE=1PE11.4)
 1500 FORMAT( 1H0, 6X, 33HLOCAL ERROR TOLERANCES FOR DVDQ -, 3(1PE14.4))
 1520 FORMAT( 1H0, 5X, 35HPARTICLE FLUX TUBE SPECIFICATIONS -/
     1            7X, 46HNUMBER OF TRAJECTORIES ON FLUX TUBE PERIPHERY=I3,
     2 3X, 27HFLUX TUBE RADIUS AT TARGET=F9.5, 3X, 10HTOLERANCE=F8.4 )
 1540 FORMAT( 1H0, 5X, 40HTARGET AND INITIAL COORDINATE ESTIMATES-/ 10X,
     1 6HJGUESS, 9X, 2HYT, 13X, 2HZT, 13X, 2HYI, 13X, 2HZI)
 1550 FORMAT( I14, 4(5X, F10.5))
 1800 FORMAT( ///6X, 51HTRAJECTORY DATA ARE WRITTEN ON UNIT 10 FOR PLOTT
     1ING//)
 2000 FORMAT( ///20X, 47HINITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
     1/ 22X,   7HALPHA0=F10.4, 5X, 6HBETA0=F10.4/ 22X, 7HALPHAR=F10.4, 5X
     2,  6HBETAR=F10.4)
 2200 FORMAT( 1H1, 35X, 44HFLUX TUBE CROSS SECTION COORDINATES IN THE -/
     1/ 28X,   13HINITIAL PLANE, 33X, 12HTARGET PLANE//
     2     8X, 2HIP,  2(9X, 2HXP, 13X, 2HYP, 13X, 2HZP, 4X)/ 4X, 6HCENTE
     3R6(1PE15.4),14H (FLOW SYSTEM))
 2300 FORMAT (I10,6(1PE15.4),19H (FLUX TUBE SYSTEM))
 2600 FORMAT (A4)
```

```
2800 FORMAT( ///    18H TRAJECTORY NUMBER,I3,5X,20HTARGET COORDINATES -
    1,10H  XPSTAR =F10.6, 4X, 8HYPSTAR =F10.6,5X, 8HZPSTAR =F10.6,
    2 14H (FLOW SYSTEM)/   70X,  8HYPSTARP=F10.6, 5X, 8HZPSTARP=F10.6,
    3 19H (FLUX TUBE SYSTEM)//
    4   15X, 6HYFINAL, 6X, 6HZFINAL,6X,10HITERATIONS,5X, 5HYINIT, 7X,
    5 5HZINIT, 7X, 25HERROR  (FLUX TUBE SYSTEM))
2900 FORMAT(// 30X,49HINITIAL POINT IS NOT IN CORRECT TRANSFORMED PLANE
    1/ 32X, 6HXINIT=1PE12.5, 5X, 5HXI3P=1PE12.5)
3000 FORMAT(// 15X, 50HFLUX TUBE CROSS SECTION AREA IN THE INITIAL PLAN
    1E=1PE12.5,  8X, 20HIN THE TARGET PLANE=1PE12.5// 15X, 21HCONCENTRA
    2TION FACTOR=0PF11.5//
    3 10X, 21HAT THE POINT (X,Y,Z)=,3F12.5/10X,27HFOR A PARTICLE OF DIA
    4METER=,F12.5)
3200 FORMAT( 10X, 36HNORMALIZED AIR SPEED AT FINAL POINT=F12.5/
    1   10X, 29HPARTICLE CONCENTRATION RATIO=F12.5)
3400 FORMAT( 1H+, 52X, 30HWITH DIAMETER TO LENGTH RATIO=1PE12.5, 3X,
    1 12HAND DENSITY=1PE12.5)
3500 FORMAT( 1H0, 9X, 22HTARGET COORDINATES  X=1PE12.5,  5X, 2HY=1PE12.
    15, 5X, 2HZ=1PE12.5)
      END
```

```
*DECK,MAP
      SUBROUTINE  MAP (YI,ZI,TOL,RW,YE,ZE)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C        MAP GUESSES THE INITIAL COORDINATES OF A TRAJECTORY THAT IS
C        AIMING FOR A POINT IN THE TARGET PLANE.  AFTER THE TRAJECTORY
C        IS COMPUTED, THE DISTANCE FROM THE TARGET IS COMPARED TO
C        THE ALLOWABLE TOLERANCE.  THE PROCESS IS REPEATED UNTIL DISTANC
C        FROM THE TARGET IS BELOW THE TOLERANCE.
C        ONCE A HISTORY OF GREATER THAN THREE TRAJECTORIES HAS BEEN
C        COMPUTED, LEAST SQUARES IS USED TO DETERMINE TRIAL INITIAL
C        COORDINATES
C             GLOSSARY
C     A       MATRIX OF COEFFICIENTS INVERTED IN MATINV
C     AA,C    INTERMEDIATE STORAGE FOR LEAST SQUARES NORMAL MATRIX TERMS
C     AC      ACCELERATION MODULUS
C     ANG     ANGLE OF DRAG VECTOR PROJECTED IN THE X-Y PLANE RELATIVE
C             TO THE X AXIS
C     B       ENTERS MATINV AS CONSTANT MATRIX AND RETURNS AS SOLUTION M
C     COSA,COSB,COSC  DIRECTION COSINES OF DRAG VECTOR
C     CNG     ANGLE OF DRAG VECTOR RELATIVE TO Z AXIS
C     DIST    DISTANCE BETWEEN END OF TRAJECTORY AND TARGET POINT
C     DV      VELOCITY OF PARTICLE RELATIVE TO AIR
C     IT      ITERATION NUMBER
C     VA      AIR SPEED AT TARGET POINT
C     VP      PARTICLE SPEED AT TARGET POINT
C     W       LEAST SQUARES SUMMAND WEIGHT
C     YE      ARRAY OF FINAL   Y COORD FOR LAST  3 GUESSES
C     YI      ARRAY OF INITIAL Y COORD FOR LAST  3 GUESSES
C     YI3     NEXT GUESS FOR INITIAL Y COORD (FLOW SYSTEM)
C     ZE      ARRAY OF FINAL   Z COORD FOR LAST  3 GUESSES
C     ZI      ARRAY OF INITIAL Z COORD FOR LAST  3 GUESSES
C     ZI3     NEXT GUESS FOR INITIAL Z COORD  (FLOW SYSTEM)
      LOGICAL IPLOT
```

```
      COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
     1RF,REO,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHAO,BETAO,IREC,
     2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
     3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XHP,XPP,ACC,DLR,JLIM
      DIMENSION YI(3), ZI(3), A(4,4), B(4), YE(3), ZE(3), DY(3), DZ(3),
     1AA( 6), C(3), PSTR(3)
      DATA ILIM/ 25/
      DO 50 J=2,3
      DY(J) = YE(J) - YPSTARP
   50 DZ(J) = ZE(J) - ZPSTARP
      IT = 0
      N = 4
C                    GENERAL ITERATION CALCULATION OF NEXT GUESS
C             GENERATE CONSTANT ARRAY (B) FOR MATINV IF IT . LE . 3
  100 DO 120 J=2,3
      I = J - 1
      B(2*I-1) = YI(J)
      B(2*I) = ZI(J)
  120 CONTINUE
C                 GENERATE COEFFICIENT ARRAY (A) FOR MATINV
      DO 140 J=2,3
      I = J - 1
      JROW = 2*I-1
      JROW2 = 2*I
      A(JROW,1) = 1.
      A(JROW,2) = 0.
      A(JROW,3) = DY(J)
      A(JROW,4) = -DZ(J)
      A(JROW2,1) = 0.
      A(JROW2,2) = 1.
      A(JROW2,3) = DZ(J)
      A(JROW2,4) = DY(J)
  140 CONTINUE
      GO TO 280
C     IF IT . GE . 3 SOLVE FOR THE NEXT INITIAL COORDINATES GUESS BY
C     LEAST SQUARES
  200 CONTINUE
C
C     INCREMENT LEAST SQUARES NORMAL EQUATIONS
C
      W = 1.0
      G = DY(3) / DIST**2
      Q = DZ(3) / DIST**2
      S = G * YI(3) + Q * ZI(3)
      AA(1) = AA(1) + G**2 * W
      AA(2) = AA(2) + G * Q * W
      AA(3) = AA(3) + G * W
      AA(4) = AA(4) + Q**2 * W
      AA(5) = AA(5) + Q * W
      AA(6) = AA(6) + W
      C(1) = C(1) + G * S * W
      C(2) = C(2) + Q * S * W
      C(3) = C(3) + S * W
C
C     SET-UP LEAST SQUARES NORMAL EQUATIONS
C
  220 A(1,1) = AA(1)
      A(1,2) = AA(2)
      A(1,3) = AA(3)
      A(2,2) = AA(4)
```

```
      A(2,3) = AA(5)
      A(3,3) = AA(6)
      DO 250 I=2,3
      K = I-1
      DO 250 J=I,3
  250 A(J,K) = A(K,J)
      DO 260 I=1,3
  260 B(I) = C(I)
      DO 265 I=1,3
      A(4,I) = 0.0
  265 A(I,4) = 0.0
      A(4,4) = 1.0
      B(4) = 0.0
C               SOLVE MATRIX EQNS TO GET NEXT GUESS
  280 CALL MATINV(A,N,B,1,DETERM)
      CALL TRANSFM(XWP,B(1),B(2),ALPHA0,BETA0,XI3,YI3,ZI3,-1)
      XI3 = XI3 + XI3P
      YI3 = YI3 + YI3P
      ZI3 = ZI3 + ZI3P
      CALL TRAJECT
      IF (IT .LT. 0) RETURN
      IT = IT + 1
C     IF (IT . GT . 3) GO TO 305
C               UPDATE ARRAYS OF INITIAL AND FINAL COORDS.
  290 DO 300 J=1,2
      YI(J) = YI(J+1)
      ZI(J) = ZI(J+1)
      DY(J) = DY(J+1)
      DZ(J) = DZ(J+1)
      YE(J) = YE(J+1)
      ZE(J) = ZE(J+1)
      PSTR(J) = PSTR(J+1)
  300 CONTINUE
  305 CONTINUE
      YI(3) = B(1)
      ZI(3) = B(2)
      CALL TRANSFM(P(1) - XP , P(3) - YP , P(5) - ZP , ALPHAR, BETAR,
     1XDUM,YE(3),ZE(3),1)
      IF ( ABS(XP) . EQ . 0.0 ) XDUM = XDUM - XPP
      IF (ABS (XDUM) . GT . RW * TOL ) WRITE(6, 3000 )
      DY(3) = YE(3)-YPSTARP
      DZ(3) = ZE(3)-ZPSTARP
      DIST = SQRT( DY(3)**2 + DZ(3)**2 )
      PSTR(3) = DIST
C                GUESS AGAIN OR GO ON TO NEXT POINT ON WINDOW?
      WRITE (6,2700) YE(3),ZE(3),IT,YI(3),ZI(3),DIST
      IF (DIST .LE.  RW*TOL ) GO TO 490
      IF( IT .LE. ILIM)IF( IT -  3) 100,310,200
      WRITE (6,2900) ILIM
      IT = -ILIM
      RETURN
C
C     INITIALIZE FOR LEAST SQUARES
C
  310 DO 320 I=1,3
  320 C(I) = 0.0
      DO 325 I=1,6
  325 AA(I) = 0.0
      DO 330 I = 1,3
      W = 1.0
```

```
      G = DY(I) / PSTR(I)**2
      Q = DZ(I) / PSTR(I)**2
      S = G * YI(I) + Q * ZI(I)
      AA(1) = AA(1) + G**2 * W
      AA(2) = AA(2) + G * Q * W
      AA(3) = AA(3) + G * W
      AA(4) = AA(4) + Q**2 * W
      AA(5) = AA(5) + Q * W
      AA(6) = AA(6) + W
      C(1) = C(1) + G * S * W
      C(2) = C(2) + Q * S * W
  330 C(3) = C(3) + S * W
      GO TO 100
C                         PRINT TRAJECTORY OUTPUT
  490 REWIND 9
      WRITE (6,1700)
      DO 494 IWRITE = 1,IREC
      READ (9)NEVAL,KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R,AC
      WRITE(6,1600) KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R, AC, NEVAL
  494 CONTINUE
C     COMPUTE AND PRINT DRAG VECTOR AT TARGET POINT
      DV = SQRT( (VX - P(2))**2 + (VY - P(4))**2 + (VZ - P(6))**2 )
      COSA = (VX - P(2))/DV
      COSB = (VY - P(4))/DV
      COSC = (VZ - P(6))/DV
      ANG = ATAN( COSB/COSA ) * 57.29577951
      CNG = ACOS( COSC ) * 57.29577951
      WRITE( 6, 3100 ) COSA, COSB, COSC, ANG, CNG
C     COMPUTE AND PRINT AIR AND PARTICLE SPEEDS AT TARGET POINT
      VA    = SQRT( VX**2 + VY**2 + VZ**2 )
      VP    = SQRT(P(2)**2 + P(4)**2 + P(6)**2)
      WRITE(6, 3200) VA, VP
      IF (IPLOT)  WRITE (10) IFLT, (XPLOT(J),YPLOT(J),ZPLOT(J),J=1,IPLT)
       RETURN
 1600 FORMAT(I6, 10(1X,1PE11.4)/10X,  24H=1PE11.4,4H  R=1PE11.4, 5H  AC=
     11PE11.4, 8H  NEVAL=I6)
 1700 FORMAT( 6H0KSTEP, 7X, 1HT, 11X, 1HX, 11X, 1HY, 11X, 1HZ, 10X,
     1 3HVPX, 9X, 3HVPY, 9X, 3HVPZ, 10X, 2HVX, 10X, 2HVY, 10X, 2HVZ)
 2700 FORMAT (10X,  2E12.4,7X,I3,5X,3E12.4)
 2900 FORMAT(///20X, 28HTOLERANCE NOT SATISIFIED IN I4, 58H TRAJECTORY I
     1TERATIONS.  GIVE UP AND TRY THE NEXT PARTICLE)
 3000 FORMAT(///20X, 57HFINAL PARTICLE POSITION IS NOT IN THE ROTATED TA
     1GET PLANE)
 3100 FORMAT( 5X, 28HDRAG VECTOR AT FINAL POINT -/  6X, 18HDIRECTION COS
     1INES-3(1PE13.4), 7X, 19HANGLES A AND GAMMA-2(1PE13.4))
 3200 FORMAT(5X, 47HAIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE2(1PE
     115.5))
      END
```

```
*DECK,TRAJECT
      SUBROUTINE TRAJECT
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C             TRAJECT CALCULATES 3-D PARTICLE TRAJECTORIES
C             EMBEDDED IN A FLOW FIELD DETERMINED BY FLOVEL.
C             THE PREDICTOR-CORRECTOR SUBROUTINE DVDQ IS USED
C             TO INTEGRATE THE EQUATIONS OF MOTION.  OUTPUT AT TIME
C             INTERVAL TPRINT IS WRITTEN ON UNIT 9.
C     DRAG PARAMETERS ARE CALCULATED BY FUNCTION PRFUN WHICH IS PARTICLE
C     TYPE-SPECIFIC.    S.R.IMPACT IS A PROBLEM-SPECIFIC CODE THAT, AFTER
C     PARTICLE IMPACT ON THE BODY, ADJUSTS INITIAL PARTICLE COORDINATES
C     SUCH THAT ON THE NEXT TRIAL IMPACTION SHOULD NOT OCCUR.
C
C             GLOSSARY
C     AC      ACCELERATION MODULUS
C     DT( )   STORAGE FOR DVDQ
C     EPS( )  LOCAL ERROR TOLERANCE FOR THE NUMERICAL INTEGRATION
C     F( )    EQUATION OF MOTION OF THE PARTICLE -
C                F(1) - X DIRECTION
C                F(2) - Y DIRECTION
C                F(3) - Z DIRECTION
C     G       GSTOP  FUNCTION (SEE DVDQ GLOSSARY)
C     H       TIME STEP
C     IFLAG   DVDQ STATUS FLAG (SEE DVDQ GLOSSARY)
C     INBODY  FLAG TO INDICATE WHEN TRAJECTORY HAS
C             PENETRATED THE BODY
C     KD(I)   ORDER OF THE ITH DIFFERENTIAL EQUATION
C     KQ(I)   THE HIGHEST ORDER DIFFERENCE USED IN THE INTEGRATION OF
C             THE ITH EQUATION
C     NEQ     NUMBER OF EQUATIONS
C     NG      NUMBER OF GSTOP FUNCTIONS (SEE DVDQ GLOSSARY)
C     NGE     SEE DVDQ GLOSSARY
C     P( )    CURRENT VALUE OF THE DEPENDENT VARIABLES (SEE CONFAC)
C     PN( )   STORAGE FOR DVDQ
C     R       REYNOLDS NUMBER
C     T       TIME
C     TFINAL  INTEGRATION CUT-OFF TIME
C     VX      AIR VELOCITY IN X DIRECTION
C     VY      AIR VELOCITY IN Y DIRECTION
C     VZ      AIR VELOCITY IN Z DIRECTION
      DIMENSION  F(3),EPS(3),KD(3),PN(6),KQ(3), DT(20,3)
      LOGICAL IPLOT
      COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
     1RF,REO,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHAO,BETAO,IREC,
     2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
     3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XWP,XPP,ACC,DLR,JLIM
      DATA MXSTEP,NEQ,NG,NGE/10,3,1,0/, KD/3*2/
C     INITIALIZE FOR THE NUMERICAL INTEGRATOR
      JT = 0
  100 IFLAG = 0
      TFINAL = (XPSTAR-XI3)*2.0
      HMAX = TFINAL
      A11 = COS( ALPHAR ) * COS( BETAR )
      A12 = SIN( ALPHAR ) * COS( BETAR )
      A13 = SIN( BETAR )
      T = 0.0
      EPS(1) = EPSI(1)
      EPS(2) = EPSI(2)
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```
      EPS(3) = EPSI(3)
      H = HI
      HMIN = HMINI
      XPLOT(1) = XI3
      YPLOT(1) = YI3
      ZPLOT(1) = ZI3
      IPLT = 1
C     COMPUTE INITIAL AIR FLOW  VELOCITIES
  110 CALL FLOVEL(XI3,YI3,ZI3,VX,VY,VZ,H,INBODY)
      P(1) = XI3
      P(2) = VX
      P(3) = YI3
      P(4) = VY
      P(5) = ZI3
      P(6) = VZ - VT
  120 F(1) = 0.0
      F(2) = 0.0
      F(3) = VT*PT/COF - FNR
      G = A11*(P(1) - XPP) + A12 * (P(3) - YP) + A13 * (P(5) - ZP)
      CALL        DVDQ(NEQ,T,P,F,KD,EPS,IFLAG,H,HMIN,
     * HMAX,TPRINT,TFINAL,MXSTEP,KSTEP,KEMAX,EMAX,
     * KQ,PN,DT,NEVAL,NG,NGE,NSTOP,G,GT)
C     COMPUTE THE TRAJECTORY
      REWIND 9
      IREC = 0
      GO TO 200
  150 AC = ACC * SQRT( F(1)**2 + F(2)**2 + F(3)**2 ) * (RF/R)**2
      WRITE(9)NEVAL,KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R, AC
      IREC = IREC + 1
      IF (.NOT. IPLOT  .AND.  IFLAG .LE. 10 ) GO TO 200
      IPLT = IPLT + 1
      XPLOT(IPLT) = P(1)
      YPLOT(IPLT) = P(3)
      ZPLOT(IPLT) = P(5)
      IF( IFLAG .GT. 10 ) RETURN
  200 CALL        DVDQ(NEQ,T,P,F,KD,EPS,IFLAG,H,HMIN,
     * HMAX,TPRINT,TFINAL,MXSTEP,KSTEP,KEMAX,EMAX,
     * KQ,PN,DT,NEVAL,NG,NGE,NSTOP,G,GT)
      GO TO( 210, 210, 150, 250, 150, 220, 230, 250, 260, 260, 150,
     1  150 ), IFLAG
  210 CALL FLOVEL(P(1),P(3),P(5),VX,VY,VZ,H,INBODY)
       IF (INBODY .EQ. 0) GO TO 215
      WRITE (6,2200) P(1), P(3), P(5), YI3, ZI3, JT
      CALL IMPACT(YI3,ZI3)
      JT = JT + 1
      IF(JT.LT. JLIM) GO TO 100
      WRITE (6,2500) JLIM
      IT=-JLIM
      RETURN
  215 R = RF*SQRT((VX - P(2))**2 + (VY - P(4))**2 + (VZ - P(6))**2 )
      PR = PRFUN(R, DLR, COF)
      F(1) = (VX - P(2))*PR
      F(2) = (VY - P(4))*PR
      F(3) = (VZ - P(6))*PR - FNR
      GO TO 200
  220 EPS(KEMAX) = 32.*EMAX*EPS(KEMAX)
      WRITE(6,1900) IFLAG, KSTEP,NEVAL
      WRITE(6,2000) EPS(KEMAX), KEMAX
      GO TO 210
```

```
  230 HMIN = H
      WRITE(6,1900) IFLAG, KSTEP,NEVAL
      WRITE(6,2100) HMIN
      GO TO 200
  260 G = A11*(P(1) - XPP) + A12 * (P(3) - YP) + A13 * (P(5) - ZP)
      GO TO 200
  250 WRITE(6,1900) IFLAG, KSTEP,NEVAL
      AC = ACC * SQRT( F(1)**2 + F(2)**2 + F(3)**2 ) * (RF/R)**2
      WRITE(6,1600) KSTEP, T, F(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     1 VZ, H, R, AC
      RETURN
C
C
 1600 FORMAT(I6, 10(1X,1PE11.4)/ 10X, 2HH=1PE11.4, 4H  R=1PE11.4, 5H  AC
     1=1PE11.4)
 1900 FORMAT( 5X, 6HIFLAG=I2, 11H FOR KSTEP=I6, 6H  NEVAL=I6)
 2000 FORMAT( 1H+, 55X, 23HEPS HAS BEEN CHANGED TO1PE11.4, 11H FOR KEMAX
     1=I2)
 2100 FORMAT( 1H+, 55X, 14HHMIN IS SET TO1PE11.4)
 2200 FORMAT( 10X, 65HTHE BODY SURFACE IS PENETRATED.  PARTICLE COORDINA
     1TES ARE (X,Y,Z),3(1PE12.5)/ 10X, 43HTRIAL INITIAL COORDINATES ARE
     2(YINIT,ZINIT)2(1PE12.4), 5X, 14HATTEMPT NUMBERI4)
 2500 FORMAT(  / 15X,  5HAFTERI4, 45H ATTEMPTS PARTICLE STILL PENETRATES
     1 THE BODY.)
      END
```

```
*DECK,POLYGON
      SUBROUTINE POLYGON(XIN,YIN,N,AREA)
C
C     COMPUTES AREA OF A PLANE POLYGON WITH N VERTICES
C
      DIMENSION XIN(N), YIN(N)
      DIMENSION X(100), Y(100)
      DATA PI/3.1415926536/
C                   CALCULATE CENTER OF POLYGON
      XSUM = 0.
      YSUM = 0.
      DO 2 I=1,N
      XSUM  = XSUM  + XIN(I)
      YSUM = YSUM + YIN(I)
    2 CONTINUE
      XCEN = XSUM/FLOAT(N)
      YCEN = YSUM/FLOAT(N)
C               REORDER POINTS IN ASCENDING VALUES OF THETA
      TPIM1 = 0.
      DO 8 IP=1,N
      THETAP = 2.*PI
      DO 4 I=1,N
      THETA = ATAN2( YIN(I)-YCEN, XIN(I)-XCEN)
      IF (THETA .LT. 0.) THETA = 2.*PI + THETA
      IF (THETA .LE. TPIM1 .OR. THETA .GT. THETAP) GO TO 4
      THETAP = THETA
      X(IP)= XIN( I)
      Y(IP) = YIN(I)
    4 CONTINUE
      TPIM1 = THETAP
```

```
    8   CONTINUE
        ASUM = 0.
        DO 40 IN=1,N
        INM1 = IN - 1
        IF (IN.EQ.1) INM1 = N
        BASE = SQRT((X(IN)-X(INM1))**2 +(Y(IN)-Y(INM1))**2)
        DENOM = X(IN) - X(INM1)
        IF (ABS(DENOM) .GT. 1.E-10) GO TO 31
        ALT = ABS(XCEN-X(INM1))
        GO TO 32
   31   SLOPE = (Y(IN)-Y(INM1))/(X(IN)-X(INM1))
        ALT = ABS(YCEN-Y(INM1)-SLOPE*(XCEN-X(INM1)))/SQRT(1.+SLOPE**2)
   32   ASUM = ASUM + ALT*BASE/2.
   40   CONTINUE
  200   AREA = ASUM
        RETURN
        END
```

```
*DECK,TRANSFM
        SUBROUTINE TRANSFM (X,Y,Z,ALPHA,BETA,XT,YT,ZT,IGO)
C
C       TRANSFORMS COORDINATES FROM THE FLOW SYSTEM TO THE PARTICLE FLUX
C       TUBE CROSS SECTION SYSTEM, OR VISE VERSA.
C       IF( IGO .GT. 0) TRANSFORM FROM FLOW TO FLUX TUBE SYSTEM
C       IF( IGO .LT. 0) TRANSFORM FROM FLUX TUBE TO FLOW SYSTEM
C
        COSA = COS(ALPHA)
        SINA = SIN(ALPHA)
         COSB = COS(BETA)
        SINB = SIN(BETA)
        IF (IGO .LT. 0) GO TO 20
        A11  = COSA*COSB
        A12 = SINA*COSB
        A13 = SINB
        A21 = -SINA
        A22 = COSA
        A23 = 0.
        A31 = -COSA*SINB
        A32 = -SINB*SINA
        A33 = COSB
        GO TO 30
C                GOING THE OTHER WAY
   20   A11= COSA*COSB
         A12 = -SINA
         A13 = -COSA*SINB
        A21 = SINA*COSB
        A22 = COSA
        A23 = -SINA*SINB
        A31 = SINB
        A32 = 0.
        A33=COSB
   30   XT = A11*X + A12*Y + A13*Z
        YT = A21*X + A22*Y + A23*Z
          ZT = A31*X + A32*Y + A33*Z
        RETURN
        END
```

```
*DECK,MATINV
      SUBROUTINE MATINV(A,N,B,M,DETERM)
C
C     MATRIX INVERSION WITH ACCOMPANYING SOLUTION OF LINEAR EQUATIONS
C
C     THIS CODE SOLVES THE MATRIX EQUATION
C              A*X=B
C     FOR X.    A IS AN N*N INPUT MATRIX.   B IS  AN N*1 INPUT VECTOR.
C     A IS REPLACED BY ITS INVERSE.   B IS REPLACED BY THE VECTOR X.
C     THE CODE CAN BE USED FOR  MATRIX INVERSION ALONE.  IN THIS MODE
C     SET M=0 IN THE INPUT.   FOR MATRIX INVERSION  PLUS LINEAR EQUATION
C     SOLUTION, SET M=1 IN THE INPUT.    THE VALUE OF THE DETERMINANT
C     OF A, DETERM, IS RETURNED FROM BOTH MODES.
C
      DIMENSION IPIVOT(30), A( N, N), B( N,1), INDEX(30,2), PIVOT(30)
      EQUIVALENCE (IROW,JROW), (ICOLUM,JCOLUM), (AMAX, T, SWAP)
C
C     INITIALIZATION
C
   10 DETERM=1.0
   15 DO 20 J=1,N
   20 IPIVOT(J)=0
   30 DO 550 I=1,N
C
C     SEARCH FOR PIVOT ELEMENT
C
   40 AMAX=0.0
   45 DO 105 J=1,N
   50 IF (IPIVOT(J)-1) 60, 105, 60
   60 DO 100 K=1,N
   70 IF (IPIVOT(K)-1) 80, 100, 740
   80 IF (ABS (AMAX)-ABS (A(J,K))) 85, 100, 100
   85 IROW=J
   90 ICOLUM=K
   95 AMAX=A(J,K)
  100 CONTINUE
  105 CONTINUE
  110 IPIVOT(ICOLUM)=IPIVOT(ICOLUM)+1
C
C     INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL
C
  130 IF (IROW-ICOLUM) 140, 260, 140
  140 DETERM=-DETERM
  150 DO 200 L=1,N
  160 SWAP=A(IROW,L)
  170 A(IROW,L)=A(ICOLUM,L)
  200 A(ICOLUM,L)=SWAP
  205 IF(M) 260, 260, 210
  210 DO 250 L=1, M
  220 SWAP=B(IROW,L)
  230 B(IROW,L)=B(ICOLUM,L)
  250 B(ICOLUM,L)=SWAP
  260 INDEX(I,1)=IROW
  270 INDEX(I,2)=ICOLUM
  310 PIVOT(I)=A(ICOLUM,ICOLUM)
  320 DETERM=DETERM*PIVOT(I)
C
C     DIVIDE PIVOT ROW BY PIVOT ELEMENT
C
  330 A(ICOLUM,ICOLUM)=1.0
```

```
  340 DO 350 L=1,N
  350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT(I)
  355 IF(M) 380, 380, 360
  360 DO 370 L=1,M
  370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT(I)
C
C     REDUCE NON-PIVOT RCWS
C
  380 DO 550 L1=1,N
  390 IF(L1-ICOLUM) 400, 550, 400
  400 T=A(L1,ICOLUM)
  420 A(L1,ICOLUM)=0.0
  430 DO 450 L=1,N
  450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T
  455 IF(M) 550, 550, 460
  460 DO 500 L=1,M
  500 B(L1,L)=B(L1,L)-B(ICCLUM,L)*T
  550 CONTINUE
C
C     INTERCHANGE COLUMNS
C
  600 DO 710 I=1,N
  610 L=N+1-I
  620 IF (INDEX(L,1)-INDEX(L,2)) 630, 710, 630
  630 JROW=INDEX(L,1)
  640 JCOLUM=INDEX(L,2)
  650 DO 705 K=1,N
  660 SWAP=A(K,JROW)
  670 A(K,JROW)=A(K,JCOLUM)
  700 A(K,JCOLUM)=SWAP
  705 CONTINUE
  710 CONTINUE
  740 RETURN
      END
```

```
*DECK,SETFLO
      SUBROUTINE SETFLO( KASE )
C     INITIALIZES FOR FLOVEL CALCULATION BY READING IN DATA PREPARED
      REAL IXX, IXY, IYY, MACH
      COMMON /VELDAT/ NSYM,  NQUAD,  I19,  I29,  LOOP,  RBETA
      COMMON/COM29/ SIG(1000), D41(1000),    XC(1000),YC(1000),ZC(1000),
     1 A11(1000),A12 (1000),A13 (1000),A21(1000),A22(1000),A23(1000),
     2 A31(1000),A32 (1000),A33 (1000),XI1(1000),XI2(1000),XI3(1000),
     3 XI4(1000),ETA1(1000),ETA2(1000),ETA4(1000),TSQ(1000),A(1000),
     4 IXX(1000),IXY (1000),IYY (1000),D12 (1000),D23(1000),D34(1000)
      REWIND 14
      READ(14) KASETP, NSYM, NQUAD, RBETA, MACH
      WRITE(6,3000)       KASE ,NSYM, NQUAD, MACH
      IF( KASE .EQ. KASETP) GO TO 100
      REWIND 14
      WRITE(6,2000) KASE, KASETP
      STOP
  100 READ (14)(XC(J),YC (J), ZC(J), A11(J), A12(J), A13(J), A21(J),
     1 A22(J), A23(J), A31(J), A32(J), A33(J),       XI1(J),ETA1(J),XI2(
     2 J), ETA2(J), XI3(J), XI4(J), ETA4(J), TSQ(J), A (J), IXX (J),
     3 IXY (J), IYY(J), D12(J), D23(J), D34(J), D41(J) ,J=1,NQUAD)
      READ(14)(SIG(I), I=1,NQUAD)
      REWIND 14
   10 IF ( NSYM - 1 ) 58, 52, 54
   52                I29 = 1
                     I19 = 2
      GO TO 60
   54               I29  = 2
      IF ( NSYM .EQ. 3 ) GO TO 56
                    I19  = 3
      GO TO 60
   56               I19  = 4
      GO TO 60
   58               I19  = 1
   60 LOOP = 2 ** NSYM + 1
      RETURN
 2000 FORMAT( 1H-, 5X, 50HTAPE AND CARD IDENTIFIERS DO NOT MATCH.  TRY A
     1GAIN/ 10X, 9HCARD ID= A4, 5X,9HTAPE ID= A4)
 3000 FORMAT( 1H1,      19HBODY IDENTIFIER IS A4, 5X, 26HNUMBER OF SYMME
     1TRY PLANES=I3, 5X, 25HNUMBER OF QJADRALATERALS=I5, 5X, 12HMACH NUM
     2BER=E12.5)
      END
```

```
*DECK,FLOVEL
      SUBROUTINE FLOVEL( XNPP, YNPP, ZNPP, VXPP, VYPP, VZPP, H, INBODY)
C     REVISED 5/11/79
C
C     GIVEN SPACE COORDINATES, XNPP,YNPP,ZNPP, POTENTIAL FLOW VELOCITY
C     COMPONENTS, VXPP,VYPP,VZPP, ARE COMPUTED AND RETURNED.
C     THE HESS-SMITH METHOD IS USED.  THE 28 QUANTITIES PLUS THE
C     SOURCE STRENGTHS, SIG(), ARE STORED IN COMMON/COM29/.
C     CONTRIBUTIONS FROM NQUAD SURFACE ELEMENTS ARE SUMMED.
C     UP TO THREE PLANES OF SYMMETRY CAN BE ACCOMMODATED.
C
      REAL M12, M23, M34, M41 , IXX, IXY, IYY
      COMMON /VELDAT/ NSYM,  NQUAD,  I19,  I29,  LOOP,  RBETA
      DIMENSION              X(8),Y(8),Z(8)
      COMMON/COM29/ SIG(1000), D41(1000),     XC(1000),YC(1000),ZC(1000),
     1 A11(1000),A12 (1000),A13 (1000),A21(1000),A22(1000),A23(1000),
     2 A31(1000),A32 (1000),A33 (1000),XI1(1000),XI2(1000),XI3(1000),
     3 XI4(1000),ETA1(1000),ETA2(1000),ETA4(1000),TSQ(1000),A(1000),
     4 IXX(1000),IXY (1000),IYY (1000),D12 (1000),D23(1000),D34(1000)
      DATA RHO1SQ, RHO2SQ/ 6.0, 16.0 /
      VXPP=0.0
      VYPP=0.0
      VZPP=0.0
       INBODY = 0
      DO 2300 I1 = 1,  NQUAD
      DO 1700  I2 = 1, LOOP
      IF ( I2 .EQ. LOOP ) GO TO     ( 2000, 910, 920, 930  ),I19
      GO TO (1000, 910, 920, 910, 930, 910, 920, 910 ), I2
  910 YC ( I1 ) = - YC ( I1 )
      A12 ( I1 ) = - A12 ( I1 )
      A22 ( I1 ) = - A22 ( I1 )
      A31 ( I1 ) = - A31 ( I1 )
      A33 ( I1 ) = - A33 ( I1 )
      GO TO 932
  920 ZC ( I1 ) = - ZC ( I1 )
      A13 ( I1 ) = - A13 ( I1 )
      A23 ( I1 ) = - A23 ( I1 )
      A31 ( I1 ) = - A31 ( I1 )
      A32 ( I1 ) = - A32 ( I1 )
      GO TO 932
  930 XC ( I1 ) = - XC ( I1 )
      A11 ( I1 ) = - A11 ( I1 )
      A21 ( I1 ) = - A21 ( I1 )
      A32 ( I1 ) = - A32 ( I1 )
      A33 ( I1 ) = - A33 ( I1 )
  932 IF ( I2 .EQ. LOOP ) GO TO      (       2100, 2200    )   ,I29
 1000 XDIF = XNPP- XC ( I1 )
      YDIF = YNPP- YC ( I1 )
      ZDIF = ZNPP- ZC ( I1 )

C  COMPUTE DISTANCE FROM NULL POINT TO ORIGIN OF J-TH ELEMENT COORDINATE
C     SYSTEM  ( J CORRESPONDS TO THE INDEX I1 )

C  INEQUALITY  ( 98 )

      ROSQ = XDIF ** 2 + YDIF ** 2 + ZDIF ** 2
      IF ( ROSQ .LT. RHO2SQ * TSQ ( I1 ) ) GO TO 1400

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATION  ( 97 )
```

```
      ARG1 = A ( I1) / SQRT ( ROSQ ) ** 3
      X   ( I2) = ARG1 * XDIF
      Y   ( I2 ) = ARG1 * YDIF
      Z   ( I2 ) = ARG1 * ZDIF
      GO TO 1700

C  TRANSFORM NULL POINT TO J - ELEMENT COORDINATE SYSTEM
C  EQUATION  ( 78 )


 1400 XNP = A11 ( I1 ) * XDIF + A12 ( I1 ) * YDIF + A13 ( I1 ) * ZDIF
      YNP =  A21 ( I1 ) * XDIF + A22 ( I1) * YDIF + A23 (I1)*ZDIF
      ZNP = A31 ( I1 ) * XDIF + A32 (I1) * YDIF + A33 (I1) * ZDIF

C  INEQUALITIES  ( 99) AND ( 100 )
      IF ( ROSQ .LT. RHO1SQ * TSQ ( I1 ) ) GO TO 1410

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 57 ) - ( 62 )

      P = YNP **2    + ZNP ** 2 - 4.0 * XNP ** 2
      QP= XNP **2    + ZNP ** 2 - 4.0 * YNP ** 2
      RO = SQRT ( ROSQ )
      ROP = RO ** (- 7)
      WXXX = XNP * ( 9.0 * P + 30.0 * XNP ** 2 ) * ROP
      WXXY = 3.0 * P * ROP * YNP
      WXYY = 3.0 * XNP * QP * ROP
      W YYY = YNP * ( 9.0 * QP + 30.0 * YNP ** 2 ) * ROP
      WXXZ = 3.0 * ZNP * P * ROP
      WXYZ       = - 15.0 * XNP * YNP * ZNP * ROP
      WYYZ = 3.0 * ZNP * QP * ROP
      ROP = - RO ** ( - 3)
      WX = ROP * XNP
      WY = ROP * YNP
      WZ = ROP * ZNP
      HIXX = .5 * IXX ( I1 )
      HIYY = .5 * IYY ( I1 )
      VX = - WXYY*HIYY - WXXY*IXY( I1) - WXXX*HIXX - WX*A( I1)
      VY = - WYYY*HIYY - WXYY*IXY( I1) - WXXY*HIXX - WY*A( I1)
      VZ = - WYYZ*HIYY - WXYZ*IXY( I1) - WXXZ*HIXX - WZ*A( I1)
      GO TO 1600

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 42 ) - ( 49 )

C                CHECK TO SEE IF POINT IS INSIDE BODY
 1410 GO TO ( 1300, 1310, 1300, 1310, 1300, 1310, 1300, 1310 ), I2
 1300 IF(ZNP .GT. 0.0 .OR. ROSQ .GT. 0.25*TSQ(I1) .OR. ABS(ZNP) .GT. H)
     1 GO TO 1411
      WRITE (6,5000) I1, I2, ZNP, ROSQ, TSQ(I1), H
 5000 FORMAT(10X,11HINSIDE QUADI5,5X,3HI2=I3/10X,15HZNP,ROSQ,TSQ,H=4(1PE
     113.4))
      INBODY = 1
      GO TO 1411
 1310 IF(ZNP .LT. 0.0 .OR. ROSQ .GT. 0.25*TSQ(I1) .OR. ABS(ZNP) .GT. H)
     1 GO TO 1411
      WRITE (6,5000) I1, I2, ZNP, ROSQ, TSQ(I1), H
      INBODY = 1
 1411 ETA4M3 = ETA4 ( I1) - ETA1 ( I1 )
```

```
      RO = SQRT ( ROSQ )                                                FLOV 121
      ETA2M1 = ETA2 ( I1 ) - ETA1 ( I1 )                                FLOV 122
      XI4M3 = XI4 ( I1 ) - XI 3 ( I1 )                                  FLOV 123
      XI2M1 = XI2 (I1 ) - XI1 ( I1 )                                    FLOV 124
      XI3M2 = XI3 ( I1 ) - XI2 ( I1 )                                   FLOV 125
      XI1M4 = XI1 ( I1 ) - XI4 ( I1 )                                   FLOV 126
      XMXI 1 = XNP - XI1 ( I1 )                                         FLOV 127
      XMXI2 = XNP - XI2 ( I1 )                                          FLOV 128
      XMXI3 = XNP - XI3 ( I1 )                                          FLOV 129
      XMXI4 = XNP - XI4 ( I1 )                                          FLOV 130
      YMETA1= YNP -  ETA1 ( I1 )                                        FLOV 131
      YMETA 2 = YNP - ETA2 ( I1 )                                       FLOV 132
      YMETA 4 = YNP - ETA4 ( I1 )                                       FLOV 133
        ZNPSQ = ZNP * ZNP                                               FLOV 134
      IF ( ZNPSQ .LT. TSQ ( I1 ) * 1.0E-6 ) ZNPSQ = 0.0                 FLOV 135
      E1 = ZNPSQ + XMXI1 **2                                            FLOV 136
      E2 = ZNPSQ + XMXI2 **2                                            FLOV 137
      E3 = ZNPSQ + XMXI3 **2                                            FLOV 138
      E4 = ZNPSQ + XMXI4 **2                                            FLOV 139
      H1 = YMETA1 * XMXI1                                               FLOV 140
      H2 = YMETA2 * XMXI2                                               FLOV 141
      H3 = YMETA1 * XMXI3                                               FLOV 142
      H4 = YMETA4 * XMXI4                                               FLOV 143
      M12 = 0.0                                                         FLOV 144
      IF ( XI2M1 .NE. 0.0) M12 = ETA2M1 / XI2M1                         FLOV 145
      M23 = 0.0                                                         FLOV 146
      IF ( XI3M2 .NE.0.0) M23 = - ETA2M1 / XI3M2                        FLOV 147
      M34 = 0.0                                                         FLOV 148
      IF ( XI4M3 .NE. 0.0) M34 = ETA4M3 / XI4M3                         FLOV 149
      M41 = 0.0                                                         FLOV 150
      IF ( XI1M4 .NE. 0.0) M41 = - ETA4M3 / XI1M4                       FLOV 151
      ANUM1 =  M12 * E1 - H1                                            FLOV 152
      ANUM2 =  M12 * E2 - H2                                            FLOV 153
      ANUM3 =  M23 * E2 - H2                                            FLOV 154
      ANUM4 =  M23 * E3 - H3                                            FLOV 155
      ANUM5 =  M34 * E3 - H3                                            FLOV 156
      ANUM6 =  M34 * E4 - H4                                            FLOV 157
      ANUM7 =  M41 * E4 - H4                                            FLOV 158
      ANUM8 =  M41 * E1 - H1                                            FLOV 159
      R 1 = SQRT ( XMXI1   ** 2 + YMETA1 ** 2 + ZNPSQ)                  FLOV 160
      R2  = SQRT ( XMXI2   ** 2 + YMETA2 ** 2 + ZNPSQ)                  FLOV 161
      R3  = SQRT ( XMXI3   ** 2 + YMETA1 ** 2 + ZNPSQ)                  FLOV 162
      R4  = SQRT ( XMXI4   ** 2 + YMETA4 ** 2 + ZNPSQ)                  FLOV 163
      Q25 = D12 ( I1 )                                                  FLOV 164
      Q26 = D23 ( I1 )                                                  FLOV 165
      Q27 = D34 ( I1 )                                                  FLOV 166
      Q28 = D41 ( I1 )                                                  FLOV 167
      VX = 0.0                                                          FLOV 168
      VY = 0.0                                                          FLOV 169
      VZ = 0.0                                                          FLOV 170
      IF ( Q25 ) 1420, 1430, 1420                                       FLOV 171
 1420 TEMP = R1 + R2                                                    FLOV 172
      TEMP1 = TEMP - Q25                                                FLOV 173
      TEMP2 = TEMP + Q25                                                FLOV 174
      ARG1 = 1.0                                                        FLOV 175
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG1=ALOG(TEMP1/TEMP2) FLOV 176
      TEMP = ARG1 / Q25                                                 FLOV 177
      VX = ETA2M1 * TEMP                                                FLOV 178
      VY = - XI2M1 * TEMP                                               FLOV 179
 1430 IF ( Q26 ) 1435, 1440, 1435                                       FLOV 180
```

```
 1435 TEMP = R2 + R3                                                    FLOV 181
      TEMP1 = TEMP - Q26                                                FLOV 182
      TEMP2 = TEMP + Q26                                                FLOV 183
      ARG2 = 1.0                                                        FLOV 184
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG2=ALOG(TEMP1/TEMP2) FLOV 185
      TEMP = ARG2 / Q26                                                 FLOV 186
      VX = VX - ETA2M1 * TEMP                                           FLOV 187
      VY = VY - XI3M2 * TEMP                                            FLOV 188
 1440 IF ( Q27 ) 1450, 1460, 1450                                       FLOV 189
 1450 TEMP = R3 + R4                                                    FLOV 190
      TEMP1 = TEMP - Q27                                                FLOV 191
      TEMP2 = TEMP + Q27                                                FLOV 192
      ARG3 = 1.0                                                        FLOV 193
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG3=ALOG(TEMP1/TEMP2) FLOV 194
      TEMP = ARG3 / Q27                                                 FLOV 195
      VX = VX + ETA4M3 * TEMP                                           FLOV 196
      VY = VY - XI4M3 * TEMP                                            FLOV 197
 1460 IF ( Q28 ) 1470, 1480, 1470                                       FLOV 198
 1470 TEMP = R4 + R1                                                    FLOV 199
      TEMP1 = TEMP - Q28                                                FLOV 200
      TEMP2 = TEMP + Q28                                                FLOV 201
      ARG4 = 1.0                                                        FLOV 202
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG4=ALOG(TEMP1/TEMP2) FLOV 203
      TEMP = ARG4 / Q28                                                 FLOV 204
      VX = VX - ETA4M3 * TEMP                                           FLOV 205
      VY = VY - XI1M4 * TEMP                                            FLOV 206
 1480 IF ( ZNPSQ .NE. 0.0 ) GO TO 1510                                  FLOV 207
      TEST = SQRT(TSQ(I1)* 1.0E-3)                                      FLOV 208
      IF(Q25.GT.TEST) IF((XMXI1*ETA2M1-YMETA1*XI2M1)/Q25) 1600,1502,1502FLOV 209
 1502 IF(Q26.GT.TEST) IF((-XMXI2*ETA2M1-YMETA2*XI3M2)/Q26)1600,1504,1504FLOV 210
 1504 IF(Q27.GT.TEST) IF((XMXI3*ETA4M3-YMETA1*XI4M3)/Q27) 1600,1506,1506FLOV 211
 1506 IF(Q28.GT.TEST) IF((-XMXI4*ETA4M3-YMETA4*XI1M4)/Q28)1600,1508,1508FLOV 212
 1508 VZ = 6.28318531E0                                                 FLOV 213
      GO TO 1600                                                        FLOV 214
 1510 IF (XI2M1 .NE. 0.0) VZ = ATAN(ANUM1/(ZNP*R1))-ATAN(ANUM2/(ZNP*R2))FLOV 215
      IF (XI3M2 .NE. 0.0)VZ=VZ+ATAN(ANUM3/(ZNP*R2))-ATAN(ANUM4/(ZNP*R3))FLOV 216
      IF (XI4M3 .NE. 0.0)VZ=VZ+ATAN(ANUM5/(ZNP*R3))-ATAN(ANUM6/(ZNP*R4))FLOV 217
      IF (XI1M4 .NE. 0.0)VZ=VZ+ATAN(ANUM7/(ZNP*R4))-ATAN(ANUM8/(ZNP*R1))FLOV 218
C                                                                       FLOV 219
C  TRANSFORM INDUCED VELOCITY COMPONENTS TO REFERENCE COORDINATE SYSTEM FLOV 220
C  EQUATION    ( 79 )                                                   FLOV 221
                                                                        FLOV 222
 1600 X   ( I2) = A11 (I1) * VX + A21 (I1) * VY + A31 (I1) * VZ         FLOV 223
      Y   ( I2) = A12 (I1) * VX + A22 (I1) * VY + A32 (I1) * VZ         FLOV 224
      Z   ( I2) = A13 (I1) * VX  + A23 (I1) * VY + A33 (I1) * VZ        FLOV 225
 1700 CONTINUE                                                          FLOV 226
                                                                        FLOV 227
 2000 VXPP = VXPP + SIG(I1) * X(1)                                      FLOV 228
      VYPP = VYPP + SIG(I1) * Y(1)                                      FLOV 229
      VZPP = VZPP + SIG(I1) * Z(1)                                      FLOV 230
      GO TO 2300                                                        FLOV 231
 2100 VXPP = VXPP + SIG(I1) * (X(1) + X(2))                             FLOV 232
      VYPP = VYPP + SIG(I1) * (Y(1) + Y(2))                             FLOV 233
      VZPP = VZPP + SIG(I1) * (Z(1) + Z(2))                             FLOV 234
      GO TO 2300                                                        FLOV 235
 2200 VXPP = VXPP + SIG(I1) * (X(1) + X(2) + X(3) + X(4))               FLOV 236
      VYPP = VYPP + SIG(I1) * (Y(1) + Y(2) + Y(3) + Y(4))               FLOV 237
      VZPP = VZPP + SIG(I1) * (Z(1) + Z(2) + Z(3) + Z(4))               FLOV 238
 2204 IF ( NSYM .EQ. 2 ) GO TO 2300                                     FLOV 239
      VXPP = VXPP - SIG(I1) * (X(5) + X(6) + X(7) + X(8))               FLOV 240
```

```
      VYPP = VYPP - SIG(I1) * (Y(5) + Y(6) + Y(7) + Y(8))
      VZPP = VZPP - SIG(I1) * (Z(5) + Z(6) + Z(7) + Z(8))
 2300 CONTINUE
      VXPP = VXPP * RBETA**2 + 1.0
      VYPP = VYPP * RBETA
      VZPP = VZPP * RBETA
      RETURN
      END
```

```
*DECK,FLOAIR
      SUBROUTINE FLOAIR( X, Z, ECC, VX, VZ, PSI, IFLAG)
C     THIS CODE RETURNS AIRFLOW VELOCITY (VX, VZ) FOR A GIVEN POINT
C     (X, Z) EXTERIOR TO AN ELLIPSOID OF REVOLUTION IN AN AIRSTREAM.
C     THE ELLIPSOID IS PROLATE WITH MAJOR AXIS PARALLEL WITH THE FREE
C     STREAM FLOW.  FLOW IS TOWARD THE POSITIVE X AXIS.  PSI IS THE
C     STREAM FUNCTION VALUE AT X,Z.  ECC IS THE ELLIPSOID ECCENTRICITY.
      IF(IFLAG)100,100,200
C     INITIALIZE
  100 E2 = ECC**2
      OME2 = 1.0 - E2
      TEC = 2.0 * ECC
      CX =-ECC/( ALOG((1.0 + ECC)/(1.0 - ECC)) - TEC/OME2)
      CZ = TEC*CX
      CPSI = ECC*CX
C     COMPUTE FLOW VELOCITIES AND STREAMFUNCTION VALUE
  200 SQRM = SQRT((X + ECC)**2 + Z**2)
      SQRN = SQRT((X - ECC)**2 + Z**2)
      VX =CX*(ALOG(( SQRM + SQRN + TEC)/ (SQRM + SQRN - TEC))/ECC
     1  - 1.0/SQRM - 1.0/SQRN) + 1.0
      VZ =   CZ*Z*( 1.0/SQRM - 1.0/SQRN)/ (X**2 + Z**2 + SQRM*SQRN - E2)
      COSH = (SQRM + SQRN)/TEC
      COS  = (SQRM - SQRN)/TEC
      PSI =  GPSI*( COSH + 0.5*( COSH**2 - 1.0)*
     1  ALOG((COSH - 1.0)/( COSH + 1.0))) * ( 1.0 - COS**2) - Z**2/2.0
      RETURN
      END
```

```
*DECK,ARYTRJ
      SUBROUTINE ARYTRJ
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     CALLS TRAJECT TO COMPUTE TRAJECTORIES OF PARTICLES TO OR ABOUT
C     AN ARBITRARY 3-DIMENSIONAL BODY.   TRAJECTORIES BEGIN AT AN ARRAY
C     OF POINTS IN SPACE.  THE ARRAY POINTS, AND CORRESPONDING
C     TRAJECTORIES, ARE DEFINED BY SPECIFYING AN INITIAL POINT,INCREMENT
C     VALUES IN THE THREE  COORDINATE DIRECTIONS, AND THE ORDER OF
C     INCREMENTING.     INPUT INTEGERS M(3) SPECIFY THE ORDER IN WHICH
C     INCREMENTING IS DONE - ALLOWED VALUES OF M ARE 1,2,3.  FOR EXAMPLE
C     SUPPOSE M(1)=2, M(2)=1, M(3)=3, THEN Y IS INCREMENTED FIRST, X IS
C     INCREMENTED SECOND AND Z IS INCREMENTED LAST.
C     IF TRAJECTORIES ARE NOT DESIRED FROM ALL OF THE ARRAY POINTS, THE
C     PARAMETER NSKIP CAN BE SET GREATER THAN ZERO, AND AFTER THE FIRST
C     TRAJECTORY ONLY EVERY NSKIP+1 TH TRAJECTORY IS COMPUTED.
C     ALSO REQUIRED ARE -  (IN ORDER OF X AXIS FIRST, Y AXIS SECOND,
C     Z AXIS THIRD)- INITIAL COORDINATE, INCREMENT, NUMBER OF INCREMENTS
C     DESIRED (INCLUDING THE INITIAL COORDINATE VALUE).
C
C     SR PARTCL IS CALLED TO READ, PROCESS AND PRINT PARTICLE DATA.
C     THIS SR CAN BE ONE OF SEVERAL THAT TREATS WATER DROPS OR ONE OF
C     VARIOUS TYPES OF ICE CRYSTALS.
C
C     UNIT 9 IS A SCRATCH UNIT USED FOR TRAJECTORY DATA STORAGE.
C     UNIT 10 IS USED FOR TRAJECTORY DATA OUTPUT FOR PLOTTING.
C
C     FLOW DATA PREPARED BY THE HESS-SMITH CODE ARE READ FROM UNIT 14
C     VIA SR SETFLO.
C
C     ALL COORDINATES AND TIMES ARE NORMALIZED (DIMENSIONLESS)
C
C     GLOSSARY
C     ACC      DIAM/ELL - USED TO COMPUTE ACCELERATION MODULUS
C     ALPHAO   ANGLE BETWEEN PROJECTION OF INITIAL VELOCITY VECTOR IN
C              X-Y PLANE AND X AXIS
C     ALPHAR   ANGLE BETWEEN PROJECTION OF FINAL VELOCITY VECTOR IN X-Y
C              PLANE AND X AXIS
C     BETAO    ANGLE BETWEEN INITIAL VELOCITY VECTOR AND ITS PROJECTION
C              IN THE X-Y PLANE
C     BETAR    ANGLE BETWEEN FINAL VELOCITY VECTOR AND ITS PROJECTION
C              IN THE X-Y PLANE
C     D        COORDINATE INCREMENT ARRAY
C     DIAM     DIAMETER OF A WATER DROP OR ICE AGGREGATE
C              BASE DIAMETER FOR A PLATE OR CYLINDER (MICROMETERS)
C     DLR      BASE DIAMETER TO LENGTH (CYLINDER) OR THICKNESS (PLATE)
C              RATIO
C     ELL      CHARACTERISTIC DIMENSION OF THE BODY ( METERS )
C     EPSI( )  PARAMETERS USED TO CONTROL LOCAL ERROR IN THE NUMERICAL
C              INTEGRATION (SEE DVDQ GLOSSARY)
C     FN       FROUDE NUMBER
C     FNR      RECIPROCAL OF THE FROUDE NUMBER
C     HI       INITIAL TIME STEP FOR NUMERICAL INTEGRATION (SEE DVDQ)
C     HMAX     MAXIMUM TIME STEP (SEE DVDQ)
C     HMIN     MINIMUM ALLOWED TIME STEP (SEE DVDQ)
C     IPLOT    IF TRUE, TRAJECTORY DATA ARE COPIED TO UNIT 10 FOR PLOTTNG
C     N        NUMBER OF COORDINATE INCREMENT STEPS ARRAY (INCLUDING THE
C              FIRST COORDINATE VALUE)
C     NPOINT   ARRAY POINT TALLY
```

```
C      NSKIP    NUMBER OF ARRAY POINTS SKIPPED BETWEEN TRAJECTORIES
C      P( )     CURRENT VALUES OF INDEPENDENT VARIABLES -
C                  P(1) = X
C                  P(2) = DX/DT
C                  P(3) = Y
C                  P(4) = DY/DT
C                  P(5) = Z
C                  P(6) = DZ/DT
C      PT       DRAG COEFFICIENT*ABS(REYNOLDS NUMBER) FOR GRAVITY SETTLING
C               OF PARTICLES
C      RF       FACTOR TO CONVERT VELOCITY DIFFERENCE TO REYNOLDS NUMBER
C      RHO      AIR DENSITY (KG/M**3)
C      RHOP     PARTICLE DENSITY (KG/M**3)
C      TEMP     AIR TEMPERATURE (DEG. KELVIN)
C      TPRINT   OUTPUT TIME INTERVAL
C      V        AIR SPEED (M/SEC)
C      VIS      AIR VISCOSITY (KG/(M-SEC))
C      VPGT     PARTICLE SPEED AT TARGET POINT
C      VT       GRAVITY SETTLING SPEED OF PARTICLE
C      VTGT     AIR SPEED AT TARGET POINT
C      X        INITIAL COORDINATE ARRAY
C      XFINAL   X COORDINATE OF THE FINAL PLANE
C      XI3,YI3,ZI3  INITIAL COORDINATES PASSED TO TRAJECT
C
C
       COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
      1RF,REO,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHA0,BETA0,IREC,
      2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
      3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XWP,XPP,ACC,DLR,JLIM
       DIMENSION HOLL(18), X(3), D(3), N(3), M(3), SX(3), SD(3), NS(3),
      1 SXI(3), SEQ(6)
       LOGICAL         IPLOT
       DATA SEQ/ 4HFIRS, 4HT    , 4HSECO, 4HND   , 4HTHIR, 4HD    /
       DATA STAR, BLNK / 3H  *, 3H    / , PI/3.1415926536/
       JLIM=0
       NFIN=0
C                          READ AND WRITE DATA
       READ (5,2600) KASE
       CALL SETFLO(KASE)
       READ(5,1000)HOLL,            IPLOT
       READ(5,1100)V, ELL, RHO, TEMP, XFINAL
       READ(5,1100) TPRINT, HI, HMINI, EPSI
C      SET DEFAULT VALUES FOR NUMERICAL INTEGRATION AND PRINT PARAMETERS
       IF(TPRINT .EQ. 0.0) TPRINT=0.1
       IF(HI .EQ. 0.0) HI=0.1
       IF(HMINI .EQ. 0.0) HMINI=0.005
       IF(EPSI(1) .EQ. 0.0) EPSI(1)=1.0E-5
       IF(EPSI(2) .EQ. 0.0) EPSI(2)=1.0E-5
       IF(EPSI(3) .EQ. 0.0) EPSI(3)=1.0E-5
       VIS = 145.8E-8 * TEMP**(3.0/2.0)/(110.4 + TEMP)
       WRITE(6,1200) HOLL
       WRITE(6,1300) V, ELL, RHO, TEMP, VIS
       WRITE(6,1400) HI,HMINI,TPRINT,XFINAL
       WRITE(6,1500) EPSI(1), EPSI(2), EPSI(3)
C      INITIALIZE
       FN = V**2/(9.8*ELL)
       FNR = 1.0/FN
        IF (.NOT. IPLOT) GO TO 5
       REWIND 10
       WRITE (6,1800)
```

```
C       ENTER PARTICLE LOOP
     5  CALL PARTCL(V,ELL,RHO,VIS,TEMP,DIAM,DLR,RHOP,VT,RF,PT,ACC,NFIN)
        IF(NFIN .EQ. 0) GO TO 6
        IF( .NOT. IPLOT) RETURN
        ENDFILE 10
        REWIND 10
        RETURN
     6  COF = PT*VT*FN
        R = RF * VT
        READ(5,8100)M, NSKIP
        IF(M(1)+M(2)+M(3) .EQ. 6) GO TO 10
        WRITE(6,8200)
        STOP
    10  DO 20 L=1,3
    20  READ(5,8000) X(L), D(L), N(L)
        WRITE(6,2000) X(1), D(1), N(1)
        WRITE(6,3000) X(2), D(2), N(2)
        WRITE(6,4000) X(3), D(3), N(3)
        WRITE(6,9000)
        WRITE(6,5000) SEQ(2*M(1)-1), SEQ(2*M(1))
        WRITE(6,6000) SEQ(2*M(2)-1), SEQ(2*M(2))
        WRITE(6,7000) SEQ(2*M(3)-1), SEQ(2*M(3))
        DO 40 L=1,3
        LL=4-M(L)
        SD(LL)=D(L)
        SXI(LL)=X(L)-D(L)
    40  NS(LL)=N(L)
        N1=NS(1)
        N2=NS(2)
        N3=NS(3)
        NPOINT=0
        SX(1)=SXI(1)
        DO 500 I=1,N1
        SX(1)=SX(1)+SD(1)
        SX(2)=SXI(2)
        DO 500 J=1,N2
        SX(2)=SX(2)+SD(2)
        SX(3)=SXI(3)
        DO 500 K=1,N3
        SX(3)=SX(3)+SD(3)
        NPOINT=NPOINT+1
        IF(MOD(NPOINT, NSKIP+1) .NE. 1) GO TO 500
        DO 50 L=1,3
        LL=4-M(L)
    50  X(L)=SX(LL)
C       INITIALIZE FOR TRAJECT
        XI3=X(1)
        YI3=X(2)
        ZI3=X(3)
        XPSTAR=XFINAL
        XPP = XFINAL
        ALPHAR=0.0
        BETAR=0.0
        YP = 0.0
        ZP = 0.0
        WRITE(6,1600) XI3, YI3, ZI3
        CALL TRAJECT
C                           PRINT TRAJECTORY OUTPUT
        REWIND 9
        WRITE (6,8700)
```

```
      DO 494 IWRITE = 1,IREC
      READ (9)NEVAL,KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R,AC
      WRITE(6,8600) KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R, AC, NEVAL
  494 CONTINUE
C              COMPUTE INITIAL AND FINAL TRAJECTORY ANGLES
      CALL FLOVEL(XI3,YI3,ZI3,VX,VY,VZ,HI,INBODY)
      ALPHAO = ATAN(VY/VX) * 180./PI
      BETAO = ATAN((VZ-VT)/SQRT(VX**2 + VY**2)) * 180./PI
      ALPHAR = ATAN(P(4)/P(2))*180./PI
      BETAR = ATAN(P(6)/SQRT(P(2)**2+P(4)**2))*180./PI
      WRITE (6,8800) ALPHAO, BETAO, ALPHAR, BETAR
C     COMPUTE AND PRINT DRAG VECTOR AT FINAL POINT
      CALL FLOVEL(P(1), P(3), P(5), VX, VY, VZ, HI, INBODY)
      DV = SQRT( (VX - P(2))**2 + (VY - P(4))**2 + (VZ - P(6))**2 )
      COSA = (VX - P(2))/DV
      COSB = (VY - P(4))/DV
      COSC = (VZ - P(6))/DV
      ANG = ATAN( COSB/COSA ) * 57.29577951
      CNG = ACOS( COSC ) * 57.29577951
      WRITE( 6, 3100 ) COSA, CCSB, COSC, ANG, CNG
C     COMPUTE AND PRINT AIR AND PARTICLE SPEEDS AT FINAL POINT
      VA   = SQRT( VX**2 + VY**2 + VZ**2 )
      VP   = SQRT(P(2)**2 + P(4)**2 + P(6)**2)
      WRITE(6, 3200) VA, VP
      IF (IPLOT)  WRITE (10) IPLT, (XPLOT(L),YPLOT(L),ZPLOT(L),L=1,IPLT)
C
  500 CONTINUE
      GO TO 5
 1000 FORMAT(18A4, 7X,L1)
 1100 FORMAT(8F10.5)
 1200 FORMAT(1H1,5X, 15HARYTRJ RUN ID -/ 8X, 18A4)
 1300 FORMAT(1H0, 5X, 21HPHYSICAL INPUT DATA -/7X,10HAIR SPEED=1PE13.6,
     1 3X, 37HCHARACTERISTIC DIMENSION OF THE BODY=1PE13.6/ 7X,35HDENSIT
     2Y AND TEMPERATURE OF AIR ARE 1PE13.6, 5H AND 1PE13.6,20H   AIR VIS
     3COSITY IS 1PE13.6)
 1400 FORMAT( 1H0, 5X, 29HNUMERICAL INTEGRATOR INPUTS -/ 7X, 10HTIME STE
     1P=1PE11.4, 3X, 18HMINIMUM TIME STEP=1PE11.4, 3X, 20HPRINT TIME INT
     2ERVAL=1PE11.4, 3X, 24HX COORD. OF FINAL PLANE=1PE11.4)
 1500 FORMAT( 1H0, 6X, 33HLOCAL ERROR TOLERANCES FOR DVDQ -, 3(1PE14.4))
 1600 FORMAT(//1H0,  38H* * * * * * *  INITIAL COORDINATES  X=1PE12.5,
     2 3X, 2HY=1PE12.5, 3X, 2HZ=1PE12.5)
 1800 FORMAT( ///6X, 52HTRAJECTORY DATA ARE WRITTEN ON UNIT 10 FOR PLOT
     1TING//)
 2000 FORMAT( 10X, 10HINITIAL X=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 2600 FORMAT (A4)
 3000 FORMAT( 10X, 10HINITIAL Y=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 3100 FORMAT(/5X, 29HDRAG VECTOR AT FINAL  POINT -/ 6X, 18HDIRECTION COS
     1INES-3(1PE13.4), 3X, 19HANGLES A AND GAMMA-2(1PE13.4))
 3200 FORMAT(5X, 47HAIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE2(1PE
     115.5))
 4000 FORMAT( 10X, 10HINITIAL Z=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 5000 FORMAT( 10X, 22HX AXIS IS INCREMENTED 2A4)
 6000 FORMAT( 10X, 22HY AXIS IS INCREMENTED 2A4)
 7000 FORMAT( 10X, 22HZ AXIS IS INCREMENTED 2A4)
 8000 FORMAT( 2F10.0, I4)
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 8100 FORMAT(4I4)
 8200 FORMAT(///10X, 47HINCREMENTING SEQUENCE IS ERRONIOUS.  TRY AGAIN.)
 8600 FORMAT(I6, 10(1X,1PE11.4)/10X,  2HH=1PE11.4,4H  R=1PE11.4, 5H  AC=
     11PE11.4, 8H  NEVAL=I6)
 8700 FORMAT(/6H0KSTEP, 7X, 1HT, 11X, 1HX, 11X, 1HY, 11X, 1HZ, 10X,
     1 3HVPX, 9X, 3HVPY, 9X, 3HVPZ, 10X, 2HVX, 10X, 2HVY, 10X, 2HVZ)
 8800 FORMAT(   /20X, 47HINITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
     1/ 22X,  7HALPHA0=F10.4, 5X, 6HBETA0=F10.4/ 22X, 7HALPHAR=F10.4, 5X
     2,  6HBETAR=F10.4)
 9000 FORMAT(1H0)
      END
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```
*DECK,TANTRA
      SUBROUTINE TANTRA
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     DETERMINES TANGENT PARTICLE TRAJECTORIES TO AN ARBITRARY
C     3-DIMENSIONAL BODY.
C
C     CALLS TRAJECT TO COMPUTE TRAJECTORIES OF PARTICLES TO OR ABOUT
C     AN ARBITRARY 3-DIMENSIONAL BODY.  TRAJECTORIES BEGIN AT POINTS
C     ON A CURVE AS SPECIFIED BY  SR. STRPNT, AND THE INITIAL POINTS ARE
C     STEPPED TOWARD THE BODY USING FIRST A COARSE STEP SIZE UNTIL
C     IMPACTION OCCURS.  THEN INITIAL COORDINATES ARE BACKED-UP ONE
C     STEP, AND A FINE STEP SIZE IS USED UNTIL IMPACTION REOCCURS.
C     THE TANGENT TRAJECTORY IS TAKEN TO BE THE ONE CALCULATED
C     IMMEDIATELY PRIOR TO THE SECOND IMPACTION.  POINTS ON THE TANGENT
C     TRAJECTORY ONLY ARE STORED FOR PLOTTING LATER IF DESIRED.
C     ALL TRAJECTORIES ARE PRINTED.
C
C     SR PARTCL IS CALLED TO READ, PROCESS AND PRINT PARTICLE DATA.
C     THIS SR CAN BE ONE OF SEVERAL THAT TREATS WATER DROPS OR ONE OF
C     VARIOUS TYPES OF ICE CRYSTALS.
C
C     UNIT 9 IS A SCRATCH UNIT USED FOR TRAJECTORY DATA STORAGE.
C     UNIT 10 IS USED FOR TRAJECTORY DATA OUTPUT FOR PLOTTING.
C
C     FLOW DATA PREPARED BY THE HESS-SMITH CODE ARE READ FROM UNIT 14
C     VIA SR SETFLO.
C
C     ALL COORDINATES AND TIMES ARE NORMALIZED (DIMENSIONLESS)
C
C     GLOSSARY
C     ACC      DIAM/ELL - USED TO COMPUTE ACCELERATION MODULUS
C     ALPHAR   ANGLE BETWEEN PROJECTION OF FINAL VELOCITY VECTOR IN X-Y
C              PLANE AND X AXIS
C     BETAR    ANGLE BETWEEN FINAL VELOCITY VECTOR AND ITS PROJECTION
C              IN THE X-Y PLANE
C     DCORS    COARSE VALUE OF DEL USED FOR ROUGH DETERMINATION OF
C              TANGENT TRAJECTORY
C     DEL      CURRENT VALUE OF STEP SIZE USED IN INCREMENTING INITIAL
C              COORDINATES TOWARD THE BODY
C     DFINE    FINE VALUE OF DEL USED FOR PRECISE DETERMINATION OF
C              TANGENT TRAJECTORY
C     DIAM     DIAMETER OF A WATER DROP OR ICE AGGREGATE
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C             BASE DIAMETER FOR A PLATE OR CYLINDER (MICROMETERS)
C       DLR   BASE DIAMETER TO LENGTH (CYLINDER) OR THICKNESS (PLATE)
C             RATIO
C       ELL   CHARACTERISTIC DIMENSION OF THE BODY ( METERS )
C       EPSI( ) PARAMETERS USED TO CONTROL LOCAL ERROR IN THE NUMERICAL
C             INTEGRATION (SEE DVDQ GLOSSARY)
C       FN    FROUDE NUMBER
C       FNR   RECIPROCAL OF THE FROUDE NUMBER
C       HI    INITIAL TIME STEP FOR NUMERICAL INTEGRATION (SEE DVDQ)
C       HMAX  MAXIMUM TIME STEP (SEE DVDQ)
C       HMIN  MINIMUM ALLOWED TIME STEP (SEE DVDQ)
C       IPLOT IF TRUE, TRAJECTORY DATA ARE COPIED TO UNIT 10 FOR PLOTTNG
C       IT    WHEN RETURNED FROM TRAJECT
C             WITH A VALUE OF ZERO, INDICATES IMPACTION HAS OCCURED.
C       KT    TRAJECTORY TALLY
C       P( )  CURRENT VALUES OF INDEPENDENT VARIABLES -
C                P(1) = X
C                P(2) = DX/DT
C                P(3) = Y
C                P(4) = DY/DT
C                P(5) = Z
C                P(6) = DZ/DT
C       PT    DRAG COEFFICIENT*ABS(REYNOLDS NUMBER) FOR GRAVITY SETTLING
C             OF PARTICLES
C       RF    FACTOR TO CONVERT VELOCITY DIFFERENCE TO REYNOLDS NUMBER
C       RHO   AIR DENSITY (KG/M**3)
C       RHOP  PARTICLE DENSITY (KG/M**3)
C       TEMP  AIR TEMPERATURE (DEG. KELVIN)
C       TPRINT  OUTPUT TIME INTERVAL
C       V     AIR SPEED (M/SEC)
C       VIS   AIR VISCOSITY (KG/(M-SEC))
C       VT    GRAVITY SETTLING SPEED OF PARTICLE
C       XFINAL  X COORDINATE OF THE FINAL PLANE
C       XI3,YI3,ZI3  INITIAL COORDINATES PASSED TO TRAJECT
C
      COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
     1RF,REO,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHA0,BETA0,IREC,
     2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
     3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XWP,XPP,ACC,DLR,JLIM
      DIMENSION HOLL(18)
      LOGICAL IPLOT
      DATA SIGNAL/999999./, KTLIM/ 25/
      JLIM=0
      NFIN=0
C                         READ AND WRITE DATA
      READ (5,2600) KASE
      CALL SETFLO(KASE)
      READ(5,1000)HOLL,         IPLOT
      READ(5,1100)V, ELL, RHO, TEMP, XFINAL
      READ(5,1100) TPRINT, HI, HMINI, EPSI
C     SET DEFAULT VALUES FOR NUMERICAL INTEGRATION AND PRINT PARAMETERS
      IF(TPRINT .EQ. 0.0) TPRINT=0.1
      IF(HI .EQ. 0.0) HI=0.1
      IF(HMINI .EQ. 0.0) HMINI=0.005
      IF(EPSI(1) .EQ. 0.0) EPSI(1)=1.0E-5
      IF(EPSI(2) .EQ. 0.0) EPSI(2)=1.0E-5
      IF(EPSI(3) .EQ. 0.0) EPSI(3)=1.0E-5
      VIS = 145.8E-8 * TEMP**(3.0/2.0)/(110.4 + TEMP)
      WRITE(6,1200) HOLL
      WRITE(6,1300) V, ELL, RHO, TEMP, VIS
```

```
      WRITE(6,1400) HI,HMINI,TPRINT,XFINAL
      WRITE(6,1500) EPSI(1), EPSI(2), EPSI(3)
C     INITIALIZE
      FN = V**2/(9.8*ELL)
      FNR = 1.0/FN
       IF (.NOT. IPLOT) GO TO 5
      REWIND 10
      WRITE (6,1800)
C     ENTER PARTICLE LOOP
    5 CALL PARTCL(V,ELL,RHO,VIS,TEMP,DIAM,DLR,RHOP,VT,RF,PT,ACC,NFIN)
      IF(NFIN .EQ. 0) GO TO 6
      IF( .NOT. IPLOT) RETURN
      ENDFILE 10
      REWIND 10
      RETURN
    6 COF = PT*VT*FN
      R = RF * VT
      MFIN=0
C     SET INITIAL COORDINATES
   10 DFINE=SIGNAL
      IT=1
      KT=0
   20 CALL STRPNT(XI3, YI3, ZI3, DEL, DCORS, DFINE, MFIN)
      IF(MFIN .GT. 0) GO TO 5
      KT=KT+1
      IF(KT .GT. KTLIM) GO TO 60
      XPSTAR=XFINAL
      XPP = XFINAL
      ALPHAR=0.0
      BETAR=0.0
      YP = 0.0
      ZP = 0.0
      WRITE(6,1600) XI3, YI3, ZI3, KT
      CALL TRAJECT
C                         PRINT TRAJECTORY OUTPUT
      REWIND 9
      WRITE (6,8700)
      DO 30  IWRITE = 1,IREC
      READ (9)NEVAL,KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R,AC
      WRITE(6,8600) KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R, AC, NEVAL
   30 CONTINUE
C     CHECK FOR IMPACTION AND ADJUST DEL IF NECESSARY
      IF(IT .LE. 0) GO TO 40
      IF(DEL .EQ. -DFINE) GO TO 50
      IF(DEL .NE. -DCORS) GO TO 20
      DEL=DFINE
      WRITE(6,3000)
      GO TO 20
C     IMPACTION HAS OCCURED
   40 IT=1
      IF(DEL .EQ. -DCORS) GO TO 20
      IF(DEL .EQ. DFINE) WRITE(6,4000)
      KT=KT-2
      DEL=-DEL
      GO TO 20
   50 IF( .NOT. IPLOT) GO TO 10
      IF (IPLOT)  WRITE (10) IPLT, (XPLOT(L),YPLOT(L),ZPLOT(L),L=1,IPLT)
      GO TO 10
```

```
   60 WRITE(6,2000) ITLIM
      GO TO 10
C
 1000 FORMAT(18A4, 7X,L1)
 1100 FORMAT(8F10.5)
 1200 FORMAT( 1H1, 5X, 32HTANGENT TRAJECTORY CODE RUN ID -/ 8X, 18A4)
 1300 FORMAT(1H0, 5X, 21HPHYSICAL INPUT DATA -/7X,10HAIR SPEED=1PE13.6,
     1 3X, 37HCHARACTERISTIC DIMENSION OF THE BODY=1PE13.6/ 7X,35HDENSIT
     2Y AND TEMPERATURE OF AIR ARE 1PE13.6, 5H AND 1PE13.6,20H   AIR VIS
     3COSITY IS 1PE13.6)
 1400 FORMAT( 1H0, 5X, 29HNUMERICAL INTEGRATOR INPUTS -/ 7X, 10HTIME STE
     1P=1PE11.4, 3X, 18HMINIMUM TIME STEP=1PE11.4, 3X, 20HPRINT TIME INT
     2ERVAL=1PE11.4, 3X, 24HX COORD. OF FINAL PLANE=1PE11.4)
 1500 FORMAT( 1H0, 6X, 33HLOCAL ERROR TOLERANCES FOR DVDQ -, 3(1PE14.4))
 1600 FORMAT(//1H0,  38H*   *   *   *  INITIAL COORDINATES  X=1PE12.5,
     1 3X, 2HY=1PE12.5, 3X, 2HZ=1PE12.5, 3X,  21HFOR TRAJECTORY NUMBER,
     2 I4)
 1800 FORMAT( ///6X, 51HTRAJECTORY DATA ARE WRITTEN ON UNIT 10 FOR PLOTT
     1ING//)
 2000 FORMAT(///5X, I4, 66H TRAJECTORIES HAVE BEEN COMPUTED.   GIVE UP A
     1ND TRY THE NEXT CASE.//)
 2600 FORMAT (A4)
 3000 FORMAT( //128H0* * * * * * * * * * * * * * * * * * * * * * * * * * *
     1 SWITCH TO FINE STEPSIZE * * * * * * * * * * * * * * * * * * * * *
     2 * * * * */)
 8600 FORMAT(I6, 10(1X,1PE11.4)/10X,  24H=1PE11.4,4H  R=1PE11.4, 5H  AC=
     11PE11.4, 8H  NEVAL=I6)
 8700 FORMAT(/6H0KSTEP, 7X, 1HT, 11X, 1HX, 11X, 1HY, 11X, 1HZ, 10X,
     1 3HVPX, 9X, 3HVPY, 9X, 3HVPZ, 10X, 2HVX, 10X, 2HVY, 10X, 2HVZ)
 4000 FORMAT( /// 129H * * * * * * * * * * * * * * * * * * * * * * * * * *
     1 TANGENT TRAJECTORY IS AS FOLLOWS * * * * * * * * * * * * * * * * *
     2* * * * * * */)
      END
```

```
*DECK,STRPNT
      SUBROUTINE STRPNT( X, Y, Z, D, DCORS, DFINE, M)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - DECEMBER 1979
C
C     CALLED BY TANTRA TO DEFINE TRAJECTORY STARTING COORDINATES FOR
C     DETERMINATION OF TANGENT TRAJECTORIES OF PARTICLES TO A THREE-
C     DIMENSIONAL BODY.   THIS VERSION STARTS ALL TRAJECTORIES ON A
C     POINTS ARE STEPPED ALONG THE LINE TOWARD THE BODY USING
C     FIRST A COARSE STEP SIZE, AND AFTER IMPACTION AND BACK-UP A FINE
C     STEP SIZE UNTIL IMPACTION REOCCURS.
C
C     GLOSSARY
C     COSA,COSB,COSG   DIRECTION COSINES OF THE STARTING POINT LINE
C     D        CURRENT VALUE OF STEP SIZE USED IN INCREMENTING INITIAL
C              COORDINATES TOWARD THE BODY
C     DCORS    COARSE VALUE OF  D  USED FOR ROUGH DETERMINATION OF
C              TANGENT TRAJECTORY
C     DFINE    FINE VALUE OF  D  USED FOR PRECISE DETERMINATION OF
C              TANGENT TRAJECTORY
C     X,Y,Z    STARTING COORDINATES
C     X1,Y1,Z1  POINT USED, ALONG WITH FIRST STARTING POINT, TO DEFINE
C                THE STARTING POINT LINE
C
      DATA SIGNAL/999999./
      IF(DFINE .LT. SIGNAL) GO TO 200
COPY IN STEP SIZE INCREMENTS AND INITIALIZE FOR A NEW TANGENT LOCATION
      READ(5,1100) DCORS, DFINE
CHECK IF TRAJECTORIES FOR THIS PARTICLE SIZE ARE FINISHED
      M=0
      IF(ABS(DCORS) + ABS(DFINE) .NE. 0.0) GO TO 100
      M=1
      RETURN
COPY IN A PAIR OF POINT COORDINATES TO DEFINE THE STARTING POINT LINE.
C     THE FIRST COORDINATES SPECIFY THE START POINT FOR THE FIRST
C     TRAJECTORY, AND THE SECOND COORDINATES ARE FOR ANY POINT ON THE
C     LINE WHICH IS CLOSER TOWARD THE BODY.
  100 READ(5,1100) X, Y, Z, X1, Y1, Z1
COMPUTE DIRECTION COSINES OF THE STARTING POINT LINE
      R = SQRT((X1-X)**2 + (Y1-Y)**2 + (Z1-Z)**2)
      COSA = (X1-X)/R
      COSB = (Y1-Y)/R
      COSG = (Z1-Z)/R
      D = DCORS
      WRITE(6,1000) X, Y, Z, X1, Y1, Z1
      WRITE(6,1200) COSA, COSB, COSG
      WRITE(6,1300) DCORS, DFINE
      RETURN
COMPUTE NEXT SET OF STARTING COORDINATES
  200 X = X + D*COSA
      Y = Y + D*COSB
      Z = Z + D*COSG
      RETURN
 1000 FORMAT(/////5X,89HTRAJECTORIES ARE TO BEGIN ALONG A LINE DEFINED B
     1Y THE POINTS (X1,Y1,Z1,) AND (X2,Y2,Z2) -/  9X,2H( ,3(1PE15.5),
     2 13H )    AND    ( , 3(1PE15.5), 2H ))
 1100 FORMAT(8F10.0)
 1200 FORMAT(5X, 60HWITH DIRECTION COSINES -(COS(ALPHA),COS(BETA),COS(GA
     1MMA)) - 3(1PE15.5)/)
 1300 FORMAT( 5X, 49HSTARTING POINT INCREMENTS ARE - COARSE INCREMENT=1P
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```
     1E12.5, 3X, 15HFINE INCREMENT=1PE12.5)
      END
```

```
*DECK, FALWAT
      SUBROUTINE FALWAT(D, RHO, ETA, T, P, V)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - DECEMBER 1979
C
C     COMPUTES STILL-AIR, TERMINAL SETTLING SPEED OF WATER DROPS
C     ACCORDING TO THE EQUATIONS OF BEARD (JAS 33, 852(1976))
C
C     GLOSSARY (SI UNITS)
C     C          4.0*G/3.0   WHERE G IS ACCELERATION OF GRAVITY (9.8)
C     CDRR       DAVIES NUMBER
C     D          DROP DIAMETER
C     ETA        VISCOSITY
C     P          PRESSURE
C     PN         PHYSICAL PROPERTY NUMBER TO 1/6 POWER
C     RHO        FLUID DENSITY
C     RHOP       WATER DENSITY
C     SIG        WATER SURFACE TENSION
C     T          TEMPERATURE
C     V          SETTLING SPEED
C
      DATA C/13.066667/, RHOP/1000./, EX/0.16666666667/
C
COMPUTE DAVIES NUMBER
      CDRR = C*(RHOP-RHO)*RHO*D**3/ETA**2
CHECK DAVIES NUMBER VALUE FOR ROUTING
      IF(CDRR .GT. 0.3261) IF(CDRR-58249.) 100,100,200
COMPUTE VIA STOKES-LAW EQUATION
      V = CDRR*ETA/(24.0*RHO*D)
      GO TO 300
COMPUTE VIA BEARDS EQUATION FOR MEDIUM SIZE DROPS
 100  Y = ALOG(CDRR)
      V = ETA/(RHO*D)*EXP(-3.18657 + Y*(0.992696 + Y*(-0.153193E-2
     1+Y*(-0.987059E-3 + Y*(-0.578878E-3 + Y*(0.855176E-4
     2-Y*0.327815E-5))))))
      GO TO 300
COMPUTE VIA BEARDS EQUATION FOR LARGE DROPS
 200  SIG = 7.570E-2 - 1.535E-4*(T - 273.0)
      PN = (SIG**3 * RHO**2/(9.8 * (RHOP-RHO) * ETA**4))**EX
      Y = ALOG(PN*C*(RHOP- RHO) * D**2/SIG)
      V = ETA*PN/(RHO*D) * EXP(-5.00015 + Y*(5.23778 + Y*(-2.04914 +
     1 Y*(0.475294 + Y*(-0.0542819 + Y*0.00238449)))))
      RETURN
CORRECT SETTLING SPEED FOR SLIP
 300  V = V*(1.0 + 54.088*ETA*SQRT(T)/P/D)
      RETURN
      END
```

```
*DECK,WCDRR
      FUNCTION WCDRR( R )
C
C     GIVEN THE REYNOLDS NUMBER, R,  THE PRODUCT OF THE DRAG COEFFICIENT
C     AND THE THE SQUARE OF THE REYNOLDS NUMBER IS RETURNED FOR A WATER
C     DROP IN AIR.  THIS FUNCTION SHOULD BE USED ONLY FOR R .GT. 200.
C     ( SEE BEARD AND PRUPPACHER, JAS 26, 1066(1969)).
C     THE DATA OF GUNN AND KINZER, J. METEOR. 6, 243(1949), ARE USED.
C
      IF( R .GT. 200. ) GO TO 100
      WCDRR = -1.0E20
      RETURN
  100 ALGR = ALOG10( R )
      WCDRR = 10.0**( 21.38446 + ALGR * ( -28.81245 + ALGR * (
     1 16.83269 + ALGR * ( -4.152207 +  ALGR * 0.3672735 ))))
      RETURN
      END
```

```
*DECK.CDRR
      FUNCTION CDRR(R)
C
C     GIVEN THE REYNOLDS NUMBER, R, THE PRODUCT OF THE DRAG COEFFICIENT
C     AND THE SQUARE OF R IS RETURNED FOR A SPHERE.  SEE NCRMENT, TO-B
C     64-102 (1 NOV. 1964).
C
      IF(R .GT. 0.05) IF(R-3.) 100,100,200
      CDRR = 24. * R
      RETURN
  100 CDRR = R*( 24.167 + R*( 3.254 - R*0.23564))
      RETURN
  200 IF(R .GT. 330.) GO TO 300
      CDRR = -28.339 + R*( 38.969 + R * (0.73204 - R * 0.56084E-3))
      RETURN
  300 CDRR = R * ( 93.462 + F * 0.37576)
      RETURN
      END
```

```
*DECK,DVDQ
      SUBROUTINE DVDQ(NEQ,T,Y,F,KD,EPS,IFLAG,H,HMIN,
     * HMAX,TPRINT,TFINAL,MXSTEP,KSTEP,KEMAX,EMAX,
     * KQ,YN,DT,NEVAL,NG,NGE,NSTOP,G,GT)
C
C
C     VARIABLE ORDER INTEGRATION SUBROUTINE
C     FOR THE SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS.
C
C     ANALYSIS AND CODING BY FRED T. KROGH,  JET PROPULSION
C     LABORATORY, PASADENA, CALIF.  APRIL 1, 1969.
C     MODIFIED BY CLEVE MOLER, UNIV. NEW MEXICO, OCT. 1972
C
C     VARIABLES IN THE CALLING SEQUENCE HAVE THE FOLLOWING
C     DIMENSIONS WHERE N=NEQ AND K=KD(1)+KD(2)+...+KD(N)
C                Y(K),F(N),KD(N),EPS(N),KQ(N),YN(K),
C                DT(20,N),G(NG),GT(NG)
C
C     PARAMETERS WHICH MUST BE ASSIGNED VALUES BEFORE THE INITIAL
C     ENTRY ARE  IFLAG, NG, NEQ, T, Y, KD, H, HMIN, HMAX,
C                 TPRINT, TFINAL, MXSTEP, AND (USUALLY) EPS.
C
C     THE USER MUST ALSO PROVIDE CODE WHICH ASSIGNS
C     VALUES TO F (ONCE PER STEP INITIALLY, AND TWICE PER STEP
C     AFTER GETTING STARTED) AND EPS (EITHER INITIALLY, OR DURING
C     THE INTEGRATION IF A RELATIVE ERROR TEST IS USED).
C
C     THE FOLLOWING PARAMETERS GIVE ADDITIONAL INFORMATION ABOUT THE
C     INTEGRATION AND ARE USED FOR STORAGE. THEY SHOULD NOT BE
C     CHANGED BY THE USER.  IFLAG,KSTEP,KEMAX,EMAX,KQ,YN, AND DT.
C
C
C
C     THE USAGE OF THE VARIABLES IS GIVEN BELOW.
C
C     NEQ=NUMBER OF EQUATIONS (INPUT)
C
C     T=INDEPENDENT VARIABLE (INITIAL VALUE SUPPLIED BY THE USER)
C
C     Y(J)=CURRENT VALUE OF A DEPENDENT VARIABLE OR DERIVATIVE.
C       THE INITIAL VALUE MUST BE SPECIFIED BY THE USER BEFORE
C       THE FIRST ENTRY. THE DIMENSION OF Y MUST BE
C       AT LEAST AS GREAT AS THE SUM OF THE ORDERS OF
```

```
C        THE DIFFERENTIAL EQUATIONS WHICH ARE BEING
C        INTEGRATED.
C        THE J-TH DERIVATIVE OF THE I-TH DEPENDENT VARIABLE IS
C        STORED IN  Y(K+J+1)  WHERE  K=KD(1)+...+KD(I-1),
C        I=1,...,NEQ,   J=0,...,KD(I)-1 .
C        (FOR EXAMPLE, FOR THE SYSTEM  F(1)=UPP, F(2)=VPP, WHERE P
C        DENOTES A PRIME, Y(1)=U, Y(2)=UP, Y(3)=V, Y(4)=VP.)
C
C     F(I)=KD(I)-TH DERIVATIVE OF THE I-TH COMPONENT WITH RESPECT
C        TO T, I=1,2,...,NEQ. THE USER MUST PROVIDE
C        THE CODE WHICH COMPUTES F GIVEN Y AND T.
C
C     KD(I)=THE ORDER OF THE I-TH DIFFERENTIAL EQUATION IN
C        THE SYSTEM. KD(I) MUST BE LESS THAN OR EQUAL TO 4.
C
C     EPS(I) IS A PARAMETER USED TO CONTROL THE LOCAL ERROR.
C        THE ESTIMATED LOCAL ERROR IS KEPT LESS THAN EPS(I) IN
C        THE (KD(I)-1)-ST DERIVATIVE OF THE I-TH COMPONENT. THUS
C        FOR EQUATIONS WITH ORDER GREATER THAN ONE, THE ERROR
C        IN A DERIVATIVE IS ESTIMATED. IN THIS CASE THE VALUE OF
C        EPS(I) REQUIRED TO OBTAIN A GIVEN ACCURACY IN THE DEPENDENT
C        VARIABLE DEPENDS ON THE SCALING.
C        IF ONE WANTS A RELATIVE ERROR TEST THEN ONE SHOULD SET EPS(I)
C        WHEN IFLAG=1 .
C        IF EPS(I)=0 AND HMAX.NE.0, IFLAG IS SET EQUAL 8.
C        IF EPS(I)=0 AND HMAX=0, NO ERROR TESTS ARE PERFORMED
C        AND THE ORDER(S) AND STEPSIZE ARE NOT CHANGED.
C        THIS OPTION SHOULD NOT BE USED IF KQ(I)=1 FOR ANY I.
C
C     IFLAG IS USED FOR COMMUNICATION BETWEEN THE INTEGRATOR
C        AND THE PROGRAM WHICH CALLS IT.  TO BEGIN THE INTEGRATION THE
C        USER SHOULD SET IFLAG=0 AND CALL DVDQ.  THIS WILL CAUSE
C        INITIALIZATION OF INTERNAL VARIABLES AND A RETURN WITH
C        IFLAG=1.  AFTER THIS INITIAL ENTRY THE VALUE OF IFLAG
C        SHOULD NOT BE CHANGED BY THE USER.
C
C        THE FOLLOWING VALUES OF IFLAG HAVE THE FOLLOWING MEANINGS.
C     =0  USED TO INITIALIZE THE INTEGRATOR.
C     =1  THE VALUE OF Y FOR THE CURRENT STEP HAS BEEN
C         PREDICTED. THE USER SHOULD COMPUTE F AND CALL DVDQ AGAIN.
C         IF A RELATIVE ERROR TEST IS USED THE NEW VALUE
C         OF EPS SHOULD ALSO BE COMPUTED HERE.
C     =2  THE VALUE OF Y FOR THE CURRENT STEP HAS BEEN
C         CORRECTED. THE USER SHOULD COMPUTE F AND CALL DVDQ.
C     =3  AN OUTPUT POINT HAS BEEN REACHED (SEE DESCRIPTION
C         OF TPRINT), PRINT RESULTS AND CALL DVDQ.
C     =4  T=TFINAL     IF DVDQ IS CALLED WITH T=TFINAL AND
C         IFLAG=4, IFLAG IS SET EQUAL TO 8. IF THE VALUE OF
C         TFINAL IS CHANGED THE INTEGRATION WILL CONTINUE.
C     =5  KSTEP=KSOUT   (SEE THE DESCRIPTION OF MXSTEP).
C     =6  EMAX.GT..1 AND IT APPEARS TO THE SUBROUTINE THAT
C         REDUCING H WILL NOT HELP BECAUSE OF ROUND-OFF ERROR.
C         IF THIS OCCURS A LARGER VALUE OF   EPS(KEMAX)   SHOULD
C         PROBABLY BE USED. IF  EPS(KEMAX)  IS NOT INCREASED, TOO
C         SMALL A STEPSIZE IS LIABLE TO BE USED. (WE HAVE FOUND THAT
C         REPLACING EPS(KEMAX) WITH 32.*EMAX*EPS(KEMAX) WORKS WELL.)
C         INCREASING EPS IN THIS WAY WILL NOT DEGRADE THE ACCURACY,
C         HOWEVER IF THE NATURE OF THE PROBLEM CHANGES IT MAY PAY TO
C         USE A SMALLER VALUE OF EPS LATER IN THE INTEGRATION.
C     =7  ABS(H).LT.HMIN.  TO CONTINUE WITH THE CURRENT
```

```
C           VALUE OF H, SET HMIN.LE.ABS(H) AND CALL DVDQ.
C           IF THE INTEGRATOR HAS JUST HALVED H ONE MAY CONTINUE
C           WITH TWICE THE STEPSIZE BY SIMPLY CALLING DVDQ. (SUCH
C           AN ACTION IS RISKY WITHOUT A CAREFUL ANALYSIS OF THE
C           SITUATION.) IF THE STEPSIZE HAS NOT JUST BEEN HALVED
C           (ABS(H).LT.HMIN MAY BE DUE TO THE USER INCREASING THE
C           VALUE OF HMIN OR TO HAVING TOO SMALL AN H AT THE END
C           OF THE STARTING PHASE.) THE INTEGRATION WILL CONTINUE
C           WITH THE CURRENT VALUE OF H AND A RETURN TO THE USER WITH
C           IFLAG=7 WILL BE MADE ON EVERY STEP UNTIL ABS(H).GE.HMIN.
C       =8  ILLEGAL PARAMETER IN THE CALLING SEQUENCE. IF DVDQ
C           IS CALLED WITH IFLAG=8 THE PROGRAM IS STOPPED.
C
C       H=CURRENT VALUE OF THE STEPSIZE. IN SELECTING THE INITIAL
C         VALUE FOR H, THE USER SHOULD REMEMBER THE FOLLOWING--
C        1. THE INTEGRATOR IS CAPABLE OF CHANGING H QUITE QUICKLY AND
C           THUS THE INITIAL CHOICE IS NOT CRITICAL.
C        2. IF IT DOES NOT LEAD TO PROBLEMS IN COMPUTING THE DERIVATIVES
C           (E.G. BECAUSE OF OVERFLOW OR TRYING TO EXTRACT THE SQUARE
C           ROOT OF A NEGATIVE NUMBER), IT IS BETTER TO CHOOSE H MUCH
C           TOO LARGE THAN MUCH TOO SMALL.
C        3. IF H*TPRINT.LE.0 INITIALLY, AN IMMEDIATE RETURN IS MADE
C           WITH IFLAG=8. THE SIGN OF H IS WHAT DETERMINES THE
C           DIRECTION OF INTEGRATION.
C        4. IF TPRINT=H*(2**K) K A NONNEGATIVE INTEGER THEN OUTPUT
C           VALUES WILL BE OBTAINED WITHOUT DOING AN INTERPOLATION.
C
C       HMIN   AFTER GETTING STARTED, AND WHENEVER H
C                IS HALVED, ABS(H) IS COMPARED WITH HMIN.
C                IF ABS(H).LT.HMIN CONTROL IS RETURNED TO
C                THE USER WITH IFLAG=7.
C
C       HMAX   THE STEPSIZE IS NOT DOUBLED IF
C                DOING SO WOULD MAKE ABS(H).GT.HMAX
C
C       TPRINT  ENABLES THE USER TO SPECIFY THE POINTS WHERE
C         OUTPUT IS DESIRED. LET TOUT=TPRINT + THE VALUE OF T THE LAST
C         TIME CONTROL WAS RETURNED TO THE USER WITH IFLAG=3. (INITIALLY
C         TOUT=THE INITIAL VALUE OF T.) CONTROL IS RETURNED TO THE
C         USER WITH IFLAG=3 WHENEVER T=TOUT. IF TOUT DOES NOT FALL
C         ON AN INTEGRATION STEP, OUTPUT VALUES ARE OBTAINED BY
C         INTERPOLATION ON THE FIRST STEP THAT (T-TOUT)*H.GT.0.
C         INTERPOLATED VALUES FOR BOTH Y AND F ARE COMPUTED.
C         (NOTE THAT A RETURN WITH IFLAG=3 IS ALWAYS MADE
C         BEFORE TAKING THE FIRST STEP.)
C
C       TFINAL   CONTROL IS RETURNED TO THE USER WITH IFLAG=4 WHEN
C         T REACHES TFINAL. IF TFINAL DOES NOT FALL ON AN INTEGRATION
C         STEP VALUES AT TFINAL ARE OBTAINED BY EXTRAPOLATION.
C
C       MXSTEP   ON THE INITIAL ENTRY, AND ON ENTRIES
C         WITH  2.LT.IFLAG.LT.6  KSOUT IS SET EQUAL TO
C         KSTEP+MXSTEP. AT THE END OF EACH STEP KSTEP IS INCREMENTED
C         AND COMPARED WITH KSOUT. IF KSTEP.GE.KSOUT CONTROL IS
C         RETURNED TO THE USER WITH IFLAG=5. (THUS IF TPRINT IS
C         SUFFICIENTLY LARGE, CONTROL WILL BE RETURNED TO THE USER
C         WITH IFLAG=5 EVERY MXSTEP STEPS.)
C
C       KSTEP=NUMBER OF INTEGRATION STEPS TAKEN (COMPUTED
C         BY THE INTEGRATOR.)
```

```
C
C     KEMAX=INDEX OF COMPONENT RESPONSIBLE FOR THE
C          VALUE OF EMAX (SEE BELOW).
C
C     EMAX=LARGEST VALUE IN ANY COMPONENT OF (ESTIMATED ERROR)/EPS(I)
C       ORDINARILY THE STEPSIZE IS HALVED IF EMAX.GT..1. WITH A
C       RECENT HISTORY OF LOCAL ROUND-OFF PROBLEMS VALUES OF EMAX AS
C       LARGE AS 1 ARE PERMITTED. THE STEPSIZE IS NOT HALVED ON ANY
C       STEP THAT ROUND OFF ERROR APPEARS TO BE LIMITING THE PRECISION.
C
C     KQ(I)=HIGHEST ORDER DIFFERENCE USED IN INTEGRATING
C       THE I-TH EQUATION. (COMPUTED BY THE INTEGRATOR)
C
C     YN=A VECTOR WITH THE DIMENSION OF Y USED TO STORE
C       THE VALUE OF Y AT THE END OF EACH INTEGRATION STEP.
C
C     DT=AN ARRAY WITH DIMENSION DT(20,NEQ) USED TO
C       STORE THE DIFFERENCE TABLE.
C
C     NEVAL=NUMBER OF TIMES F IS EVALUATED (= NUMBER OF
C       RETURNS MADE WITH IFLAG=1 OR 2).  (COMPUTED BY DVDQ.)
C
C     NG MUST BE SET = 0 BY THE USER IF THE GSTOP FEATURE IS
C       NOT USED.  OTHERWISE SEE BELOW.
C
C
C     A GSTOP IS DEFINED AS A RETURN WHICH IS MADE TO THE USER WHEN A
C     USER SPECIFIED FUNCTION G PASSES THROUGH ZERO. THE USER MAY
C     SPECIFY ANY NUMBER OF FUNCTIONS G OF TWO TYPES. ZEROS OF THE FIRST
C     TYPE ARE LOCATED WITHOUT REQUIRING A DERIVATIVE EVALUATION
C     BEYOND THE ZERO. THIS TYPE OF GSTOP REQUIRES THAT G BE EVALUATED
C     BEFORE EACH DERIVATIVE EVALUATION. ZEROS OF THE SECOND TYPE ARE
C     LOCATED USING INTERPOLATION, WHICH IS MORE ACCURATE THAN THE
C     EXTRAPOLATION USED IN THE PRECEDING CASE AND ONLY REQUIRES ONE
C     EVALUATION OF G PER STEP. THUS ONE SHOULD USE THE SECOND TYPE OF
C     GSTOP IF POSSIBLE. USERS NOT USING THE GSTOP FEATURE NEED READ
C     NO FURTHER.
C
C     THE GSTOP FEATURE IS INVOKED BY USING A NONZERO VALUE OF  NG .
C     IT IS TURNED OFF BY SETTING NG=0 .  IT IS NOT NECESSARY TO
C     MAKE SEPARATE CALLS TO DVDQ TO DO THIS.
C
C     NG=    THE NUMBER OF COMPONENTS IN G TO BE EXAMINED FOR A ZERO.
C
C     NGE=THE NUMBER OF COMPONENTS OF G THAT MUST BE EXAMINED FOR
C            A ZERO BEFORE COMPUTING THE DERIVATIVES (FIRST TYPE OF
C            GSTOP). IF NGE.LT.0 OR NGE.GT.NG, IFLAG IS SET
C            EQUAL 8 AND AN IMMEDIATE RETURN IS MADE. IF NGE.GT.0,
C            G(1),G(2),...,G(NGE) ARE EXAMINED FOR A ZERO BEFORE EACH
C            DERIVATIVE EVALUATION, THE REMAINING COMPONENTS (IF ANY)
C            ARE EXAMINED AT THE END OF EACH STEP.
C
C     NSTOP= THE COMPONENT OF G RESPONSIBLE FOR A GSTOP (COMPUTED BY
C             THE INTEGRATOR).
C
C     G=     A VECTOR CONTAINING THE CURRENT VALUES OF THE FUNCTIONS
C            WHOSE ZEROS ARE TO BE DETERMINED.
C
C     GT=    A VECTOR WITH THE SAME DIMENSION AS G USED BY THE
C            SUBROUTINE FOR TEMPORARY STORAGE.
```

```
C
C     RETURNS FROM CALLING DVDQ WITH IFLAG.GT.8 SHOULD BE INTERPETED
C     AS FOLLOWS.
C     IFLAG
C     = 9 COMPUTE G(NGE+1),....,G(NG) (THE COMPONENTS OF G WITH
C         ZEROS TO BE LOCATED USING INTERPOLATION). THEN CALL DVDQ.
C         NO RETURN IS MADE WITH IFLAG=9 IF NGE=NG.
C     =10 COMPUTE G(1),G(2),....,G(NGE) (THE COMPONENTS OF G WITH
C         ZEROS TO BE LOCATED USING EXTRAPOLATION). THEN CALL DVDQ.
C         NO RETURN IS MADE WITH IFLAG=10 IF NGE=0.
C     =11 A GSTOP HAS BEEN FOUND.  G(NSTOP)=0.  PRINT RESULTS. IF THEIR
C         ARE NO DISCONTINUITIES CALL DVDQ TO CONTINUE THE INTEGRATION.
C     =12 G(NSTOP) CHANGES SIGN, BUT THERE IS DIFFICULTY IN CONVERGING
C         TO A ZERO. THE USER MAY WISH TO MAKE A SPECIAL CHECK TO BE
C         CERTAIN THAT EVERYTHING IS ALL RIGHT. TO CONTINUE THE
C         INTEGRATION CALL DVDQ.
C
C
C     SUBROUTINE DVDQ(NEQ,T,Y,F,KD,EPS,IFLAG,H,HMIN,
C    * HMAX,TPRINT,TFINAL,MXSTEP,KSTEP,KEMAX,EMAX,
C    * KQ,YN,DT,NEVAL,NG,NGE,NSTOP,G,GT)
      INTEGER  NEQ,KD,IFLAG,MXSTEP,KSTEP,KEMAX,KQ,NEVAL,NG,NGE,NSTOP
      REAL  T,Y,F,EPS,H,HMIN,HMAX,TPRINT,TFINAL,EMAX,
     2    YN,DT,G,GT
      DIMENSION Y(1),F(1),YN(1),DT(20,1),KD(1),KQ(1),EPS(1),G(1),GT(1)
      INTEGER  IB,IFL,IFLG,IFLS,IFLGS,IGK,IGKM,KBIT2,KDMAX,KDD,KDC,
     2    LDOUB,LFD,LGSS,LGSC,LGSE,NE,NGA,IM1,KK,JM2,KMAXO,KM,KMD,KM1,
     3    KQMAX,KQM,KQQ,KQ1,KQQ2,LRND,JS,KSOUT,LSC,LSTC,NV,I,J,K,L
      REAL  FAC,GAM,GAS,DD,EIGHTH,GI,HH,EPSGS,ERRMX,ERND,
     2    TWO,FRND,RG,ETA,TG,ONEP1,RND,RNDC,RQMAX,TL,E2HAVE,
     3    E2HMAX,E2HFAC,E2H,TOLT,PT,TP,PTS1,PTS2,PTS3,PTS4,PTS5,TPS1,
     4    TPD,TPD1,TPS3,TPS5,TPS4,TPS2,TPS6,TPD2,D,P01,P075,E,P1,
     5    P25,P5,P75,S,ABS,AMOD,AMIN1,AMAX1,SIGN
      DIMENSION GAM(20,4),GAS(20),ETA(18,18)
      DIMENSION DD(26),D(25),PT(21),FAC(3),GI(2),RG(3)
      EQUIVALENCE (DD(2),D(1))
      DATA KBIT2 /0/
C
C
C     CHECK IFLAG
C
      IF (IFLAG) 1190, 10, 60
C
C     CHECK TO INITIALIZE CONSTANTS
C
   10 IF (KBIT2) 50,12,50
C
C     DETERMINE MACHINE PRECISION
C
   12 RND=1.
   14 RND=RND/2.
      KBIT2=KBIT2+1
      IF(1.+RND .GT. 1.) GO TO 14
      RND=8.*RND
      KQMAX=0.3*FLOAT(KBIT2+1)
      IF(KQMAX.GT.19) KQMAX=19
      KBIT2=2*KBIT2+2
C
C     KQMAX GIVES THE MAXIMUM ORDER OF POLYNOMIAL APPROXIMATION USED.
C     THERE IS LITTLE POINT IN HAVING KQMAX MUCH BIGGER THAN THE NUMBER
```

```
C     OF DECIMAL DIGITS IN THE MANTISSA.
C
C     RND IS APPROXIMATELY 2**(3-B) WHERE B IS
C     THE NUMBER OF BITS IN THE MANTISSA.
C     KBIT2=2*B+2 WHERE B IS THE NUMBER OF BITS IN THE MANTISSA.
C     IF THE DERIVATIVES ARE NOT COMPUTED TO THE ACCURACY EXPECTED
C     FROM THE WORD LENGTH OF THE COMPUTER (FOR EXAMPLE BECAUSE OF
C     CANCELLATION PROBLEMS OR TABULAR DATA), THEN THESE CONSTANTS
C     CAN BE CHANGED TO REFLECT THE NUMBER OF BITS WHICH ARE
C     SIGNIFICANT IN THE COMPUTED DERIVATIVES. (THIS IS NOT NECESSARY,
C     BUT IS WISE IF THE ACCURACY REQUESTED IS DIFFICULT TO OBTAIN
C     BECAUSE THE DERIVATIVES HAVE SO FEW SIGNIFICANT DIGITS.)
C
C     ON IBM360, KQMAX WILL = 16, RND = 8.88D-16, KBIT2 = 108
C     ON CDC6600, KQMAX WILL = 14, RND = 2.84E-14, KBIT2 = 98
C     ON UNIVAC 1108, KQMAX WILL = 18, RND = 6.94D-18, KBIT2 = 122
C
C
      KMAXO=4
C     KMAXO IS THE MAXIMUM ORDER DIFFERENTIAL EQUATION THIS
C     IMPLEMENTATION WILL INTEGRATE.
C
      FAC(1)=1.
      FAC(2)=FAC(1)/2.
      FAC(3)=FAC(2)/3.
      TWO=2.
      P1=.1
      P01=.01
      P25=.25
      P5=.5
      P75=.75
      P075=.075
      ONEP1=1.1
      PT(1)=1.
      KM=KQMAX+1
      DO 16 I=1,KM
        PT(I+1)=2.*PT(I)
   16 CONTINUE
C
C     COMPUTE GAS AND GAM
C
C     GAS(I) IS THE I-TH ADAMS-MOULTON CORRECTOR COEFFICIENT AND
C     GAM(I,J) IS THE I-TH ADAMS-FALKNER PREDICTOR COEFFICIENT
C     FOR INTEGRATING J-TH ORDER DIFFERENTIAL EQUATIONS,
C     I = 1,2,...,KQMAX+1,  J = 1,2,...,KMAXO.
C
      KMD=KM+KMAXO
      DO 20 K=1,KMD
        S=K
        D(K)=1./S
   20 CONTINUE
      GAM(1,1)=D(1)
      DO 22 J=2,KMAXO
        GAM(1,J)=D(J)*FAC(J-1)
   22 CONTINUE
      DO 26 I=2,KM
        KK=KMD+1-I
        DO 24 K=1,KK
          S=I-1
          D(K)=D(K)-D(K+1)/S
```

```
   24   CONTINUE
        GAM(I,1)=D(1)
        DO 26 J=2,KMAXO
          GAM(I,J)=D(J)*FAC(J-1)
   26 CONTINUE
      GAS(1)=1.
      DO 28 I=2,KM
        GAS(I)=GAM(I,1)-GAM(I-1,1)
   28 CONTINUE
C
C     GENERATE ETA
C
C     ETA(I,J), I=1,2,...,J IS USED IN THE FIRST MODIFICATION OF THE
C     I-TH DIFFERENCE OF A J-TH ORDER METHOD AFTER THE STEPSIZE IS
C     HALVED.
C     ETA(I,J), J=1,2,...,I-1 IS USED IN THE SECOND MODIFICATION OF
C     THE (J+1)-ST DIFFERENCE OF AN I-TH ORDER METHOD
C
      K=KQMAX-1
      EIGHTH=FAC(2)*FAC(2)*FAC(2)
      ETA(1,1)=EIGHTH
      ETA(2,1)=EIGHTH
      TP=FAC(2)*FAC(2)
      DO 33 J=2,K
        TP=TP/2.
        ETA(J,J)=(TP+ETA(J-1,J-1))/2.
        IF(J.EQ.2) GO TO 32
        JM2=J-2
        DO 30 IB=1,JM2
          I=J-IB
          ETA(I,J)=(ETA(I+1,J)+ETA(I-1,J-1))/2.
   30   CONTINUE
   32   ETA(1,J)=ETA(2,J)/2.
   33 CONTINUE
      DO 34 I=1,K
        TP=0.
        DO 34 J=1,I
          TP=TP+ETA(J,I)
          ETA(I+1,J)=TP
   34 CONTINUE
      TP=FAC(2)
      DO 36 J=1,K
        TP=TP/2.
        D(J)=ETA(J+1,J)+TP
   36 CONTINUE
      DO 38 J=1,K
        DO 38 I=1,J
          ETA(I,J)=ETA(I,J)/D(J)
   38 CONTINUE
      KM1=K-1
      DO 40 J=1,KM1
        D(J)=D(J+1)/D(J)
   40 CONTINUE
      DO 42 I=2,KM1
        DO 42 J=1,I
          ETA(I+1,J)=-ETA(I+2,J)+ETA(I+1,J)*D(I)
   42 CONTINUE
      TP=EIGHTH
      DO 46 I=2,KM1
        TP=TP/2.
```

```
          S=TP
          DO 44 J=1,I
            S=S+ETA(I+1,J)
   44     CONTINUE
          IM1=I-1
          DO 46 J=1,IM1
            ETA(I,J)=ETA(I+1,J)/S
   46 CONTINUE
C
C     INITIALIZE VARIABLES
C
   50 PTS1=PT(1)
      PTS2=PT(2)
      PTS3=PT(3)
      PTS4=PT(4)
      PTS5=PT(5)
      LGSS=0
      LGSD=0
      LGSE=0
      LFD=0
      E2HAVE=0.
      E2HMAX=0.
      DO 52 I=1,KMD
        DD(I)=0.
   52 CONTINUE
      KSTEP=-1
      NE=NEQ
      IF (NE.LE.0) GO TO 1190
      HH=H
      NV=0
      KDMAX=0
      DO 56 J=1,NE
        KQ(J)=1
        DO 54 I=1,KQMAX
          DT(I,J)=0.
   54   CONTINUE
        KDD=KD(J)
        IF ((KDD.EQ.0).OR.(KDD.GT.KMAXO)) HH=0.
        IF (KDD.GT.KDMAX) KDMAX=KDD
        NV=NV+KDD
   56 CONTINUE
C
      IF ((TPRINT*HH).LE.0.) GO TO 1190
      ERRMX=P1
      ERND=0.
      EMAX=ERND
      RNDC=RND*P25
      LDOUB=0
      E2HFAC=P25
      LSC=8
      LSTC=4
C     LSC AND LSTC ARE USED IN COMBINATION AS FOLLOWS
C       LSTC=4,  LSC=4     FIRST TIME THROUGH THE FIRST STEP
C       LSTC=3,  LSC=4     SECOND TIME THROUGH THE FIRST STEP
C                          (NECESSARY TO CHECK STABILITY)
C       LSTC=2,  LSC=4     THIRD TIME THROUGH THE FIRST STEP
C                          (ONLY OCCURS IF INSTABILITY POSSIBLE)
C       LSTC=2,  LSC=2     SECOND STEP  (IF KQ(I)=2 , I=1,...,NEQ)
C       LSTC=1,  LSC=0     STARTING, ONE DERIVATIVE EVAL. PER STEP.
C       LSTC=1,  LSC.GT.0  SET WHEN STARTING TWO DERIV. EVAL. PER STEP
```

```
C        LSTC=-1  LSC.LT.0  SET WHEN HALVING THE STEPSIZE
C       IN THE LAST TWO CASES LSC IS SET EQUAL TO LSTC*(MAXIMUM KQ(I)
C       +1). AT THE END OF EACH STEP IF LSC.NE.0 IT IS REPLACED BY
C       LSC-LSTC UNTIL LSC=0, AT WHICH TIME LSTC IS SET EQUAL TO 0.
C        WHEN DOUBLING H, LSTC IS SET EQUAL TO -1 AND LSC TO -3.
C       UNDER CERTAIN CONDITIONS WHEN KQ(I)=1, LSTC IS SET =-1 AND LSC=-5
C
      KSOUT=MXSTEP
      TOUT=T
      IFL=13
      IFLAG=1
      NGA=0
      NEVAL=0
      IF(NG.NE.0) GO TO 1420
      GO TO 315
C     END OF INITIALIZATION
C
C
C     ENTRY WITH IFLAG.GT.0
C
C     CHECK FOR GSTOPS
C
   60 IF(NG.EQ.NGA) GO TO 65
      IF(NG.LT.0) GO TO 1190
      NGA=NG
      LGSS=-NGA
      LGSD=0
      LGSE=0
      IFLG=-20
C
C
   65 IF (IFL.LT.2) GO TO 320
      IF (IFL.EQ.2) GO TO 80
      IF (IFL.GT.5) GO TO 1180
C
C     SET STEP STOP
      KSOUT=KSTEP+MXSTEP
      IF (IFL.EQ.5) GO TO 210
      IF (IFL.EQ.4) GO TO 1210
C
C     SET PRINT STOP
   70 TOUT=T+TPRINT
C
   75 TPS1=ABS(AMOD((TOUT-T)/HH,TWO)-PTS1)
      LFD=-1
      IF (TPS1.GE.P5) LFD=1
C
C     LFD IS USED TO INDICATE WHETHER DOUBLING H IS PERMITTED.
C     IF LFD.LT.0 AT THE END OF A STEP THEN DOUBLING H IS
C     NOT PERMITTED. THE SIGN OF LFD IS CHANGED JUST BEFORE THE
C     END OF EACH STEP. IF TPRINT=H*(POWER OF 2) THEN
C     OUTPUT VALUES WILL BE OBTAINED WITHOUT INTERPOLATION.
C
      GO TO 200
C
C
C     ENTRY WITH IFLAG=2
C
C     UPDATE DIFFERENCE TABLE
C     AND COMPUTE KQM=MAXIMUM VALUE OF KQ(I), I=1,2,...,NEQ.
```

```
C
   80 KQM=0
      DO 90 I=1,NE
        KQQ=KQ(I)
        IF (KQQ.GT.KQM) KQM=KQQ
        D(1)=F(I)
        DO 85 K=1,KQQ
          D(K+1)=D(K)-DT(K,I)
          DT(K,I)=D(K)
   85   CONTINUE
        DT(KQQ+1,I)=D(KQQ+1)
   90 CONTINUE
C     END OF UPDATING DIFFERENCE TABLE
C
C     STORE Y(J) IN YN(J)
      DO 95 J=1,NV
        YN(J)=Y(J)
   95 CONTINUE
C
      LFD=-LFD
      TL=T
      KSTEP=KSTEP+1
C
      IF (LGSS) 1430,110,1510
  100 IFLAG=2
  110 IF (LSC.EQ.0) GO TO 140
      LSC=LSC-LSTC
      IF (LSC.EQ.0) GO TO 130
      IF (LSTC.NE.(-1)) GO TO 140
      IF (LDOUB.LT.0) RNDC=RND*P1
  120 E2HAVE=E2HMAX
      TPS1=PTS1
      GO TO 190
  130 IF (ABS(HH).LT.HMIN) GO TO 1000
      LSTC=0
  140 IF (LDOUB.NE.1) GO TO 150
      IF ((LFD.GT.0).AND.(ABS(HH+HH).LE.HMAX)) GO TO 1030
      GO TO 200
  150 RQMAX=PTS1/FLOAT(KQM+3)
      IF ((LSTC.NE.0).OR.(E2HAVE.EQ.0.)) GO TO 120
      TPS1=E2HMAX/E2HAVE
      IF (TPS1-PTS1) 160,190,170
  160 E2HFAC=AMIN1(P075,E2HFAC-RQMAX,E2HFAC*TPS1)
      GO TO 180
  170 TPS1=TPS1*TPS1
      E2HFAC=AMIN1(PTS1,E2HFAC*TPS1)
  180 RNDC=(ONEP1-E2HFAC)*RND
      E2HAVE=P5*(E2HMAX+E2HAVE)
  190 ERRMX=AMAX1(P1,ERRMX-RQMAX*TPS1)
C     E2HFAC IS A FACTOR WHICH IS TAKEN TIMES AN INITIAL ESTIMATE OF
C            E2H TO GET A FINAL VALUE OF E2H. (E2H=ESTIMATE OF WHAT
C            (ESTIMATED ERROR)/(REQUESTED ERROR) WOULD BE IF H WERE
C            DOUBLED.)
C     E2HMAX IS THE MAXIMUM VALUE OF THE INITIAL ESTIMATE OF E2H OVER
C            ALL COMPONENTS WITH KQ(I).GT.1.
C     E2HAVE IS A WEIGHTED AVERAGE OF PAST VALUES OF E2HMAX.
C     THE VALUE OF E2HFAC TENDS TO BE SMALLER WHEN E2HMAX IS
C     CONSISTANTLY SMALLER THAN E2HAVE.
C
C
```

```
C     CHECK FOR PRINT STCP AND FOR T REACHING TFINAL
  200 TPD=(TOUT-TL)/HH
      TPD1=(TFINAL-TL)/HH
C
      IF (LGSE.LT.0) GO TO 1780
      IF (TPD1.LT.FAC(1)) GO TO 1220
      IF (TPD.LE.0.) GO TO 1280
C
C     CHECK FOR STEP STOP
      IF (KSOUT.GT.KSTEP) GO TO 210
C
      IFL=5
      GO TO 310
C
C     CHECK TO SEE IF ROUND-OFF ERROR IS PROMINENT
  210 IF (EMAX.EQ.ERND) GO TO 220
C     IT IS
      IFL=6
      IF (EMAX.GE.P1) GO TO 310
      IF ((LSTC.GE.0).OR.(LDOUB.EQ.1)) ERRMX=PTS1
C
  220 IFL=1
  230 T=TL+HH
C
C     START A NEW STEP
C
C     PREDICT
  240 J=0
      DO 290 I=1,NE
        KDD=KD(I)
        KDC=KDD
  250   KQQ=KQ(I)
        TPD=0.
        K=KDC
  260   TPD=TPD+DT(KQQ,I)*GAM(KQQ,KDC)
        KQQ=KQQ-1
        IF (KQQ.GT.0) GO TO 260
  270   K=K-1
        IF (K.LE.0) GO TO 280
        L=J+K
        TPD=YN(L+1)*FAC(K)+HH*TPD
        GO TO 270
  280   J=J+1
        Y(J)=YN(J)+HH*TPD
        KDC=KDC-1
        IF (KDC.GT.0) GO TO 250
  290 CONTINUE
C     END OF PREDICT
C
      IF (IFL) 1240,320,300
  300 IF (LGSD.NE.0) GO TO 1520
C
  310 IFLAG=IFL
  315 IF (IFLAG.LE.2) NEVAL=NEVAL+1
C
      RETURN
C
C
C     ENTRY WITH IFLAG=1
  320 ERND=0.
```

```
      EMAX=0.
      E2HMAX=0.
      J=0
      IF (LDOUB.GE.0) LDOUB=1
C
C     LDOUB IS SET IN THE LOOP BELOW AS FOLLOWS
C     LDOUB=0   HALVE
C     LDOUB=1   DOUBLE
C     LDOUB=2   DO NOT DOUBLE
C
C     LDOUB.LT.0 AT THE BEGINNING OF THE LOOP INDICATES THE FOLLOWING
C       =-3  STEPSIZE HAS JUST BEEN HALVED. IF A DISCONTINUITY IS
C            NOT INDICATED MODIFY THE DIFFERENCE TABLE AND REPEAT
C            THE STEP.
C       =-2  STEP AFTER LDOUB=-3. PROCEED AS USUAL (ORDER IS NOT
C            CHANGED)
C       =-1  STEP AFTER LDOUB=-2. MODIFY THE DIFFERENCE TABLE ONCE
C            AGAIN AND REPEAT THE STEP.
C     IF LDOUB IS SET EQUAL TO -4 THE ORDER IN AT LEAST ONE COMPONENT
C     HAS BEEN GREATLY REDUCED AND THE STEP IS REPEATED.
C
C
C     BEGINNING OF LOOP FOR CORRECTING, ESTIMATING THE ERROR,
C     AND ADJUSTING THE NUMBER OF DIFFERENCES USED
C
      DO 790 I=1,NE
        KDD=KD(I)
        KQQ=KQ(I)
C       KQQ GIVES THE ORDER OF THE PREDICTOR FORMULA AND KQQ+1 THE
C       ORDER OF THE CORRECTOR FORMULA.
C
        KQ1=KQQ+1
        D(1)=F(I)
C       FORM THE DIFFERENCE TABLE FROM PREDICTED DERIVATIVE VALUES.
        DO 330 K=1,KQ1
          D(K+1)=D(K)-DT(K,I)
  330   CONTINUE
C       D(K) GIVES THE (K-1)-ST DIFFERENCE FORMED FROM PREDICTED
C       DERIVATIVE VALUES
        TPS3=ABS(D(KQQ+1))
        IF (LDOUB.LT.0) GO TO 720
C
  340   IF (KQQ.NE.1) GO TO 520
C
C       KQ(I)=1  IS TREATED AS A SPECIAL CASE
        E2H=PTS2
        TPS5=DT(3,I)
        IF (LSTC.LT.2) GO TO 370
C       FIRST STEP OF INTEGRATION
        IF (LSTC.NE.4) GO TO 350
        TPS4=0.
        IF (KDD.GT.1) TPS3=AMAX1(TPS3,ABS(HH*D(1)))
        TPS3=TPS3*P1
        GO TO 510
  350   DT(2,I)=D(2)
        D(2)=D(1)-DT(5,I)
        TPS2=-D(2)
        TPS3=PTS5*ABS(TPS2)
C       FIRST STEP THAT KQ(I)=1
  360   DT(7,I)=PT(4)
```

```
      IF (LSTC-2) 420,380,380
  370 IF (TPS5.EQ.0.) GO TO 360
      IF (DT(6,I).EQ.0.) GO TO 400
      TPS2=DT(5,I)-DT(1,I)
  380 TPS4=DT(4,I)
      TPS1=ABS(TPS4)
      TPS4=TPS2*SIGN(PTS2,TPS4)-TPS5*TPS1
      IF (TPS4.GT.(-TPS1)) GO TO 410
  390 TPS6=-PTS1
      GO TO 450
C     FIRST STEP AFTER THE STEPSIZE HAS BEEN CHANGED
  400 DT(6,I)=PT(1)
      TPS6=0.
      GO TO 450
  410 IF (TPS4.LT.TPS1) GO TO 440
      IF (TPS1.EQ.0.) GO TO 390
  420 TPS6=PTS1
      GO TO 450
  430 KQ(I)=2
      IF (2-LSTC) 510,510,520
  440 TPS6=TPS4/TPS1
  450 TPS4=TPS5+TPS6
      IF (TPS4.LT.P25) GO TO 430
C     INCREASE E2H IF (-S).GT..25
      E2H=PTS4*TPS4
      IF (2-LSTC) 460,470,480
  460 LSC=0
      GO TO 510
  470 IF (TPS5-P25) 430,460,460
  480 IF (TPS4.GT.PTS2) GO TO 490
      IF (TPS4.GT.P5) D(2)=D(2)*GAM(2,1)
      GO TO 510
  490 IF (TPS4.LT.PTS4) GO TO 500
      TPS4=PTS4
      D(2)=D(2)/PT(3)
C     THE ESTIMATE OF E (AND HENCE OF E2H) IS INCREASED IF (-S).GE.8.
      TPS3=TPS3*DT(7,I)
      GO TO 510
  500 D(2)=D(2)*(PTS2*(TPS4-PTS1)/(TPS4*TPS4))
      IF (TPS4.GE.3.) E2H=E2H*DT(7,I)
C     STORE D(1)=PREDICTED DERIVATIVE  AND  D(2)=2*(CORRECTED Y -
C     PREDICTED Y)/H    D(1) AND D(2) ARE USED TO COMPUTE (-S) ON
C     THE NEXT STEP.
  510 DT(5,I)=D(1)
      DT(4,I)=D(2)
      D(4)=TPS4
C    STORE D(4)= CURRENT ESTIMATE OF (-S).  (-S).GT.3 IS AN INDICATION
C    THAT THE STEPSIZE SHOULD BE LIMITED BECAUSE OF STABILITY PROBLEMS.
C    S=H*(ESTIMATE OF EIGENVALUE OF F)=H*(DIFFERENCE BETWEEN PREDICTED
C    AND CORRECTED DERIVATIVE VALUES)/(DIFFERENCE BETWEEN PREDICTED
C    AND CORRECTED INTEGRALS OF THE DERIVATIVE VALUES)
C    THE TREATMENT OF THE CASE KQ(I)=1 COULD BE IMPROVED BY USING A
C    SPECIAL METHOD FOR STIFF EQUATIONS WHEN (-S).GT.3  (MAYBE).
C    (THE ENTIRE TREATMENT OF THE CASE KQ(I)=1 IS FAR FROM IDEAL.)
      DT(3,I)=D(4)
C
C     CORRECT
  520 KDC=0
      TPD=D(KQ1)
      J=J+KDD
```

```
      K=J                                                               DVDQ 764
  530 TPD=HH*TPD                                                        DVDQ 765
      KDC=KDC+1                                                         DVDQ 766
      Y(K)=Y(K)+GAM(KQQ+1,KDC)*TPD                                      DVDQ 767
      K=K-1                                                             DVDQ 768
      IF (KDC.LT.KDD) GO TO 530                                         DVDQ 769
C     END OF CORRECT                                                    DVDQ 770
C                                                                       DVDQ 771
      IF (EPS(I).NE.0.) GO TO 560                                       DVDQ 772
  550 IF (HMAX) 1190,780,1190                                           DVDQ 773
  560 TPS4=ABS(D(KQQ+2))                                                DVDQ 774
      TPS2=ABS(D(KQQ))                                                  DVDQ 775
      TPS6=HH/EPS(I)                                                    DVDQ 776
C                                                                       DVDQ 777
      E=ABS(GAS(KQQ+1)*TPS3*TPS6)                                       DVDQ 778
C     E GIVES  ABS((ESTIMATED ERROR)/EPS(I))                            DVDQ 779
C                                                                       DVDQ 780
      LRND=1                                                            DVDQ 781
C                                                                       DVDQ 782
C     LRND= 1  MEANS NO ROUND-OFF ERROR                                 DVDQ 783
C         = 0  MEANS SOME ROUND-OFF ERROR                               DVDQ 784
C         =-1  MEANS EXTREME ROUND-OFF ERROR                            DVDQ 785
C                                                                       DVDQ 786
      FRND=RNDC*ABS(PT(KQQ+2)*D(1))                                     DVDQ 787
C     CHECK TO SEE IF ROUND OFF ERROR IS DOMINANT                       DVDQ 788
      IF ((TPS3+TPS4).GT.FRND) GO TO 570                                DVDQ 789
      LRND=0                                                            DVDQ 790
      IF ((PTS4*TPS2).LT.FRND) LRND=-1                                  DVDQ 791
C                                                                       DVDQ 792
  570 IF (E.LE.ERND) GO TO 590                                          DVDQ 793
      IF (E.LE.EMAX) GO TO 580                                          DVDQ 794
      EMAX=E                                                            DVDQ 795
      KEMAX=I                                                           DVDQ 796
  580 IF (LRND.LE.0) GO TO 590                                          DVDQ 797
      ERND=E                                                            DVDQ 798
      IF (ERND.GT.ERRMX) LDOUB=0                                        DVDQ 799
  590 IF (LDOUB.LE.0) GO TO 780                                         DVDQ 800
      TPS1=ABS(DD(KQQ))                                                 DVDQ 801
      TPS5=TPS1                                                         DVDQ 802
      IF (KQQ-2) 600,610,620                                            DVDQ 803
  600 E2H=E*E2H                                                         DVDQ 804
      IF (E2H.LT.P01) GO TO 780                                         DVDQ 805
      IF (D(4).LT.3.) GO TO 770                                         DVDQ 806
      LSTC=-1                                                           DVDQ 807
      LSC=-5                                                            DVDQ 808
      GO TO 770                                                         DVDQ 809
  610 TPS1=TPS2                                                         DVDQ 810
      IF (LSTC.NE.2) GO TO 620                                          DVDQ 811
      KQ(I)=3                                                           DVDQ 812
      TPS2=0.                                                           DVDQ 813
      TPS4=0.                                                           DVDQ 814
      LRND=0                                                            DVDQ 815
  620 E2H=TPS2+TPS3+TPS4                                                DVDQ 816
      E2H=ABS(GAS(KQQ-1)*PT(KQQ+1)*E2H*TPS6)                            DVDQ 817
C     E2H IS USED AS AN ESTIMATE OF WHAT THE VALUE OF E WOULD BE        DVDQ 818
C     IF H WERE DOUBLED. THE ESTIMATE IS CONSERVATIVELY LARGE.          DVDQ 819
      IF (E2H.GT.E2HMAX) E2HMAX=E2H                                     DVDQ 820
C                                                                       DVDQ 821
      IF (LRND) 630,640,660                                             DVDQ 822
C     EXTREME ROUND-OFF ERROR--REDUCE E2H                               DVDQ 823
```

```
  630    K=(KBIT2/KQQ)-4
         IF (K.LE.3) GO TO 640
         IF (K.GT.KQMAX) K=KQMAX
         E2H=E2H/PT(K+1)
         GO TO 650
  640    E2H=AMIN1(E2H,E2H*3.*E2HFAC)
  650    E2H=E2H*P1
         TPS6=PTS4
         GO TO 670
C
  660    E2H=E2H*E2HFAC
         TPS6=KQQ+2
C        TEST TO SEE IF DIFFERENCES DECREASE MORE RAPIDLY THAN NECESSARY
C
  670    IF (TPS5.LT.(TPS3*TPS6)) GO TO 680
         IF (TPS2.LE.(TPS4*TPS6)) GO TO 760
C        THEY DO   INCREASE KQ(I)
         IF (KQQ.NE.KQMAX) KQ(I)=KQ1
         GO TO 760
C
C        TEST TO SEE IF DIFFERENCES DECREASE TOO SLOWLY
  680    TPS6=TPS6*P25
         IF ((TPS1.GT.(TPS3*TPS6)).OR.(TPS2.GT.(TPS4*TPS6))) GO TO 760
C        THEY DO
         IF (LSTC.LE.0) GO TO 750
         IF (E2H.LT.P01) GO TO 750
         IF (LSC-LSTC) 690,750,770
  690    IF (KSTEP-4) 750,700,710
  700    KQ1=LSTC
  710    LSC=KQ1
C        END OF ONE DERIVATIVE EVALUATION PER STEP
         GO TO 770
C
C        AFTER HALVING H. REDUCE KQ(I) IF A DISCONTINUITY HAS OCCURRED.
  720    IF (LDOUB.EQ.(-2)) GO TO 340
         DT(KQQ+1,I)=D(KQQ+1)
         IF (LDOUB.EQ.(-1)) DT(KQQ+1,I)=D(KQQ+2)
         K=KQQ
  730    IF (K.EQ.1) GO TO 740
         IF ((ABS(D(K-1)).GT.(PT(2)*ABS(D(K+1)))).OR.
     1     (ABS(D(K)).GT.(PT(2)*ABS(D(K+2))))) GO TO 740
         K=K-1
         GO TO 730
  740    IF ((K+K).GE.KQQ) GO TO 780
         LDOUB=-4
         E2H=0.
         KQQ=K+1
C
C
C        DIFFERENCES DECREASE TOO SLOWLY REDUCE KQ(I).
  750    KQ(I)=KQQ-1
         IF (KQQ.EQ.2) DT(3,I)=0.
  760    IF (E2H.LT.P01) GO TO 780
  770    LDOUB=2
  780    CONTINUE
C
C
  790 CONTINUE
C
C     END OF LOOP FOR CORRECTING, ESTIMATING THE ERROR, ETC.
```

```
C
C
      IF (IFL.LT.0) GO TO 1250
C     TEST FOR HALVING H
      IF (LDOUB) 800,950,870
  800 LDOUB=LDOUB+1
      IF (LDOUB+1) 810,870,820
  810 IF (LDOUB.EQ.(-2)) GO TO 820
C     ORDER IN AT LEAST ONE COMPONENT HAS BEEN GREATLY REDUCED
      LDOUB=0
      GO TO 220
  820 DO 860 I=1,NE
        KQQ=KQ(I)
        TP=DT(KQQ+1,I)
        IF (KQQ.LE.3) GO TO 860
        IF (LDOUB.NE.0) GO TO 840
        DO 830 K=3,KQQ
C       SECOND MODIFICATION OF DIFFERENCE TABLE AFTER HALVING H
          DT(K,I)=DT(K,I)+ETA(KQQ-1,K-2)*TP
  830   CONTINUE
        GO TO 860
  840   DO 850 K=2,KQQ
C       FIRST MODIFICATION OF DIFFERENCE TABLE AFTER HALVING H
          DT(K,I)=DT(K,I)+ETA(K-1,KQQ-1)*TP
  850   CONTINUE
  860 CONTINUE
      IFL=0
      GO TO 240
C
  870 IFL=2
      IF (LSTC.LE.0) GO TO 300
      IF (2-LSTC) 880,900,940
  880 LSTC=LSTC-1
      IF (LSTC.EQ.3) GO TO 890
      IF (LSC) 920,960,920
  890 IFL=1
      GO TO 300
  900 IF (LSC-2) 910,930,920
  910 LSTC=0
  920 LDOUB=2
      GO TO 80
  930 LSTC=1
      LSC=0
      GO TO 80
  940 IF (LSC) 300,80,300
C
C     HALVE H
  950 HH=FAC(2)*HH
      IF (LSTC.LT.2) GO TO 990
      ERND=P25*ERND
C     IN LOOP TO FIND A NEW INITIAL STEPSIZE
      IF (ERND.GE.P1) GO TO 950
      LSTC=4
  960 LSC=4
      DO 970 I=1,NE
        KQ(I)=1
  970 CONTINUE
      IF (LSTC-3) 890,890,1170
C
C     ENTRY AFTER IFLAG=7
```

```
  980 IF (LDOUB.EQ.0) GO TO 990
      LSC=1
      LSTC=1
      GO TO 140
C     TEST TO SEE IF H IS TOO SMALL FOR HALVING
  990 IF (ABS(HH).GE.HMIN) GO TO 1040
      IF (IFL.EQ.7) GO TO 1010
 1000 IFL=7
      GO TO 1020
C
 1010 HH=HH+HH
      IFL=2
 1020 H=HH
      GO TO 310
C
C
C     ERROR CRITERIA PERMIT DOUBLING
 1030 HH=HH+HH
      IF (LSTC.EQ.1) GO TO 1050
      LSC=-3
 1040 LSTC=-1
C
C     CHANGE THE STEPSIZE
 1050 DO 1160 I=1,NE
        KQQ=KQ(I)
        IF (KQQ.NE.1) GO TO 1070
        DT(6,I)=0.
        D(3)=DT(3,I)*PT(2)
        IF (D(3).GT.PT(3)) LSC=-6
        IF (LDOUB.NE.0) GO TO 1060
        KQM=8
        IF (D(3).GE.PT(5)) DT(7,I)=DT(7,I)*PT(2)
        D(3)=D(3)/PT(3)
 1060   DT(3,I)=D(3)
        GO TO 1160
C
C       BEGINNING OF LOOP FOR CHANGING DIFFERENCE TABLE TO
C       CORRESPOND TO NEW VALUE OF H
 1070   DO 1080 K=1,KQQ
          D(K)=DT(K,I)/PT(K)
          IF (LDOUB.EQ.0) D(K)=D(K)/PT(K)
 1080   CONTINUE
        KQQ2=KQQ-2
        IF (KQQ2) 1160,1140,1090
 1090   DO 1130 J=1,KQQ2
          IF (LDOUB.NE.0) GO TO 1110
C
C         HALVE
          K=KQQ
 1100     D(K-1)=D(K-1)+D(K)
          K=K-1
          IF (K+J-KQQ) 1130,1130,1100
C
C         DOUBLE
 1110     DO 1120 K=J,KQQ2
            D(K+1)=D(K+1)-D(K+2)
 1120     CONTINUE
 1130   CONTINUE
C
 1140   DO 1150 K=2,KQQ
```

```
         IF (LDOUB.NE.0) D(K)=D(K)*PT(K)
         DT(K,I)=D(K)*PT(K)
 1150   CONTINUE
C       DIFFERENCE TABLE NOW CORRESPONDS TO NEW VALUE OF H
C
 1160 CONTINUE
 1170 H=HH
      IF (LDOUB.NE.0) GO TO 75
      LFD=1
      IF (LSTC.GE.0) GO TO 220
      LDOUB=-3
      LSC=LSTC-KQM
      GO TO 220
C     END OF CHANGING STEPSIZE
C
C
 1180 K=IFL-5
      GO TO (220,980,1200,1570,1570,1720,1720,80,1480,1450,1630,1570), K
C
C     ILLEGAL VALUE OF PARAMETER   INTEGRATION CAN NOT PROCEED
 1190 IFL=8
      GO TO 310
 1200 WRITE (6,4000)
 4000 FORMAT (26HOIFLAG=8  IN CALL TO DVDQ1.)
      STOP
C
C
 1210 IF (T-TFINAL) 200,1190,200
C
C
 1220 IFL=4
      IF (KSTEP.NE.0) GO TO 1270
      TPD2=TPD
C     ESTIMATE ERROR WHEN EXTRAPOLATION FROM INITIAL POINT IS REQUESTED
 1230 HH=HH*TPD1*P75
C
      IFLS=IFL
      IFL=-1
      GO TO 230
C
 1240 IF ((LGSD.EQ.0).OR.(IFLS.NE.4)) GO TO 60
      LGSE=-1
      TPD=FAC(1)
      GO TO 1820
 1250 HH=H
      IF (EMAX.LT.P01) GO TO 1260
C     ERROR IS TOO LARGE, REDUCE H AND REPEAT THE FIRST STEP
      IF (TPD1.LT.0.) GO TO 1190
      LDOUB=1
      ERND=FAC(1)/TPD1
      ERND=ERND*ERND*P25
      GO TO 950
C
 1260 IFL=IFLS
      IF (IFL.NE.4) GO TO 1790
      TPD=TPD2
      IFLAG=3
 1270 IF (TPD1.GT.TPD) GO TO 1280
      T=TFINAL
      TPD=TPD1
```

```
      GO TO 1290
 1280 T=TOUT
      IFL=3
 1290 IF ((TPD.EQ.0.).AND.(IFLAG.LE.2)) GO TO 310
C
C     INTERPOLATE FOR OUTPUT
 1300 TP=TPD
      D(2)=TP
      KQQ2=0
      KDC=0
      D(1)=PT(1)
      DD(1)=PT(1)
      DO 1310 K=2,KQM
        DD(1)=DD(1)+PT(1)
        TP=TP+PT(1)
        D(K+1)=(D(K)*TP)/DD(1)
 1310 CONTINUE
      GO TO 1350
C
C     COMPUTE THE INTERPOLATING INTEGRATION COEFFICIENTS
 1320 KQQ2=1
      L=KQM-KDC
      KDC=KDC+1
 1330 IF (L.LE.0) GO TO 1350
      TP=0.
      K=L
      J=L+KDC
 1340 JS=J-K
      TP=TP+GAS(K)*D(JS+1)
      K=K-1
      IF (K.GT.0) GO TO 1340
      D(J)=TP
C
C     D(J) IS THE INTEGRATION COEFFICIENT FOR THE INTERPOLATION WHICH
C     CORRESPONDS TO GAM(J-KDC,KDC).
C
      L=L-1
      GO TO 1330
C     END OF COMPUTING INTEGRATION COEFFICIENTS
C
C     PERFORM THE PARTIAL STEP INTEGRATION
 1350 J=0
      DO 1415 I=1,NE
      KDD=KD(I)
      IF (KDC.GT.KDD) GO TO 1410
      TP=0.
      KQQ=KQ(I)+KQQ2
 1360 L=KQQ-KDC
      IF (L.LE.0) GO TO 1370
      TP=TP+D(KQQ)*DT(L,I)
      KQQ=KQQ-1
      IF (KQQ) 1390,1390,1360
 1370 K=J+KDD
      L=KDC
 1380 L=L-1
      IF (L.EQ.0) GO TO 1400
      TP=TP*HH+YN(K)*FAC(L)*TPD
      K=K-1
      GO TO 1380
 1390 F(I)=TP
```

```
      GO TO 1415                                                        DVDQ1124
 1400 Y(K)=YN(K)+HH*TP                                                  DVDQ1125
 1410 J=J+KDD                                                           DVDQ1126
 1415 CONTINUE                                                          DVDQ1127
      IF (KDC.NE.KDMAX) GO TO 1320                                      DVDQ1128
C     END OF PARTIAL STEP INTEGRATION                                   DVDQ1129
      IF (LGSE) 1800,310,1810                                           DVDQ1130
C                                                                       DVDQ1131
C     INITIALIZE FOR GSTOPS                                             DVDQ1132
 1420 NGA=IABS(NG)                                                      DVDQ1133
      LGSS=-NGA                                                         DVDQ1134
      LGSD=0                                                            DVDQ1135
      LGSE=0                                                            DVDQ1136
      IFLG=-20                                                          DVDQ1137
      IF (NG) 1425,315,315                                              DVDQ1138
 1425 IFLG=-IFL                                                         DVDQ1139
      IFLG=-IFL                                                         DVDQ1140
 1430 LGSD=NGE                                                          DVDQ1141
      IF (LGSD) 1190,1450,1440                                          DVDQ1142
 1440 IFL=15                                                            DVDQ1143
      GO TO 1470                                                        DVDQ1144
C     ENTRY WITH IFL=15                                                 DVDQ1145
 1450 LGSS=0                                                            DVDQ1146
      IF (LGSD-NGA) 1460,1480,1190                                      DVDQ1147
 1460 LGSS=LGSD+1                                                       DVDQ1148
      IFL=14                                                            DVDQ1149
 1470 IFLAG=IFL-5                                                       DVDQ1150
      GO TO 315                                                         DVDQ1151
C     ENTRY WITH IFL=14                                                 DVDQ1152
 1480 DO 1490 I=1,NGA                                                   DVDQ1153
      GT(I)=G(I)                                                        DVDQ1154
 1490 CONTINUE                                                          DVDQ1155
      GO TO 1730                                                        DVDQ1156
C     END OF INITIALIZATION FOR GSTOPS                                  DVDQ1157
C                                                                       DVDQ1158
C     ENTRY TO EVALUATE G AT THE END OF THE STEP                        DVDQ1159
 1500 LGSE=1                                                            DVDQ1160
 1510 IGK=LGSS                                                          DVDQ1161
      IFLG=0                                                            DVDQ1162
      IFL=9                                                             DVDQ1163
      GO TO 310                                                         DVDQ1164
C     ENTRY TO EVALUATE G BEFORE EVALUATING THE DERIVATIVES             DVDQ1165
 1520 IFLG=IFL                                                          DVDQ1166
      IFL=10                                                            DVDQ1167
 1530 IFLAG=10                                                          DVDQ1168
      IGKM=LGSD                                                         DVDQ1169
 1540 IGK=1                                                             DVDQ1170
 1550 GO TO 315                                                         DVDQ1171
 1560 IGK=IGK+1                                                         DVDQ1172
      IF (IGK.GT.IGKM) GO TO 1650                                       DVDQ1173
C     ENTRY WITH IFL=9,10, AND 17                                       DVDQ1174
C     TEST FOR G CHANGING SIGN                                          DVDQ1175
 1570 IF (G(IGK)*GT(IGK)) 1600,1580,1590                                DVDQ1176
 1580 IF (GT(IGK).NE.0.) GO TO 1600                                     DVDQ1177
      IF (TL.EQ.TG) GO TO 1560                                          DVDQ1178
 1590 IF (LGSE.GT.0) GT(IGK)=G(IGK)                                     DVDQ1179
      GO TO 1560                                                        DVDQ1180
C     G CHANGES SIGN -- PREPARE FOR ITERATION TO FIND ZERO              DVDQ1181
 1600 NSTOP=IGK                                                         DVDQ1182
      IFLGS=IFL                                                         DVDQ1183
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```
C     COMPUTE INITIAL VALUE FOR RG (=RATIO OF PARTIAL STEPSIZE WHERE
C     G IS KNOWN/THE INTEGRATION STEPSIZE)
      IF (IFLG.EQ.0) GO TO 1610
      RG(3)=FAC(1)
      RG(2)=0.
      IF ((IFLG.EQ.2).AND.(IGK.LT.LGSS)) RG(2)=FAC(1)
      GO TO 1620
 1610 RG(3)=0.
      RG(2)=-FAC(1)
 1620 IF (LGSE.LT.0) RG(3)=TPD
      LGSE=-3
      GI(2)=GT(IGK)
      EPSGS=RND
      IFL=16
      K=1
      GO TO 1640
C     END OF PREPARATION TO BEGIN THE ITERATION
C
C     ENTRY WITH IFL=16
C     ITERATE TO FIND GSTOP
 1630 K=1
      IF ((GI(2)*G(IGK)).GT.0.) K=2
      IF (ABS(GI(K)).GT.ABS(G(IGK))) GO TO 1640
C     CONVERGENCE PROBLEMS
      LGSE=LGSE-1
      IF (LGSE.EQ.(-5)) EPSGS=PTS1
      EPSGS=EPSGS*PTS4
 1640 GI(K)=G(IGK)
      RG(K)=RG(3)
C     SECANT ITERATION (GIVES NEW PARTIAL STEPSIZE/H)
      TPD=RG(1)-(GI(1)*(RG(2)-RG(1)))/(GI(2)-GI(1))
      T=TL+TPD*HH
C     TEST FOR CONVERGENCE OF ITERATION
      IF (ABS(TPD-RG(3)).LE.EPSGS) GO TO 1560
      RG(3)=TPD
      GO TO 1300
 1650 IF (10-IFL) 1660,1700,100
 1660 IF (IGKM.NE.NGA) GO TO 1710
      IF (LGSE.GT.(-3)) GO TO 1690
      IF (LSTC.NE.4) GO TO 1670
C     ESTIMATE ERROR -- GSTOP IS THE RESULT OF EXTRAPOLATING FROM
C     THE INITIAL POINT
      TPD1=TPD
      RG(3)=TPD
      GO TO 1230
 1670 IFL=11
      IF (LGSE.LT.(-4)) IFL=12
 1680 IFLAG=IFL
C     TEST TO SEE IF GSTOP IS PRECEDED BY ANOTHER STOP
      IF ((HH*(T-TOUT).LE.0.).AND.(HH*(T-TFINAL).LE.0.)) GO TO 1300
C     IT IS
      RG(3)=TPD
      IFLS=IFL
      GO TO 200
 1690 LGSE=1
      IFL=IFLG
      IF (IFL.LT.0) GO TO 60
 1700 IGKM=NGA
      IFL=IFLG
      GO TO 310
```

```
 1710 IFL=17                                                           DVDQ1244
      IFLAG=9                                                          DVDQ1245
      IGKM=NGA                                                         DVDQ1246
      GO TO 315                                                        DVDQ1247
C     ENTRY WITH IFL=11 AND 12                                         DVDQ1248
C     SET PARAMETERS TO INCICATE A GSTOP HAS BEEN FOUND                DVDQ1249
 1720 GT(NSTOP)=0.                                                     DVDQ1250
 1730 LGSE=1                                                           DVDQ1251
      IGKM=NGA                                                         DVDQ1252
      TG=TL                                                            DVDQ1253
      IF (IFLG) 1740,1760,1770                                         DVDQ1254
 1740 IF (IFL.LT.13) GO TO 1750                                        DVDQ1255
      IF (IFLG.EQ.(-20)) GO TO 100                                     DVDQ1256
      IFL=-IFLG                                                        DVDQ1257
      GO TO 310                                                        DVDQ1258
 1750 HH=H                                                             DVDQ1259
      GO TO 200                                                        DVDQ1260
 1760 TPD=0.                                                           DVDQ1261
      T=TL                                                             DVDQ1262
      LGSE=-2                                                          DVDQ1263
      GO TO 1300                                                       DVDQ1264
 1770 IF (IFLG-3) 220,200,200                                          DVDQ1265
 1780 IF (LGSE.EQ.(-1)) GO TO 1790                                     DVDQ1266
      LGSE=-1                                                          DVDQ1267
      GO TO 1220                                                       DVDQ1268
 1790 TPD=RG(3)                                                        DVDQ1269
      T=TL+TPD*HH                                                      DVDQ1270
      IF (LGSE.NE.(-1)) GO TO 1670                                     DVDQ1271
      IFL=IFLS                                                         DVDQ1272
      LGSE=-3                                                          DVDQ1273
      GO TO 1680                                                       DVDQ1274
 1800 IF (LGSE+2) 1550,1500,310                                        DVDQ1275
 1810 IF (TPD.LE.0.) GO TO 310                                         DVDQ1276
      LGSE=-2                                                          DVDQ1277
 1820 IFLG=IFL                                                         DVDQ1278
      IFL=17                                                           DVDQ1279
      IFLAG=9                                                          DVDQ1280
      IF (LGSD .GT. 0) GO TO 1530                                      DVDQ1281
      GO TO 1540                                                       DVDQ1282
      END                                                              DVDQ1283
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15. Supplementary Notes

Final report. Project Manager, Robert J. Shaw, Propulsion Systems Division, NASA Lewis Research Center, Cleveland, Ohio 44135. The microfiche supplement at the back of this report contains an example problem printout and code listings.

16. Abstract

Calculations can be performed for any atmospheric conditions and for all water drop sizes, from the smallest cloud droplet to large raindrops. Any subsonic, external, non-lifting flow can be accommodated; flow into, but not through, inlets also can be simulated. Experimental water drop drag relations are used in the water drop equations of motion and effects of gravity settling are included. Seven codes are described: 1. a code used to debug and plot body surface description data, 2. a code that processes the body surface data to yield the potential flow field, 3. a code that computes flow velocities at arrays of points in space, 4. a code that computes water drop trajectories from an array of points in space, 5. a code that computes water drop trajectories and fluxes to arbitrary target points, 6. a code that computes water drop trajectories tangent to the body, 7. a code that produces stereo pair plots which include both the body and trajectories. Code descriptions include operating instructions, card inputs and printouts for example problems, and listings of the FORTRAN codes. Accuracy of the calculations is discussed, and trajectory calculation results are compared with prior calculations and with experimental data.

17. Key Words (Suggested by Author(s)) Water drop trajectories; Three-dimensional potential flow; Computer programs; Tangent trajectories; Water drop fluxes; Aircraft icing	18. Distribution Statement Unclassified – Unlimited Subject Category 02		
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MICROFICHE SUPPLEMENT TO NASA CR-3291

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 BODY ID.  TEST
                             TEST BODY

          P A R A M E T R I C   I N F O R M A T I O N


          NO SYMMETRY SPECIFIED

          PLOTS ARE PREPARED
```

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
1	1	2.000000	2.000000	1.500000	1.500000	.958086	1.591395
		0.000000	0.000000	1.670000	1.732000	.276584	1.389794
		0.000000	0.000000	.229700	0.000000	.074655	.094899
	2	2.000000	2.000000	1.500000	1.500000	.941794	1.598349
		0.000000	0.000000	1.460000	1.670000	.251249	1.254020
		0.000000	0.000000	.465900	.229700	.223380	.282927
	3	2.000000	2.000000	1.500000	1.500000	.915363	1.605113
		0.000000	0.000000	1.140000	1.460000	.202414	1.019539
		0.000000	0.000000	.652000	.465900	.348052	.445612
	4	2.000000	2.000000	1.500000	1.500000	.891771	1.609275
		0.000000	0.000000	.800000	1.140000	.146221	.750320
		0.000000	0.000000	.768100	.652000	.428210	.557494
	5	2.000000	2.000000	1.500000	1.500000	.874522	1.620269
		0.000000	0.000000	.400000	.800000	.088802	.447901
		0.000000	0.000000	.842600	.768100	.476787	.613081
	6	2.000000	2.000000	1.500000	1.500000	.865649	1.624811
		0.000000	0.000000	0.000000	.400000	.029238	.147089
		0.000000	0.000000	.866000	.842600	.499797	.641222
	7	2.000000	2.000000	1.500000	1.500000	.863087	1.626041
		0.000000	0.000000	-.400000	0.000000	-.082222	-.148316
		0.000000	0.000000	.800000	.866000	.498318	.623224
	8	2.000000	2.000000	1.500000	1.500000	.872872	1.627233
		0.000000	0.000000	-.800000	-.400000	-.218218	-.442846
		0.000000	0.000000	.600000	.800000	.436436	.524111
	9	2.000000	2.000000	1.500000	1.500000	.872872	1.618821
		0.000000	0.000000	-1.200000	-.800000	-.218218	-.751160
		0.000000	0.000000	.400000	.600000	.436436	.386778
	10	2.000000	2.000000	1.500000	1.500000	.872872	1.607148
		0.000000	0.000000	-1.600000	-1.200000	-.218218	-1.085976
		0.000000	0.000000	.200000	.400000	.436436	.242716
	11	2.000000	2.000000	1.500000	1.500000	.945063	1.589795
		0.000000	0.000000	-1.732000	-1.600000	-.272824	-1.365206
		0.000000	0.000000	0.000000	.200000	.180064	.084464
	12	2.000000	2.000000	1.500000	1.500000	.958086	1.591395
		0.000000	0.000000	-1.670000	-1.732000	-.276584	-1.389794
		0.000000	0.000000	-.229700	0.000000	-.074655	-.094899

FOLDOUT FRAME

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
500000	1.500000	.958086	1.591395	0.
670000	1.732000	.276584	1.389794	.1803E+01
229700	0.000000	.074655	.094899	.2076E+00
500000	1.500000	.941794	1.598349	.8882E-15
460000	1.670000	.251249	1.254020	.1758E+01
465900	.229700	.223380	.282927	.2350E+00
500000	1.500000	.915363	1.605113	.2665E-14
140000	1.460000	.202414	1.019539	.1612E+01
652000	.465900	.348052	.445612	.2299E+00
500000	1.500000	.891771	1.609275	.2665E-14
800000	1.140000	.146221	.750320	.1405E+01
768100	.652000	.428210	.557494	.1985E+00
500000	1.500000	.874522	1.620269	.9992E-15
400000	.800000	.088802	.447901	.1217E+01
842600	.768100	.476787	.613081	.2097E+00
500000	1.500000	.865649	1.624811	.2220E-15
000000	.400000	.029238	.147089	.1058E+01
866000	.842600	.499797	.641222	.2001E+00
500000	1.500000	.863087	1.626041	.2220E-15
400000	0.000000	-.082222	-.148316	.1025E+01
800000	.866000	.498318	.623224	.2007E+00
500000	1.500000	.872872	1.627233	.8882E-15
800000	-.400000	-.218218	-.442846	.1118E+01
600000	.800000	.436436	.524111	.2291E+00
500000	1.500000	.872872	1.618821	.1776E-14
200000	-.800000	-.218218	-.751160	.1360E+01
400000	.600000	.436436	.386778	.2291E+00
500000	1.500000	.872872	1.607148	.8882E-15
600000	-1.200000	-.218218	-1.085976	.1688E+01
200000	.400000	.436436	.242716	.2291E+00
500000	1.500000	.945063	1.589795	0.
732000	-1.600000	-.272824	-1.365206	.1803E+01
000000	.200000	.180064	.084464	.1833E+00
500000	1.500000	.958086	1.591395	0.
670000	-1.732000	-.276584	-1.389794	.1803E+01
229700	0.000000	-.074655	-.094899	.2076E+00

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
1	13	2.000000	2.000000	1.500000	1.500000	.941794	1.598349
		0.000000	0.000000	-1.460000	-1.670000	-.251249	-1.254020
		0.000000	0.000000	-.465900	-.229700	-.223380	-.282927
	14	2.000000	2.000000	1.500000	1.500000	.915363	1.605113
		0.000000	0.000000	-1.140000	-1.460000	-.202414	-1.019539
		0.000000	0.000000	-.652000	-.465900	-.348052	-.445612
	15	2.000000	2.000000	1.500000	1.500000	.891771	1.609275
		0.000000	0.000000	-.800000	-1.140000	-.146221	-.750320
		0.000000	0.000000	-.768100	-.652000	-.428210	-.557494
	16	2.000000	2.000000	1.500000	1.500000	.874522	1.620269
		0.000000	0.000000	-.400000	-.800000	-.088802	-.447901
		0.000000	0.000000	-.842600	-.768100	-.476787	-.613081
	17	2.000000	2.000000	1.500000	1.500000	.865649	1.624811
		0.000000	0.000000	0.000000	-.400000	-.029238	-.147089
		0.000000	0.000000	-.866000	-.842600	-.499797	-.641222
	18	2.000000	2.000000	1.500000	1.500000	.865649	1.624811
		0.000000	0.000000	.400000	0.000000	.029238	.147089
		0.000000	0.000000	-.842600	-.866000	-.499797	-.641222
	19	2.000000	2.000000	1.500000	1.500000	.874522	1.620269
		0.000000	0.000000	.800000	.400000	.088802	.447901
		0.000000	0.000000	-.768100	-.842600	-.476787	-.613081
	20	2.000000	2.000000	1.500000	1.500000	.891771	1.609275
		0.000000	0.000000	1.140000	.800000	.146221	.750320
		0.000000	0.000000	-.652000	-.768100	-.428210	-.557494
	21	2.000000	2.000000	1.500000	1.500000	.915363	1.605113
		0.000000	0.000000	1.460000	1.140000	.202414	1.019539
		0.000000	0.000000	-.465900	-.652000	-.348052	-.445612
	22	2.000000	2.000000	1.500000	1.500000	.941794	1.598349
		0.000000	0.000000	1.670000	1.460000	.251249	1.254020
		0.000000	0.000000	-.229700	-.465900	-.223380	-.282927
	23	2.000000	2.000000	1.500000	1.500000	.958086	1.591395
		0.000000	0.000000	1.732000	1.670000	.276584	1.389794
		0.000000	0.000000	0.000000	-.229700	-.074655	-.094899
2	1	1.500000	1.500000	1.000000	1.000000	.435365	1.220560
		1.732000	1.670000	1.870000	2.000000	.855263	1.831729
		0.000000	.229700	.354600	0.000000	.281038	.149900

SCIENCE ASSOCIATES
MASSACHUSETTS

	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
00	1.500000	.941794	1.598349	.8882E-15
00	-1.670000	-.251249	-1.254020	.1758E+01
00	-.229700	-.223380	-.282927	.2350E+00
00	1.500000	.915363	1.605113	.2665E-14
00	-1.460000	-.202414	-1.019539	.1612E+01
00	-.465900	-.348052	-.445612	.2299E+00
00	1.500000	.891771	1.609275	.2665E-14
00	-1.140000	-.146221	-.750320	.1405E+01
00	-.652000	-.428210	-.557494	.1985E+00
00	1.500000	.874522	1.620269	.9992E-15
00	-.800000	-.088802	-.447901	.1217E+01
00	-.768100	-.476787	-.613081	.2097E+00
000	1.500000	.865649	1.624811	.2220E-15
000	-.400000	-.029238	-.147089	.1058E+01
000	-.842600	-.499797	-.641222	.2001E+00
000	1.500000	.865649	1.624811	.2220E-15
000	0.000000	.029238	.147089	.1058E+01
500	-.866000	-.499797	-.641222	.2001E+00
000	1.500000	.874522	1.620269	.9992E-15
000	.400000	.088802	.447901	.1217E+01
100	-.842600	-.476787	-.613081	.2097E+00
000	1.500000	.891771	1.609275	.2665E-14
000	.800000	.146221	.750320	.1405E+01
000	-.768100	-.428210	-.557494	.1985E+00
000	1.500000	.915363	1.605113	.2665E-14
000	1.140000	.202414	1.019539	.1612E+01
900	-.652000	-.348052	-.445612	.2299E+00
000	1.500000	.941794	1.598349	.8882E-15
000	1.460000	.251249	1.254020	.1758E+01
700	-.465900	-.223380	-.282927	.2350E+00
000	1.500000	.958086	1.591395	0.
000	1.670000	.276584	1.389794	.1803E+01
000	-.229700	-.074655	-.094899	.2076E+00
000	1.000000	.435365	1.220560	.5764E-02
000	2.000000	.855263	1.831729	.6416E+00
600	0.000000	.261038	.149900	.1708E+00

FOLDOUT FRAME 2

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
2	2	1.500000	1.500000	1.000000	1.000000	.390089	1.2417
		1.670000	1.460000	1.600000	1.870000	.652170	1.6528
		.229700	.465900	.600000	.354600	.650004	.4146
	3	1.500000	1.500000	1.000000	1.000000	.324553	1.2416
		1.460000	1.140000	1.200000	1.600000	.447006	1.3516
		.465900	.652000	.800000	.600000	.833577	.6318
	4	1.500000	1.500000	1.000000	1.000000	.288009	1.2429
		1.140000	.800000	.800000	1.200000	.287154	.9857
		.652000	.768100	.916500	.800000	.913561	.7861
	5	1.500000	1.500000	1.000000	1.000000	.270929	1.2501
		.800000	.400000	.400000	.800000	.163401	.6000
		.768100	.842600	.979800	.916500	.948629	.8766
	6	1.500000	1.500000	1.000000	1.000000	.261384	1.2500
		.400000	0.000000	0.000000	.400000	.052527	.2000
		.842600	.866000	1.000000	.979800	.963805	.9220
	7	1.500000	1.500000	1.000000	1.000000	.126140	1.2460
		0.000000	-.400000	-.400000	0.000000	-.312996	-.1995
		.866000	.800000	.800000	1.000000	.941341	.8671
	8	1.500000	1.500000	1.000000	1.000000	0.000000	1.2500
		-.400000	-.800000	-.800000	-.400000	-.447214	-.6000
		.800000	.600000	.600000	.800000	.894427	.7000
	9	1.500000	1.500000	1.000000	1.000000	0.000000	1.2500
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.0000
		.600000	.400000	.400000	.600000	.894427	.5000
	10	1.500000	1.500000	1.000000	1.000000	0.000000	1.2500
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.4000
		.400000	.200000	.200000	.400000	.894427	.3000
	11	1.500000	1.500000	1.000000	1.000000	.159008	1.2167
		-1.600000	-1.732000	-2.000000	-1.600000	-.593315	-1.7392
		.200000	0.000000	0.000000	.200000	.789109	.1020
	12	1.500000	1.500000	1.000000	1.000000	.435365	1.2205
		-1.732000	-1.670000	-1.870000	-2.000000	-.855263	-1.8317
		0.000000	-.229700	-.354600	0.000000	-.281038	-.1499
	13	1.500000	1.500000	1.000000	1.000000	.390089	1.2417
		-1.670000	-1.460000	-1.600000	-1.870000	-.652170	-1.6528
		-.229700	-.465900	-.600000	-.354600	-.650004	-.4146

5

FOLDOUT FRAME 1

NX / NY / NZ	NPX / NPY / NPZ	D / T / A
.390089	1.241719	.8288E-02
.652170	1.652830	.6561E+00
.650004	.414680	.1846E+00
.324553	1.241630	.6043E-02
.447006	1.351646	.6814E+00
.833577	.631851	.2159E+00
.288009	1.242990	.4216E-02
.287154	.985715	.6600E+00
.913561	.786135	.2025E+00
.270929	1.250180	.2656E-02
.163401	.600088	.6744E+00
.948629	.876683	.2108E+00
.261384	1.250017	.7710E-03
.052527	.200626	.6594E+00
.963805	.922094	.2075E+00
.126140	1.246098	.3153E-01
-.312996	-.199566	.6708E+00
.941341	.867167	.2125E+00
0.000000	1.250000	.3553E-14
-.447214	-.600000	.6708E+00
.894427	.700000	.2236E+00
0.000000	1.250000	.3553E-14
-.447214	-1.000000	.6708E+00
.894427	.500000	.2236E+00
0.000000	1.250000	.6661E-14
-.447214	-1.400000	.6708E+00
.894427	.300000	.2236E+00
.159008	1.216789	.3975E-01
-.593315	-1.739216	.6708E+00
.789109	.102018	.1685E+00
.435365	1.220560	.5764E-02
-.855263	-1.831729	.6416E+00
-.281038	-.149900	.1708E+00
.390089	1.241719	.8288E-02
-.652170	-1.652830	.6561E+00
-.650004	-.414680	.1846E+00

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
2	14	1.500000	1.500000	1.000000	1.000000	.324553	1.241630
		-1.460000	-1.140000	-1.200000	-1.600000	-.447006	-1.351646
		-.465900	-.652000	-.800000	-.600000	-.833577	-.631851
	15	1.500000	1.500000	1.000000	1.000000	.288009	1.242990
		-1.140000	-.800000	-.800000	-1.200000	-.287154	-.985715
		-.652000	-.768100	-.916500	-.800000	-.913561	-.786135
	16	1.500000	1.500000	1.000000	1.000000	.270929	1.250180
		-.800000	-.400000	-.400000	-.800000	-.163401	-.600088
		-.768100	-.842600	-.979800	-.916500	-.948629	-.876683
	17	1.500000	1.500000	1.000000	1.000000	.261384	1.250017
		-.400000	0.000000	0.000000	-.400000	-.052527	-.200026
		-.842600	-.866000	-1.000000	-.979800	-.963805	-.922094
	18	1.500000	1.500000	1.000000	1.000000	.261384	1.250017
		0.000000	.400000	.400000	0.000000	.052527	.200026
		-.866000	-.842600	-.979800	-1.000000	-.963805	-.922094
	19	1.500000	1.500000	1.000000	1.000000	.270929	1.250180
		.400000	.800000	.800000	.400000	.163401	.600088
		-.842600	-.768100	-.916500	-.979800	-.948629	-.876683
	20	1.500000	1.500000	1.000000	1.000000	.288009	1.242990
		.800000	1.140000	1.200000	.800000	.287154	.985715
		-.768100	-.652000	-.800000	-.916500	-.913561	-.786135
	21	1.500000	1.500000	1.000000	1.000000	.324553	1.241630
		1.140000	1.460000	1.600000	1.200000	.447006	1.351646
		-.652000	-.465900	-.600000	-.800000	-.833577	-.631851
	22	1.500000	1.500000	1.000000	1.000000	.390089	1.241719
		1.460000	1.670000	1.870000	1.600000	.652170	1.652830
		-.465900	-.229700	-.354600	-.600000	-.650004	-.414680
	23	1.500000	1.500000	1.000000	1.000000	.435365	1.220560
		1.670000	1.732000	2.000000	1.870000	.855263	1.831729
		-.229700	0.000000	0.000000	-.354600	-.281038	-.149900
3	1	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		2.000000	1.870000	1.870000	2.000000	.938893	1.935000
		0.000000	.354600	.354600	0.000000	.344208	.177300
	2	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.870000	1.600000	1.600000	1.870000	.672591	1.735000
		.354600	.600000	.600000	.354600	.740014	.477300

FOLDOUT FRA

X	NX	NPX	D
Y	NY	NPY	T
Z	NZ	NPZ	A
1.000000	.324553	1.241630	.6043E-02
-1.600000	-.447006	-1.351646	.6814E+00
-.600000	-.833577	-.631851	.2159E+00
1.000000	.288009	1.242990	.4216E-02
-1.200000	-.287154	-.985715	.6600E+00
-.800000	-.913561	-.786135	.2025E+00
1.000000	.270929	1.250180	.2656E-02
-.800000	-.163401	-.600088	.6744E+00
-.916500	-.948629	-.876683	.2108E+00
1.000000	.261384	1.250017	.7710E-03
-.400000	-.052527	-.200026	.6594E+00
-.979800	-.963805	-.922094	.2075E+00
1.000000	.261384	1.250017	.7710E-03
0.000000	.052527	.200026	.6594E+00
-1.000000	-.963805	-.922094	.2075E+00
1.000000	.270929	1.250180	.2656E-02
.400000	.163401	.600088	.6744E+00
-.979800	-.948629	-.876683	.2108E+00
1.000000	.288009	1.242990	.4216E-02
.800000	.287154	.985715	.6600E+00
-.916500	-.913561	-.786135	.2025E+00
1.000000	.324553	1.241630	.6043E-02
1.200000	.447006	1.351646	.6814E+00
-.800000	-.833577	-.631851	.2159E+00
1.000000	.390089	1.241719	.8288E-02
1.600000	.652170	1.652830	.6561E+00
-.600000	-.650004	-.414680	.1846E+00
1.000000	.435365	1.220560	.5764E-02
1.870000	.855263	1.831729	.6416E+00
-.354600	-.281038	-.149900	.1708E+00
0.000000	0.000000	.500000	0.
2.000000	.938893	1.935000	.1069E+01
0.000000	.344208	.177300	.3777E+00
0.000000	0.000000	.500000	.4885E-14
1.870000	.672591	1.735000	.1064E+01
.354600	.740014	.477300	.3649E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
3	3	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.600000	1.200000	1.200000	1.600000	.447214	1.400000
		.600000	.800000	.800000	.600000	.894427	.700000
	4	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.200000	.800000	.800000	1.200000	.279631	1.000000
		.800000	.916500	.916500	.800000	.960107	.858250
	5	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.800000	.400000	.400000	.800000	.156305	.600000
		.916500	.979800	.979800	.916500	.987709	.948150
	6	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.400000	0.000000	0.000000	.400000	.050436	.200000
		.979800	1.000000	1.000000	.979800	.998727	.989900
	7	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		0.000000	-.400000	-.400000	0.000000	-.447214	-.200000
		1.000000	.800000	.800000	1.000000	.894427	.900000
	8	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.600000	-2.000000	-2.000000	-1.600000	-.447214	-1.800000
		.200000	0.000000	0.000000	.200000	.894427	.100000
	12	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-2.000000	-1.870000	-1.870000	-2.000000	-.938893	-1.935000
		0.000000	-.354600	-.354600	0.000000	-.344208	-.177300
	13	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.870000	-1.600000	-1.600000	-1.870000	-.672591	-1.735000
		-.354600	-.600000	-.600000	-.354600	-.740014	-.477300
	14	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.600000	-1.200000	-1.200000	-1.600000	-.447214	-1.400000
		-.600000	-.800000	-.800000	-.600000	-.894427	-.700000

FOLDOUT FRA

ES

NX / NY / NZ	NPX / NPY / NPZ	D / T / A
0.000000	.500000	.6661E-14
.447214	1.400000	.1095E+01
.894427	.700000	.4472E+00
0.000000	.500000	.2442E-14
.279631	1.000000	.1083E+01
.960107	.858250	.4166E+00
0.000000	.500000	.2442E-14
.156305	.600000	.1079E+01
.987709	.948150	.4050E+00
0.000000	.500000	.5551E-16
.050436	.200000	.1077E+01
.998727	.989900	.4005E+00
0.000000	.500000	.3109E-14
-.447214	-.200000	.1095E+01
.894427	.900000	.4472E+00
0.000000	.500000	.3553E-14
-.447214	-.600000	.1095E+01
.894427	.700000	.4472E+00
0.000000	.500000	.3553E-14
-.447214	-1.000000	.1095E+01
.894427	.500000	.4472E+00
0.000000	.500000	.6661E-14
-.447214	-1.400000	.1095E+01
.894427	.300000	.4472E+00
0.000000	.500000	.4441E-15
-.447214	-1.800000	.1095E+01
.894427	.100000	.4472E+00
0.000000	.500000	0.
-.938893	-1.935000	.1069E+01
-.344208	-.177300	.3777E+00
0.000000	.500000	.4885E-14
-.672591	-1.735000	.1064E+01
-.740014	-.477300	.3649E+00
0.000000	.500000	.6661E-14
-.447214	-1.400000	.1095E+01
-.894427	-.700000	.4472E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
3	15	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.200000	-.800000	-.800000	-1.200000	-.279631	-1.000000
		-.800000	-.916500	-.916500	-.800000	-.960107	-.858250
	16	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.800000	-.400000	-.400000	-.800000	-.156305	-.600000
		-.916500	-.979800	-.979800	-.916500	-.987709	-.948150
	17	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.400000	0.000000	0.000000	-.400000	-.050436	-.200000
		-.979800	-1.000000	-1.000000	-.979800	-.998727	-.989900
	18	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		0.000000	.400000	.400000	0.000000	.050436	.200000
		-1.000000	-.979800	-.979800	-1.000000	-.998727	-.989900
	19	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.400000	.800000	.800000	.400000	.156305	.600000
		-.979800	-.916500	-.916500	-.979800	-.987709	-.948150
	20	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.800000	1.200000	1.200000	.800000	.279631	1.000000
		-.916500	-.800000	-.800000	-.916500	-.960107	-.858250
	21	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.200000	1.600000	1.600000	1.200000	.447214	1.400000
		-.800000	-.600000	-.600000	-.800000	-.894427	-.700000
	22	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.600000	1.870000	1.870000	1.600000	.672591	1.735000
		-.600000	-.354600	-.354600	-.600000	-.740014	-.477300
	23	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.870000	2.000000	2.000000	1.870000	.938893	1.935000
		-.354600	0.000000	0.000000	-.354600	-.344208	-.177300
4	1	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		2.000000	1.870000	1.850000	1.972000	.939127	1.923092
		0.000000	.354600	.341500	0.000000	.339980	.174052
	2	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		1.870000	1.600000	1.585000	1.850000	.675158	1.726269
		.354600	.600000	.586600	.341500	.736411	.470688
	3	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		1.600000	1.200000	1.195000	1.585000	.449471	1.395016
		.600000	.800000	.784400	.586600	.892614	.692774

FOLDOUT FRAM

X	NX	NPX	D
Y	NY	NPY	T
Z	NZ	NPZ	A
0.000000	0.000000	.500000	.2442E-14
1.200000	-.279631	-1.000000	.1083E+01
-.800000	-.960107	-.858250	.4166E+00
0.000000	0.000000	.500000	.2442E-14
-.800000	-.156305	-.600000	.1079E+01
-.916500	-.987709	-.948150	.4050E+00
0.000000	0.000000	.500000	.5551E-16
-.400000	-.050436	-.200000	.1077E+01
-.979800	-.998727	-.989900	.4005E+00
0.000000	0.000000	.500000	.3553E-14
0.000000	.050436	.200000	.1077E+01
1.000000	-.998727	-.989900	.4005E+00
0.000000	0.000000	.500000	.2220E-14
.400000	.156305	.600000	.1079E+01
-.979800	-.987709	-.948150	.4050E+00
0.000000	0.000000	.500000	.3109E-14
.800000	.279631	1.000000	.1083E+01
-.916500	-.960107	-.858250	.4166E+00
0.000000	0.000000	.500000	.6661E-14
1.200000	.447214	1.400000	.1095E+01
-.800000	-.894427	-.700000	.4472E+00
0.000000	0.000000	.500000	.6217E-14
1.600000	.672591	1.735000	.1064E+01
-.600000	-.740014	-.477300	.3649E+00
0.000000	0.000000	.500000	.6217E-14
1.870000	.938893	1.935000	.1069E+01
-.354600	-.344208	-.177300	.3777E+00
-.500000	-.049532	-.248068	.7648E-03
1.972000	.939127	1.923092	.6238E+00
0.000000	.339980	.174052	.1853E+00
-.500000	-.043145	-.249477	.7887E-03
1.850000	.675158	1.726269	.6205E+00
.341500	.736411	.470688	.1816E+00
-.500000	-.034875	-.249169	.6327E-03
1.585000	.449471	1.395016	.6693E+00
.586600	.892614	.632774	.2213E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
4	4	0.000000	0.000000	-.500000	-.500000	-.031043	-.249537
		1.200000	.800000	.800000	1.[illegible]5000	.281449	.998756
		.800000	.916500	.901200	.784400	.959074	.850538
	5	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		.800000	.400000	.400000	.800000	.157442	.600001
		.916500	.979800	.965500	.901200	.987096	.940749
	6	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		.400000	0.000000	0.000000	.400000	.050789	.200000
		.979800	1.000000	.986000	.965500	.998310	.982825
	7	0.000000	0.000000	-.500000	-.500000	-.012608	-.249496
		0.000000	-.400000	-.400000	0.000000	-.434526	-.199997
		1.000000	.800000	.800000	.986000	.900571	.896509
	8	0.000000	0.000000	-.500000	-.500000	0.000000	-.250000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	0.000000	0.000000	-.500000	-.500000	0.000000	-.250000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	0.000000	0.000000	-.500000	-.500000	0.000000	-.250000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	0.000000	0.000000	-.500000	-.500000	-.012880	-.247831
		-1.600000	-2.000000	-1.972000	-1.600000	-.460010	-1.793015
		.200000	0.000000	0.000000	.200000	.867820	.100024
	12	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		-2.000000	-1.870000	-1.850000	-1.972000	-.939127	-1.923092
		0.000000	-.354600	-.341500	0.000000	-.339980	-.174052
	13	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		-1.870000	-1.600000	-1.585000	-1.850000	-.675158	-1.726269
		-.354600	-.600000	-.586600	-.341500	-.736411	-.470688
	14	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		-1.600000	-1.200000	-1.195000	-1.585000	-.449471	-1.395016
		-.600000	-.800000	-.784400	-.586600	-.892614	-.692774
	15	0.000000	0.000000	-.500000	-.500000	-.031043	-.249537
		-1.200000	-.800000	-.800000	-1.195000	-.281449	-.998756
		-.800000	-.916500	-.901200	-.784400	-.959074	-.850538

ES

NX / NY / NZ	NPX / NPY / NPZ	D / T / A
-.031043	-.249537	.4237E-03
.281449	.998756	.6507E+00
.959074	.850538	.2072E+00
-.029218	-.250016	.2468E-03
.157442	.600001	.6451E+00
.987096	.940749	.2026E+00
-.028252	-.250002	.7487E-04
.050789	.200000	.6412E+00
.998310	.982825	.2003E+00
-.012608	-.249496	.3152E-02
-.434526	-.199997	.6708E+00
.900571	.896509	.2221E+00
0.000000	-.250000	.3553E-14
-.447214	-.600000	.6708E+00
.894427	.700000	.2236E+00
0.000000	-.250000	.3553E-14
-.447214	-1.000000	.6708E+00
.894427	.500000	.2236E+00
0.000000	-.250000	.6661E-14
-.447214	-1.400000	.6708E+00
.894427	.300000	.2236E+00
-.012880	-.247831	.3220E-02
-.460010	-1.793015	.6708E+00
.887820	.100024	.2174E+00
-.049532	-.248068	.7648E-03
-.939127	-1.923092	.6238E+00
-.339980	-.174052	.1853E+00
-.043145	-.249477	.7887E-03
-.675158	-1.726269	.6205E+00
-.736411	-.470688	.1816E+00
-.034875	-.249169	.6327E-03
-.449471	-1.395016	.6693E+00
-.892614	-.692774	.2213E+00
-.031043	-.249537	.4237E-03
-.281449	-.998756	.6507E+00
-.959074	-.850538	.2072E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
4	16	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		-.800000	-.400000	-.400000	-.800000	-.157442	-.600001
		-.916500	-.979800	-.965500	-.901200	-.987096	-.940749
	17	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		-.400000	0.000000	0.000000	-.400000	-.050789	-.200000
		-.979800	-1.000000	-.986000	-.965500	-.998310	-.982825
	18	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		0.000000	.400000	.400000	0.000000	.050789	.200000
		-1.000000	-.979800	-.965500	-.986000	-.998310	-.982825
	19	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		.400000	.800000	.800000	.400000	.157442	.600001
		-.979800	-.916500	-.901200	-.965500	-.987096	-.940749
	20	0.000000	0.000000	-.500000	-.500000	-.031043	-.249537
		.800000	1.200000	1.195000	.800000	.281449	.998756
		-.916500	-.800000	-.784400	-.901200	-.959074	-.850538
	21	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		1.200000	1.600000	1.585000	1.195000	.449471	1.395016
		-.800000	-.600000	-.586600	-.784400	-.892614	-.692774
	22	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		1.600000	1.870000	1.850000	1.585000	.675158	1.726269
		-.600000	-.354600	-.341500	-.586600	-.736411	-.470688
	23	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		1.870000	2.000000	1.972000	1.850000	.939127	1.923092
		-.354600	0.000000	0.000000	-.341500	-.339980	-.174052
5	1	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		1.972000	1.850000	1.785000	1.885600	.934141	1.874150
		0.000000	.341500	.303900	0.000000	.322188	.161626
	2	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747369
		1.850000	1.585000	1.540000	1.785000	.683173	1.690281
		.341500	.586600	.544000	.303900	.718091	.444215
	3	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		1.585000	1.195000	1.175000	1.540000	.457325	1.373892
		.586600	.784400	.737400	.544000	.882618	.663304
	4	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		1.195000	.800000	.800000	1.175000	.288525	.992572
		.784400	.901200	.853800	.737400	.952677	.819383

FOLDOUT FRAME

X Y Z	NX NY NZ	NPX NPY NPZ	D T A
500000	-.029218	-.250016	.2468E-03
800000	-.157442	-.600001	.6451E+00
901200	-.987096	-.940749	.2026E+00
500000	-.028252	-.250002	.7487E-04
400000	-.050789	-.200000	.6412E+00
965500	-.998310	-.982825	.2003E+00
500000	-.028252	-.250002	.7487E-04
000000	.050789	.200000	.6412E+00
986000	-.998310	-.982825	.2003E+00
500000	-.029218	-.250016	.2468E-03
400000	.157442	.600001	.6451E+00
965500	-.987096	-.940749	.2026E+00
500000	-.031043	-.249537	.4237E-03
800000	.281449	.998756	.6507E+00
901200	-.959074	-.850538	.2072E+00
500000	-.034875	-.249169	.6327E-03
195000	.449471	1.395016	.6693E+00
784400	-.892614	-.692774	.2213E+00
500000	-.043145	-.249477	.7887E-03
585000	.675158	1.726269	.6205E+00
586600	-.736411	-.470688	.1816E+00
500000	-.049532	-.248068	.7648E-03
850000	.939127	1.923092	.6238E+00
341500	-.339980	-.174052	.1853E+00
000000	-.153543	-.743334	.1969E-02
835600	.934141	1.874150	.6143E+00
000000	.322188	.161626	.1727E+00
000000	-.132740	-.747389	.2518E-02
785000	.683173	1.690281	.6222E+00
303900	.718091	.444215	.1776E+00
000000	-.108809	-.747752	.1887E-02
540000	.457325	1.373892	.6640E+00
544000	.882618	.663304	.2139E+00
000000	-.095703	-.747958	.1347E-02
175000	.288525	.992572	.6461E+00
737400	.952677	.819383	.2021E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
5	5	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.7500
		.800000	.400000	.400000	.800000	.162020	.6000
		.901200	.965500	.921400	.853800	.982682	.9104
	6	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.7500
		.400000	0.000000	0.000000	.400000	.052106	.2000
		.965500	.986000	.942800	.921400	.994858	.9539
	7	-.500000	-.500000	-1.000000	-1.000000	-.039925	-.7485
		0.000000	-.400000	-.400000	0.000000	-.379842	-.1999
		.986000	.800000	.800000	.942800	.924189	.8822
	8	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.7500
		-.400000	-.800000	-.800000	-.400000	-.447214	-.6000
		.800000	.600000	.600000	.800000	.894427	.7000
	9	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.7500
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.0000
		.600000	.400000	.400000	.600000	.894427	.5000
	10	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.7500
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.4000
		.400000	.200000	.200000	.400000	.894427	.3000
	11	-.500000	-.500000	-1.000000	-1.000000	-.044855	-.7413
		-1.600000	-1.972000	-1.885600	-1.600000	-.519160	-1.7647
		.200000	0.000000	0.000000	.200000	.853499	.1002
	12	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.7433
		-1.972000	-1.850000	-1.785000	-1.885600	-.934141	-1.8741
		0.000000	-.341500	-.303900	0.000000	-.322188	-.1616
	13	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.7473
		-1.850000	-1.585000	-1.540000	-1.785000	-.683173	-1.6902
		-.341500	-.586600	-.544000	-.303900	-.718091	-.4442
	14	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.7477
		-1.585000	-1.195000	-1.175000	-1.540000	-.457325	-1.3738
		-.586600	-.784400	-.737400	-.544000	-.882618	-.6633
	15	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.7479
		-1.195000	-.800000	-.800000	-1.175000	-.288525	-.9925
		-.784400	-.901200	-.853800	-.737400	-.952677	-.8193
	16	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.7500
		-.800000	-.400000	-.400000	-.800000	-.162020	-.6000
		-.901200	-.965500	-.921400	-.853800	-.982682	-.9104

FOLDOUT FRA

X Y Z	NX NY NZ	NPX NPY NPZ	D T A
000000 800000 853800	-.089915 .162020 .982682	-.750055 .600009 .910468	.8107E-03 .6500E+00 .2035E+00
000000 400000 921400	-.086851 .052106 .994858	-.750005 .200003 .953924	.2238E-03 .6436E+00 .2010E+00
000000 000000 942800	-.039925 -.379842 .924189	-.748551 -.199961 .882279	.9981E-02 .6668E+00 .2164E+00
000000 400000 800000	0.000000 -.447214 .894427	-.750000 -.600000 .700000	.3553E-14 .6708E+00 .2236E+00
000000 800000 600000	0.000000 -.447214 .894427	-.750000 -1.000000 .500000	.3553E-14 .6708E+00 .2236E+00
000000 200000 400000	0.000000 -.447214 .894427	-.750000 -1.400000 .300000	.6661E-14 .6708E+00 .2236E+00
000000 600000 200000	-.044855 -.519160 .853499	-.741375 -1.764760 .100234	.1121E-01 .6545E+00 .1926E+00
000000 685600 000000	-.153543 -.934141 -.322188	-.743334 -1.874150 -.161626	.1969E-02 .6143E+00 .1727E+00
000000 785000 303900	-.132740 -.683173 -.718091	-.747389 -1.690281 -.444215	.2518E-02 .6222E+00 .1776E+00
000000 540000 544000	-.108809 -.457325 -.882618	-.747752 -1.373892 -.663304	.1887E-02 .6640E+00 .2139E+00
000000 175000 737400	-.095703 -.288525 -.952677	-.747958 -.992572 -.819383	.1347E-02 .6461E+00 .2021E+00
000000 000000 53800	-.089915 -.162020 -.982682	-.750055 -.600009 -.910468	.8107E-03 .6500E+00 .2035E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
5	17	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		-.400000	0.000000	0.000000	-.400000	-.052106	-.200003
		-.965500	-.986000	-.942800	-.921400	-.994858	-.953924
	18	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		0.000000	.400000	.400000	0.000000	.052106	.200003
		-.986000	-.965500	-.921400	-.942800	-.994858	-.953924
	19	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.750055
		.400000	.800000	.800000	.400000	.162020	.600009
		-.965500	-.901200	-.853800	-.921400	-.982682	-.910468
	20	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		.800000	1.195000	1.175000	.800000	.288525	.992572
		-.901200	-.784400	-.737400	-.853800	-.952677	-.819383
	21	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		1.195000	1.585000	1.540000	1.175000	.457325	1.373892
		-.784400	-.586600	-.544000	-.737400	-.882618	-.663304
	22	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747389
		1.585000	1.850000	1.785000	1.540000	.683173	1.690281
		-.586600	-.341500	-.303900	-.544000	-.718091	-.444215
	23	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		1.850000	1.972000	1.885600	1.785000	.934141	1.874150
		-.341500	0.000000	0.000000	-.303900	-.322188	-.161626
6	1	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		1.885600	1.785000	1.670000	1.732000	.921489	1.773614
		0.000000	.303900	.229700	0.000000	.280799	.134912
	2	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245329
		1.785000	1.540000	1.460000	1.670000	.702123	1.614691
		.303900	.544000	.465900	.229700	.670724	.386555
	3	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		1.540000	1.175000	1.140000	1.460000	.475316	1.329324
		.544000	.737400	.652000	.465900	.857948	.600627
	4	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		1.175000	.800000	.800000	1.140000	.304683	.979004
		.737400	.853800	.768100	.652000	.936981	.753512
	5	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		.800000	.400000	.400000	.800000	.172638	.600034
		.853800	.921400	.842600	.768100	.971923	.846449

FOLDOUT FRAME 1

DY

X	X	NX	NPX	D
Y	Y	NY	NPY	T
Z	Z	NZ	NPZ	A
-1.000000	-1.000000	-.086851	-.750005	.2238E-03
0.000000	-.400000	-.052106	-.200003	.6436E+00
-.942800	-.921400	-.994858	-.953924	.2010E+00
-1.000000	-1.000000	-.086851	-.750005	.2238E-03
.400000	0.000000	.052106	.200003	.6436E+00
-.921400	-.942800	-.994858	-.953924	.2010E+00
-1.000000	-1.000000	-.089915	-.750055	.8107E-03
.800000	.400000	.162020	.600009	.6500E+00
-.853800	-.921400	-.982682	-.910468	.2035E+00
-1.000000	-1.000000	-.095703	-.747958	.1347E-02
1.175000	.800000	.288525	.992572	.6461E+00
-.737400	-.853800	-.952677	-.819383	.2021E+00
-1.000000	-1.000000	-.108809	-.747752	.1887E-02
1.540000	1.175000	.457325	1.373892	.6640E+00
-.544000	-.737400	-.882618	-.663304	.2139E+00
-1.000000	-1.000000	-.132740	-.747389	.2518E-02
1.785000	1.540000	.683173	1.690281	.6222E+00
-.303900	-.544000	-.718091	-.444215	.1776E+00
-1.000000	-1.000000	-.153543	-.743334	.1969E-02
1.885600	1.785000	.934141	1.874150	.6143E+00
0.000000	-.303900	-.322188	-.161626	.1727E+00
-1.500000	-1.500000	-.268347	-1.229655	.3684E-02
1.670000	1.732000	.921489	1.773614	.5910E+00
.229700	0.000000	.280799	.134912	.1448E+00
-1.500000	-1.500000	-.239065	-1.245329	.5490E-02
1.460000	1.670000	.702123	1.614691	.6180E+00
.465900	.229700	.670724	.386555	.1696E+00
-1.500000	-1.500000	-.194936	-1.245068	.3782E-02
1.140000	1.460000	.475316	1.329324	.6494E+00
.652000	.465900	.857948	.600627	.1996E+00
-1.500000	-1.500000	-.170981	-1.245783	.2596E-02
.800000	1.140000	.304683	.979004	.6374E+00
.768100	.652000	.936981	.753512	.1908E+00
-1.500000	-1.500000	-.159881	-1.250120	.1677E-02
.400000	.800000	.172638	.600034	.6584E+00
.842600	.768100	.971923	.846449	.2058E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
6	6	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250012
		.400000	0.000000	0.000000	.400000	.055250	.200010
		.921400	.942800	.866000	.842600	.986601	.893198
	7	-1.000000	-1.000000	-1.500000	-1.500000	-.074106	-1.248100
		0.000000	-.400000	-.400000	0.000000	-.251846	-.199835
		.942800	.800000	.800000	.866000	.964926	.852389
	8	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	-1.000000	-1.000000	-1.500000	-1.500000	-.105654	-1.225923
		-1.600000	-1.885600	-1.732000	-1.600000	-.687853	-1.707445
		.200000	0.000000	0.000000	.200000	.718119	.100626
	12	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		-1.885600	-1.785000	-1.670000	-1.732000	-.921489	-1.773614
		0.000000	-.303900	-.229700	0.000000	-.280799	-.134912
	13	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245329
		-1.785000	-1.540000	-1.460000	-1.670000	-.702123	-1.614691
		-.303900	-.544000	-.465900	-.229700	-.670724	-.386555
	14	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		-1.540000	-1.175000	-1.140000	-1.460000	-.475316	-1.329324
		-.544000	-.737400	-.652000	-.465900	-.857948	-.600627
	15	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		-1.175000	-.800000	-.800000	-1.140000	-.304683	-.979004
		-.737400	-.853800	-.768100	-.652000	-.936981	-.753512
	16	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		-.800000	-.400000	-.400000	-.800000	-.172638	-.600034
		-.853800	-.921400	-.842600	-.768100	-.971923	-.846449
	17	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250012
		-.400000	0.000000	0.000000	-.400000	-.055250	-.200010
		-.921400	-.942800	-.866000	-.842600	-.986601	-.893198

FOLDOUT FRAME

EST BODY

	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
00	-1.500000	-1.500000	-.153515	-1.250012	.4933E-03
00	0.000000	.400000	.055250	.200010	.6481E+00
00	.866000	.842600	.986601	.893198	.2027E+00
00	-1.500000	-1.500000	-.074106	-1.248100	.1853E-01
00	-.400000	0.000000	-.251846	-.199835	.6560E+00
00	.800000	.866000	.964926	.852389	.2073E+00
00	-1.500000	-1.500000	0.000000	-1.250000	.3553E-14
00	-.800000	-.400000	-.447214	-.600000	.6708E+00
00	.600000	.800000	.894427	.700000	.2236E+00
00	-1.500000	-1.500000	0.000000	-1.250000	.3553E-14
00	-1.200000	-.600000	-.447214	-1.000000	.6708E+00
00	.400000	.600000	.894427	.500000	.2236E+00
00	-1.500000	-1.500000	0.000000	-1.250000	.6661E-14
00	-1.600000	-1.200000	-.447214	-1.400000	.6708E+00
00	.200000	.400000	.894427	.300000	.2236E+00
00	-1.500000	-1.500000	-.105654	-1.225923	.2641E-01
00	-1.732000	-1.600000	-.687853	-1.707445	.6096E+00
00	0.000000	.200000	.718119	.100626	.1454E+00
00	-1.500000	-1.500000	-.268347	-1.229655	.3684E-02
00	-1.670000	-1.732000	-.921489	-1.773614	.5910E+00
00	-.229700	0.000000	-.280799	-.134912	.1448E+00
00	-1.500000	-1.500000	-.239065	-1.245329	.5490E-02
00	-1.460000	-1.670000	-.702123	-1.614691	.6180E+00
00	-.465900	-.229700	-.670724	-.386555	.1696E+00
00	-1.500000	-1.500000	-.194936	-1.245063	.3762E-02
00	-1.140000	-1.460000	-.475316	-1.329324	.6494E+00
00	-.652000	-.465900	-.857948	-.600627	.1996E+00
00	-1.500000	-1.500000	-.170981	-1.245783	.2596E-02
00	-.800000	-1.140000	-.304683	-.979004	.6374E+00
00	-.768100	-.652000	-.936981	-.753512	.1908E+00
00	-1.500000	-1.500000	-.159881	-1.250120	.1677E-02
00	-.400000	-.800000	-.172638	-.600034	.6584E+00
00	-.842600	-.768100	-.971923	-.846449	.2058E+00
00	-1.500000	-1.500000	-.153515	-1.250012	.4933E-03
00	0.000000	-.400000	-.055250	-.200010	.6481E+00
00	-.866000	-.842600	-.986601	-.893198	.2027E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
6	18	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250012
		0.000000	.400000	.400000	0.000000	.055250	.200010
		-.942800	-.921400	-.842600	-.866000	-.986601	-.893198
	19	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		.400000	.800000	.800000	.400000	.172638	.600034
		-.921400	-.853800	-.768100	-.842600	-.971923	-.846449
	20	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		.800000	1.175000	1.140000	.800000	.304683	.979004
		-.853800	-.737400	-.652000	-.768100	-.936981	-.753512
	21	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		1.175000	1.540000	1.460000	1.140000	.475316	1.329324
		-.737400	-.544000	-.465900	-.652000	-.857948	-.600627
	22	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245329
		1.540000	1.785000	1.670000	1.460000	.702123	1.614691
		-.544000	-.303900	-.229700	-.465900	-.670724	-.386555
	23	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		1.785000	1.885600	1.732000	1.670000	.921489	1.773614
		-.303900	0.000000	0.000000	-.229700	-.280799	-.134912
7	1	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.699678
		1.732000	1.670000	1.465000	1.490700	.885202	1.611865
		0.000000	.229700	.137800	0.000000	.211244	.096576
	2	-1.[illegible]0000	-1.500000	-2.000000	-2.000000	-.372374	-1.733772
		1.[illegible]000	1.460000	1.322000	1.465000	.725701	1.484752
		.229700	.465900	.344400	.137800	.578529	.297994
	3	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.738932
		1.460000	1.140000	1.072000	1.322000	.507279	1.250730
		.465900	.652000	.517900	.344400	.804085	.497910
	4	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.738266
		1.140000	.800000	.800000	1.072000	.335023	.954054
		.652000	.768100	.628900	.517900	.902837	.644837
	5	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.750276
		.800000	.400000	.400000	.800000	.193980	.600104
		.768100	.842600	.718000	.628900	.948555	.739306
	6	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.750025
		.400000	0.000000	0.000000	.400000	.061556	.200030
		.842600	.866000	.745400	.718000	.969388	.792992

TEST BODY

	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
0000	-1.500000	-1.500000	-.153515	-1.250012	.4933E-03
0000	.400000	0.000000	.055250	.200010	.6481E+00
1400	-.842600	-.866000	-.986601	-.893198	.2027E+00
0000	-1.500000	-1.500000	-.159881	-1.250120	.1677E-02
0000	.800000	.400000	.172638	.600034	.6584E+00
3800	-.768100	-.842600	-.971923	-.846449	.2058E+00
0000	-1.500000	-1.500000	-.170981	-1.245783	.2596E-02
5000	1.140000	.800000	.304683	.979004	.6374E+00
7400	-.652000	-.768100	-.936981	-.753512	.1908E+00
0000	-1.500000	-1.500000	-.194936	-1.245068	.3782E-02
0000	1.460000	1.140000	.475316	1.329324	.6494E+00
4000	-.465900	-.652000	-.857948	-.600627	.1996E+00
000	-1.500000	-1.500000	-.239065	-1.245329	.5490E-02
5000	1.670000	1.460000	.702123	1.614691	.6180E+00
3900	-.229700	-.465900	-.670724	-.386555	.1696E+00
000	-1.500000	-1.500000	-.268347	-1.229655	.3684E-02
5600	1.732000	1.670000	.921489	1.773614	.5910E+00
000	0.000000	-.229700	-.280799	-.134912	.1448E+00
000	-2.000000	-2.000000	-.414479	-1.699678	.3180E-02
000	1.465000	1.490700	.885202	1.611865	.5833E+00
9700	.137800	0.000000	.211244	.096576	.1038E+00
000	-2.000000	-2.000000	-.372374	-1.733772	.7874E-02
000	1.322000	1.465000	.725701	1.484752	.6199E+00
900	.344400	.137800	.578529	.297994	.1525E+00
000	-2.000000	-2.000000	-.310024	-1.738932	.6345E-02
000	1.072000	1.322000	.507279	1.250730	.6350E+00
800	.517900	.344400	.804085	.497910	.1772E+00
000	-2.000000	-2.000000	-.269527	-1.738266	.4544E-02
000	.800000	1.072000	.335023	.954054	.6218E+00
100	.628900	.517900	.902837	.644837	.1695E+00
00	-2.000000	-2.000000	-.250229	-1.750276	.3462E-02
000	.400000	.800000	.193980	.600104	.6750E+00
600	.718000	.628900	.948555	.739306	.2108E+00
00	-2.000000	-2.000000	-.237694	-1.750025	.9694E-03
000	0.000000	.400000	.061556	.200030	.6572E+00
00	.745400	.718000	.969388	.792992	.2063E+00

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
7	7	-1.500000	-1.500000	-2.000000	-2.000000	-.197278	-1.7495
		0.000000	-.400000	-.400000	0.000000	-.113683	-.1997
		.866000	.800000	.718000	.745400	.973734	.7824
	8	-1.500000	-1.500000	-2.000000	-2.000000	-.075980	-1.7473
		-.400000	-.800000	-.800000	-.400000	-.368319	-.59985
		.800000	.600000	.600000	.718000	.926589	.67977
	9	-1.500000	-1.500000	-2.000000	-2.000000	0.000000	-1.75000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.00000
		.600000	.400000	.400000	.600000	.894427	.50000
	10	-1.500000	-1.500000	-2.000000	-2.000000	-.050829	-1.72040
		-1.200000	-1.600000	-1.400000	-1.200000	-.496741	-1.35282
		.400000	.200000	.256000	.400000	.866409	.31411
	11	-1.500000	-1.500000	-2.000000	-2.000000	-.348626	-1.76253
		-1.600000	-1.732000	-1.490700	-1.400000	-.842191	-1.55051
		.200000	0.000000	0.000000	.256000	.411307	.11394
	12	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.69967
		-1.732000	-1.670000	-1.465000	-1.490700	-.885202	-1.61186
		0.000000	-.229700	-.137800	0.000000	-.211244	-.09657
	13	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.73377
		-1.670000	-1.460000	-1.322000	-1.465000	-.725701	-1.48475
		-.229700	-.465900	-.344400	-.137800	-.578529	-.29799
	14	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.73893
		-1.460000	-1.140000	-1.072000	-1.322000	-.507279	-1.25073
		-.465900	-.652000	-.517900	-.344400	-.804085	-.49791
	15	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.73826
		-1.140000	-.800000	-.800000	-1.072000	-.335023	-.95405
		-.652000	-.768100	-.628900	-.517900	-.902837	-.64483
	16	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.75027
		-.800000	-.400000	-.400000	-.800000	-.193980	-.60010
		-.768100	-.842600	-.718000	-.628900	-.948555	-.73930
	17	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.75002
		-.400000	0.000000	0.000000	-.400000	-.061556	-.20003
		-.842600	-.866000	-.745400	-.718000	-.969388	-.79299
	18	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.75002
		0.000000	.400000	.400000	0.000000	.061556	.20003
		-.866000	-.842600	-.718000	-.745400	-.969388	-.79299

FOLDOUT FRAME

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
00000	-2.000000	-.197278	-1.749550	.9397E-02
00000	0.000000	-.113683	-.199759	.6572E+00
18000	.745400	.973734	.782469	.2054E+00
00000	-2.000000	-.075980	-1.747311	.1900E-01
00000	-.400000	-.368319	-.599857	.6708E+00
00000	.718000	.926589	.679777	.2158E+00
00000	-2.000000	0.000000	-1.750000	.3553E-14
00000	-.800000	-.447214	-1.000000	.6708E+00
00000	.600000	.894427	.500000	.2236E+00
00000	-2.000000	-.050829	-1.720409	.1271E-01
00000	-1.200000	-.496741	-1.352829	.6708E+00
56000	.400000	.866409	.314114	.1731E+00
00000	-2.000000	-.348626	-1.762537	.1445E-01
90700	-1.400000	-.842191	-1.550513	.6525E+00
00000	.256000	.411307	.113943	.1354E+00
00000	-2.000000	-.414479	-1.699678	.3180E-02
65000	-1.490700	-.885202	-1.611865	.5033E+00
37800	0.000000	-.211244	-.096576	.1038E+00
00000	-2.000000	-.372374	-1.733772	.7874E-02
22000	-1.465000	-.725701	-1.464752	.6199E+00
44400	-.137800	-.578529	-.297994	.1525E+00
00000	-2.000000	-.310024	-1.738932	.6345E-02
72000	-1.322000	-.507279	-1.250730	.6350E+00
17900	-.344400	-.804085	-.497910	.1772E+00
0000	-2.000000	-.269527	-1.738266	.4544E-02
0000	-1.072000	-.335023	-.954054	.6218E+00
8900	-.517900	-.902837	-.644837	.1695E+00
0000	-2.000000	-.250229	-1.750276	.3462E-02
0000	-.800000	-.193980	-.600104	.6750E+00
8000	-.628900	-.948555	-.739306	.2108E+00
0000	-2.000000	-.237694	-1.750025	.9694E-03
0000	-.400000	-.061556	-.200030	.6572E+00
5400	-.718000	-.969388	-.792992	.2063E+00
0000	-2.000000	-.237694	-1.750025	.9694E-03
0000	0.000000	.061556	.200030	.6572E+00
8000	-.745400	-.969388	-.792992	.2063E+00

FOLDOUT FRAME 2

PROGRAM PBOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NP
7	19	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.75
		.400000	.800000	.800000	.400000	.193980	.60
		-.842600	-.768100	-.628900	-.718000	-.948555	-.739
	20	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.73
		.800000	1.140000	1.072000	.800000	.335023	.95
		-.768100	-.652000	-.517900	-.628900	-.902837	-.644
	21	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.738
		1.140000	1.460000	1.322000	1.072000	.507279	1.250
		-.652000	-.465900	-.344400	-.517900	-.804085	-.497
	22	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.733
		1.460000	1.670000	1.465000	1.322000	.725701	1.484
		-.465900	-.229700	-.137800	-.344400	-.578529	-.297
	23	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.699
		1.670000	1.732000	1.490700	1.465000	.885202	1.611
		-.229700	0.000000	0.000000	-.137800	-.211244	-.036

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N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NP
8	1	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218
		1.490700	1.322000	1.000000	1.055000	.747834	1.240
		0.000000	.344400	.235700	0.000000	.288382	.149
	2	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214
		1.322000	.800000	.800000	1.000000	.463200	.990
		.344400	.628900	.381500	.235700	.777203	.411
	3	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.2509
		.800000	.400000	.400000	.800000	.246251	.6003
		.628900	.718000	.515300	.381500	.883807	.5603
	4	-2.000000	-2.000000	-2.500000	-2.500000	-.366809	-2.2500
		.400000	0.000000	0.000000	.400000	.075569	.2001
		.718000	.745700	.552800	.515300	.927222	.6329
	5	-2.000000	-2.000000	-2.500000	-2.500000	-.366809	-2.2500
		0.000000	-.400000	-.400000	0.000000	-.075569	-.2001
		.745700	.718000	.515300	.552800	.927222	.6329
	6	-2.000000	-2.000000	-2.500000	-2.500000	-.372805	-2.2503
		-.400000	-.800000	-.800000	-.400000	-.278586	-.6001
		.718000	.600000	.381500	.515300	.885102	.5534

FOLDOUT FRA

TEST BODY

X	X	X	NX	NPX	D
Y	Y	Y	NY	NPY	T
Z	Z	Z	NZ	NPZ	A
.500000	-2.000000	-2.000000	-.250229	-1.750276	.3462E-02
.800000	.800000	.400000	.193980	.600104	.6750E+00
.768100	-.628900	-.718000	-.948555	-.739306	.2108E+00
.500000	-2.000000	-2.000000	-.269527	-1.738266	.4544E-02
.140000	1.072000	.800000	.335023	.954054	.6218E+00
.652000	-.517900	-.628900	-.902837	-.644837	.1695E+00
.500000	-2.000000	-2.000000	-.310024	-1.738932	.6345E-02
.460000	1.322000	1.072000	.507279	1.250730	.6350E+00
.465900	-.344400	-.517900	-.804085	-.497910	.1772E+00
.500000	-2.000000	-2.000000	-.372374	-1.733772	.7874E-02
.670000	1.465000	1.322000	.725701	1.484752	.6199E+00
.229700	-.137800	-.344400	-.578529	-.297994	.1525E+00
.500000	-2.000000	-2.000000	-.414479	-1.699678	.3180E-02
.732000	1.490700	1.465000	.885202	1.611865	.5833E+00
.000000	0.000000	-.137800	-.211244	-.096576	.1038E+00
****		************		************	
.000000	-2.500000	-2.500000	-.597981	-2.218024	.1342E-01
.322000	1.000000	1.055000	.747834	1.240723	.7391E+00
.344400	.235700	0.000000	.268382	.149617	.1939E+00
.000000	-2.500000	-2.500000	-.425912	-2.214445	.1034E-01
.800000	.800000	1.000000	.463200	.990269	.7238E+00
.628900	.381500	.235700	.777203	.411287	.2322E+00
.000000	-2.500000	-2.500000	-.397801	-2.250969	.9877E-02
400000	.400000	.800000	.246251	.600392	.7233E+00
718000	.515300	.381500	.883807	.560379	.2263E+00
000000	-2.500000	-2.500000	-.366809	-2.250072	.2272E-02
000000	0.000000	.400000	.075569	.200101	.6805E+00
745700	.552800	.515300	.927222	.632913	.2157E+00
000000	-2.500000	-2.500000	-.366809	-2.250072	.2272E-02
400000	-.400000	0.000000	-.075569	-.200101	.6805E+00
718000	.515300	.552800	.927222	.632913	.2157E+00
000000	-2.500000	-2.500000	-.372805	-2.250383	.3496E-02
800000	-.800000	-.400000	-.278586	-.600126	.7233E+00
600000	.381500	.515300	.885102	.553499	.2260E+00

FOLDOUT FRAME 2

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ	
8	7	-2.000000	-2.000000	-2.500000	-2.500000	-.396212	-2.218355	
		-.800000	-1.200000	-1.000000	-.800000	-.458473	-.956945	
		.600000	.400000	.235700	.381500	.795499	.416059	
	8	-2.000000	-2.000000	-2.500000	-2.500000	-.537231	-2.212088	
		-1.200000	-1.490700	-1.055000	-1.000000	-.740960	-1.209729	
		.400000	0.000000	0.000000	.235700	.402941	.166619	
	9	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218024	
		-1.490700	-1.322000	-1.000000	-1.055000	-.747834	-1.240723	
		0.000000	-.344400	-.235700	0.000000	-.288382	-.149617	
	10	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214445	
		-1.322000	-.800000	-.800000	-1.000000	-.463200	-.990269	
		-.344400	-.628900	-.381500	-.235700	-.777203	-.411287	
	11	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.250969	
		-.800000	-.400000	-.400000	-.800000	-.246251	-.600392	
		-.628900	-.718000	-.515300	-.381500	-.883607	-.560379	
	12	-2.000000	-2.000000	-2.500000	-2.500000	-.366578	-2.250074	
		-.400000	0.000000	0.000000	-.400000	-.075231	-.200104	
		-.718000	-.745400	-.552800	-.515300	-.927341	-.632837	
	13	-2.000000	-2.000000	-2.500000	-2.500000	-.366578	-2.250074	
		0.000000	.400000	.400000	0.000000	.075231	.200104	
		-.745400	-.718000	-.515300	-.552800	-.927341	-.632837	
	14	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.250969	
		.400000	.800000	.800000	.400000	.246251	.600392	
		-.718000	-.628900	-.381500	-.515300	-.883807	-.560379	
	15	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214445	
		.800000	1.322000	1.000000	.800000	.463200	.990269	
		-.628900	-.344400	-.235700	-.381500	-.777203	-.411287	
	16	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218024	
		1.322000	1.490700	1.055000	1.000000	.747834	1.240723	
		-.344400	0.000000	0.000000	-.235700	-.288382	-.149617	
		***********			***********			*******
9	1	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.626833	0.
		1.055000	.800000	0.000000	0.000000	.411733	.687692	
		0.000000	.381500	0.000000	0.000000	.275208	.149145	

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
00000	-2.500000	-.396212	-2.218355	.1214E-01
00000	-.800000	-.458473	-.956945	.6502E+00
35700	.381500	.795499	.416059	.1686E+00
00000	-2.500000	-.537231	-2.212088	.2711E-01
55000	-1.000000	-.740960	-1.209729	.7391E+00
00000	.235700	.402941	.166619	.2145E+00
00000	-2.500000	-.597981	-2.218024	.1342E-01
00000	-1.055000	-.747834	-1.240723	.7391E+00
35700	0.000000	-.288382	-.149617	.1939E+00
00000	-2.500000	-.425912	-2.214445	.1034E-01
00000	-1.000000	-.463200	-.990269	.7238E+00
81500	-.235700	-.777203	-.411287	.2322E+00
00000	-2.500000	-.397801	-2.250969	.9877E-02
00000	-.800000	-.246251	-.600392	.7233E+00
15300	-.381500	-.883807	-.560379	.2263E+00
00000	-2.500000	-.366578	-2.250074	.2342E-02
00000	-.400000	-.075231	-.200104	.6804E+00
52800	-.515300	-.927341	-.632837	.2157E+00
00000	-2.500000	-.366578	-2.250074	.2342E-02
00000	0.000000	.075231	.200104	.6804E+00
15300	-.552800	-.927341	-.632837	.2157E+00
00000	-2.500000	-.397801	-2.250969	.9877E-02
00000	.400000	.246251	.600392	.7233E+00
81500	-.515300	-.883807	-.560379	.2263E+00
00000	-2.500000	-.425912	-2.214445	.1034E-01
00000	.800000	.463200	.990269	.7238E+00
35700	-.381500	-.777203	-.411287	.2322E+00
0000	-2.500000	-.597981	-2.218024	.1342E-01
5000	1.000000	.747834	1.240723	.7391E+00
0000	-.235700	-.288382	-.149617	.1939E+00
	************		************	
0000	-3.000000	-.868756	-2.626833	0.
0000	0.000000	.411733	.687692	.1167E+01
0000	0.000000	.275208	.149145	.2316E+00

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
9	2	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.629
		.800000	.400000	0.000000	0.000000	.200002	.434
		.381500	.515300	0.000000	0.000000	.597912	.336
	3	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		.400000	0.000000	0.000000	0.000000	.062764	.141
		.515300	.552800	0.000000	0.000000	.669478	.389
	4	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		0.000000	-.400000	0.000000	0.000000	-.062764	-.141
		.552800	.515300	0.000000	0.000000	.669478	.389
	5	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.629
		-.400000	-.800000	0.000000	0.000000	-.200002	-.434
		.515300	.381500	0.000000	0.000000	.597912	.336
	6	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.626
		-.800000	-1.055000	0.000000	0.000000	-.411733	-.687
		.381500	0.000000	0.000000	0.000000	.275208	.149
	7	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.626
		-1.055000	-.800000	0.000000	0.000000	-.411733	-.687
		0.000000	-.381500	0.000000	0.000000	-.275208	-.149
	8	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.629
		-.800000	-.400000	0.000000	0.000000	-.200002	-.434
		-.381500	-.515300	0.000000	0.000000	-.597912	-.336
	9	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		-.400000	0.000000	0.000000	0.000000	-.062764	-.141
		-.515300	-.552800	0.000000	0.000000	-.669478	-.389
	10	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.63
		0.000000	.400000	0.000000	0.000000	.062764	.14
		-.552800	-.515300	0.000000	0.000000	-.669478	-.38
	11	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.62
		.400000	.800000	0.000000	0.000000	.200002	.43
		-.515300	-.381500	0.000000	0.000000	-.597912	-.33
	12	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.62
		.800000	1.055000	0.000000	0.000000	.411733	.68
		-.381500	0.000000	0.000000	0.000000	-.275208	-.14

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189 BASIC ELEMENTS WERE INPUT

FOLDOUT FRA

X Y Z	NX NY NZ	NPX NPY NPZ	D T A
.000000 .000000 .000000	-.776209 .200002 .597912	-2.629150 .434170 .336208	.1332E-14 .1018E+01 .1672E+00
.000000 .000000 .000000	-.740175 .062764 .669478	-2.635472 .141262 .389779	.2220E-15 .8219E+00 .1494E+00
.000000 .000000 .000000	-.740175 -.062764 .669478	-2.635472 -.141262 .389779	.3053E-15 .8219E+00 .1494E+00
.000000 .000000 .000000	-.776209 -.200002 .597912	-2.629150 -.434170 .336208	.1110E-14 .1018E+01 .1672E+00
.000000 .000000 .000000	-.868756 -.411733 .275208	-2.626833 -.687692 .149145	.8882E-15 .1167E+01 .2316E+00
.000000 .000000 .000000	-.868756 -.411733 -.275208	-2.626833 -.687692 -.149145	0. .1167E+01 .2316E+00
.000000 .000000 .000000	-.776209 -.200002 -.597912	-2.629150 -.434170 -.336208	.1332E-14 .1018E+01 .1672E+00
.000000 .000000 .000000	-.740175 -.062764 -.669478	-2.635472 -.141262 -.389779	.2220E-15 .8219E+00 .1494E+00
.000000 .000000 .000000	-.740175 .062764 -.669478	-2.635472 .141262 -.389779	.3053E-15 .8219E+00 .1494E+00
.000000 .000000 .000000	-.776209 .200002 -.597912	-2.629150 .434170 -.336208	.1110E-14 .1018E+01 .1672E+00
.000000 .000000 .000000	-.868756 .411733 -.275208	-2.626833 .687692 -.149145	.8882E-15 .1167E+01 .2316E+00

************ ************

FOLDOUT FRAME 2

CRT PLOTS

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MINIMJM AND MAXIMUM COORDINATES IN THE   SCALED,   TRANSLATED,   RCTATED SYSTEM -
  X AXIS=   -3.00000E+00    2.00000E+00
  Y AXIS=   -2.00000E+00    2.00000E+00
  Z AXIS=   -1.00000E+00    1.00000E+00

COORDINATE TRANSLATIONS USED TO CENTER THE PLCTS - DELX, DELY, DELZ -
   AFTER SCALING, TRANSLATING, ROTATING -    5.00000E-01    0.            0.

VIEW OF BODY LOOKING DOWN THE    -Y  AXIS TOWARD THE ORIGIN
45-DEGREE VIEW FROM THE  +X  -Y  +Z SIDE
45-DEGREE VIEW FROM THE  +X  -Y  -Z SIDE
45-DEGREE VIEW FROM THE  -X  -Y  +Z SIDE
45-DEGREE VIEW FROM THE  -X  -Y  -Z SIDE
VIEW OF BODY LOOKING DOWN THE    -Z  AXIS TOWARD THE ORIGIN
45-DEGREE VIEW FROM THE  -X  +Y  -Z SIDE
45-DEGREE VIEW FROM THE  +X  +Y  -Z SIDE
VIEW OF BODY LOOKING DOWN THE    -X  AXIS TOWARD THE ORIGIN
45-DEGREE VIEW FROM THE  -X  +Y  +Z SIDE
VIEW OF BODY LOOKING DOWN THE    +X  AXIS TOWARD THE ORIGIN
VIEW OF BODY LOOKING DOWN THE    +Y  AXIS TOWARD THE ORIGIN
VIEW OF BODY LOOKING DOWN THE    +Z  AXIS TOWARD THE ORIGIN
45-DEGREE VIEW FROM THE  +X  +Y  +Z SIDE
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BOXC

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PROGRAM BOXC                  ATMOSPHERIC SCIENCE ASSOCIATES
                                 BEDFORD, MASSACHUSETTS                    PAGE    1
 BODY ID.  TEST
                            TEST BODY

          INPUT PARAMETERS-

            IFLAG= 0      LIST= 0      ISIG=  0      IPRS= 0       MPR= 0

            NCODE= 0      NNON= 0      NOFF=  0     KMACH= 0     KTP14= 1

          NUMBER OF LEAKY QUADRALATERALS=   0   FRACTION OF FREE-STREAM VELOCITY LEAKED= 0.

         P A R A M E T R I C   I N F O R M A T I O N

                                 GENERATED UNIFORM FLOWS

                                        X-FLOW

         NO SYMMETRY SPECIFIED
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PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
1	1	2.000000	2.000000	1.500000	1.500000	.958086	1.59139
		0.000000	0.000000	1.670000	1.732000	.276584	1.38979
		0.000000	0.000000	.229700	0.000000	.074655	.09489
	2	2.000000	2.000000	1.500000	1.500000	.941794	1.59834
		0.000000	0.000000	1.460000	1.670000	.251249	1.25402
		0.000000	0.000000	.465900	.229700	.223380	.28292
	3	2.000000	2.000000	1.500000	1.500000	.915363	1.60511
		0.000000	0.000000	1.140000	1.460000	.202414	1.01953
		0.000000	0.000000	.652000	.465900	.348052	.44561
	4	2.000000	2.000000	1.500000	1.500000	.891771	1.60927
		0.000000	0.000000	.800000	1.140000	.146221	.75032
		0.000000	0.000000	.768100	.652000	.428210	.55749
	5	2.000000	2.000000	1.500000	1.500000	.874522	1.62026
		0.000000	0.000000	.400000	.800000	.088802	.44790
		0.000000	0.000000	.842600	.768100	.476787	.61308
	6	2.000000	2.000000	1.500000	1.500000	.865649	1.62481
		0.000000	0.000000	0.000000	.400000	.029238	.14708
		0.000000	0.000000	.866000	.842600	.499797	.64122
	7	2.000000	2.000000	1.500000	1.500000	.863087	1.62604
		0.000000	0.000000	-.400000	0.000000	-.082222	-.14831
		0.000000	0.000000	.800000	.866000	.498318	.62322
	8	2.000000	2.000000	1.500000	1.500000	.872872	1.62723
		0.000000	0.000000	-.800000	-.400000	-.218218	-.44284
		0.000000	0.000000	.600000	.800000	.436436	.52411
	9	2.000000	2.000000	1.500000	1.500000	.872872	1.61882
		0.000000	0.000000	-1.200000	-.800000	-.218218	-.75116
		0.000000	0.000000	.400000	.600000	.436436	.38677
	10	2.000000	2.000000	1.500000	1.500000	.872872	1.60714
		0.000000	0.000000	-1.600000	-1.200000	-.218218	-1.08597
		0.000000	0.000000	.200000	.400000	.436436	.24271
	11	2.000000	2.000000	1.500000	1.500000	.945063	1.58979
		0.000000	0.000000	-1.732000	-1.600000	-.272824	-1.36520
		0.000000	0.000000	0.000000	.200000	.180164	.08446
	12	2.000000	2.000000	1.500000	1.500000	.958086	1.59139
		0.000000	0.000000	-1.670000	-1.732000	-.276584	-1.38979
		0.000000	0.000000	-.229700	0.000000	-.074655	-.09489

FOLDOUT FRA

TMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS PAGE 2

T BODY

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
1.500000	1.500000	.958086	1.591395	0.
1.670000	1.732000	.276584	1.389794	.1803E+01
.229700	0.000000	.074655	.094899	.2076E+00
1.500000	1.500000	.941794	1.598349	.8882E-15
1.460000	1.670000	.251249	1.254020	.1758E+01
.465900	.229700	.223380	.282927	.2350E+00
1.500000	1.500000	.915363	1.605113	.2665E-14
1.140000	1.460000	.202414	1.019539	.1612E+01
.652000	.465900	.348052	.445612	.2299E+00
1.500000	1.500000	.891771	1.609275	.2665E-14
.800000	1.140000	.146221	.750320	.1405E+01
.768100	.652000	.428210	.557494	.1985E+00
1.500000	1.500000	.874522	1.620269	.9992E-15
.400000	.800000	.088802	.447901	.1217E+01
.842600	.768100	.476787	.613081	.2097E+00
1.500000	1.500000	.865649	1.624811	.2220E-15
0.000000	.400000	.029238	.147089	.1058E+01
.866000	.842600	.499797	.641222	.2001E+00
1.500000	1.500000	.863087	1.626041	.2220E-15
-.400000	0.000000	-.082222	-.148316	.1025E+01
.800000	.866000	.498318	.623224	.2007E+00
1.500000	1.500000	.872872	1.627233	.8882E-15
-.800000	-.400000	-.218218	-.442846	.1118E+01
.600000	.800000	.436436	.524111	.2291E+00
1.500000	1.500000	.872872	1.618821	.1776E-14
-1.200000	-.800000	-.218218	-.751160	.1360E+01
.400000	.600000	.436436	.386778	.2291E+00
1.500000	1.500000	.872872	1.607148	.8882E-15
-1.600000	-1.200000	-.218218	-1.085976	.1688E+01
.200000	.400000	.436436	.242716	.2291E+00
1.500000	1.500000	.945063	1.589795	0.
-1.732000	-1.600000	-.272824	-1.365206	.1803E+01
0.000000	.200000	.180164	.084464	.1833E+00
1.500000	1.500000	.958086	1.591395	0.
-1.670000	-1.732000	-.276584	-1.389794	.1803E+01
-.229700	0.000000	-.074655	-.094899	.2076E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
1	13	2.000000	2.000000	1.500000	1.500000	.941794	1.598
		0.000000	0.000000	-1.460000	-1.670000	-.251249	-1.25
		0.000000	0.000000	-.465900	-.229700	-.223380	-.282
	14	2.000000	2.000000	1.500000	1.500000	.915363	1.605
		0.000000	0.000000	-1.140000	-1.460000	-.202414	-1.019
		0.000000	0.000000	-.652000	-.465900	-.348052	-.445
	15	2.000000	2.000000	1.500000	1.500000	.891771	1.609
		0.000000	0.000000	-.800000	-1.140000	-.146221	-.750
		0.000000	0.000000	-.768100	-.652000	-.428210	-.557
	16	2.000000	2.000000	1.500000	1.500000	.874522	1.620
		0.000000	0.000000	-.400000	-.800000	-.088802	-.447
		0.000000	0.000000	-.842600	-.768100	-.476787	-.613
	17	2.000000	2.000000	1.500000	1.500000	.865649	1.624
		0.000000	0.000000	0.000000	-.400000	-.029238	-.147
		0.000000	0.000000	-.866000	-.842600	-.499797	-.641
	18	2.000000	2.000000	1.500000	1.500000	.865649	1.624
		0.000000	0.000000	.400000	0.000000	.029238	.147
		0.000000	0.000000	-.842600	-.866000	-.499797	-.641
	19	2.000000	2.000000	1.500000	1.500000	.874522	1.620
		0.000000	0.000000	.800000	.400000	.088802	.4479
		0.000000	0.000000	-.768100	-.842600	-.476787	-.6130
	20	2.000000	2.000000	1.500000	1.500000	.891771	1.6092
		0.000000	0.000000	1.140000	.800000	.146221	.7503
		0.000000	0.000000	-.652000	-.768100	-.428210	-.5574
	21	2.000000	2.000000	1.500000	1.500000	.915363	1.6051
		0.000000	0.000000	1.460000	1.140000	.202414	1.0195
		0.000000	0.000000	-.465900	-.652000	-.348052	-.4456
	22	2.000000	2.000000	1.500000	1.500000	.941794	1.5983
		0.000000	0.000000	1.670000	1.460000	.251249	1.2540
		0.000000	0.000000	-.229700	-.465900	-.223380	-.2829
	23	2.000000	2.000000	1.500000	1.500000	.958086	1.5913
		0.000000	0.000000	1.732000	1.670000	.276584	1.3897
		0.000000	0.000000	0.000000	-.229700	-.074655	-.0948
2	1	1.500000	1.500000	1.000000	1.000000	.435365	1.2205
		1.732000	1.670000	1.870000	2.000000	.855263	1.8317
		0.000000	.229700	.354600	0.000000	.281036	.1499

FOLDOUT FRAME /

TEST BODY

X	X	X	NX	NPX	D
Y	Y	Y	NY	NPY	T
Z	Z	Z	NZ	NPZ	A
00000	1.500000	1.500000	.941794	1.598349	.8882E-15
00000	-1.460000	-1.670000	-.251249	-1.254020	.1758E+01
00000	-.465900	-.229700	-.223380	-.282927	.2350E+00
00000	1.500000	1.500000	.915363	1.605113	.2665E-14
00000	-1.140000	-1.460000	-.202414	-1.019539	.1612E+01
00000	-.652000	-.465900	-.348052	-.445612	.2299E+00
00000	1.500000	1.500000	.891771	1.609275	.2665E-14
00000	-.800000	-1.140000	-.146221	-.750320	.1405E+01
00000	-.768100	-.652000	-.428210	-.557494	.1985E+00
00000	1.500000	1.500000	.874522	1.620269	.9992E-15
00000	-.400000	-.800000	-.088802	-.447901	.1217E+01
00000	-.842600	-.768100	-.476787	-.613081	.2097E+00
00000	1.500000	1.500000	.865649	1.624811	.2220E-15
00000	0.000000	-.400000	-.029238	-.147089	.1058E+01
00000	-.866000	-.842600	-.499797	-.641222	.2001E+00
00000	1.500000	1.500000	.865649	1.624811	.2220E-15
0000	.400000	0.000000	.029238	.147089	.1058E+01
0000	-.842600	-.866000	-.499797	-.641222	.2001E+00
0000	1.500000	1.500000	.874522	1.620269	.9992E-15
0000	.800000	.400000	.088802	.447901	.1217E+01
0000	-.768100	-.842600	-.476787	-.613081	.2097E+00
0000	1.500000	1.500000	.891771	1.609275	.2665E-14
0000	1.140000	.800000	.146221	.750320	.1405E+01
0000	-.652000	-.768100	-.428210	-.557494	.1985E+00
0000	1.500000	1.500000	.915363	1.605113	.2665E-14
0000	1.460000	1.140000	.202414	1.019539	.1612E+01
0000	-.465900	-.652000	-.348052	-.445612	.2299E+00
000	1.500000	1.500000	.941794	1.598349	.8882E-15
000	1.670000	1.460000	.251249	1.254020	.1758E+01
000	-.229700	-.465900	-.223380	-.282927	.2350E+00
000	1.500000	1.500000	.958086	1.591395	0.
000	1.732000	1.670000	.276584	1.389794	.1803E+01
000	0.000000	-.229700	-.074655	-.094899	.2076E+00
000	1.000000	1.000000	.435365	1.220560	.5764E-02
000	1.870000	2.000000	.855263	1.831729	.6416E+00
700	.354600	0.000000	.281038	.149900	.1708E+00

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
2	2	1.500000	1.500000	1.000000	1.000000	.390089	1.241719
		1.670000	1.460000	1.600000	1.870000	.652170	1.652830
		.229700	.465900	.600000	.354600	.650004	.414680
	3	1.500000	1.500000	1.000000	1.000000	.324553	1.241630
		1.460000	1.140000	1.200000	1.600000	.447006	1.351646
		.465900	.652000	.800000	.600000	.833577	.631851
	4	1.500000	1.500000	1.000000	1.000000	.288009	1.242990
		1.140000	.800000	.800000	1.200000	.287154	.985715
		.652000	.768100	.916500	.800000	.913561	.786135
	5	1.500000	1.500000	1.000000	1.000000	.270929	1.250160
		.800000	.400000	.400000	.800000	.163401	.600088
		.768100	.842600	.979800	.916500	.948629	.876683
	6	1.500000	1.500000	1.000000	1.000000	.261384	1.250017
		.400000	0.000000	0.000000	.400000	.052527	.200026
		.842600	.866000	1.000000	.979800	.963805	.922094
	7	1.500000	1.500000	1.000000	1.000000	.126140	1.246098
		0.000000	-.400000	-.400000	0.000000	-.312996	-.199566
		.866000	.800000	.800000	1.000000	.941341	.867167
	8	1.500000	1.500000	1.000000	1.000000	0.000000	1.250000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	1.500000	1.500000	1.000000	1.000000	0.000000	1.250000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	1.500000	1.500000	1.000000	1.000000	0.000000	1.250000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	1.500000	1.500000	1.000000	1.000000	.159008	1.216789
		-1.600000	-1.732000	-2.000000	-1.600000	-.593315	-1.739216
		.200000	0.000000	0.000000	.200000	.789109	.102018
	12	1.500000	1.500000	1.000000	1.000000	.435365	1.220560
		-1.732000	-1.670000	-1.870000	-2.000000	-.855263	-1.831729
		0.000000	-.229700	-.354600	0.000000	-.281038	-.149900
	13	1.500000	1.500000	1.000000	1.000000	.390089	1.241719
		-1.670000	-1.460000	-1.600000	-1.870000	-.652170	-1.652830
		-.229700	-.465900	-.600000	-.354600	-.650004	-.414680

FOLDOUT FRAME 1

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	C T A
.000000	1.000000	.390089	1.241719	.8288E-02
.600000	1.870000	.652170	1.652830	.6561E+00
.600000	.354600	.650004	.414680	.1846E+00
.000000	1.000000	.324553	1.241630	.6043E-02
.200000	1.600000	.447006	1.351646	.6814E+00
.800000	.600000	.833577	.631851	.2159E+00
.000000	1.000000	.288009	1.242990	.4216E-02
.800000	1.200000	.287154	.985715	.6600E+00
.916500	.800000	.913561	.786135	.2025E+00
1.000000	1.000000	.270929	1.250180	.2656E-02
.400000	.800000	.163401	.600088	.6744E+00
.979800	.916500	.948629	.876683	.2108E+00
1.000000	1.000000	.261384	1.250017	.7718E-03
0.000000	.400000	.052527	.200026	.6594E+00
1.000000	.979800	.963805	.922094	.2075E+00
1.000000	1.000000	.126140	1.246098	.3153E-01
-.400000	0.000000	-.312996	-.199566	.6708E+00
.600000	1.000000	.941341	.867167	.2125E+00
1.000000	1.000000	0.000000	1.250000	.3553E-14
-.800000	-.400000	-.447214	-.600000	.6708E+00
.600000	.800000	.894427	.700000	.2236E+00
1.000000	1.000000	0.000000	1.250000	.3553E-14
1.200000	-.800000	-.447214	-1.000000	.6708E+00
.400000	.600000	.894427	.500000	.2236E+00
1.000000	1.000000	0.000000	1.250000	.6661E-14
1.600000	-1.200000	-.447214	-1.400000	.6708E+00
.200000	.400000	.894427	.300000	.2236E+00
1.000000	1.000000	.159008	1.216789	.3975E-01
2.000000	-1.600000	-.593315	-1.739216	.6708E+00
0.000000	.200000	.789109	.102018	.1685E+00
1.000000	1.000000	.435365	1.220560	.5764E-02
1.870000	-2.000000	-.855263	-1.831729	.6416E+00
-.354600	0.000000	-.281038	-.149900	.1708E+00
1.000000	1.000000	.390089	1.241719	.8288E-02
1.600000	-1.870000	-.652170	-1.652830	.6561E+00
-.600000	-.354600	-.650004	-.414680	.1846E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
2	14	1.500000	1.500000	1.000000	1.000000	.324553	1.241630
		-1.460000	-1.140000	-1.200000	-1.600000	-.447006	-1.351646
		-.465900	-.652000	-.800000	-.600000	-.833577	-.631851
	15	1.500000	1.500000	1.000000	1.000000	.288009	1.242990
		-1.140000	-.800000	-.800000	-1.200000	-.287154	-.985715
		-.652000	-.768100	-.916500	-.800000	-.913561	-.786135
	16	1.500000	1.500000	1.000000	1.000000	.270929	1.250180
		-.800000	-.400000	-.400000	-.800000	-.163401	-.600088
		-.768100	-.842600	-.979800	-.916500	-.948629	-.876683
	17	1.500000	1.500000	1.000000	1.000000	.261384	1.250017
		-.400000	0.000000	0.000000	-.400000	-.052527	-.200026
		-.842600	-.866000	-1.000000	-.979800	-.963805	-.922094
	18	1.500000	1.500000	1.000000	1.000000	.261384	1.250017
		0.000000	.400000	.400000	0.000000	.052527	.200026
		-.866000	-.842600	-.979800	-1.000000	-.963805	-.922094
	19	1.500000	1.500000	1.000000	1.000000	.270929	1.250180
		.400000	.800000	.800000	.400000	.163401	.600088
		-.842600	-.768100	-.916500	-.979800	-.948629	-.876683
	20	1.500000	1.500000	1.000000	1.000000	.288009	1.242990
		.800000	1.140000	1.200000	.800000	.287154	.985715
		-.768100	-.652000	-.800000	-.916500	-.913561	-.786135
	21	1.500000	1.500000	1.000000	1.000000	.324553	1.241630
		1.140000	1.460000	1.600000	1.200000	.447006	1.351646
		-.652000	-.465900	-.600000	-.600000	-.833577	-.631851
	22	1.500000	1.500000	1.000000	1.000000	.390089	1.241719
		1.460000	1.670000	1.870000	1.600000	.652170	1.652830
		-.465900	-.229700	-.354600	-.600000	-.650034	-.414680
	23	1.500000	1.500000	1.000000	1.000000	.435365	1.220560
		1.670000	1.732000	2.000000	1.870000	.855263	1.831729
		-.229700	0.000000	0.000000	-.354600	-.281038	-.149960
3	1	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		2.000000	1.873000	1.870000	2.000000	.938693	1.935000
		0.000000	.354600	.354600	0.000000	.344208	.177300
	2	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.870000	1.600000	1.600000	1.870000	.672591	1.735000
		.354600	.600000	.600000	.354600	.740014	.477300

FOLDOUT FRAME 1

IATES
S

NX NY NZ	NPX NPY NPZ	D T A
.324553	1.241630	.6043E-02
-.447006	-1.351646	.6814E+00
-.833577	-.631851	.2159E+00
.288009	1.242990	.4216E-02
-.287154	-.985715	.6600E+00
-.913561	-.786135	.2025E+00
.270929	1.250180	.2656E-02
-.163401	-.600088	.6744E+00
-.948629	-.876683	.2108E+00
.261384	1.250017	.7710E-03
-.052527	-.200026	.6594E+00
-.963805	-.922094	.2075E+00
.261384	1.250017	.7710E-03
.052527	.200026	.6594E+00
-.963805	-.922094	.2075E+00
.270929	1.250180	.2656E-02
.163401	.600088	.6744E+00
-.948629	-.876683	.2108E+00
.288009	1.242990	.4216E-02
.287154	.985715	.6600E+00
-.913561	-.786135	.2025E+00
.324553	1.241630	.6043E-02
.447006	1.351646	.6814E+00
-.833577	-.631851	.2159E+00
.390089	1.241719	.8288E-02
.652170	1.652830	.6561E+00
-.650004	-.414680	.1846E+00
.435365	1.220560	.5764E-02
.855263	1.831729	.6416E+00
-.281038	-.149900	.1708E+00
0.000000	.500000	0.
.938893	1.935000	.1069E+01
.344208	.177300	.3777E+00
0.000000	.500000	.4885E-14
.672591	1.735000	.1064E+01
.740014	.477300	.3649E+00

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
3	3	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		1.600000	1.200000	1.200000	1.600000	.447214	1.40000
		.600000	.800000	.800000	.600000	.894427	.70000
	4	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		1.200000	.800000	.800000	1.200000	.279631	1.00000
		.800000	.916500	.916500	.800000	.960107	.85825
	5	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		.800000	.400000	.400000	.800000	.156305	.60000
		.916500	.979800	.979800	.916500	.987709	.94815
	6	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		.400000	0.000000	0.000000	.400000	.050436	.20000
		.979800	1.000000	1.000000	.979800	.998727	.98990
	7	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		0.000000	-.400000	-.400000	0.000000	-.447214	-.20000
		1.000000	.800000	.800000	1.000000	.894427	.90000
	8	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.60000
		.800000	.600000	.600000	.800000	.894427	.70000
	9	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.00000
		.600000	.400000	.400000	.600000	.894427	.50000
	10	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.40000
		.400000	.200000	.200000	.400000	.894427	.30000
	11	1.000000	1.000000	0.000000	0.000000	0.000000	.50000
		-1.600000	-2.000000	-2.000000	-1.600000	-.447214	-1.8000
		.200000	0.000000	0.000000	.200000	.894427	.1000
	12	1.000000	1.000000	0.000000	0.000000	0.000000	.5000
		-2.000000	-1.870000	-1.870000	-2.000000	-.938893	-1.9350
		0.000000	-.354600	-.354600	0.000000	-.344208	-.1773
	13	1.000000	1.000000	0.000000	0.000000	0.000000	.5000
		-1.870000	-1.600000	-1.600000	-1.870000	-.672591	-1.7350
		-.354600	-.600000	-.600000	-.354600	-.740014	-.4773
	14	1.000000	1.000000	0.000000	0.000000	0.000000	.5000
		-1.600000	-1.200000	-1.200000	-1.600000	-.447214	-1.4000
		-.600000	-.800000	-.800000	-.600000	-.894427	-.7000

FOLDOUT FRAME 1

TEST BODY

	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
0000	0.000000	0.000000	0.000000	.500000	.6661E-14
0000	1.200000	1.600000	.447214	1.400000	.1095E+01
0000	.800000	.600000	.894427	.700000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.2442E-14
0000	.800000	1.200000	.279631	1.000000	.1083E+01
6500	.916500	.800000	.960107	.858250	.4166E+00
0000	0.000000	0.000000	0.000000	.500000	.2442E-14
0000	.400000	.800000	.156305	.600000	.1079E+01
9800	.979800	.916500	.987709	.948150	.4050E+00
0000	0.000000	0.000000	0.000000	.500000	.5551E-16
0000	0.000000	.400000	.050436	.200000	.1077E+01
0000	1.000000	.979800	.998727	.989900	.4005E+00
0000	0.000000	0.000000	0.000000	.500000	.3109E-14
0000	-.400000	0.000000	-.447214	-.200000	.1095E+01
0000	.800000	1.000000	.894427	.900000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.3553E-14
0000	-.800000	-.400000	-.447214	-.600000	.1095E+01
0000	.600000	.800000	.894427	.700000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.3553E-14
0000	-1.200000	-.800000	-.447214	-1.000000	.1095E+01
0000	.400000	.600000	.894427	.500000	.4472E+00
0000	0.000000	0.000000	0.000000	.500000	.6661E-14
0000	-1.600000	-1.200000	-.447214	-1.400000	.1095E+01
0000	.200000	.400000	.894427	.300000	.4472E+00
000	0.000000	0.000000	0.000000	.500000	.4441E-15
0000	-2.000000	-1.600000	-.447214	-1.800000	.1095E+01
000	0.000000	.200000	.894427	.100000	.4472E+00
000	0.000000	0.000000	0.000000	.500000	0.
000	-1.870000	-2.000000	-.938893	-1.935000	.1069E+01
4600	-.354600	0.000000	-.344208	-.177300	.3777E+00
000	0.000000	0.000000	0.000000	.500000	.4885E-14
000	-1.600000	-1.870000	-.672591	-1.735000	.1064E+01
000	-.600000	-.354600	-.740014	-.477300	.3649E+00
000	0.000000	0.000000	0.000000	.500000	.6661E-14
000	-1.200000	-1.600000	-.447214	-1.400000	.1095E+01
00	-.800000	-.600000	-.894427	-.700000	.4472E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
3	15	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-1.200000	-.800000	-.800000	-1.200000	-.279631	-1.000000
		-.800000	-.916500	-.916500	-.800000	-.960107	-.858250
	16	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.800000	-.400000	-.400000	-.800000	-.156305	-.600000
		-.916500	-.979800	-.979800	-.916500	-.987709	-.948150
	17	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		-.400000	0.000000	0.000000	-.400000	-.050436	-.200000
		-.979800	-1.000000	-1.000000	-.979800	-.998727	-.989900
	18	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		0.000000	.400000	.400000	0.000000	.050436	.200000
		-1.000000	-.979800	-.979800	-1.000000	-.998727	-.989900
	19	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.400000	.800000	.800000	.400000	.156305	.600000
		-.979800	-.916500	-.916500	-.979800	-.987709	-.948150
	20	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		.800000	1.200000	1.200000	.800000	.279631	1.000000
		-.916500	-.800000	-.800000	-.916500	-.960107	-.858250
	21	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.200000	1.600000	1.600000	1.200000	.447214	1.400000
		-.800000	-.600000	-.600000	-.800000	-.894427	-.700000
	22	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.600000	1.870000	1.870000	1.600000	.672591	1.735000
		-.600000	-.354600	-.354600	-.600000	-.740014	-.477300
	23	1.000000	1.000000	0.000000	0.000000	0.000000	.500000
		1.870000	2.000000	2.000000	1.870000	.938893	1.935000
		-.354600	0.000000	0.000000	-.354600	-.344206	-.177300
4	1	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		2.000000	1.870000	1.850000	1.972000	.939127	1.923092
		0.000000	.354600	.341500	0.000000	.339980	.174052
	2	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		1.870000	1.600000	1.585000	1.850000	.675158	1.726269
		.354600	.600000	.586600	.341500	.736411	.470688
	3	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		1.600000	1.200000	1.195000	1.585000	.449471	1.395016
		.600000	.800000	.784400	.586600	.892614	.692774

FOLDOUT FRAME

NX / NY / NZ	NPX / NPY / NPZ	D / T / A
0.000000	.500000	.2442E-14
-.279631	-1.000000	.1083E+01
-.960107	-.858250	.4166E+00
0.000000	.500000	.2442E-14
-.156305	-.600000	.1079E+01
-.987709	-.948150	.4050E+00
0.000000	.500000	.5551E-16
-.050436	-.200000	.1077E+01
-.998727	-.989900	.4005E+00
0.000000	.500000	.3553E-14
.050436	.200000	.1077E+01
-.998727	-.989900	.4005E+00
0.000000	.500000	.2220E-14
.156305	.600000	.1079E+01
-.987709	-.948150	.4050E+00
0.000000	.500000	.3109E-14
.279631	1.000000	.1083E+01
-.960107	-.858250	.4166E+00
0.000000	.500000	.6661E-14
.447214	1.400000	.1095E+01
-.894427	-.700000	.4472E+00
0.000000	.500000	.6217E-14
.672591	1.735000	.1064E+01
-.740014	-.477300	.3649E+00
0.000000	.500000	.6217E-14
.938893	1.935000	.1069E+01
-.344206	-.177300	.3777E+00
-.049532	-.248068	.7648E-03
.939127	1.923092	.6238E+00
.339980	.174052	.1853E+00
-.043145	-.249477	.7887E-03
.675158	1.726269	.6205E+00
.736411	.470688	.1816E+00
-.034875	-.249169	.6327E-03
.449471	1.395016	.6693E+00
.892614	.692774	.2213E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

PA

BODY ID. TEST

TEST BCDY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
4	4	0.000000	0.000000	-.500000	-.500000	-.031043	-.2495
		1.200000	.800000	.800000	1.195000	.281449	.9987
		.800000	.916500	.901200	.784400	.959074	.8509
	5	0.000000	0.000000	-.500000	-.500000	-.029218	-.2500
		.800000	.400000	.400000	.800000	.157442	.6000
		.[illegible]16500	.979800	.965500	.901200	.967096	.9407
	6	0.000000	0.000000	-.500000	-.500000	-.028252	-.2500
		.400000	0.000000	0.000000	.400000	.050789	.2000
		.979800	1.000000	.986000	.965500	.998310	.9826
	7	0.000000	0.000000	-.500000	-.500000	-.012608	-.2499
		0.000000	-.400000	-.400000	0.000000	-.434526	-.1999
		1.000000	.800000	.800000	.986000	.900571	.896
	8	0.000000	0.000000	-.500000	-.500000	0.000000	-.2500
		-.400000	-.800000	-.800000	-.400000	-.447214	-.6000
		.800000	.600000	.600000	.800000	.894427	.7000
	9	0.000000	0.000000	-.500000	-.500000	0.000000	-.2500
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000
		.600000	.400000	.400000	.600000	.894427	.500
	10	0.000000	0.000000	-.500000	-.500000	0.000000	-.250
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400
		.400000	.200000	.200000	.400000	.894427	.300
	11	0.000000	0.000000	-.500000	-.500000	-.012880	-.247
		-1.600000	-2.000000	-1.972000	-1.600000	-.460010	-1.793
		.200000	0.000000	0.000000	.200000	.887820	.100
	12	0.000000	0.000000	-.500000	-.500000	-.049532	-.248
		-2.000000	-1.870000	-1.850000	-1.972000	-.939127	-1.923
		0.000000	-.354600	-.341500	0.000000	-.339980	-.174
	13	0.000000	0.000000	-.500000	-.500000	-.043145	-.249
		-1.870000	-1.600000	-1.585000	-1.850000	-.675158	-1.72
		-.354600	-.600000	-.586600	-.341500	-.736411	-.47
	14	0.000000	0.000000	-.500000	-.500000	-.034875	-.249
		-1.600000	-1.200000	-1.195000	-1.585000	-.449471	-1.39
		-.600000	-.800000	-.784400	-.586600	-.892614	-.69
	15	0.000000	0.000000	-.500000	-.500000	-.031043	-.24
		-1.200000	-.800000	-.800000	-1.195000	-.281449	-.99
		-.800000	-.916500	-.901200	-.784400	-.959074	-.85

FOLDOUT FRA

	X	NX	NPX	D
	Y	NY	NPY	T
	Z	NZ	NPZ	A
0000	-.500000	-.031043	-.249537	.4237E-03
0000	1.195000	.281449	.998756	.6507E+00
1200	.784400	.959074	.850538	.2072E+00
0000	-.500000	-.029218	-.250016	.2468E-03
0000	.800000	.157442	.600061	.6451E+00
5500	.901200	.967096	.940749	.2026E+00
0000	-.500000	-.028252	-.250002	.7487E-04
0000	.400000	.050789	.200000	.6412E+00
6000	.965500	.998310	.982825	.2003E+00
0000	-.500000	-.012606	-.249496	.3152E-02
0000	0.000000	-.434526	-.199997	.6708E+00
0000	.986000	.900571	.896509	.2221E+00
0000	-.500000	0.000000	-.250000	.3553E-14
0000	-.400000	-.447214	-.600000	.6708E+00
0000	.800000	.894427	.700000	.2236E+00
0000	-.500000	0.000000	-.250000	.3553E-14
0000	-.800000	-.447214	-1.000000	.6708E+00
0000	.600000	.894427	.500000	.2236E+00
0000	-.500000	0.000000	-.250000	.6661E-14
0000	-1.200000	-.447214	-1.400000	.6708E+00
0000	.400000	.894427	.300000	.2236E+00
0000	-.500000	-.012880	-.247831	.3220E-02
2000	-1.600000	-.460010	-1.793015	.6708E+00
0000	.200000	.887820	.100024	.2174E+00
0000	-.500000	-.049532	-.248068	.7648E-03
0000	-1.972000	-.939127	-1.923092	.6238E+00
1500	0.000000	-.339980	-.174052	.1853E+00
0000	-.500000	-.043145	-.249477	.7887E-03
5000	-1.850000	-.675158	-1.726269	.6205E+00
6600	-.341500	-.736411	-.470688	.1816E+00
0000	-.500000	-.034875	-.249169	.6327E-03
5000	-1.585000	-.449471	-1.395016	.6693E+00
4400	-.586600	-.892614	-.692774	.2213E+00
0000	-.500000	-.031043	-.249537	.4237E-03
0000	-1.195000	-.281449	-.998756	.6507E+00
1200	-.784400	-.959074	-.850538	.2072E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

PAGE

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
4	16	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		-.800000	-.400000	-.400000	-.800000	-.157442	-.600001
		-.916500	-.979800	-.965500	-.901200	-.987096	-.940749
	17	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		-.400000	0.000000	0.000000	-.400000	-.050789	-.200000
		-.979800	-1.000000	-.986000	-.965500	-.998310	-.982825
	18	0.000000	0.000000	-.500000	-.500000	-.028252	-.250002
		0.000000	.400000	.400000	0.000000	.050789	.200000
		-1.000000	-.979800	-.965500	-.986000	-.998310	-.982825
	19	0.000000	0.000000	-.500000	-.500000	-.029218	-.250016
		.400000	.800000	.800000	.400000	.157442	.600001
		-.979800	-.916500	-.901200	-.965500	-.987096	-.940749
	20	0.000000	0.000000	-.500000	-.500000	-.031043	-.249537
		.800000	1.200000	1.195000	.800000	.281449	.998756
		-.916500	-.800000	-.784400	-.901200	-.959074	-.850538
	21	0.000000	0.000000	-.500000	-.500000	-.034875	-.249169
		1.200000	1.600000	1.585000	1.195000	.449471	1.395016
		-.800000	-.600000	-.586600	-.784400	-.892614	-.692774
	22	0.000000	0.000000	-.500000	-.500000	-.043145	-.249477
		1.600000	1.870000	1.850000	1.585000	.675158	1.726269
		-.600000	-.354600	-.341500	-.586600	-.736411	-.470688
	23	0.000000	0.000000	-.500000	-.500000	-.049532	-.248068
		1.870000	2.000000	1.972000	1.850000	.939127	1.923092
		-.354600	0.000000	0.000000	-.341500	-.339980	-.174052
5	1	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		1.972000	1.850000	1.785000	1.685600	.934141	1.874150
		0.000000	.341500	.303900	0.000000	.322188	.161626
	2	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747389
		1.850000	1.585000	1.540000	1.785000	.683173	1.690281
		.341500	.586600	.544000	.303900	.718091	.444215
	3	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		1.585000	1.195000	1.175000	1.540000	.457325	1.373892
		.586600	.784400	.737400	.544000	.882618	.663304
	4	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		1.195000	.800000	.800000	1.175000	.288525	.992572
		.784400	.901200	.853800	.737400	.952677	.819383

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FOLDOUT FRAME

	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
000	-.500000	-.029218	-.250016	.2468E-03
000	-.800000	-.157442	-.600001	.6451E+00
500	-.901200	-.987096	-.940749	.2026E+00
000	-.500000	-.028252	-.250002	.7487E-04
000	-.400000	-.050789	-.200000	.6412E+00
000	-.965500	-.998310	-.982825	.2003E+00
000	-.500000	-.028252	-.250002	.7487E-04
000	0.000000	.050789	.200000	.6412E+00
500	-.986000	-.998310	-.982825	.2003E+00
000	-.500000	-.029218	-.250016	.2468E-03
000	.400000	.157442	.600001	.6451E+00
200	-.965500	-.987096	-.940749	.2026E+00
000	-.500000	-.031043	-.249537	.4237E-03
000	.800000	.281449	.998756	.6507E+00
400	-.901200	-.959074	-.850538	.2072E+00
000	-.500000	-.034875	-.249169	.6327E-03
003	1.195000	.449471	1.395016	.6693E+00
600	-.784400	-.892614	-.692774	.2213E+00
000	-.500000	-.043145	-.249477	.7887E-03
000	1.585000	.675158	1.726269	.6205E+00
500	-.586600	-.736411	-.470688	.1816E+00
000	-.500000	-.049532	-.248068	.7648E-03
000	1.850000	.939127	1.923092	.6238E+00
000	-.341500	-.339980	-.174052	.1853E+00
000	-1.000000	-.153543	-.743334	.1969E-02
000	1.685600	.934141	1.874150	.6143E+00
000	0.000000	.322188	.161626	.1727E+00
000	-1.000000	-.132740	-.747389	.2518E-02
000	1.785000	.683173	1.690281	.6222E+00
000	.303900	.718091	.444215	.1776E+00
000	-1.000000	-.108809	-.747752	.1887E-02
000	1.540000	.457325	1.373892	.6640E+00
400	.544000	.882618	.663304	.2139E+00
000	-1.000000	-.095703	-.747958	.1347E-02
000	1.175000	.288525	.992572	.6461E+00
000	.737400	.952677	.819383	.2021E+00

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
5	5	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.750055
		.800000	.400000	.400000	.800000	.162020	.600009
		.901200	.965500	.921400	.853800	.982682	.910468
	6	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		.400000	0.000000	0.000000	.400000	.052106	.200003
		.965500	.986000	.942800	.921400	.994858	.953924
	7	-.500000	-.500000	-1.000000	-1.000000	-.039925	-.748551
		0.000000	-.400000	-.400000	0.000000	-.379842	-.199961
		.986000	.800000	.800000	.942800	.924189	.862279
	8	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.750000
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600000
		.800000	.600000	.600000	.800000	.894427	.700000
	9	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.750000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000000
		.600000	.400000	.400000	.600000	.894427	.500000
	10	-.500000	-.500000	-1.000000	-1.000000	0.000000	-.750000
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400000
		.400000	.200000	.200000	.400000	.894427	.300000
	11	-.500000	-.500000	-1.000000	-1.000000	-.044855	-.741375
		-1.600000	-1.972000	-1.885600	-1.600000	-.519160	-1.764760
		.200000	0.000000	0.000000	.200000	.853499	.100234
	12	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		-1.972000	-1.850000	-1.785000	-1.885600	-.934141	-1.874150
		0.000000	-.341500	-.303900	0.000000	-.322188	-.161626
	13	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747389
		-1.850000	-1.585000	-1.540000	-1.785000	-.683173	-1.690281
		-.341500	-.586600	-.544000	-.303900	-.718091	-.444215
	14	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		-1.585000	-1.195000	-1.175000	-1.540000	-.457325	-1.373892
		-.586600	-.784400	-.737400	-.544000	-.882618	-.663304
	15	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		-1.195000	-.800000	-.800000	-1.175000	-.288525	-.992572
		-.784400	-.901200	-.853800	-.737400	-.952677	-.819383
	16	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.750055
		-.800000	-.400000	-.400000	-.800000	-.162020	-.600009
		-.901200	-.965500	-.921400	-.853800	-.982682	-.910468

FOLDOUT FRAME

DY

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
-1.000000	-1.000000	-.089915	-.750055	.8107E-03
.400000	.800000	.162020	.600009	.6500E+00
.921400	.853800	.982682	.910468	.2035E+00
-1.000000	-1.000000	-.086851	-.750005	.2238E-03
0.000000	.400000	.052106	.200003	.6436E+00
.942800	.921400	.994858	.953924	.2010E+00
-1.000000	-1.000000	-.039925	-.748551	.9981E-02
-.400000	0.000000	-.379842	-.199961	.6668E+00
.800000	.942800	.924189	.882279	.2164E+00
-1.000000	-1.000000	0.000000	-.750000	.3553E-14
-.800000	-.400000	-.447214	-.600000	.6708E+00
.600000	.800000	.894427	.700000	.2236E+00
-1.000000	-1.000000	0.000000	-.750000	.3553E-14
-1.200000	-.800000	-.447214	-1.000000	.6708E+00
.400000	.600000	.894427	.500000	.2236E+00
-1.000000	-1.000000	0.000000	-.750000	.6661E-14
-1.600000	-1.200000	-.447214	-1.400000	.6708E+00
.200000	.400000	.894427	.300000	.2236E+00
-1.000000	-1.000000	-.044855	-.741375	.1121E-01
-1.885600	-1.600000	-.519160	-1.764760	.6545E+00
0.000000	.200000	.853499	.100234	.1926E+00
-1.000000	-1.000000	-.153543	-.743334	.1969E-02
-1.785000	-1.885600	-.934141	-1.874150	.6143E+00
-.303900	0.000000	-.322188	-.161626	.1727E+00
-1.000000	-1.000000	-.132740	-.747389	.2518E-02
-1.540000	-1.785000	-.683173	-1.690281	.6222E+00
-.544000	-.303900	-.718091	-.444215	.1776E+00
-1.000000	-1.000000	-.108809	-.747752	.1887E-02
-1.175000	-1.540000	-.457325	-1.373892	.6640E+00
-.737400	-.544000	-.882618	-.663304	.2139E+00
-1.000000	-1.000000	-.095703	-.747958	.1347E-02
-.800000	-1.175000	-.288525	-.992572	.6461E+00
-.853800	-.737400	-.952677	-.819383	.2021E+00
-1.000000	-1.000000	-.089915	-.750055	.8107E-03
-.400000	-.800000	-.162020	-.600009	.6500E+00
-.921400	-.853800	-.982682	-.910468	.2035E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X	X	X	X	NX	NPX
		Y	Y	Y	Y	NY	NPY
		Z	Z	Z	Z	NZ	NPZ
5	17	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		-.400000	0.000000	0.000000	-.400000	-.052106	-.200003
		-.965500	-.986000	-.942800	-.921400	-.994858	-.953924
	18	-.500000	-.500000	-1.000000	-1.000000	-.086851	-.750005
		0.000000	.400000	.400000	0.000000	.052106	.200003
		-.986000	-.965500	-.921400	-.942800	-.994858	-.953924
	19	-.500000	-.500000	-1.000000	-1.000000	-.089915	-.750055
		.400000	.800000	.800000	.400000	.162020	.600009
		-.965500	-.901200	-.853800	-.921400	-.982682	-.910468
	20	-.500000	-.500000	-1.000000	-1.000000	-.095703	-.747958
		.800000	1.195000	1.175000	.800000	.288525	.992572
		-.901200	-.784400	-.737400	-.853800	-.952677	-.819383
	21	-.500000	-.500000	-1.000000	-1.000000	-.108809	-.747752
		1.195000	1.585000	1.540000	1.175000	.457325	1.373892
		-.784400	-.586600	-.544000	-.737400	-.882618	-.663304
	22	-.500000	-.500000	-1.000000	-1.000000	-.132740	-.747389
		1.585000	1.850000	1.785000	1.540000	.683173	1.690281
		-.586600	-.341500	-.303900	-.544000	-.718091	-.444215
	23	-.500000	-.500000	-1.000000	-1.000000	-.153543	-.743334
		1.850000	1.972000	1.885600	1.785000	.934141	1.874150
		-.341500	0.000000	0.000000	-.303900	-.322188	-.161626
6	1	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		1.885600	1.785000	1.670000	1.732000	.921489	1.773614
		0.000000	.303900	.229700	0.000000	.280799	.134912
	2	-1.000000	-1.000000	-1.500000	-1.500000	-.239[illegible]65	-1.245329
		1.785000	1.540000	1.460000	1.670000	.70[illegible]123	1.614691
		.303900	.544000	.465900	.229700	.670724	.386555
	3	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		1.540000	1.175000	1.140000	1.460000	.475316	1.329324
		.544000	.737400	.652000	.465900	.857948	.600627
	4	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		1.175000	.800000	.800000	1.140000	.304683	.979004
		.737400	.853800	.768100	.652000	.936981	.753512
	5	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		.800000	.400000	.400000	.800000	.172638	.600034
		.853800	.921400	.842600	.768100	.971923	.846449

FOLDOUT FRAME 1

	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
00	-1.000000	-.086851	-.750005	.2238E-03
00	-.400000	-.052106	-.200003	.6436E+00
00	-.921400	-.994858	-.953924	.2010E+00
00	-1.000000	-.086851	-.750005	.2238E-03
00	0.000000	.052106	.200003	.6436E+00
00	-.942800	-.994858	-.953924	.2010E+00
00	-1.000000	-.089915	-.750055	.8107E-03
00	.400000	.162020	.600009	.6500E+00
00	-.921400	-.982682	-.910468	.2035E+00
00	-1.000000	-.095703	-.747958	.1347E-02
00	.800000	.288525	.992572	.6461E+00
00	-.853800	-.952677	-.819383	.2021E+00
00	-1.000000	-.108609	-.747752	.1887E-02
00	1.175000	.457325	1.373892	.6640E+00
00	-.737400	-.882618	-.663304	.2139E+00
00	-1.000000	-.132740	-.747389	.2518E-02
00	1.540000	.683173	1.690281	.6222E+00
00	-.544000	-.718091	-.444215	.1776E+00
00	-1.000000	-.153543	-.743334	.1969E-02
00	1.785000	.934141	1.874150	.6143E+00
00	-.303900	-.322188	-.161626	.1727E+00
00	-1.500000	-.268347	-1.229655	.3684E-02
00	1.732000	.921489	1.773614	.5910E+00
00	0.000000	.280799	.134912	.1448E+00
00	-1.500000	-.239065	-1.245329	.5490E-02
00	1.670000	.702123	1.614691	.6180E+00
00	.229700	.670724	.386555	.1696E+00
00	-1.500000	-.194936	-1.245068	.3762E-02
00	1.460000	.475316	1.329324	.6494E+00
00	.465900	.857948	.600627	.1996E+00
00	-1.500000	-.170981	-1.245783	.2596E-02
00	1.140000	.304683	.979304	.6374E+00
00	.652000	.936981	.753512	.1908E+00
00	-1.500000	-.159881	-1.250120	.1677E-02
00	.800000	.172638	.600034	.6584E+00
00	.768100	.971923	.846449	.2658E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
6	6	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250
		.400000	0.000000	0.000000	.400000	.055250	.200
		.921400	.942800	.866000	.842600	.986601	.893
	7	-1.000000	-1.000000	-1.500000	-1.500000	-.074106	-1.248
		0.000000	-.400000	-.400000	0.000000	-.251846	-.199
		.942800	.800000	.800000	.866000	.964926	.852
	8	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250
		-.400000	-.800000	-.800000	-.400000	-.447214	-.600
		.800000	.600000	.600000	.800000	.894427	.700
	9	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.000
		.600000	.400000	.400000	.600000	.894427	.500
	10	-1.000000	-1.000000	-1.500000	-1.500000	0.000000	-1.250
		-1.200000	-1.600000	-1.600000	-1.200000	-.447214	-1.400
		.400000	.200000	.200000	.400000	.894427	.300
	11	-1.000000	-1.000000	-1.500000	-1.500000	-.105654	-1.225
		-1.600000	-1.885600	-1.732000	-1.600000	-.687853	-1.707
		.200000	0.000000	0.000000	.200000	.718119	.100
	12	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229
		-1.885600	-1.785000	-1.670000	-1.732000	-.921489	-1.773
		0.000000	-.303900	-.229700	0.000000	-.280799	-.134
	13	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245
		-1.785000	-1.540000	-1.460000	-1.670000	-.702123	-1.614
		-.303900	-.544000	-.465900	-.229700	-.670724	-.386
	14	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245
		-1.540000	-1.175000	-1.140000	-1.460000	-.475316	-1.329
		-.544000	-.737400	-.652000	-.465900	-.857948	-.600
	15	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.2457
		-1.175000	-.800000	-.800000	-1.140000	-.304683	-.9790
		-.737400	-.853800	-.768100	-.652000	-.936981	-.7535
	16	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.2501
		-.800000	-.400000	-.400000	-.800000	-.172638	-.6000
		-.853800	-.921400	-.842600	-.768100	-.971923	-.8464
	17	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.2500
		-.400000	0.000000	0.000000	-.400000	-.055250	-.2000
		-.921400	-.942800	-.866000	-.842600	-.986601	-.8931

FOLDOUT FRAME 1

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
1.500000	-1.500000	-.153515	-1.250012	.4933E-03
.000000	.400000	.055250	.200010	.6481E+00
.866000	.842600	.986601	.893198	.2027E+00
.500000	-1.500000	-.074106	-1.248100	.1853E-01
.400000	0.000000	-.251846	-.199835	.6560E+00
.800000	.866000	.964926	.852389	.2073E+00
1.500000	-1.500000	0.000000	-1.250000	.3553E-14
.800000	-.400000	-.447214	-.600000	.6708E+00
.600000	.800000	.894427	.700000	.2236E+00
1.500000	-1.500000	0.000000	-1.250000	.3553E-14
.200000	-.800000	-.447214	-1.000000	.6708E+00
.400000	.600000	.894427	.500000	.2236E+00
1.500000	-1.500000	0.000000	-1.250000	.6661E-14
.600000	-1.200000	-.447214	-1.400000	.6708E+00
.200000	.400000	.894427	.300000	.2236E+00
1.500000	-1.500000	-.105654	-1.225923	.2641E-01
.732000	-1.600000	-.687853	-1.707445	.6096E+00
.000000	.200000	.718119	.100626	.1454E+00
.500000	-1.500000	-.268347	-1.229655	.3684E-02
.670000	-1.732000	-.921489	-1.773614	.5910E+00
.229700	0.000000	-.280799	-.134912	.1448E+00
.500000	-1.500000	-.239065	-1.245329	.5490E-02
.460000	-1.670000	-.702123	-1.614691	.6180E+00
.465900	-.229700	-.670724	-.386555	.1696E+00
500000	-1.500000	-.194936	-1.245068	.3782E-02
140000	-1.460000	-.475316	-1.329324	.6494E+00
652000	-.465900	-.857948	-.600627	.1996E+00
500000	-1.500000	-.170981	-1.245783	.2596E-02
800000	-1.140000	-.304683	-.979004	.6374E+00
768100	-.652000	-.936981	-.753512	.1908E+00
500000	-1.500000	-.159881	-1.250120	.1677E-02
400000	-.800000	-.172638	-.600034	.6584E+00
842600	-.768100	-.971923	-.846449	.2058E+00
500000	-1.500000	-.153515	-1.250012	.4933E-03
000000	-.400000	-.055250	-.200010	.6481E+00
866000	-.842600	-.986601	-.893198	.2027E+00

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
6	18	-1.000000	-1.000000	-1.500000	-1.500000	-.153515	-1.250012
		0.000000	.400000	.400000	0.000000	.055250	.200010
		-.942800	-.921400	-.842600	-.866000	-.986601	-.893198
	19	-1.000000	-1.000000	-1.500000	-1.500000	-.159881	-1.250120
		.400000	.800000	.800000	.400000	.172638	.600034
		-.921400	-.853800	-.768100	-.842600	-.971923	-.846449
	20	-1.000000	-1.000000	-1.500000	-1.500000	-.170981	-1.245783
		.800000	1.175000	1.140000	.800000	.304683	.979004
		-.853800	-.737400	-.652000	-.768100	-.936981	-.753512
	21	-1.000000	-1.000000	-1.500000	-1.500000	-.194936	-1.245068
		1.175000	1.540000	1.460000	1.140000	.475316	1.329324
		-.737400	-.544000	-.465900	-.652000	-.857948	-.600627
	22	-1.000000	-1.000000	-1.500000	-1.500000	-.239065	-1.245329
		1.540000	1.785000	1.670000	1.460000	.702123	1.614691
		-.544000	-.303900	-.229700	-.465900	-.670724	-.386555
	23	-1.000000	-1.000000	-1.500000	-1.500000	-.268347	-1.229655
		1.785000	1.885600	1.732000	1.670000	.921489	1.773614
		-.303900	0.000000	0.000000	-.229700	-.280799	-.134912
7	1	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.699678
		1.732000	1.670000	1.465000	1.490700	.885202	1.611865
		0.000000	.229700	.137800	0.000000	.211244	.096576
	2	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.733772
		1.670000	1.460000	1.322000	1.465000	.725701	1.484752
		.229700	.465900	.344400	.137800	.578529	.297994
	3	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.738932
		1.460000	1.140000	1.072000	1.322000	.507279	1.250730
		.465900	.652000	.517900	.344400	.804085	.497910
	4	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.738266
		1.140000	.800000	.800000	1.072000	.335023	.954054
		.652000	.768100	.628900	.517900	.902837	.644837
	5	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.750276
		.800000	.400000	.400000	.800000	.193980	.600104
		.768100	.842600	.718000	.628900	.948555	.739306
	6	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.750025
		.400000	0.000000	0.000000	.400000	.061556	.200030
		.842600	.866000	.745400	.718000	.969388	.792992

FOLDOUT FRA

BODY

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
-1.500000	-1.500000	-.153515	-1.250012	.4933E-03
.400000	0.000000	.055250	.200010	.6481E+00
-.842600	-.866000	-.986601	-.893198	.2027E+00
-1.500000	-1.500000	-.159881	-1.250120	.1677E-02
.800000	.400000	.172638	.600034	.6584E+00
-.768100	-.842600	-.971923	-.846449	.2058E+00
-1.500000	-1.500000	-.170981	-1.245783	.2596E-02
1.140000	.800000	.304683	.979004	.6374E+00
-.652000	-.768100	-.936981	-.753512	.1908E+00
-1.500000	-1.500000	-.194936	-1.245068	.3782E-02
1.460000	1.140000	.475316	1.329324	.6494E+00
-.465900	-.652000	-.857948	-.600627	.1996E+00
-1.500000	-1.500000	-.239065	-1.245329	.5490E-02
1.670000	1.460000	.702123	1.614691	.6180E+00
-.229700	-.465900	-.670724	-.386555	.1696E+00
-1.500000	-1.500000	-.268347	-1.229655	.3664E-02
1.732000	1.670000	.921489	1.773614	.5910E+00
0.000000	-.229700	-.280799	-.134912	.1448E+00
-2.000000	-2.000000	-.414479	-1.699678	.3180E-02
1.465000	1.490700	.885202	1.611865	.5833E+00
.137800	0.000000	.211244	.096576	.1038E+00
-2.000000	-2.000000	-.372374	-1.733772	.7874E-02
1.322000	1.465000	.725701	1.484752	.6199E+00
.344400	.137800	.578529	.297994	.1525E+00
-2.000000	-2.000000	-.310024	-1.738932	.6345E-02
1.072000	1.322000	.507279	1.250730	.6350E+00
.517900	.344400	.804085	.497910	.1772E+00
-2.000000	-2.000000	-.269527	-1.738266	.4544E-02
.800000	1.072000	.335023	.954054	.6218E+00
.628900	.517900	.902837	.644837	.1695E+00
-2.000000	-2.000000	-.250229	-1.750276	.3482E-02
.400000	.800000	.193980	.600104	.6750E+00
.718000	.628900	.948555	.739306	.2108E+00
-2.000000	-2.000000	-.237694	-1.750025	.9694E-03
0.000000	.400000	.061556	.200030	.6572E+00
.745400	.718000	.969388	.792992	.2063E+00

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ
7	7	-1.500000	-1.500000	-2.000000	-2.000000	-.197278	-1.74955
		0.000000	-.400000	-.400000	0.000000	-.113683	-.19975
		.866000	.800000	.718000	.745400	.973734	.78246
	8	-1.500000	-1.500000	-2.000000	-2.000000	-.075980	-1.74731
		-.400000	-.800000	-.800000	-.400000	-.368319	-.59985
		.800000	.600000	.600000	.718000	.926589	.67977
	9	-1.500000	-1.500000	-2.000000	-2.000000	0.000000	-1.75000
		-.800000	-1.200000	-1.200000	-.800000	-.447214	-1.00000
		.600000	.400000	.400000	.600000	.894427	.50000
	10	-1.500000	-1.500000	-2.000000	-2.000000	-.050829	-1.72040
		-1.200000	-1.600000	-1.400000	-1.200000	-.496741	-1.35282
		.400000	.200000	.256000	.400000	.866409	.31411
	11	-1.500000	-1.500000	-2.000000	-2.000000	-.348626	-1.76253
		-1.600000	-1.732000	-1.490700	-1.400000	-.842191	-1.55051
		.200000	0.000000	0.000000	.256000	.411307	.11394
	12	-1.500000	-1.500000	-2.000000	-2.000000	-.414479	-1.69967
		-1.732000	-1.670000	-1.465000	-1.490700	-.885202	-1.61186
		0.000000	-.229700	-.137800	0.000000	-.211244	-.09657
	13	-1.500000	-1.500000	-2.000000	-2.000000	-.372374	-1.73377
		-1.670000	-1.460000	-1.322000	-1.465000	-.725701	-1.48475
		-.229700	-.465900	-.344400	-.137800	-.578529	-.29799
	14	-1.500000	-1.500000	-2.000000	-2.000000	-.310024	-1.73893
		-1.460000	-1.140000	-1.072000	-1.322000	-.507279	-1.25073
		-.465900	-.652000	-.517900	-.344400	-.804085	-.49791
	15	-1.500000	-1.500000	-2.000000	-2.000000	-.269527	-1.73826
		-1.140000	-.800000	-.800000	-1.072000	-.335023	-.95405
		-.652000	-.768100	-.628900	-.517900	-.902837	-.64483
	16	-1.500000	-1.500000	-2.000000	-2.000000	-.250229	-1.75027
		-.800000	-.400000	-.400000	-.800000	-.193980	-.60010
		-.768100	-.842600	-.718000	-.628900	-.948555	-.73930
	17	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.75002
		-.400000	0.000000	0.000000	-.400000	-.061556	-.20003
		-.842600	-.866000	-.745400	-.718000	-.969388	-.79299
	18	-1.500000	-1.500000	-2.000000	-2.000000	-.237694	-1.75002
		0.000000	.400000	.400000	0.000000	.061556	.20003
		-.866000	-.842600	-.718000	-.745400	-.969388	-.79299

FOLDOUT FRAME

	X Y Z	NX NY NZ	NPX NPY NPZ	C T A
000	-2.000000	-.197278	-1.749550	.9397E-02
000	0.000000	-.113683	-.199759	.6572E+00
000	.745400	.973734	.782469	.2054E+00
000	-2.000000	-.075980	-1.747311	.1900E-01
000	-.400000	-.368319	-.599857	.6708E+00
000	.718000	.926589	.679777	.2158E+00
000	-2.000000	0.000000	-1.750000	.3553E-14
000	-.600000	-.447214	-1.000000	.6708E+00
000	.600000	.894427	.500000	.2236E+00
000	-2.000000	-.050829	-1.720409	.1271E-01
000	-1.200000	-.496741	-1.352829	.6708E+00
000	.400000	.866409	.314114	.1731E+00
000	-2.000000	-.348626	-1.762537	.1445E-01
700	-1.400000	-.842191	-1.550513	.6525E+00
000	.256000	.411307	.113943	.1354E+00
000	-2.000000	-.414479	-1.699678	.3180E-02
000	-1.490700	-.885202	-1.611865	.5833E+00
800	0.000000	-.211244	-.096576	.1038E+00
000	-2.000000	-.372374	-1.733772	.7874E-02
2000	-1.465000	-.725701	-1.464752	.6199E+00
400	-.137800	-.578529	-.297994	.1525E+00
000	-2.000000	-.310024	-1.738932	.6345E-02
2000	-1.322000	-.507279	-1.250730	.6350E+00
900	-.344400	-.804085	-.497910	.1772E+00
000	-2.000000	-.269527	-1.738266	.4544E-02
000	-1.072000	-.335023	-.954054	.6218E+00
900	-.517900	-.902837	-.644837	.1695E+00
000	-2.000000	-.250229	-1.750276	.3462E-02
000	-.600000	-.193980	-.600104	.6750E+00
900	-.628900	-.948555	-.739306	.2108E+00
000	-2.000000	-.237694	-1.750025	.9694E-03
000	-.400000	-.061556	-.200030	.6572E+00
400	-.718000	-.969388	-.792992	.2063E+00
000	-2.000000	-.237694	-1.750025	.9694E-03
000	0.000000	.061556	.200030	.6572E+00
000	-.745400	-.969388	-.792992	.2063E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NP NP NP
7	19	-1.500000 .400000 -.842600	-1.500000 .800000 -.768100	-2.000000 .800000 -.628900	-2.000000 .400000 -.718000	-.250229 .193980 -.948555	-1.75 .60 -.73
	20	-1.500000 .800000 -.768100	-1.500000 1.140000 -.652000	-2.000000 1.072000 -.517900	-2.000000 .800000 -.628900	-.269527 .335023 -.902837	-1.73 .95 -.64
	21	-1.500000 1.140000 -.652000	-1.500000 1.460000 -.465900	-2.000000 1.322000 -.344400	-2.000000 1.072000 -.517900	-.310024 .507279 -.804085	-1.73 1.25 -.49
	22	-1.500000 1.460000 -.465900	-1.500000 1.670000 -.229700	-2.000000 1.465000 -.137800	-2.000000 1.322000 -.344400	-.372374 .725701 -.578529	-1.73 1.48 -.29
	23	-1.500000 1.670000 -.229700	-1.500000 1.732000 0.000000	-2.000000 1.490700 0.000000	-2.000000 1.465000 -.137800	-.414479 .885202 -.211244	-1.69 1.61 -.09

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N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NP NP NP
8	1	-2.000000 1.490700 0.000000	-2.000000 1.322000 .344400	-2.500000 1.000000 .235700	-2.500000 1.055000 0.000000	-.597981 .747834 .288382	-2.218 1.240 .149
	2	-2.000000 1.322000 .344400	-2.000000 .800000 .628900	-2.500000 .800000 .381500	-2.500000 1.000000 .235700	-.425912 .463200 .777203	-2.214 .990 .411
	3	-2.000000 .800000 .628900	-2.000000 .400000 .718000	-2.500000 .400000 .515300	-2.500000 .800000 .381500	-.397601 .246251 .883807	-2.250 .600 .560
	4	-2.000000 .400000 .718000	-2.000000 0.000000 .745700	-2.500000 0.000000 .552800	-2.500000 .400000 .515300	-.366809 .075569 .927222	-2.250 .200 .632
	5	-2.000000 0.000000 .745700	-2.000000 -.400000 .718000	-2.500000 -.400000 .515300	-2.500000 0.000000 .552800	-.366809 -.075569 .927222	-2.250 -.200 .632
	6	-2.000000 -.400000 .718000	-2.000000 -.800000 .600000	-2.500000 -.800000 .381500	-2.500000 -.400000 .515300	-.372805 -.278586 .885102	-2.250 -.600 .553

FOLDOUT FRAME

X Y Z	NX NY NZ	NPX NPY NPZ	D T A
-2.000000	-.250229	-1.750276	.3462E-02
.400000	.193980	.600104	.6750E+00
-.718000	-.948555	-.739306	.2108E+00
-2.000000	-.269527	-1.738266	.4544E-02
.800000	.335023	.954054	.6218E+00
-.628900	-.902837	-.644837	.1695E+00
-2.000000	-.310024	-1.738932	.6345E-02
1.072000	.507279	1.250730	.6350E+00
-.517900	-.804085	-.497910	.1772E+00
-2.000000	-.372374	-1.733772	.7874E-02
1.322000	.725701	1.484752	.6199E+00
-.344400	-.578529	-.297994	.1525E+00
-2.000000	-.414479	-1.699678	.3180E-02
1.465000	.885202	1.611865	.5833E+00
-.137800	-.211244	-.096576	.1038E+00
************		************	
-2.500000	-.597981	-2.218024	.1342E-01
1.055000	.747834	1.240723	.7391E+00
0.000000	.288382	.149617	.1939E+00
-2.500000	-.425912	-2.214445	.1034E-01
1.000000	.463200	.990269	.7238E+00
.235700	.777203	.411287	.2322E+00
-2.500000	-.397601	-2.250969	.9877E-02
.600000	.246251	.600392	.7233E+00
.381500	.883807	.560379	.2263E+00
-2.500000	-.366809	-2.250072	.2272E-02
.400000	.075569	.200101	.6805E+00
.515300	.927222	.632913	.2157E+00
-2.500000	-.366809	-2.250072	.2272E-02
0.000000	-.075569	-.200101	.6805E+00
.552800	.927222	.632913	.2157E+00
-2.500000	-.372805	-2.250383	.3496E-02
-.400000	-.278586	-.600126	.7233E+00
.515300	.885102	.553499	.2260E+00

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X Y Z	X Y Z	X Y Z	X Y Z	NX NY NZ	NP NP NP
8	7	-2.000000	-2.000000	-2.500000	-2.500000	-.396212	-2.21
		-.800000	-1.200000	-1.000000	-.800000	-.458473	-.95
		.600000	.400000	.235700	.381500	.795499	.41
	8	-2.000000	-2.000000	-2.500000	-2.500000	-.537231	-2.21
		-1.200000	-1.490700	-1.055000	-1.000000	-.740960	-1.20
		.400000	0.000000	0.000000	.235700	.402941	.16
	9	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218
		-1.490700	-1.322000	-1.000000	-1.055000	-.747834	-1.240
		0.000000	-.344400	-.235700	0.000000	-.288382	-.149
	10	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214
		-1.322000	-.800000	-.800000	-1.000000	-.463200	-.990
		-.344400	-.628900	-.381500	-.235700	-.777203	-.411
	11	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.250
		-.800000	-.400000	-.400000	-.800000	-.246251	-.600
		-.628900	-.718000	-.515300	-.381500	-.883807	-.560
	12	-2.000000	-2.000000	-2.500000	-2.500000	-.366578	-2.250
		-.400000	0.000000	0.000000	-.400000	-.075231	-.200
		-.718000	-.745400	-.552800	-.515300	-.927341	-.632
	13	-2.000000	-2.000000	-2.500000	-2.500000	-.366578	-2.250
		0.000000	.400000	.400000	0.000000	.075231	.200
		-.745400	-.718000	-.515300	-.552800	-.927341	-.632
	14	-2.000000	-2.000000	-2.500000	-2.500000	-.397801	-2.250
		.400000	.800000	.800000	.400000	.246251	.600
		-.718000	-.628900	-.381500	-.515300	-.883807	-.560
	15	-2.000000	-2.000000	-2.500000	-2.500000	-.425912	-2.214
		.800000	1.322000	1.000000	.800000	.463200	.990
		-.628900	-.344400	-.235700	-.381500	-.777203	-.411
	16	-2.000000	-2.000000	-2.500000	-2.500000	-.597981	-2.218
		1.322000	1.490700	1.055000	1.000000	.747834	1.240
		-.344400	0.000000	0.000000	-.235700	-.288382	-.149
		************			************		
9	1	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.626
		1.055000	.800000	0.000000	0.000000	.411733	.687
		0.000000	.381500	0.000000	0.000000	.275208	.149

FOLDOUT FRAME

BODY

X	X	NX	NPX	D
Y	Y	NY	NPY	T
Z	Z	NZ	NPZ	A
-2.500000	-2.500000	-.396212	-2.218355	.1214E-01
-1.000000	-.800000	-.458473	-.956945	.6502E+00
.235700	.381500	.795499	.416059	.1886E+00
-2.500000	-2.500000	-.537231	-2.212088	.2711E-01
-1.055000	-1.000000	-.740960	-1.209729	.7391E+00
0.000000	.235700	.402941	.166619	.2145E+00
-2.500000	-2.500000	-.597981	-2.218024	.1342E-01
-1.000000	-1.055000	-.747834	-1.240723	.7391E+00
-.235700	0.000000	-.288382	-.149617	.1939E+00
-2.500000	-2.500000	-.425912	-2.214445	.1034E-01
-.800000	-1.000000	-.463200	-.990269	.7238E+00
-.381500	-.235700	-.777203	-.411287	.2322E+00
-2.500000	-2.500000	-.397801	-2.250969	.9877E-02
-.400000	-.800000	-.246251	-.600392	.7233E+00
-.515300	-.381500	-.883807	-.560379	.2263E+00
-2.500000	-2.500000	-.366578	-2.250074	.2342E-02
0.000000	-.400000	-.075231	-.200104	.6804E+00
-.552800	-.515300	-.927341	-.632837	.2157E+00
-2.500000	-2.500000	-.366578	-2.250074	.2342E-02
.400000	0.000000	.075231	.200104	.6804E+00
-.515300	-.552800	-.927341	-.632837	.2157E+00
-2.500000	-2.500000	-.397801	-2.250969	.9877E-02
.800000	.400000	.246251	.600392	.7233E+00
-.381500	-.515300	-.883807	-.560379	.2263E+00
-2.500000	-2.500000	-.425912	-2.214445	.1034E-01
1.000000	.800000	.463200	.990269	.7238E+00
-.235700	-.381500	-.777203	-.411287	.2322E+00
-2.500000	-2.500000	-.597981	-2.218024	.1342E-01
1.055000	1.000000	.747834	1.240723	.7391E+00
0.000000	-.235700	-.288382	-.149617	.1939E+00
	************		************	
-3.000000	-3.000000	-.868756	-2.626833	0.
0.000000	0.000000	.411733	.687692	.1167E+01
0.000000	0.000000	.275208	.149145	.2316E+00

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

N	M	X / Y / Z	X / Y / Z	X / Y / Z	X / Y / Z	NX / NY / NZ	NPX / NPY / NPZ
9	2	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.629
		.800000	.400000	0.000000	0.000000	.200002	.434
		.381500	.515300	0.000000	0.000000	.597912	.336
	3	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		.400000	0.000000	0.000000	0.000000	.062764	.141
		.515300	.552800	0.000000	0.000000	.669478	.389
	4	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.635
		0.000000	-.400000	0.000000	0.000000	-.062764	-.141
		.552800	.515300	0.000000	0.000000	.669478	.3897
	5	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.6291
		-.400000	-.800000	0.000000	0.000000	-.200002	-.4341
		.515300	.381500	0.000000	0.000000	.597912	.3362
	6	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.6268
		-.800000	-1.055000	0.000000	0.000000	-.411733	-.6876
		.381500	0.000000	0.000000	0.000000	.275208	.1491
	7	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.6268
		-1.055000	-.800000	0.000000	0.000000	-.411733	-.6876
		0.000000	-.381500	0.000000	0.000000	-.275208	-.1491
	8	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.6291
		-.800000	-.400000	0.000000	0.000000	-.200002	-.4341
		-.381500	-.515300	0.000000	0.000000	-.597912	-.3362
	9	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.6354
		-.400000	0.000000	0.000000	0.000000	-.062764	-.1412
		-.515300	-.552800	0.000000	0.000000	-.669478	-.3897
	10	-2.500000	-2.500000	-3.000000	-3.000000	-.740175	-2.6354
		0.000000	.400000	0.000000	0.000000	.062764	.1412
		-.552800	-.515300	0.000000	0.000000	-.669478	-.3897
	11	-2.500000	-2.500000	-3.000000	-3.000000	-.776209	-2.6291
		.400000	.800000	0.000000	0.000000	.200002	.4341
		-.515300	-.381500	0.000000	0.000000	-.597912	-.3362
	12	-2.500000	-2.500000	-3.000000	-3.000000	-.868756	-2.6268
		.800000	1.055000	0.000000	0.000000	.411733	.6876
		-.381500	0.000000	0.000000	0.000000	-.275208	-.1491

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FOLDOUT FRAME

BODY

X Y Z	X Y Z	NX NY NZ	NPX NPY NPZ	D T A
-3.000000	-3.000000	-.776209	-2.629150	.1332E-14
0.000000	0.000000	.200002	.434170	.1018E+01
0.000000	0.000000	.597912	.336208	.1672E+00
-3.000000	-3.000000	-.740175	-2.635472	.2220E-15
0.000000	0.000000	.062764	.141262	.8219E+00
0.000000	0.000000	.669478	.389779	.1494E+00
-3.000000	-3.000000	-.740175	-2.635472	.3053E-15
0.000000	0.000000	-.062764	-.141262	.8219E+00
0.000000	0.000000	.669478	.389779	.1494E+00
-3.000000	-3.000000	-.776209	-2.629150	.1110E-14
0.000000	0.000000	-.200002	-.434170	.1018E+01
0.000000	0.000000	.597912	.336208	.1672E+00
-3.000000	-3.000000	-.868756	-2.626833	.8882E-15
0.000000	0.000000	-.411733	-.687692	.1167E+01
0.000000	0.000000	.275208	.149145	.2316E+00
-3.000000	-3.000000	-.868756	-2.626833	0.
0.000000	0.000000	-.411733	-.687692	.1167E+01
0.000000	0.000000	-.275208	-.149145	.2316E+00
-3.000000	-3.000000	-.776209	-2.629150	.1332E-14
0.000000	0.000000	-.200002	-.434170	.1018E+01
0.000000	0.000000	-.597912	-.336208	.1672E+00
-3.000000	-3.000000	-.740175	-2.635472	.2220E-15
0.000000	0.000000	-.062764	-.141262	.8219E+00
0.000000	0.000000	-.669478	-.389779	.1494E+00
-3.000000	-3.000000	-.740175	-2.635472	.3053E-15
0.000000	0.000000	.062764	.141262	.8219E+00
0.000000	0.000000	-.669478	-.389779	.1494E+00
-3.000000	-3.000000	-.776209	-2.629150	.1110E-14
0.000000	0.000000	.200002	.434170	.1018E+01
0.000000	0.000000	-.597912	-.336208	.1672E+00
-3.000000	-3.000000	-.868756	-2.626833	.8882E-15
0.000000	0.000000	.411733	.687692	.1167E+01
0.000000	0.000000	-.275208	-.149145	.2316E+00

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FOLDOUT FRAME 2

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189 BASIC ELEMENTS WERE INPUT
FLOWS HAS SET UP  1  X  FLOWS,  0  Y  FLOWS, AND  0  Z  FLOWS.

NEAR ELEMENTS =  12340
INTERMEDIATE ELEMENTS =  12849
FAR ELEMENTS =  10532
     LEAVING VFORM
     LEAVING AFORM
THE  189 X  189 MATRIX WITH   1 RIGHT SIDES WAS SOLVED DIRECTLY.
     LEAVING ATAPES
```

PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
1	1	1.591395	.650542	.186355	.286460	.958086
		1.389794	.423205	-.603774	-.928109	.276584
		.094899	.576795	-.154707	-.237613	.074655
	2	1.598349	.722874	.242954	.336094	.941794
		1.254020	.522546	-.520217	-.719651	.251249
		.282927	.477454	-.439108	-.607572	.223380
	3	1.605113	.827395	.333108	.402599	.915363
		1.019539	.684582	-.389636	-.470922	.202414
		.445612	.315418	-.649454	-.784950	.348052
	4	1.609275	.907577	.410662	.452482	.891771
		.750320	.823696	-.257457	-.283676	.146221
		.557494	.176304	-.767312	-.845451	.428210
	5	1.620269	.940808	.456097	.484793	.874522
		.447901	.885119	-.124538	-.132373	.088802
		.613081	.114881	-.813376	-.864553	.476787
	6	1.624811	.975755	.487598	.499713	.865649
		.147089	.952098	.010372	.016630	.029238
		.641222	.047902	-.845127	-.866126	.499797
	7	1.626041	1.022562	.516020	.504625	.863087
		-.148316	1.045673	.185219	.181129	-.082222
		.623224	-.045673	-.863186	-.844124	.493318
	8	1.627233	1.027046	.501079	.487683	.872872
		-.442846	1.054824	.385641	.375486	-.218218
		.524111	-.054824	-.809336	-.788023	.436436
	9	1.618821	1.037872	.505633	.487230	.872872
		-.751160	1.077179	.454951	.438350	-.218218
		.386778	-.077179	-.783890	-.755286	.436436
	10	1.607148	1.045350	.507243	.485237	.872872
		-1.085976	1.092756	.504246	.482370	-.218218
		.242716	-.092756	-.762363	-.725290	.436436
	11	1.589795	.843584	.275088	.326094	.945063
		-1.365206	.711633	.631390	.748462	-.272824
		.034464	.288367	-.487141	-.577466	.180064
	12	1.591395	.659238	.182435	.276812	.958086
		-1.389794	.434594	.633456	.960895	-.276584
		-.094899	.565406	-.004927	-.007473	-.074655

FOLDOUT FRA

EST BODY

X-FLOW

VT TSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ	VN SIG
50542	.186355	.286460	.958086	.000000
23205	-.603774	-.928109	.276584	-.139050
76795	-.154717	-.237613	.074655	
22874	.242954	.336094	.941794	.000000
22546	-.520217	-.719651	.251249	-.137437
77454	-.439138	-.607572	.223380	
27395	.333138	.402599	.915363	.000000
84582	-.389636	-.470922	.202414	-.133778
15418	-.649454	-.784950	.348052	
07577	.410652	.452482	.891771	.000000
23696	-.257457	-.283676	.146221	-.130613
76304	-.767312	-.845451	.428210	
40808	.456097	.484793	.874522	.000000
85119	-.124538	-.132373	.068802	-.123792
14881	-.813376	-.864553	.476787	
75755	.487598	.499713	.865649	.000000
52098	.010372	.010630	.029238	-.127684
47902	-.845127	-.866126	.499797	
22562	.516023	.504625	.863087	.000000
45673	.185219	.181129	-.082222	-.127758
45673	-.863186	-.844124	.493318	
27046	.501379	.487683	.872872	.000000
54824	.385641	.375486	-.218218	-.134528
54824	-.809336	-.788023	.436436	
37872	.505633	.487230	.872872	.000000
77179	.454951	.436350	-.218218	-.136366
77179	-.783839	-.755286	.436436	
45350	.507243	.485237	.872872	.000000
92756	.504246	.482370	-.218218	-.126897
92756	-.762363	-.729290	.436436	
33584	.275088	.326094	.945063	.000000
11633	.631390	.748462	-.272824	-.144478
88367	-.487141	-.577466	.180064	
59238	.182435	.276812	.958086	.000000
45594	.633458	.960895	-.276584	-.143742
55406	-.004927	-.007473	-.074655	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
1	13	1.598349	.686910	.228408	.332515	.941794
		-1.254020	.471645	.545503	.794140	-.251249
		-.282927	.528155	.349431	.508700	-.223380
	14	1.605113	.794765	.319054	.401444	.915363
		-1.019539	.631651	.417354	.525129	-.202414
		-.445612	.368349	.596382	.750388	-.348052
	15	1.609275	.883063	.399134	.452056	.891771
		-.750320	.779800	.290707	.329203	-.146221
		-.557494	.220200	.732075	.829018	-.428210
	16	1.620269	.918614	.445350	.484818	.874522
		-.447901	.843852	.170819	.185953	-.088802
		-.613081	.156148	.785065	.854619	-.476787
	17	1.624811	.938859	.469935	.500602	.865649
		-.147089	.881457	.060633	.064581	-.029238
		-.641222	.118543	.810455	.863265	-.499797
	18	1.624811	.941987	.471601	.500645	.865649
		.147089	.887340	-.0[illegible]2714	-.045345	.029238
		-.641222	.112660	.814314	.864464	-.499797
	19	1.620269	.928862	.450482	.484982	.874522
		.447901	.862784	-.152091	-.163739	.088802
		-.613081	.137216	.797947	.859059	-.476787
	20	1.609275	.902372	.408274	.452446	.891771
		.750320	.814275	-.271614	-.301000	.146221
		-.557494	.185725	.757505	.839459	-.428210
	21	1.605113	.824376	.331816	.402505	.915363
		1.019539	.679596	-.397026	-.481607	.202414
		-.445612	.320404	.641767	.778488	-.348052
	22	1.598349	.721173	.242312	.335997	.941794
		1.254020	.520090	-.523530	-.726026	.251249
		-.282927	.479910	.432699	.599994	-.223380
	23	1.591395	.649987	.186167	.286416	.958086
		1.389794	.422484	-.604720	-.930356	.276584
		-.094899	.577516	.148733	.228917	-.074655
2	1	1.220560	1.298463	1.168799	.900141	.435365
		1.831729	1.686005	-.543418	-.418509	.855263
		.149900	-.686005	-.156877	-.120818	.281038

FOLDOUT FRAME

DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
.332515	.941794	.000000
.794140	-.251249	-.141206
.508700	-.223380	
.401444	.915363	.000000
.525129	-.202414	-.136358
.750388	-.348052	
.452056	.891771	.000000
.329203	-.146221	-.132383
.829018	-.428210	
.484818	.874522	.000000
.185953	-.088802	-.129915
.854619	-.476787	
.500602	.865649	.000000
.064581	-.029238	-.128441
.863265	-.499797	
.500645	.865649	.000000
-.045345	.029238	-.128168
.864464	-.499797	
.484982	.874522	.000000
-.163739	.088802	-.129054
.859059	-.476787	
.452446	.891771	.000000
-.301000	.146221	-.130873
.839459	-.428210	
.402505	.915363	.000000
-.481607	.202414	-.133979
.778488	-.348052	
.335997	.941794	.000000
-.726026	.251249	-.137551
.599994	-.223380	
.286416	.958086	.000000
-.930356	.276584	-.139085
.228917	-.074655	
.900141	.435365	.000000
-.418509	.855263	-.041547
-.120818	.281038	

FOLDOUT FRAME 2

PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
2	2	1.241719	1.342441	1.235652	.920459	.390089
		1.652830	1.802147	-.395679	-.294746	.652170
		.414680	-.802147	-.344554	-.256670	.650004
	3	1.241630	1.394162	1.318375	.945640	.324553
		1.351646	1.943687	-.240723	-.172665	.447006
		.631851	-.943687	-.384222	-.275593	.833577
	4	1.242993	1.422806	1.362458	.957585	.288009
		.985715	2.024378	-.135694	-.095371	.287154
		.786135	-1.024378	-.386876	-.271910	.913561
	5	1.250180	1.439029	1.385168	.962571	.270929
		.600088	2.070805	-.055319	-.038442	.163401
		.876683	-1.070805	-.386075	-.268289	.948629
	6	1.250017	1.440042	1.388034	.963884	.261384
		.200026	2.073722	.055597	.038608	.052527
		.922094	-1.073722	-.379465	-.263509	.963805
	7	1.246098	1.454052	1.441656	.991475	.126140
		-.199566	2.114266	.103242	.071003	-.312996
		.867167	-1.114266	-.158854	-.109249	.941341
	8	1.250000	1.464273	1.463954	.999782	0.000000
		-.600000	2.144096	.027353	.018687	-.447214
		.700000	-1.144096	.013631	.009344	.894427
	9	1.250000	1.459110	1.458560	.999623	0.000000
		-1.000000	2.129001	.035829	.024556	-.447214
		.500000	-1.129001	.017915	.012278	.894427
	10	1.250000	1.413037	1.412346	.999511	0.000000
		-1.400000	1.996674	.039537	.027980	-.447214
		.300000	-.996674	.019768	.013990	.894427
	11	1.216789	1.329756	1.312735	.987245	.159008
		-1.739216	1.768252	.118463	.089086	-.593315
		.102018	-.768252	-.175463	-.131951	.789109
	12	1.220560	1.240825	1.106576	.891807	.435365
		-1.831729	1.539647	.561339	.452391	-.855263
		-.149900	-.539647	.005949	.004795	-.281036
	13	1.241719	1.307517	1.201637	.919023	.390089
		-1.652830	1.709599	.417526	.319327	-.652170
		-.414680	-.709599	.302225	.231144	-.650004

FOLDOUT FRAME 1

Y

X-FLOW

VX VY VZ	DCX DCY DCZ	NX NY NZ	VN SIG
1.235652	.920459	.390089	.000000
-.395679	-.294746	.652170	-.031945
-.344554	-.256670	.650004	
1.318375	.945640	.324553	.000000
-.240723	-.172665	.447006	-.019186
-.384222	-.275593	.833577	
1.362458	.957585	.288009	.000000
-.135694	-.095371	.287154	-.011885
-.386876	-.271910	.913561	
1.385168	.962571	.270929	.000000
-.055319	-.038442	.163401	-.008418
-.386075	-.268289	.948629	
1.368034	.963684	.261384	.000000
.055597	.038608	.052527	-.007881
-.379465	-.263509	.963805	
1.441656	.991475	.126140	.000000
.103242	.071003	-.312996	.022592
-.158854	-.109249	.941341	
1.463954	.999782	0.000000	.000000
.027353	.018687	-.447214	.051235
.013631	.009344	.894427	
1.458560	.999623	0.000000	.000000
.035829	.024556	-.447214	.049986
.017915	.012278	.894427	
1.412346	.999511	0.000000	.000000
.039537	.027980	-.447214	.047884
.019758	.013990	.894427	
1.312795	.987245	.159008	.000000
.118463	.089086	-.593315	.011237
-.175453	-.131951	.789109	
1.106576	.891807	.435365	.000000
.561339	.452391	-.855263	-.052420
.005949	.004795	-.281038	
1.201637	.919023	.390089	.000000
.417526	.319327	-.652170	-.039199
.302225	.231144	-.650004	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
2	14	1.241630	1.375733	1.300194	.945091	.324553
		-1.351646	1.892642	.259936	.188943	-.447006
		-.631851	-.892642	.366840	.266651	-.833577
	15	1.242990	1.414596	1.354205	.957309	.288009
		-.985715	2.001080	.156928	.110935	-.287154
		-.786135	-1.001080	.377600	.266931	-.913561
	16	1.250180	1.439168	1.385197	.962478	.270929
		-.600088	2.071262	.088699	.061631	-.163401
		-.876683	-1.071262	.380331	.264268	-.948629
	17	1.250017	1.449715	1.399292	.965212	.261384
		-.200026	2.101673	.030686	.021167	-.052527
		-.922094	-1.101673	.377813	.260612	-.963805
	18	1.250017	1.451738	1.401268	.965235	.261384
		.200026	2.107544	-.022042	-.015183	.052527
		-.922094	-1.107544	.378823	.260944	-.963805
	19	1.250180	1.445716	1.391589	.962560	.270929
		.600088	2.090095	-.079317	-.054863	.163401
		-.876683	-1.090095	.383776	.265457	-.948629
	20	1.242990	1.426664	1.366014	.957488	.288009
		.985715	2.035371	-.146440	-.102645	.287154
		-.786135	-1.035371	.384619	.269593	-.913561
	21	1.241630	1.396261	1.320233	.945549	.324553
		1.351646	1.949544	-.245998	-.176183	.447006
		-.631851	-.949544	.382116	.273671	-.833577
	22	1.241719	1.343418	1.236477	.920396	.390089
		1.652830	1.804772	-.398238	-.296481	.652170
		-.414680	-.804772	.342426	.254891	-.650004
	23	1.220560	1.298765	1.169035	.900112	.435365
		1.831729	1.686792	-.544285	-.419079	.855263
		-.149900	-.686792	.154603	.119039	-.281038
3	1	.500000	1.212633	1.212570	.999948	0.000000
		1.935000	1.470479	-.004275	-.003526	.938893
		.177300	-.470479	.011662	.009617	.344208
	2	.500000	1.221483	1.221289	.999841	0.000000
		1.735000	1.492020	-.016098	-.013179	.672591
		.477300	-.492020	.014632	.011979	.740014

FOLDOUT FRAME 1

DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
.945091	.324553	.000000
.186943	-.447006	-.024030
.266651	-.833577	
.957309	.288009	.000000
.110935	-.287154	-.014970
.266931	-.913561	
.962478	.270929	.000000
.061631	-.163401	-.010137
.264268	-.948629	
.965212	.261384	.000000
.021167	-.052527	-.007697
.260612	-.963805	
.965235	.261384	.000000
-.015183	.052527	-.007196
.260944	-.963805	
.962560	.270929	.000000
-.054863	.163401	-.008545
.265457	-.948629	
.957488	.288009	.000000
-.102645	.287154	-.012085
.269593	-.913561	
.945549	.324553	.000000
-.176183	.447006	-.019350
.273671	-.833577	
.920396	.390089	.000000
-.296481	.652170	-.032050
.254891	-.650004	
.900112	.435365	.000000
-.419079	.855263	-.041587
.119039	-.281038	
.999948	0.000000	.000000
-.003526	.938893	.009526
.009617	.344208	
.999841	0.000000	.000000
-.013179	.672591	.009772
.011979	.740014	

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
3	3	.500000	1.232356	1.232287	.999879	0.000000
		1.400000	1.518701	-.017153	-.013919	.447214
		.700000	-.518701	.008577	.006960	.894427
	4	.500000	1.237037	1.236982	.999955	0.000000
		1.000000	1.530261	-.011243	-.009088	.279631
		.858250	-.530261	.003274	.002647	.960107
	5	.500000	1.234013	1.234011	.999998	0.000000
		.600000	1.522789	-.002482	-.002011	.156305
		.948150	-.522789	.000393	.000318	.987709
	6	.500000	1.220064	1.220020	.999964	0.000000
		.200000	1.488557	.010370	.008500	.050436
		.989900	-.488557	-.000524	-.000429	.998727
	7	.500000	1.206541	1.206516	.999979	0.000000
		-.200000	1.455742	-.007029	-.005826	-.447214
		.900000	-.455742	-.003515	-.002913	.894427
	8	.500000	1.196347	1.196331	.999986	0.000000
		-.600000	1.431247	.005573	.004659	-.447214
		.700000	-.431247	.002787	.002329	.894427
	9	.500000	1.185439	1.185352	.999927	0.000000
		-1.000000	1.405265	.012836	.010828	-.447214
		.500000	-.405265	.006418	.005414	.894427
	10	.500000	1.175488	1.175287	.999829	0.000000
		-1.400000	1.381772	.019439	.016537	-.447214
		.300000	-.381772	.009719	.008268	.894427
	11	.500000	1.164000	1.163439	.999519	0.000000
		-1.800000	1.354895	.032302	.027751	-.447214
		.100000	-.354895	.016151	.013876	.894427
	12	.500000	1.168003	1.167855	.999873	0.000000
		-1.935000	1.364231	.006398	.005477	-.938893
		-.177300	-.364231	-.017450	-.014940	-.344208
	13	.500000	1.195403	1.195120	.999763	0.000000
		-1.735000	1.428989	.019253	.016106	-.672591
		-.477300	-.428989	-.017499	-.014638	-.740014
	14	.500000	1.218760	1.218532	.999813	0.000000
		-1.400000	1.485377	.021080	.017296	-.447214
		-.700000	-.485377	-.010540	-.008648	-.894427

FOLDOUT FRAME 1

X-FLOW

VX VY VZ	DCX DCY DCZ	NX NY NZ	VN SIG
1.232207	.999879	0.000000	.000000
-.017153	-.013919	.447214	.010857
.008577	.006960	.894427	
1.236932	.999955	0.000000	.000000
-.011243	-.009088	.279631	.011576
.003274	.002647	.960107	
1.234011	.999998	0.000000	.000000
-.002482	-.002011	.156305	.011805
.000393	.000318	.987709	
1.220020	.999964	0.000000	.000000
.010370	.008500	.050436	.010980
-.000524	-.000429	.998727	
1.206516	.999979	0.000000	.000000
-.007029	-.005826	-.447214	.011147
-.003515	-.002913	.894427	
1.196331	.999986	0.000000	.000000
.005573	.004659	-.447214	.011654
.002787	.002329	.894427	
1.185352	.999927	0.000000	.000000
.012836	.010828	-.447214	.010632
.006418	.005414	.894427	
1.175237	.999829	0.000000	.000000
.019439	.016537	-.447214	.008609
.009719	.008268	.894427	
1.163439	.999519	0.000000	.000000
.032302	.027751	-.447214	.004981
.016151	.013876	.894427	
1.167855	.999873	0.000000	.000000
.006398	.005477	-.938893	.006411
-.017450	-.014940	-.344208	
1.195120	.999763	0.000000	.000000
.019253	.016106	-.672591	.007340
-.017439	-.014638	-.740014	
1.218532	.999813	0.000000	.000000
.021030	.017296	-.447214	.008900
.010540	-.008648	-.894427	

FOLDOUT FRAME 2

PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
3	15	.500000	1.234579	1.234462	.999905	0.000000
		-1.000000	1.524186	.016316	.013216	-.279631
		-.858250	-.524186	-.004752	-.003849	-.960107
	16	.500000	1.244132	1.244037	.999964	0.000000
		-.600000	1.547863	.010366	.008332	-.156305
		-.948150	-.547863	-.001640	-.001319	-.987709
	17	.500000	1.249397	1.249390	.999994	0.000000
		-.200000	1.560993	.004210	.003369	-.050436
		-.989900	-.560993	-.000213	-.000170	-.998727
	18	.500000	1.251259	1.251258	.999999	0.000000
		.200000	1.565650	-.001969	-.001573	.050436
		-.989900	-.565650	-.000099	-.000079	-.998727
	19	.500000	1.249969	1.249942	.999979	0.000000
		.600000	1.562422	-.008053	-.006451	.156305
		-.948150	-.562422	-.001276	-.001021	-.987709
	20	.500000	1.245269	1.245195	.999933	0.000000
		1.000000	1.550694	-.013864	-.011133	.279631
		-.858250	-.550694	-.004038	-.003242	-.960107
	21	.500000	1.236471	1.236305	.999866	0.000000
		1.400000	1.528862	-.018128	-.014661	.447214
		-.700000	-.528862	-.009064	-.007331	-.894427
	22	.500000	1.223413	1.223215	.999838	0.000000
		1.735000	1.496738	-.016278	-.013306	.672591
		-.477300	-.496738	-.014795	-.012093	-.740014
	23	.500000	1.213215	1.213153	.999949	0.000000
		1.935000	1.471890	-.004220	-.003478	.938893
		-.177300	-.471890	-.011510	-.009487	-.344208
4	1	-.248068	1.156990	1.155568	.998771	-.049532
		1.923092	1.338626	.053200	.045981	.939127
		.174052	-.338626	.021401	.018497	.339980
	2	-.249477	1.161134	1.160040	.999058	-.043145
		1.726269	1.348232	.029883	.025736	.675158
		.470683	-.348232	.040558	.034938	.736411
	3	-.249169	1.165449	1.164708	.999364	-.034875
		1.395016	1.358272	.010548	.006051	.449471
		.692774	-.358272	.040195	.034489	.892614

FOLDOUT FRAME /

DDY

X-FLOW

VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
1.234462	.999905	0.000000	.000000
.016316	.013216	-.279631	.010302
-.004752	-.003849	-.960107	
1.244037	.999964	0.000000	.000000
.010366	.008332	-.156305	.011310
-.001640	-.001319	-.987709	
1.249390	.999994	0.000000	.000000
.004210	.003369	-.050436	.011924
-.000213	-.000170	-.998727	
1.251258	.999999	0.000000	.000000
-.001969	-.001573	.050436	.012193
-.000099	-.000079	-.998727	
1.249942	.999979	0.000000	.000000
-.008053	-.006451	.156305	.012128
-.001276	-.001021	-.987709	
1.245135	.999933	0.000000	.000000
-.013864	-.011133	.279631	.011700
-.004038	-.003242	-.960107	
1.236305	.999866	0.000000	.000000
-.018128	-.014661	.447214	.010921
-.009064	-.007331	-.894427	
1.223215	.999838	0.000000	.000000
-.016278	-.013306	.672591	.009813
-.014795	-.012093	-.740014	
1.213153	.999949	0.000000	.000000
-.004220	-.003478	.938893	.009545
-.011510	-.009487	-.344208	
1.155568	.998771	-.049532	.000000
.053200	.045981	.939127	.004922
.021401	.018497	.339980	
1.160040	.999058	-.043145	.000000
.029883	.025736	.675154	.004422
.040558	.034938	.736411	
1.164708	.999364	-.034875	.000000
.010548	.009051	.449471	.004010
.040195	.034489	.892614	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	V1 VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
4	4	-.249537	1.166421	1.165810	.999476	-.031043
		.998756	1.360539	-.000124	-.000106	.281449
		.850538	-.360539	.037770	.032381	.959074
	5	-.250016	1.163090	1.162505	.999497	-.029218
		.600001	1.352777	-.008737	-.007555	.157442
		.940749	-.352777	.035812	.030790	.987096
	6	-.250002	1.152040	1.151345	.999397	-.028252
		.200000	1.327196	-.021558	-.018722	.050769
		.982825	-.327196	.033683	.029235	.998310
	7	-.249496	1.135124	1.134800	.999714	-.012608
		-.199997	1.288507	-.026978	-.023767	-.434528
		.896509	-.288507	.002870	.002529	.900571
	8	-.250000	1.119936	1.119873	.999944	0.000000
		-.600000	1.254256	-.010588	-.009454	-.447214
		.700000	-.254256	-.005294	-.004727	.894427
	9	-.250000	1.111342	1.111342	.999999	0.000000
		-1.000000	1.235082	.001286	.001157	-.447214
		.500000	-.235082	.000643	.000578	.894427
	10	-.250000	1.108832	1.108740	.999917	0.000000
		-1.400000	1.229508	.012740	.011489	-.447214
		.300000	-.229508	.006370	.005745	.894427
	11	-.247831	1.115217	1.114799	.999625	-.012880
		-1.793015	1.243710	.017342	.015550	-.460010
		.100024	-.243710	.025159	.022559	.887820
	12	-.248068	1.128924	1.126893	.998201	-.049532
		-1.923092	1.274468	-.065545	-.058060	-.939127
		-.174052	-.274468	.016879	.014951	-.339980
	13	-.249477	1.147986	1.146858	.999018	-.043145
		-1.726269	1.317872	-.042024	-.036607	-.675158
		-.470688	-.317872	-.028665	-.024969	-.736411
	14	-.249169	1.160735	1.160026	.999389	-.034875
		-1.395016	1.347306	-.020453	-.017620	-.449471
		-.692774	-.347306	-.035024	-.030174	-.892614
	15	-.249537	1.169028	1.168465	.999518	-.031043
		-.998756	1.366627	-.009974	-.008532	-.281449
		-.850538	-.366627	-.034893	-.029848	-.959074

FOLDOUT FRAME 1

W

DCX DCY DCZ	NX NY NZ	VN SIG
.999476	-.031043	.000000
-.000106	.281449	.004083
.032381	.959074	
.999497	-.029218	.000000
-.007555	.157442	.004254
.030790	.987096	
.999397	-.028252	.000000
-.018722	.050769	.004249
.029235	.998310	
.999714	-.012608	.000000
-.023767	-.434526	.000604
.002529	.900571	
.999944	0.000000	.000000
-.009454	-.447214	-.001173
-.004727	.894427	
.999999	0.000000	.000000
.001157	-.447214	-.001694
.000578	.894427	
.999917	0.000000	.000000
.011489	-.447214	-.002980
.005745	.894427	
.999625	-.012880	.000000
.015550	-.460010	-.003264
.022559	.887820	
.998201	-.049532	.000000
-.058060	-.939127	.007805
.014951	-.339980	
.999018	-.043145	.000000
-.036607	-.675158	.006628
-.024969	-.736411	
.999389	-.034875	.000000
-.017620	-.449471	.005602
-.030174	-.892614	
.999518	-.031043	.000000
-.008532	-.281449	.005201
-.029848	-.959074	

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
4	16	-.250016	1.174210	1.173709	.999573	-.029218
		-.600001	1.378769	-.005058	-.004308	-.157442
		-.940749	-.378769	-.033935	-.028900	-.987096
	17	-.250002	1.177071	1.176601	.999601	-.028252
		-.200003	1.385497	-.002132	-.001854	-.050789
		-.982825	-.385497	-.033187	-.028194	-.998310
	18	-.250002	1.177939	1.177467	.999600	-.028252
		.200003	1.387539	-.000154	-.000131	.050789
		-.982825	-.387539	-.033330	-.028295	-.998310
	19	-.250016	1.176983	1.176476	.999569	-.029218
		.600001	1.385288	.002234	.001940	.157442
		-.940749	-.385288	-.034459	-.029278	-.987096
	20	-.249537	1.174127	1.173553	.999511	-.031043
		.998756	1.378574	.006152	.005248	.281449
		-.850538	-.378574	-.036176	-.030811	-.959074
	21	-.249169	1.169520	1.168800	.999384	-.034675
		1.395016	1.367777	.014296	.012223	.449471
		-.692774	-.367777	-.038458	-.032892	-.892614
	22	-.249477	1.163098	1.162013	.999367	-.043145
		1.726269	1.352797	.032273	.027748	.675158
		-.470688	-.352797	-.038492	-.033094	-.736411
	23	-.248068	1.157588	1.156167	.998772	-.049532
		1.923092	1.340010	.054224	.046842	.939127
		-.174052	-.340010	-.018660	-.016120	-.339980
5	1	-.743334	1.160425	1.146655	.988142	-.153543
		1.874150	1.346587	.168493	.145199	.934141
		.161626	-.346587	.057936	.049927	.322188
	2	-.747389	1.166631	1.156305	.991149	-.132740
		1.690281	1.361028	.104989	.089994	.683173
		.444215	-.361028	.113850	.097597	.718091
	3	-.747752	1.171864	1.164881	.994042	-.108809
		1.373892	1.373264	.051909	.044296	.457325
		.663304	-.373264	.116710	.099593	.882618
	4	-.747958	1.173024	1.167569	.995350	-.095703
		.992572	1.375986	.020130	.017212	.288525
		.819383	-.375986	.111176	.094777	.952677

W

DCX DCY DCZ	NX NY NZ	VN SIG
.999573	-.029218	.000000
-.004308	-.157442	.005076
-.028990	-.987096	
.999601	-.028252	.000000
-.001854	-.350789	.004937
-.028194	-.936310	
.999600	-.028252	.000000
-.000131	.350789	.004766
-.028295	-.936310	
.999569	-.029218	.000000
.001940	.157442	.004603
-.029278	-.987096	
.999511	-.031043	.000000
.005248	.281449	.004347
-.030811	-.959074	
.999384	-.034675	.000000
.012223	.449471	.004212
-.032892	-.892614	
.999067	-.043145	.000000
.027748	.675158	.004566
-.033094	-.736411	
.998772	-.049532	.000000
.046842	.939127	.004967
-.016120	-.339980	
.988142	-.153543	-.000000
.145199	.934141	.015792
.049927	.322188	
.991149	-.132740	-.000000
.089994	.683173	.013445
.097597	.718091	
.994042	-.108809	-.000000
.044296	.457325	.010893
.099593	.882618	
.995350	-.095703	-.000000
.017212	.288525	.009621
.094777	.952677	

FOLDOUT FRAME 2

PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
5	5	-.750055	1.170769	1.165817	.995771	-.089915
		.600009	1.370699	-.004751	-.004067	.162020
		.910468	-.370699	.107457	.091784	.982682
	6	-.750055	1.161565	1.156220	.995398	-.086851
		.200003	1.349234	-.041883	-.036057	.052106
		.953924	-.349234	.103132	.088787	.994858
	7	-.748551	1.145511	1.143638	.998365	-.039925
		-.199961	1.312195	-.060743	-.053027	-.379842
		.882279	-.312195	.024440	.021335	.924189
	8	-.750000	1.124601	1.124251	.999689	0.000000
		-.600000	1.264728	-.025092	-.022312	-.447214
		.700000	-.264728	-.012546	-.011156	.894427
	9	-.750000	1.114870	1.114851	.999992	0.000000
		-1.000000	1.242934	-.004028	-.003613	-.447214
		.500000	-.242934	-.002014	-.001807	.894427
	10	-.750000	1.115443	1.115255	.999831	0.000000
		-1.400000	1.244214	.018316	.016420	-.447214
		.300000	-.244214	.009158	.008210	.894427
	11	-.741375	1.132611	1.130300	.997960	-.044855
		-1.764760	1.282807	.017624	.015560	-.519160
		.100234	-.282807	.070123	.061913	.853499
	12	-.743334	1.132236	1.115714	.985408	-.153543
		-1.874150	1.281958	-.191336	-.168990	-.934141
		-.161626	-.281958	.023044	.020353	-.322188
	13	-.747389	1.151358	1.140735	.990816	-.132740
		-1.690281	1.325626	-.126978	-.110286	-.683173
		-.444215	-.325626	-.090072	-.078231	-.718091
	14	-.747752	1.165286	1.158299	.994004	-.108869
		-1.373892	1.357891	-.069581	-.059712	-.457325
		-.663304	-.357891	-.106741	-.091601	-.882618
	15	-.747958	1.173015	1.167615	.995397	-.095703
		-.992572	1.375964	-.038301	-.032652	-.288525
		-.819383	-.375964	-.105695	-.090106	-.952677
	16	-.750055	1.177768	1.172992	.995944	-.089915
		-.600009	1.387138	-.020972	-.017807	-.162020
		-.910468	-.387138	-.103871	-.086193	-.982682

FOLDOUT FRAME

DCX DCY DCZ	NX NY NZ	VN SIG
95771 34067 91784	-.089915 .162020 .982682	.000000 .009344
95398 36057 88787	-.086851 .052106 .994858	-.000000 .009411
98365 53027 21335	-.039925 -.379842 .924189	.000000 -.000416
99689 22312 11156	0.000000 -.447214 .894427	.000000 -.007092
99992 03613 01807	0.000000 -.447214 .894427	.000000 -.007455
99831 16420 08210	0.000000 -.447214 .894427	.000000 -.009000
97960 15560 61913	-.044855 -.519160 .853499	.000000 -.005237
85408 68990 20353	-.153543 -.934141 -.322188	-.000000 .022041
90816 10286 78231	-.132740 -.683173 -.718091	-.000000 .016214
94004 59712 91601	-.108869 -.457325 -.882618	-.000000 .014426
95397 32652 90106	-.095703 -.288525 -.952677	-.000000 .012115
95944 17807 88193	-.089915 -.162020 -.982682	.000000 .011020

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ
5	17	-.750005	1.180390	1.175928	.996219	-.086851
		-.200003	1.393322	-.007814	-.006620	-.052106
		-.953924	-.393322	-.102249	-.086623	-.994858
	18	-.750005	1.181278	1.176812	.996220	-.086851
		.200003	1.395417	.003321	.002812	.052106
		-.953924	-.395417	-.102562	-.086823	-.994858
	19	-.750055	1.180608	1.175825	.995949	-.089915
		.600009	1.393835	.015707	.013304	.162020
		-.910468	-.393835	-.104938	-.088936	-.982682
	20	-.747958	1.178349	1.172939	.995409	-.095703
		.992572	1.388506	.031346	.026601	.288525
		-.819383	-.388506	-.108337	-.091940	-.952677
	21	-.747752	1.174632	1.167657	.994063	-.108809
		1.373892	1.379760	.058416	.049732	.457325
		-.663304	-.379760	-.113680	-.096779	-.882618
	22	-.747389	1.167891	1.157552	.991148	-.132740
		1.690281	1.363969	.108970	.093305	.683173
		-.444215	-.363969	-.110304	-.094447	-.718091
	23	-.743334	1.160774	1.146999	.988133	-.153543
		1.874150	1.347396	.170110	.146548	.934141
		-.161626	-.347396	-.053408	-.046011	-.322188
6	1	-1.229655	1.132362	1.090828	.963321	-.268347
		1.773614	1.282243	.291169	.257134	.921489
		.134912	-.282243	.086937	.076775	.280799
	2	-1.245329	1.144713	1.111521	.971003	-.239765
		1.614691	1.310369	.197828	.172819	.702123
		.336555	-.310369	.189089	.165185	.670724
	3	-1.245068	1.158983	1.136725	.980795	-.194936
		1.329324	1.343242	.102894	.088779	.475316
		.600627	-.343242	.201273	.173663	.857948
	4	-1.245783	1.165866	1.148618	.985205	-.170981
		.979004	1.359244	.048514	.041612	.304683
		.753512	-.359244	.193825	.166250	.936981
	5	-1.250120	1.169561	1.154226	.986888	-.159881
		.600034	1.367873	.006877	.005880	.172638
		.846449	-.367873	.188649	.161299	.971923

FOLDOUT FRAME 1

DCX	NX	VN
DCY	NY	SIG
DCZ	NZ	
.996219	-.086851	.000000
-.006620	-.052106	.010240
-.086623	-.994858	
.996220	-.086851	.000000
.002812	.052106	.009850
-.086823	-.994858	
.995949	-.069915	.000000
.013304	.162020	.009820
-.088936	-.982682	
.995409	-.095703	-.000000
.026601	.288525	[illegible]0025
-.091940	-.952677	
.994063	-.108809	-.000000
.049732	.457325	.011212
-.096779	-.882618	
.991148	-.132740	-.000000
.093305	.683173	.013668
-.094447	-.718091	
.988133	-.153543	-.000000
.146548	.934141	.015888
-.046011	-.322188	
.963321	-.268347	-.000000
.257134	.921489	.027232
.076775	.280799	
.971003	-.239965	-.000000
.172819	.702123	.024419
.165185	.670724	
.980795	-.194936	-.000000
.088779	.475316	.019161
.173663	.857948	
.985205	-.170981	-.000000
.041612	.304683	.016512
.166250	.936981	
.986888	-.159881	-.000000
.005880	.172638	.015703
.161299	.971923	

FOLDOUT FRAME 2

PROGRAM BOXC

BODY ID. TEST

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ
6	6	-1.250012	1.170850	1.155253	.986679	-.153515
		.200010	1.370889	-.053638	-.045811	.055250
		.893198	-.370889	.182761	.156093	.986601
	7	-1.248100	1.174562	1.168781	.995078	-.074106
		-.199835	1.379597	-.096906	-.082504	-.251846
		.852389	-.379597	.064470	.054888	.964926
	8	-1.250000	1.154940	1.154001	.999187	0.000000
		-.600000	1.333886	-.041635	-.036050	-.447214
		.700000	-.333886	-.020818	-.018025	.894427
	9	-1.250000	1.138016	1.137954	.999954	0.000000
		-1.000000	1.295081	-.009750	-.008568	-.447214
		.500000	-.295081	-.004875	-.004284	.894427
	10	-1.250000	1.143892	1.143401	.999571	0.000000
		-1.400000	1.308488	.029956	.026188	-.447214
		.300000	-.308488	.014978	.013094	.894427
	11	-1.225923	1.161360	1.150415	.990576	-.105654
		-1.707445	1.348756	-.011041	-.009507	-.687853
		.100626	-.348756	.158631	.136634	.718119
	12	-1.229655	1.118520	1.069951	.956586	-.268347
		-1.773614	1.251088	-.323600	-.289310	-.921489
		-.134912	-.251088	.039432	.035254	-.280799
	13	-1.245329	1.130909	1.097016	.970030	-.239065
		-1.614691	1.278956	-.230259	-.203614	-.702123
		-.386555	-.278956	-.149960	-.132601	-.670724
	14	-1.245068	1.151328	1.129039	.980641	-.194936
		-1.329324	1.325556	-.127739	-.110993	-.475316
		-.600627	-.325556	-.185734	-.161321	-.857948
	15	-1.245783	1.162543	1.145364	.985223	-.170981
		-.979004	1.351506	-.072753	-.062581	-.314683
		-.753512	-.351506	-.185350	-.159435	-.936981
	16	-1.250120	1.169385	1.154316	.987114	-.159881
		-.600034	1.367462	-.040457	-.034597	-.172638
		-.846449	-.367462	-.182699	-.156235	-.971923
	17	-1.250012	1.172927	1.159016	.988140	-.153515
		-.200010	1.375757	-.014301	-.012192	-.055250
		-.893198	-.375757	-.179542	-.153072	-.986601

FOLDOUT FRAME 1

CX / CY / CZ	NX / NY / NZ	VN / SIG
CX	NX	VN
CY	NY	SIG
CZ	NZ	
6679	-.153515	-.000000
5811	.055250	.015444
6093	.986601	
5078	-.074106	.000000
2504	-.251846	.000059
4888	.964926	
9187	0.000000	.000000
6050	-.447214	-.013633
8025	.894427	
9954	0.000000	.000000
8568	-.447214	-.013916
4284	.894427	
8571	0.000000	.000000
6188	-.447214	-.016569
3094	.894427	
0576	-.105654	.000000
9507	-.687853	-.002403
6634	.718119	
6586	-.268347	-.000000
9310	-.921489	.036006
5254	-.280799	
0030	-.239065	-.000000
6614	-.702123	.031398
2601	-.670724	
8641	-.194936	-.000000
0993	-.475316	.024287
1321	-.857948	
6223	-.170981	-.000000
2581	-.304683	.020145
9435	-.936981	
7114	-.159881	-.000000
4597	-.172638	.018139
6235	-.971923	
8140	-.153515	-.000000
2192	-.055250	.016626
3072	-.986601	

FOLDOUT FRAME 2

PROGRAM BOXC

ATMOSPHERIC SCIENCE ASSOCIATES
BEDFORD, MASSACHUSETTS

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX	VT	VX	DCX	NX
		NPY	VTSQ	VY	DCY	NY
		NPZ	CP	VZ	DCZ	NZ
6	18	-1.250012	1.173694	1.159779	.986144	-.153515
		.200010	1.377557	.007630	.006552	.055250
		-.893198	-.377557	-.180031	-.153388	-.986601
	19	-1.250120	1.171902	1.156827	.987136	-.159881
		.600034	1.373354	.032565	.027788	.172638
		-.846449	-.373354	-.184514	-.157448	-.971923
	20	-1.245783	1.167332	1.150142	.985274	-.170981
		.979004	1.362663	.062430	.053481	.304683
		-.753512	-.362663	-.189579	-.162403	-.936981
	21	-1.245068	1.159668	1.137419	.980815	-.194936
		1.329324	1.344829	.111184	.095876	.475316
		-.600627	-.344829	-.196837	-.169736	-.857948
	22	-1.245329	1.144845	1.111627	.970984	-.239065
		1.614691	1.310671	.202859	.177193	.702123
		-.386555	-.310671	-.183850	-.160598	-.670724
	23	-1.229655	1.132343	1.090782	.963296	-.268347
		1.773614	1.282201	.293104	.258846	.921489
		-.134912	-.282201	-.080540	-.071127	-.280799
7	1	-1.699678	1.071793	.975394	.910058	-.414479
		1.611865	1.148740	.431871	.402943	.885202
		.096576	-.148740	.104085	.097113	.211244
	2	-1.733772	1.092781	1.014192	.928083	-.372374
		1.484752	1.194171	.318158	.291155	.725701
		.297994	-.194171	.253683	.232145	.578529
	3	-1.738932	1.121965	1.066664	.950711	-.310024
		1.250730	1.258805	.179768	.160226	.507279
		.497910	-.258805	.297852	.265474	.804085
	4	-1.738266	1.142165	1.099857	.962958	-.269527
		.954054	1.304542	.097975	.085780	.335023
		.644837	-.304542	.291988	.255644	.902837
	5	-1.750276	1.158627	1.121590	.968034	-.250229
		.600104	1.342417	.037906	.032716	.193980
		.739306	-.342417	.288124	.248677	.948555
	6	-1.750025	1.174333	1.139526	.970360	-.237694
		.200030	1.379059	-.034967	-.029776	.061556
		.792992	-.379059	.281632	.239823	.969388

FOLDOUT FRAME 1

DCX	NX	VN
DCY	NY	SIG
DCZ	NZ	
.986144	-.153515	-.000030
.006552	.055250	.016044
-.153388	-.986601	
.987136	-.159881	-.000030
.027788	.172638	.016340
-.157448	-.971923	
.985274	-.170981	-.000000
.053481	.304683	.017048
-.162403	-.936981	
.980815	-.194936	.000000
.095876	.475316	.019582
-.169736	-.857948	
.970984	-.239065	-.000000
.177193	.702123	.024706
-.160598	-.670724	
.963296	-.268347	-.000000
.258848	.921489	.027344
-.071127	-.280799	
.910058	-.414479	-.000030
.402943	.885202	.041810
.097113	.211244	
.928083	-.372374	-.000000
.291155	.725701	.037841
.232145	.578529	
.950711	-.310024	-.000000
.160226	.507279	.030138
.265474	.804085	
.962958	-.269527	-.000000
.085780	.335023	.025359
.255644	.902837	
.968034	-.250229	-.000030
.032716	.193980	.023756
.248677	.948555	
.970360	-.237694	-.000030
.029776	.061556	.022518
.239823	.969388	

FOLDOUT FRAME 2

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CF	VX VY VZ	DCX DCY DCZ	NX NY NZ	VN SIG
7	7	-1.749550	1.205607	1.178688	.977672	-.197278	.000000
		-.199759	1.453488	-.115921	-.096152	-.113683	.015226
		.782469	-.453488	.225268	.186851	.973734	
	8	-1.747311	1.230972	1.225355	.995437	-.075980	.000000
		-.599857	1.515291	-.100709	-.081813	-.368319	-.008877
		.679777	-.515291	.060447	.049105	.926589	
	9	-1.750000	1.227360	1.227221	.999871	0.000000	.000000
		-1.000000	1.506461	-.017632	-.014365	-.447214	-.024519
		.500000	-.506461	-.008816	-.007183	.894427	
	10	-1.720409	1.218753	1.215655	.997458	-.050829	.000000
		-1.352829	1.485359	.022100	.018133	-.496741	-.018933
		.314114	-.485359	.083999	.068914	.866409	
	11	-1.762537	1.166416	1.083060	.928542	-.348626	-.000000
		-1.550513	1.360526	-.292335	-.250627	-.842191	.034454
		.113943	-.360526	.319428	.273854	.411307	
	12	-1.699678	1.081512	.977211	.903560	-.414479	0.000000
		-1.611865	1.169668	-.462855	-.427970	-.885202	.049582
		-.096576	-.169668	.022186	.020514	-.211244	
	13	-1.733772	1.086144	1.006208	.926404	-.372374	-.000000
		-1.484752	1.179709	-.356337	-.328121	-.725701	.045341
		-.297994	-.179709	-.200604	-.184693	-.578529	
	14	-1.738932	1.114650	1.059335	.950374	-.310024	-.000000
		-1.250730	1.242445	-.210056	-.188450	-.507279	.035901
		-.497910	-.242445	-.275918	-.247538	-.804085	
	15	-1.738266	1.136204	1.093988	.962844	-.269527	-.000000
		-.954054	1.290960	-.125252	-.110237	-.335023	.029572
		-.644837	-.290960	-.280114	-.246534	-.902837	
	16	-1.750276	1.151282	1.114573	.968114	-.250229	-.000000
		-.600104	1.325451	-.071497	-.062102	-.193980	.026698
		-.739306	-.325451	-.279403	-.242689	-.948555	
	17	-1.750025	1.158015	1.124810	.971326	-.237694	-.000000
		-.200030	1.340998	-.023565	-.020350	-.061556	.024180
		-.792992	-.340998	-.274307	-.236877	-.969388	
	18	-1.750025	1.158514	1.125308	.971338	-.237694	-.000000
		.200030	1.342154	.015083	.013019	.061556	.023503
		-.792992	-.342154	-.274958	-.237345	-.969388	

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX / NPY / NPZ	VT / VTSQ / CP	VX / VY / VZ	DCX / DCY / DCZ	NX / NY / NZ	VN / SIG
7	19	-1.750276	1.152916	1.116233	.966183	-.250229	-.000000
		.600104	1.329215	.060962	.052876	.193980	.024579
		-.739306	-.329215	-.281996	-.244593	-.948555	
	20	-1.738266	1.139416	1.097239	.962984	-.269527	-.000000
		.954054	1.298269	.111503	.097859	.335023	.026002
		-.644837	-.298269	-.286136	-.251169	-.902837	
	21	-1.738932	1.120131	1.064935	.950724	-.310024	-.000000
		1.250730	1.254694	.188418	.168210	.507279	.030634
		-.497910	-.254694	-.291729	-.260442	-.804085	
	22	-1.733772	1.091523	1.012990	.928052	-.372374	-.000000
		1.464752	1.191423	.323365	.296251	.725701	.038158
		-.297994	-.191423	-.246391	-.225731	-.578529	
	23	-1.699678	1.071357	.974973	.910036	-.414479	-.000000
		1.611865	1.147806	.433686	.404800	.885202	.041913
		-.096576	-.147806	-.095654	-.089283	-.211244	
		************		************		************	
8	1	-2.218024	.953089	.763560	.801143	-.597981	-.000000
		1.240723	.908378	.521127	.546777	.747834	.065691
		.149617	.091622	.231907	.243322	.288382	
	2	-2.214445	1.078634	.975907	.904762	-.425912	-.000000
		.990269	1.163451	.237422	.220114	.463200	.039168
		.411287	-.163451	.393304	.364631	.777203	
	3	-2.250969	1.127743	1.034668	.917468	-.397801	-.000000
		.600392	1.271805	.117301	.104014	.246251	.036289
		.560379	-.271805	.433021	.383971	.883807	
	4	-2.250072	1.160877	1.079656	.930043	-.366809	-.000000
		.200101	1.347636	.007608	.006554	.075569	.032128
		.632913	-.347636	.426436	.367391	.927222	
	5	-2.250072	1.187823	1.104142	.929551	-.366809	-.000000
		-.200101	1.410923	-.082736	-.069654	-.075569	.032261
		.632913	-.410923	.430056	.362054	.927222	
	6	-2.250383	1.215486	1.127038	.927273	-.372805	-.000000
		-.600126	1.477407	-.178891	-.147176	-.278586	.031772
		.553499	-.477407	.418424	.344244	.885102	

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ	VN SIG
8	7	-2.218355	1.206050	1.107315	.918133	-.396212	-.000000
		-.956945	1.454557	-.246493	-.204380	-.458473	.033983
		.416059	-.454557	.409454	.339500	.795499	
	8	-2.212088	1.083768	.912254	.841752	-.537231	-.000000
		-1.209729	1.174554	-.477735	-.440855	-.740960	.058742
		.166619	-.174554	.337711	.311608	.402941	
	9	-2.218024	.965398	.772784	.800483	-.597981	-.000000
		-1.240723	.931993	-.555522	-.575433	-.747834	.069724
		-.149617	.068007	-.161841	-.167642	-.288382	
	10	-2.214445	1.074426	.971402	.904113	-.425912	.000000
		-.990269	1.154391	-.269128	-.250485	-.463200	.043639
		-.411287	-.154391	-.371939	-.346175	-.777203	
	11	-2.250969	1.117305	1.024801	.917209	-.397801	-.000000
		-.600392	1.248370	-.145030	-.129804	-.246251	.039174
		-.560379	-.248370	-.420854	-.376669	-.883807	
	12	-2.250074	1.138957	1.059640	.930360	-.366578	-.000000
		-.200104	1.297223	-.042453	-.037274	-.075231	.033966
		-.632837	-.297223	-.415432	-.364748	-.927341	
	13	-2.250074	1.139033	1.059741	.930387	-.366578	-.000000
		.200104	1.297395	.032406	.028451	.075231	.033347
		-.632837	-.297395	-.416287	-.365474	-.927341	
	14	-2.250969	1.117486	1.025191	.917408	-.397801	.000000
		.600392	1.248774	.131954	.118082	.246251	.037211
		-.560379	-.248774	-.424672	-.380025	-.883807	
	15	-2.214445	1.073361	.971068	.904682	-.425912	.000000
		.990269	1.152146	.246436	.229607	.463200	.039860
		-.411287	-.152146	-.385268	-.358930	-.777203	
	16	-2.218024	.950934	.762055	.801375	-.597981	-.000000
		1.240723	.904276	.524166	.551212	.747834	.065833
		-.149617	.095724	-.220904	-.232302	-.288382	
		************		************		************	
9	1	-2.626833	.660120	.326828	.495104	-.868756	.000000
		.687692	.435759	.468030	.709007	.411733	.104713
		.149145	.564241	.331497	.502177	.275208	

BODY ID. TEST

TEST BODY

X-FLOW

N	M	NPX NPY NPZ	VT VTSQ CP	VX VY VZ	DCX DCY DCZ	NX NY NZ	VN SIG
9	2	-2.629150	.835434	.526675	.630421	-.776209	-.000000
		.434170	.697949	.195323	.233798	.200002	.088646
		.336208	.302051	.618394	.740208	.597912	
	3	-2.635472	.879817	.591517	.672319	-.740175	.000000
		.141262	.774078	.046040	.052329	.062764	.086147
		.389779	.225922	.649665	.738410	.669478	
	4	-2.635472	.890766	.598838	.672273	-.740175	-.000000
		-.141262	.793463	-.079632	-.089465	-.062764	.086400
		.389779	.206537	.654604	.734878	.669478	
	5	-2.629150	.869668	.548218	.630376	-.776209	.000000
		-.434170	.756323	-.228735	-.263014	-.200002	.089504
		.336208	.243677	.635135	.730376	.597912	
	6	-2.626833	.703717	.348373	.495047	-.868756	.000000
		-.687692	.495218	-.497144	-.706454	-.411733	.106041
		.149145	.504782	.355953	.505818	.275208	
	7	-2.626833	.664268	.328750	.494906	-.868756	.000000
		-.687692	.441252	-.493026	-.742209	-.411733	.106522
		-.149145	.558748	-.300168	-.451879	-.275208	
	8	-2.629150	.820631	.517287	.630352	-.776209	.000000
		-.434170	.673435	-.217408	-.264928	-.200002	.090273
		-.336208	.326565	-.598819	-.729705	-.597912	
	9	-2.635472	.857280	.576419	.672381	-.740175	-.000000
		-.141262	.734930	-.067674	-.078941	-.062764	.087213
		-.389779	.265070	-.630944	-.735984	-.669478	
	10	-2.635472	.856967	.576233	.672410	-.740175	-.000000
		.141262	.734392	.056429	.065847	.062764	.086864
		-.389779	.265608	-.631733	-.737244	-.669478	
	11	-2.629150	.819951	.516958	.630475	-.776209	.000000
		.434170	.672319	.203153	.247763	.200002	.089184
		-.336208	.327681	-.603150	-.735605	-.597912	
	12	-2.626833	.653104	.323443	.495240	-.868756	-.000000
		.687692	.426545	.471156	.721410	.411733	.104895
		-.149145	.573455	-.316135	-.484050	-.275208	

************ ************ ************

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LEAVING FRINT1

          LEAVING MAIN
```

FLOPNT

BODY IDENTIFIER IS TEST NUMBER CF SYMMETRY PLANES= 0 NUMBER OF QUADRALAT

FOLDOUT FRAME /

= 0 NUMBER OF QUADRALATERALS= 189 MACH NUMBER= 0.

FOLDOUT FRAME 2

```
FLOPNT RUN ID -
      TEST PROBLEM WITH TEST BODY


INPUT DATA -

     INITIAL X=-4.5000E+00   INCREMENT= 1.0000E+00   NUMBER OF VALUES=   4
     INITIAL Y= 0.           INCREMENT= 0.           NUMBER OF VALUES=   1
     INITIAL Z= 1.0000E+00   INCREMENT=-5.0000E-01   NUMBER OF VALUES=   5


     X AXIS IS INCREMENTED FIRST
     Y AXIS IS INCREMENTED THIRD
     Z AXIS IS INCREMENTED SECOND

               * INDICATES THE POINT IS INSIDE THE BODY


      X            Y            Z              VX           VY           VZ
 -4.5000000   0.0000000   1.0000000     9.4274E-01  -1.8463E-03   3.1225E-02
 -3.5000000   0.0000000   1.0000000     8.9363E-01  -5.2865E-03   1.0830E-01
 -2.5000000   0.0000000   1.0000000     9.8504E-01  -2.1047E-02   2.8638E-01
 -1.5000000   0.0000000   1.0000000     1.1528E+00  -7.7206E-02   1.6956E-01


      X            Y            Z              VX           VY           VZ
 -4.5000000   0.0000000    .5000000     9.2698E-01  -1.8687E-03   2.0175E-02
 -3.5000000   0.0000000    .5000000     8.0239E-01  -5.3770E-03   1.0116E-01
     INSIDE QUAD  179       I2=  1
     ZNP,ROSQ,TSQ,H=  -8.9149E-02   2.2821E-01   1.0355E+00   1.0000E-01
     INSIDE QUAD  180       I2=  1
     ZNP,ROSQ,TSQ,H=  -3.5348E-02   6.6282E-02   6.7553E-01   1.0000E-01
     INSIDE QUAD  181       I2=  1
     ZNP,ROSQ,TSQ,H=  -3.5348E-02   6.6282E-02   6.7553E-01   1.0000E-01
     INSIDE QUAD  182       I2=  1
     ZNP,ROSQ,TSQ,H=  -8.9149E-02   2.2821E-01   1.0355E+00   1.0000E-01
 -2.5000000   0.0000000    .5000000     1.4448E+00  -2.2314E-02   1.2787E-01
 -1.5000000   0.0000000    .5000000     1.2122E+00  -6.2494E-02   3.9898E-02


      X            Y            Z              VX           VY           VZ
 -4.5000000   0.0000000   0.0000000     9.1975E-01  -1.7342E-03   1.5068E-03
 -3.5000000   0.0000000   0.0000000     7.3093E-01  -4.4575E-03   4.6059E-03
 -2.5000000   0.0000000   0.0000000     1.2744E+00  -1.3680E-02   1.8615E-02
 -1.5000000   0.0000000   0.0000000     1.2164E+00  -3.0605E-02   3.3288E-02


      X            Y            Z              VX           VY           VZ
 -4.5000000   0.0000000   -.5000000     9.2565E-01  -1.4964E-03  -1.7501E-02
 -3.5000000   0.0000000   -.5000000     7.9717E-01  -3.3034E-03  -9.4089E-02
     INSIDE QUAD  185       I2=  1
     ZNP,ROSQ,TSQ,H=  -8.9149E-02   2.2821E-01   1.0355E+00   1.0000E-01
     INSIDE QUAD  186       I2=  1
     ZNP,ROSQ,TSQ,H=  -3.5348E-02   6.6282E-02   6.7553E-01   1.0000E-01
     INSIDE QUAD  187       I2=  1
     ZNP,ROSQ,TSQ,H=  -3.5348E-02   6.6282E-02   6.7553E-01   1.0000E-01
     INSIDE QUAD  188       I2=  1
     ZNP,ROSQ,TSQ,H=  -8.9149E-02   2.2821E-01   1.0355E+00   1.0000E-01
 -2.5000000   0.0000000   -.5000000     1.4261E+00  -4.1937E-03  -1.0065E-01
 -1.5000000   0.0000000   -.5000000     1.2105E+00  -1.1531E-02   1.9700E-02
```

```
+00   NUMBER OF VALUES=    4
      NUMBER OF VALUES=    1
-01   NUMBER OF VALUES=    5



E THE BODY


              VY               VZ              V
-01   -1.8463E-03      3.1225E-02      9.4326E-01
-01   -5.2865E-03      1.0830E-01      9.0019E-01
-01   -2.1047E-02      2.8638E-01      1.0260E+00
+00   -7.7206E-02      1.6956E-01      1.1678E+00


              VY               VZ              V
-01   -1.8687E-03      2.0175E-02      9.2720E-01
-01   -5.3770E-03      1.0116E-01      8.0876E-01

   1.0355E+00     1.0000E-01

   6.7553E-01     1.0000E-01

   6.7553E-01     1.0000E-01

   1.0355E+00     1.0000E-01
+00   -2.2314E-02      1.2787E-01      1.4506E+00     *
+00   -6.2494E-02      3.9898E-02      1.2145E+00


              VY               VZ              V
-01   -1.7342E-03      1.5068E-03      9.1975E-01
-01   -4.4575E-03      4.6059E-03      7.3096E-01
+00   -1.3680E-02      1.8615E-02      1.2746E+00
+00   -3.0605E-02      3.3288E-02      1.2173E+00


              VY               VZ              V
-01   -1.4964E-03     -1.7501E-02      9.2582E-01
-01   -3.3034E-03     -9.4089E-02      8.0271E-01

   1.0355E+00     1.0000E-01

   6.7553E-01     1.0000E-01

   6.7553E-01     1.0000E-01

   1.0355E+00     1.0000E-01
00    -4.1937E-03     -1.0065E-01      1.4297E+00     *
00    -1.1531E-02      1.9700E-02      1.2108E+00
```

FOLDOUT FRAME 2

X	Y	Z	VX	VY	VZ	V
-4.5000000	0.0000000	-1.0000000	9.4052E-01	-1.2184E-03	-2.9389E-02	9.4098E-01
-3.5000000	0.0000000	-1.0000000	8.8645E-01	-2.3480E-03	-1.0521E-01	8.9268E-01
-2.5000000	0.0000000	-1.0000000	9.6251E-01	-3.3361E-03	-2.8834E-01	1.0048E+00
-1.5000000	0.0000000	-1.0000000	1.1359E+00	-2.5233E-03	-2.0899E-01	1.1550E+00

* INDICATES THE POINT IS INSIDE THE BODY

ARYTRJ

BODY IDENTIFIER IS TEST   NUMBER CF SYMMETRY PLANES= 0   NUMBER OF QUADRAL

FOLDOUT FRAME

PLANES= 0 NUMBER OF QUADRALATERALS= 189 MACH NUMBER= 0.

FOLDOUT FRAME 2

```
ARYTRJ RUN ID -
   TEST PROBLEM WITH TEST BOCY

PHYSICAL INPUT DATA -
 AIR SPEED= 9.000000E+01   CHARACTERISTIC DIMENSION OF THE BODY= 1.000000E+00
 DENSITY AND TEMPERATURE OF AIR ARE  9.092500E-01 AND  2.686590E+02   AIR VISCOSI

NUMERICAL INTEGRATOR INPUTS -
 TIME STEP= 1.0000E-01   MINIMUM TIME STEP= 5.0000E-03   PRINT TIME INTERVAL= 1.0

 LOCAL ERROR TOLERANCES FOR DVDQ -    1.0000E-05    1.0000E-05    1.0000E-05
```


FOLDOUT FRAME

IMENSION OF THE BODY= 1.000000E+00
DOE-01 AND 2.686590E+02 AIR VISCOSITY IS 1.693764E-05

5.0000E-03 PRINT TIME INTERVAL= 1.0000E+00 X COORD. OF FINAL PLANE= 0.

0E-05 1.0000E-05 1.0000E-05

FOLDOUT FRAME 2

```
          WATER DROP DIAMETER = 3.00000E+02 MICROMETERS

                    PARTICLE SETTLING SPEED= 1.27827E+00 M/SEC
          INITIAL X=-5.0000E+00  INCREMENT= 0.            NUMBER OF VALUES=   1
          INITIAL Y=-1.0000E+00  INCREMENT= 2.0000E+00   NUMBER OF VALUES=   2
          INITIAL Z= 1.0000E+00  INCREMENT=-2.0000E+00   NUMBER OF VALUES=   2


          X AXIS IS INCREMENTED THIRD
          Y AXIS IS INCREMENTED FIRST
          Z AXIS IS INCREMENTED SECOND


 * * * * * * *  INITIAL COORDINATES  X=-5.00000E+00   Y=-1.00000E+00   Z= 1.00000E
     IFLAG= 7 FOR KSTEP=    27  NEVAL=     49             HMIN IS SET TO 3.1250E-03


 KSTEP        T              X            Y            Z            VPX          VPY
    0  0.           -5.0000E+00 -1.0000E+00  1.0000E+00  9.6596E-01 -1.4267E-02  1.
          H= 1.0000E-01  R= 2.0586E+01  AC= 0.            NEVAL=      1
   10  1.0000E+00 -4.0344E+00 -1.0145E+00  1.0021E+00  9.6478E-01 -1.5232E-02  3.
          H= 1.0000E-01  R= 6.8363E+01  AC= 7.6445E-04  NEVAL=     12
   11  1.0000E+00 -4.0344E+00 -1.0145E+00  1.0021E+00  9.6478E-01 -1.5232E-02  3.
          H= 1.0000E-01  R= 7.6138E+01  AC= 6.1630E-04  NEVAL=     13
   21  2.0000E+00 -3.0718E+00 -1.0325E+00  1.0094E+00  9.5991E-01 -2.2680E-02  1.
          H= 1.0000E-01  R= 1.8029E+02  AC= 5.1929E-04  NEVAL=     31
   31  2.3125E+00 -2.7720E+00 -1.0404E+00  1.0151E+00  9.5930E-01 -2.7841E-02  2.
          H= 3.1250E-03  R= 2.0134E+02  AC= 5.1576E-04  NEVAL=     57
   41  2.4000E+00 -2.6881E+00 -1.0429E+00  1.0172E+00  9.5956E-01 -2.9385E-02  2.
          H= 1.2500E-02  R= 2.0860E+02  AC= 5.0906E-04  NEVAL=     77
   51  2.8000E+00 -2.3035E+00 -1.0561E+00  1.0293E+00  9.6440E-01 -3.6556E-02  3.
          H= 1.0000E-01  R= 2.2229E+02  AC= 4.9929E-04  NEVAL=     97
   54  3.0000E+00 -2.1101E+00 -1.0637E+00  1.0379E+00  9.6916E-01 -3.9522E-02  4.
          H= 1.0000E-01  R= 2.0962E+02  AC= 5.3730E-04  NEVAL=    104
   64  3.2500E+00 -1.8670E+00 -1.0739E+00  1.0492E+00  9.7641E-01 -4.2069E-02  4.
          H= 1.2500E-02  R= 1.9778E+02  AC= 5.6999E-04  NEVAL=    130
   74  3.5000E+00 -1.6219E+00 -1.0846E+00  1.0613E+00  9.8411E-01 -4.3370E-02  4.
          H= 5.0000E-02  R= 1.7680E+02  AC= 5.9854E-04  NEVAL=    150
   81  4.0000E+00 -1.1265E+00 -1.1064E+00  1.0860E+00  9.9693E-01 -4.3131E-02  4.
          H= 2.0000E-01  R= 1.4402E+02  AC= 6.9847E-04  NEVAL=    164
   86  5.0000E+00 -1.1968E-01 -1.1471E+00  1.1313E+00  1.0160E+00 -3.7496E-02  4.
          H= 2.0000E-01  R= 1.5173E+02  AC= 6.0359E-04  NEVAL=    175
   86  5.1177E+00  0.          -1.1515E+00  1.1361E+00  1.0181E+00 -3.6517E-02  3.
          H= 2.0000E-01  R= 1.5173E+02  AC= 6.2904E-04  NEVAL=    175

                    INITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
                      ALPHA0=     -.8462       BETA0=      .0988
                      ALPHAR=    -2.0542       BETAR=     2.2413

      DRAG VECTOR AT FINAL  POINT -
       DIRECTION COSINES-   8.2179E-01   3.8626E-01  -4.1888E-01   ANGLES A AND GAM
      AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.10221E+00     1.01954E+00


 * * * * * * *  INITIAL COORDINATES  X=-5.00000E+00   Y= 1.00000E+00   Z=-1.00000E
     IFLAG= 7 FOR KSTEP=    28  NEVAL=     60             HMIN IS SET TO 3.1250E-03
```


FOLDOUT FRAME

```
ROMETERS

 27827E+00 M/SEC
          NUMBER OF VALUES=    1
000E+00   NUMBER OF VALUES=    2
000E+00   NUMBER OF VALUES=    2




E+00     Y=-1.00000E+00    Z= 1.00000E+00
          HMIN IS SET TO 3.1250E-03


  Z             VPX          VPY          VPZ          VX           VY           VZ
000E+00   9.6596E-01 -1.4267E-02  1.6667E-03  9.6596E-01 -1.4267E-02  1.5870E-02
          NEVAL=     1
021E+00   9.6478E-01 -1.5232E-02  3.1541E-03  9.4312E-01 -3.4403E-02  4.0864E-02
445E-04   NEVAL=    12
021E+00   9.6478E-01 -1.5232E-02  3.1541E-03  9.4151E-01 -3.7761E-02  4.5294E-02
630E-04   NEVAL=    13
094E+00   9.5991E-01 -2.2680E-02  1.4476E-02  9.4637E-01 -8.7974E-02  1.2281E-01
928E-04   NEVAL=    31
151E+00   9.5930E-01 -2.7841E-02  2.2740E-02  9.6591E-01 -9.7990E-02  1.4245E-01
576E-04   NEVAL=    57
172E+00   9.5956E-01 -2.9385E-02  2.5288E-02  9.7691E-01 -1.0088E-01  1.4898E-01
906E-04   NEVAL=    77
293E+00   9.6440E-01 -3.6556E-02  3.7613E-02  1.0420E+00 -9.9754E-02  1.5379E-01
929E-04   NEVAL=    97
373E+00   9.6916E-01 -3.9522E-02  4.2861E-02  1.0858E+00 -8.3119E-02  1.2343E-01
730E-04   NEVAL=   104
492E+00   9.7641E-01 -4.2069E-02  4.7262E-02  1.0977E+00 -7.2147E-02  1.0213E-01
999E-04   NEVAL=   130
613E+00   9.8411E-01 -4.3370E-02  4.9320E-02  1.1037E+00 -5.4774E-02  7.0318E-02
854E-04   NEVAL=   150
860E+00   9.9693E-01 -4.3131E-02  4.8716E-02  1.0957E+00 -2.2761E-02  2.4140E-02
847E-04   NEVAL=   164
313E+00   1.0160E+00 -3.7496E-02  4.1078E-02  1.1046E+00  5.6844E-03 -6.0732E-03
359E-04   NEVAL=   175
361E+00   1.0161E+00 -3.6517E-02  3.9872E-02  1.1046E+00  5.6844E-03 -6.0732E-03
904E-04   NEVAL=   175

Y ANGLES (DEGREES) -
A0=      .0988
AR=     2.2413


01  -4.1888E-01   ANGLES A AND GAMMA-    2.5175E+01    1.1476E+02
 ARE     1.10221E+00     1.01954E+00



E+00     Y= 1.00000E+00    Z=-1.00000E+00
          HMIN IS SET TO 3.1250E-03
```

FOLDOUT FRAME 2

```
KSTEP       T               X              Y              Z              VPX            VPY
   0   0.            -5.0000E+00   1.0000E+00 -1.0000E+00   9.6340E-01   1.2975E-02 -2.
         H= 1.0000E-01  R= 1.5173E+02   AC= 0.              NEVAL=      1
  10   1.0000E+00 -4.0369E+00   1.0132E+00 -1.0295E+00   9.6232E-01   1.3708E-02 -3.
         H= 1.0000E-01  R= 4.5689E+01   AC= 1.2573E-03      NEVAL=     16
  11   1.0000E+00 -4.0369E+00   1.0132E+00 -1.0295E+00   9.6232E-01   1.3708E-02 -3.
         H= 1.0000E-01  R= 5.2997E+01   AC= 9.3450E-04      NEVAL=     18
  21   2.0000E+00 -3.0769E+00   1.0291E+00 -1.0623E+00   9.5692E-01   1.9735E-02 -3.
         H= 1.0000E-01  R= 1.5349E+02   AC= 5.8890E-04      NEVAL=     38
  31   2.7656E+00 -2.3454E+00   1.0485E+00 -1.0985E+00   9.5602E-01   3.1574E-02 -5.
         H= 3.1250E-03  R= 2.0016E+02   AC= 5.4970E-04      NEVAL=     66
  41   2.9000E+00 -2.2168E+00   1.0529E+00 -1.1066E+00   9.5733E-01   3.3578E-02 -6.
         H= 5.0000E-02  R= 2.0280E+02   AC= 5.4600E-04      NEVAL=     86
  44   3.0000E+00 -2.1210E+00   1.0563E+00 -1.1130E+00   9.5864E-01   3.4974E-02 -6.
         H= 5.0000E-02  R= 2.0340E+02   AC= 5.4493E-04      NEVAL=     92
  54   3.3875E+00 -1.7482E+00   1.0707E+00 -1.1405E+00   9.6613E-01   3.9311E-02 -7.
         H= 6.2500E-03  R= 1.9948E+02   AC= 5.8877E-04      NEVAL=    117
  64   3.5500E+00 -1.5909E+00   1.0772E+00 -1.1532E+00   9.7046E-01   4.0630E-02 -8.
         H= 5.0000E-02  R= 1.9617E+02   AC= 5.9103E-04      NEVAL=    137
  71   4.0000E+00 -1.1512E+00   1.0960E+00 -1.1910E+00   9.8418E-01   4.2377E-02 -8.
         H= 1.0000E-01  R= 1.8893E+02   AC= 5.9535E-04      NEVAL=    152
  80   5.0000E+00 -1.5051E-01   1.1371E+00 -1.2786E+00   1.0170E+00   3.8245E-02 -8.
         H= 5.0000E-02  R= 2.0139E+02   AC= 5.5777E-04      NEVAL=    172
  84   5.1477E+00  1.3878E-17   1.1427E+00 -1.2909E+00   1.0214E+00   3.6966E-02 -8.
         H= 2.5000E-02  R= 2.0627E+02   AC= 5.1777E-04      NEVAL=    181

                     INITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
                        ALPHA0=       .7716       BETA0=     -1.7363
                        ALPHAR=      2.0727       BETAR=     -4.5852

     DRAG VECTOR AT FINAL  POINT -
      DIRECTION COSINES-   8.4447E-01  -2.5705E-01   4.6989E-01   ANGLES A AND GAMM
     AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.14163E+00    1.02538E+00
```


FOLDOUT FRAME

```
 Z          VPX          VPY          VPZ           VX           VY           VZ
0E+00   9.6340E-01   1.2975E-02  -2.9207E-02   9.6340E-01   1.2975E-02  -1.5004E-02
        NEVAL=      1
95E+00  9.6232E-01   1.3708E-02  -3.0100E-02   9.3841E-01   3.1623E-02  -4.0163E-02
73E-03  NEVAL=     16
95E+00  9.6232E-01   1.3708E-02  -3.0100E-02   9.3552E-01   3.4700E-02  -4.4642E-02
50E-04  NEVAL=     18
23E+00  9.5692E-01   1.9735E-02  -3.8095E-02   9.2806E-01   7.9368E-02  -1.2368E-01
90E-04  NEVAL=     38
35E+00  9.5602E-01   3.1574E-02  -5.8414E-02   9.8771E-01   9.4036E-02  -1.7743E-01
70E-04  NEVAL=     66
66E+00  9.5733E-01   3.3578E-02  -6.2513E-02   1.0045E+00   9.1879E-02  -1.8064E-01
00E-04  NEVAL=     86
30E+00  9.5864E-01   3.4974E-02  -6.5529E-02   1.0231E+00   8.7798E-02  -1.8064E-01
93E-04  NEVAL=     92
05E+00  9.6613E-01   3.9311E-02  -7.6149E-02   1.0615E+00   7.4554E-02  -1.6886E-01
77E-04  NEVAL=    117
32E+00  9.7046E-01   4.0630E-02  -8.0008E-02   1.0775E+00   6.7191E-02  -1.5845E-01
03E-04  NEVAL=    137
10E+00  9.8418E-01   4.2377E-02  -8.7065E-02   1.1159E+00   4.1874E-02  -1.1020E-01
35E-04  NEVAL=    152
36E+00  1.0170E+00   3.8245E-02  -8.4091E-02   1.1389E+00   3.9491E-03  -2.2823E-02
77E-04  NEVAL=    172
39E+00  1.0214E+00   3.6966E-02  -8.1971E-02   1.1416E+00   3.2180E-04  -1.4954E-02
77E-04  NEVAL=    181

ANGLES (DEGREES) -
=    -1.7363
=    -4.5852


01   4.6989E-01   ANGLES A AND GAMMA-  -1.6930E+01   6.1973E+01
ARE     1.14163E+00     1.02538E+00
```

FOLDOUT FRAME 2

CONFAC

BODY IDENTIFIER IS TEST   NUMBER OF SYMMETRY PLANES= 0   NUMBER OF QUADRALA

METRY PLANES= 0   NUMBER OF QUADRALATERALS= 169   MACH NUMBER= 0.

FOLDOUT FRAME 2

CONFAC RUN ID -
TEST PROBLEM WITH TEST BOCY

PHYSICAL INPUT DATA -
AIR SPEED= 9.000000E+01   CHARACTERISTIC DIMENSION OF THE BODY= 1.000000E+00
DENSITY AND TEMPERATURE OF AIR ARE 9.092500E-01 AND 2.686590E+02   AIR VIS

NUMERICAL INTEGRATOR INPUTS -
TIME STEP= 1.0000E-0 :   MINIMUM TIME STEP= 5.0000E-03   PRINT TIME INTERVAL=

LOCAL ERROR TOLERANCES FOR DVDQ -   1.0000E-05   1.0000E-05   1.0000E-05

PARTICLE FLUX TUBE SPECIFICATIONS -
NUMBER OF TRAJECTORIES ON FLUX TUEE PERIPHERY= 4   FLUX TUBE RADIUS AT TARG

TARGET AND INITIAL COORDINATE ESTIMATES-

JGUESS	YT	ZT	YI	ZI
1	0.00000	0.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	0.00000

FOLDOUT FRAME 1

```
TERISTIC DIMENSION OF THE BODY= 1.000000E+00
RE  9.092500E-01 AND  2.686590E+02   AIR VISCOSITY IS  1.693764E-05

TIME STEP= 5.0000E-03   PRINT TIME INTERVAL= 1.0000E+00   UPSTREAM START DISTANCE=-5.0000E+

-     1.0000E-05     1.0000E-05     1.0000E-05

UEE PERIPHERY=  4   FLUX TUBE RADIUS AT TARGET=   .00328   TOLERANCE=   .5000

IMATES-
 ZT              YI              ZI
00000          0.00000         0.00000
00000          0.00000         0.00000
```

FOLDOUT FRAME 2

```
          WATER DROP DIAMETER = 3.00000E+02 MICROMETERS

                  PARTICLE SETTLING SPEED= 1.27327E+00 M/SEC

          TARGET COORDINATES  X=-1.50000E+00     Y= 1.10000E+00     Z= 8.00000E-01


TRAJECTORY NUMBER  0     TARGET COORDINATES -  XPSTAR = -1.500000    YPSTAR =  1.
                                                                     YPSTARP=  1.

              YFINAL      ZFINAL      ITERATIONS      YINIT      ZINIT       ERROR
            .1209E+01   .8603E+00         1         .1101E+01   .8012E+00   .1352E+
            .1210E+01   .8813E+00         2         .1102E+01   .8024E+00   .1367E+
            .1097E+01   .8052E+00         3         .9795E+00   .7039E+00   .5981E-
            .1102E+01   .7993E+00         4         .9834E+00   .6981E+00   .2112E-
            .1099E+01   .7979E+00         5         .9800E+00   .6961E+00   .2383E-
            .1100E+01   .7998E+00         6         .9811E+00   .6983E+00   .4269E-

KSTEP      T              X            Y            Z            VPX          VPY
   0  0.          -5.0000E+00  9.8110E-01  6.9829E-01  9.6002E-01  1.3571E-02 -1.6
        H= 1.0000E-01  R= 2.7725E+02  AC= 0.           NEVAL=      1
  10  7.0000E-01 -4.3281E+00  9.9068E-01  6.9725E-01  9.5929E-01  1.3983E-02 -1.0
        H= 1.0000E-01  R= 5.2057E+01  AC= 8.3495E-04  NEVAL=     13
  14  1.0000E+00 -4.0405E+00  9.9497E-01  6.9705E-01  9.5819E-01  1.4671E-02 -2.0
        H= 1.0000E-01  R= 8.7192E+01  AC= 5.9458E-04  NEVAL=     17
  24  1.8625E+00 -3.2173E+00  1.0101E+00  6.9995E-01  9.4867E-01  2.2660E-02  9.6
        H= 6.2500E-03  R= 2.0038E+02  AC= 5.2003E-04  NEVAL=     42
  34  2.0000E+00 -3.0870E+00  1.0134E+00  7.0151E-01  9.4620E-01  2.5388E-02  1.3
        H= 5.0000E-02  R= 2.2830E+02  AC= 4.9527E-04  NEVAL=     62
  35  2.0000E+00 -3.0870E+00  1.0134E+00  7.0151E-01  9.4620E-01  2.5388E-02  1.3
        H= 5.0000E-02  R= 2.3878E+02  AC= 4.5273E-04  NEVAL=     64
  45  2.8000E+00 -2.3352E+00  1.0437E+00  7.2664E-01  9.3723E-01  5.2614E-02  5.5
        H= 5.0000E-02  R= 3.3778E+02  AC= 4.3878E-04  NEVAL=     86
  49  3.0000E+00 -2.1475E+00  1.0549E+00  7.3919E-01  9.4051E-01  5.9150E-02  6.9
        H= 1.0000E-01  R= 3.2750E+02  AC= 4.4993E-04  NEVAL=     94
  59  3.6804E+00 -1.5000E+00  1.0996E+00  7.9979E-01  9.6535E-01  6.9304E-02  1.0
        H= 5.0000E-02  R= 2.7658E+02  AC= 4.7412E-04  NEVAL=    117
    DRAG VECTOR AT FINAL POINT -
      DIRECTION COSINES-    8.1247E-01    4.2971E-02    5.8142E-01    ANGLES A AND GAMM
    AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.14461E+00     9.73484E-01


                  INITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
                     ALPHA0=       .8099       BETA0=      -.0973
                     ALPHAR=      4.1063       BETAR=      6.1774


TRAJECTORY NUMBER  1     TARGET COORDINATES -  XPSTAR = -1.500352    YPSTAR =  1.0
                                                                     YPSTARF=  0.0

              YFINAL      ZFINAL      ITERATIONS      YINIT      ZINIT       ERROR
           -.3022E-03   .3611E-02         1         .7256E-03   .4269E-02   .4483E-

KSTEP      T              X            Y            Z            VPX          VPY
   0  0.          -5.0000E+00  9.8182E-01  7.0256E-01  9.6008E-01  1.3563E-02 -1.5
        H= 1.0000E-01  R= 2.7658E+02  AC= 0.           NEVAL=      1
  10  7.0000E-01 -4.3281E+00  9.9140E-01  7.0157E-01  9.5935E-01  1.3974E-02 -1.0
        H= 1.0000E-01  R= 5.2019E+01  AC= 8.3454E-04  NEVAL=     15
  14  1.0000E+00 -4.0404E+00  9.9568E-01  7.0133E-01  9.5825E-01  1.4660E-02 -1.5
```

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FOLDOUT FRAME

RS

+00 M/SEC

.10000E+00   Z= 8.00000E-01

R = -1.500000   YPSTAR = 1.100000   ZPSTAR =   .800000 (FLOW SYSTEM)
                  YPSTARP= 1.100000   ZPSTARP=   .800000 (FLUX TUBE SYSTEM)

YINIT	ZINIT	ERROR (FLUX TUBE SYSTEM)
1101E+01	.8012E+00	.1352E+00
1102E+01	.8024E+00	.1367E+00
9795E+00	.7039E+00	.5981E-02
9834E+00	.6981E+00	.2112E-02
9800E+00	.6961E+00	.2383E-02
9811E+00	.6983E+00	.4269E-03

	VPX	VPY	VPZ	VX	VY	VZ
1	9.6002E-01	1.3571E-02	-1.6308E-03	9.6002E-01	1.3571E-02	1.2572E-02
	NEVAL= 1					
1	9.5929E-01	1.3983E-02	-1.0880E-03	9.3821E-01	2.6512E-02	2.5291E-02
4	NEVAL= 13					
1	9.5819E-01	1.4671E-02	-2.0919E-04	9.1998E-01	4.0543E-02	3.9618E-02
4	NEVAL= 17					
1	9.4867E-01	2.2660E-02	9.6867E-03	8.7914E-01	9.4479E-02	1.0518E-01
4	NEVAL= 42					
1	9.4620E-01	2.5388E-02	1.3176E-02	8.7511E-01	1.0894E-01	1.2621E-01
4	NEVAL= 62					
1	9.4620E-01	2.5388E-02	1.3176E-02	8.7450E-01	1.1444E-01	1.3473E-01
4	NEVAL= 64					
1	9.3723E-01	5.2614E-02	5.5791E-02	9.6531E-01	1.5681E-01	2.6234E-01
4	NEVAL= 86					
1	9.4051E-01	5.9150E-02	6.9614E-02	1.0177E+00	1.4009E-01	2.7029E-01
4	NEVAL= 94					
1	9.6535E-01	6.9304E-02	1.0475E-01	1.1213E+00	7.7552E-02	2.1635E-01
4	NEVAL= 117					

5.8142E-01   ANGLES A AND GAMMA-   3.0275E+00   5.4450E+01
   1.14461E+00   9.73484E-01

ES (DEGREES) -
 -.0973
 6.1774

R = -1.500352   YPSTAR = 1.099975   ZPSTAR =   .803261 (FLOW SYSTEM)
                  YPSTARP= 0.000000   ZPSTARP=   .003280 (FLUX TUBE SYSTEM)

YINIT	ZINIT	ERROR (FLUX TUBE SYSTEM)
7256E-03	.4269E-02	.4483E-03

	VPX	VPY	VPZ	VX	VY	VZ
1	9.6008E-01	1.3563E-02	-1.5749E-03	9.6008E-01	1.3563E-02	1.2628E-02
	NEVAL= 1					
1	9.5935E-01	1.3974E-02	-1.0309E-03	9.3835E-01	2.6478E-02	2.5248E-02
4	NEVAL= 15					
1	9.5825E-01	1.4660E-02	-1.5069E-04	9.2023E-01	4.0463E-02	3.9745E-02

FOLDOUT FRAME 2

```
      H= 1.0000E-01  R= 8.7058E+01  AC= 5.9484E-04  NEVAL=    23
  24  1.8688E+00 -3.2112E+00  1.0110E+(0  7.0439E-01  9.4870E-01  2.2724E-02
      H= 6.2500E-03  R= 2.0090E+02  AC= 5.1944E-04  NEVAL=    48
  34  1.9750E+00 -3.1105E+00  1.0135E+(0  7.0557E-01  9.4682E-01  2.4783E-02
      H= 2.5000E-02  R= 2.2224E+02  AC= 5.0001E-04  NEVAL=    68
  36  2.0000E+00 -3.0869E+00  1.0141E+00  7.0590E-01  9.4636E-01  2.5322E-02
      H= 2.5000E-02  R= 2.3257E+02  AC= 4.7405E-04  NEVAL=    72
  46  2.4750E+00 -2.6395E+00  1.0293E+00  7.1651E-01  9.3803E-01  3.9867E-02
      H= 5.0000E-02  R= 3.1803E+02  AC= 4.4628E-04  NEVAL=    92
  53  3.0000E+00 -2.1471E+00  1.0554E+00  7.4345E-01  9.4086E-01  5.8707E-02
      H= 2.0000E-01  R= 3.2760E+02  AC= 4.4585E-04  NEVAL=   106
  63  3.6250E+00 -1.5528E+00  1.0959E+(0  7.9793E-01  9.6301E-01  6.8579E-02
      H= 5.0000E-02  R= 2.8288E+02  AC= 4.6314E-04  NEVAL=   129
  65  3.6794E+00 -1.5004E+00  1.0997E+(0  8.0359E-01  9.6549E-01  6.8798E-02
      H= 5.0000E-02  R= 2.7205E+02  AC= 4.8639E-04  NEVAL=   133
 DRAG VECTOR AT FINAL POINT -
  DIRECTION COSINES-   8.2736E-01   3.1554E-02   5.6078E-01   ANGLES A AND
 AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE    1.14496E+00    9.73520E


TRAJECTORY NUMBER  2     TARGET COORDINATES -  XPSTAR = -1.500235     YPSTAR =
                                                                      YPSTARF=

            YFINAL      ZFINAL       ITERATIONS      YINIT       ZINIT        ER
          .3951E-02  -.1236E-02          1        .4128E-02  -.3891E-03    .140

KSTEP         T            X           Y            Z            VPX         VPY
   0  0.           -5.0001E+00  9.8523E-(1  6.9791E-01  9.6007E-01  1.3617E-02
      H= 1.0000E-01  R= 2.7205E+02  AC= 0.               NEVAL=     1
  10  7.0000E-01 -4.3282E+00  9.9484E-(1  6.9686E-01  9.5934E-01  1.4030E-02
      H= 1.0000E-01  R= 5.1988E+01  AC= 8.3522E-04  NEVAL=    15
  14  1.0000E+00 -4.0405E+00  9.9914E-(1  6.9664E-01  9.5824E-01  1.4719E-02
      H= 1.0000E-01  R= 8.7042E+01  AC= 5.9501E-04  NEVAL=    23
  24  1.8688E+00 -3.2113E+00  1.0145E+00  6.9956E-01  9.4666E-01  2.2828E-02
      H= 6.2500E-03  R= 2.0108E+02  AC= 5.1932E-04  NEVAL=    48
  34  1.9750E+00 -3.1106E+00  1.0170E+00  7.0074E-01  9.4677E-01  2.4901E-02
      H= 2.5000E-02  R= 2.2250E+02  AC= 4.9985E-04  NEVAL=    68
  36  2.0000E+00 -3.0870E+00  1.0176E+00  7.0105E-01  9.4630E-(1  2.5444E-02
      H= 2.5000E-02  R= 2.3288E+02  AC= 4.7383E-04  NEVAL=    72
  46  2.6250E+00 -2.4990E+00  1.0393E+00  7.1738E-01  9.3677E-01  4.6008E-02
      H= 5.0000E-02  R= 3.3341E+02  AC= 4.4043E-04  NEVAL=    93
  52  3.0000E+00 -2.1473E+00  1.0592E+(0  7.3850E-01  9.4062E-01  5.9214E-02
      H= 1.0000E-01  R= 3.2871E+02  AC= 4.4545E-04  NEVAL=   105
  62  3.6250E+00 -1.5532E+00  1.1001E+(0  7.9309E-01  9.6281E-01  6.9236E-02
      H= 5.0000E-02  R= 2.8409E+02  AC= 4.6253E-04  NEVAL=   128
  64  3.6800E+00 -1.5002E+00  1.1039E+00  7.9877E-01  9.6534E-01  6.9463E-02
      H= 5.0000E-02  R= 2.7313E+02  AC= 4.8587E-04  NEVAL=   132
 DRAG VECTOR AT FINAL POINT -
  DIRECTION COSINES-   8.2653E-01   3.2372E-02   5.6197E-01   ANGLES A AND G
 AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE    1.14547E+00    9.73446E-


TRAJECTORY NUMBER  3     TARGET COORDINATES -  XPSTAR = -1.499648     YPSTAR =
                                                                      YPSTARP=

            YFINAL      ZFINAL       ITERATIONS      YINIT       ZINIT        ER
          .3971E-03  -.2022E-02          1        .4452E-03  -.1895E-02    .131

KSTEP         T            X           Y            Z            VPX         VPY
   0  0.           -5.0000E+00  9.8154E-(1  6.9640E-01  9.6000E-01  1.3583E-02
      H= 1.0000E-01  R= 2.7313E+02  AC= 0.               NEVAL=     1
  10  7.0000E-01 -4.3282E+00  9.9114E-(1  6.9535E-01  9.5927E-01  1.3995E-02
      H= 1.0000E-01  R= 5.2060E+01  AC= 8.3513E-04  NEVAL=    13
  14  1.0000E+00 -4.0405E+00  9.9542E-(1  6.9513E-01  9.5817E-01  1.4684E-02
```

FOLDOUT FRAME

65

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```
=   23
70E-01  2.2724E-02  9.8902E-03  8.7962E-01  9.4692E-02  1.0612E-01
=     48
32E-01  2.4783E-02  1.2530E-02  8.7645E-01  1.0571E-01  1.2211E-01
=     68
36E-01  2.5322E-02  1.3231E-02  8.7562E-01  1.1110E-01  1.3036E-01
=     72
03E-01  3.9867E-02  3.3994E-02  9.0337E-01  1.5468E-01  2.1774E-01
=     92
36E-01  5.8707E-02  6.9232E-02  1.0128E+00  1.4126E-01  2.6912E-01
=    106
01E-01  6.8579E-02  1.0215E-01  1.1111E+00  8.4626E-02  2.2827E-01
=    129
49E-01  6.8798E-02  1.0407E-01  1.1229E+00  7.4802E-02  2.1077E-01
=    133

-01    ANGLES A AND GAMMA-    2.1841E+00    5.5890E+01
496E+00     9.73520E-01


500235      YPSTAR =  1.103272      ZPSTAR =    .800000 (FLOW SYSTEM)
            YPSTARF=   .003280      ZPSTARP=  -.000000 (FLUX TUBE SYSTEM)

     ZINIT          ERROR  (FLUX TUBE SYSTEM)
2  -.3891E-03   .1406E-02

VPX          VPY          VPZ          VX           VY           VZ
07E-01  1.3617E-02 -1.6521E-03  9.6007E-01  1.3617E-02  1.2551E-02
=      1
34E-01  1.4030E-02 -1.1109E-03  9.3831E-01  2.6589E-02  2.5095E-02
=     15
24E-01  1.4719E-02 -2.3501E-04  9.2016E-01  4.0642E-02  3.9509E-02
=     23
56E-01  2.2828E-02  9.7640E-03  8.7928E-01  9.5240E-02  1.0563E-01
=     48
77E-01  2.4901E-02  1.2396E-02  8.7602E-01  1.0636E-01  1.2160E-01
=     68
30E-01  2.5444E-02  1.3095E-02  8.7515E-01  1.1181E-01  1.2984E-01
=     72
77E-01  4.6008E-02  4.3395E-02  9.2909E-01  1.6091E-01  2.4252E-01
=     93
52E-01  5.9214E-02  6.9218E-02  1.0123E+00  1.4274E-01  2.6969E-01
=    105
11E-01  6.9236E-02  1.0236E-01  1.1112E+00  8.5586E-02  2.2938E-01
=    128
14E-01  6.9463E-02  1.0433E-01  1.1232E+00  7.5645E-02  2.1166E-01
=    132

01    ANGLES A AND GAMMA-    2.2429E+00    5.5808E+01
547E+00     9.73446E-01


99648      YPSTAR =  1.100025      ZFSTAR =    .796739 (FLOW SYSTEM)
           YPSTARP=  -.000000      ZPSTARP=  -.003280 (FLUX TUBE SYSTEM)

     ZINIT          ERROR  (FLUX TUBE SYSTEM)
  -.1895E-02   .1319E-02

PX           VPY          VPZ          VX           VY           VZ
0E-01  1.3583E-02 -1.6586E-03  9.6000E-01  1.3583E-02  1.2544E-02
     1
7E-01  1.3995E-02 -1.1167E-03  9.3816E-01  2.6541E-02  2.5099E-02
     13
7E-01  1.4684E-02 -2.3900E-04  9.1991E-01  4.0595E-02  3.9543E-02
```

FOLDOUT FRAME 2

```
     H= 1.0000E-01  R= 8.7222E+01  AC= 5.9455E-04  NEVAL=    17
 24  1.8625E+00 -3.2174E+00  1.0106E+00  6.9800E-01  9.4863E-01  2.2692E-02
     H= 6.2500E-03  R= 2.0058E+02  AC= 5.1985E-04  NEVAL=    42
 34  2.0000E+00 -3.0871E+00  1.0139E+00  6.9955E-01  9.4614E-01  2.5428E-02
     H= 5.0000E-02  R= 2.2856E+02  AC= 4.9509E-04  NEVAL=    62
 35  2.0000E+00 -3.0871E+00  1.0139E+00  6.9955E-01  9.4614E-01  2.5428E-02
     H= 5.0000E-02  R= 2.3908E+02  AC= 4.5250E-04  NEVAL=    64
 45  2.8000E+00 -2.3354E+00  1.0443E+00  7.2468E-01  9.3711E-01  5.2784E-02
     H= 5.0000E-02  R= 3.3842E+02  AC= 4.3855E-04  NEVAL=    86
 49  3.0000E+00 -2.1477E+00  1.0555E+00  7.3724E-01  9.4038E-01  5.9353E-02
     H= 1.0000E-01  R= 3.2808E+02  AC= 4.4975E-04  NEVAL=    94
 59  3.6500E+00 -1.5296E+00  1.0983E+00  7.9477E-01  9.6385E-01  6.9443E-02
     H= 5.0000E-02  R= 2.8269E+02  AC= 4.6343E-04  NEVAL=   117
 60  3.6808E+00 -1.4998E+00  1.1004E+00  7.9793E-01  9.6528E-01  6.9554E-02
     H= 5.0000E-02  R= 2.7710E+02  AC= 4.7361E-04  NEVAL=   119
 DRAG VECTOR AT FINAL POINT -
  DIRECTION COSINES-   8.1238E-01   4.2836E-02   5.8156E-01   ANGLES A AND G
 AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.14489E+00    9.73459E-


TRAJECTORY NUMBER  4     TARGET COORDINATES -  XPSTAR = -1.499765     YPSTAR =
                                                                      YPSTARP=

             YFINAL      ZFINAL      ITERATIONS      YINIT       ZINIT        ERR
          -.4310E-02   .7579E-04         1        -.3891E-02  -.3977E-03   .1033

KSTEP       T            X            Y            Z           VPX          VPY
  0  0.          -4.9999E+00  9.7721E-01  6.9790E-01  9.5996E-01  1.3530E-02 -
     H= 1.0000E-01  R= 2.7710E+02  AC= 0.          NEVAL=     1
 10  7.0000E-01 -4.3281E+00  9.8676E-01  6.9687E-01  9.5923E-01  1.3941E-02 -
     H= 1.0000E-01  R= 5.2125E+01  AC= 8.3473E-04  NEVAL=    13
 14  1.0000E+00 -4.0405E+00  9.9104E-01  6.9667E-01  9.5813E-01  1.4628E-02 -
     H= 1.0000E-01  R= 8.7353E+01  AC= 5.9414E-04  NEVAL=    17
 24  1.8625E+00 -3.2174E+00  1.0061E+00  6.9959E-01  9.4856E-01  2.2624E-02  9
     H= 6.2500E-03  R= 2.0095E+02  AC= 5.1945E-04  NEVAL=    42
 34  2.0000E+00 -3.0871E+00  1.0094E+00  7.0116E-01  9.4606E-01  2.5356E-02  1
     H= 5.0000E-02  R= 2.2900E+02  AC= 4.9474E-04  NEVAL=    62
 35  2.0000E+00 -3.0871E+00  1.0094E+00  7.0116E-01  9.4606E-01  2.5356E-02  1
     H= 5.0000E-02  R= 2.3953E+02  AC= 4.5218E-04  NEVAL=    64
 45  2.8000E+00 -2.3355E+00  1.0398E+00  7.2645E-01  9.3704E-01  5.2642E-02  5
     H= 5.0000E-02  R= 3.3867E+02  AC= 4.3847E-04  NEVAL=    86
 49  3.0000E+00 -2.1478E+00  1.0510E+00  7.3908E-01  9.4034E-01  5.9173E-02  7
     H= 1.0000E-01  R= 3.2816E+02  AC= 4.4983E-04  NEVAL=    94
 59  3.6500E+00 -1.5297E+00  1.0935E+00  7.9682E-01  9.6387E-01  6.9148E-02  1
     H= 5.0000E-02  R= 2.8240E+02  AC= 4.6359E-04  NEVAL=   116
 60  3.6811E+00 -1.4997E+00  1.0957E+00  8.0003E-01  9.6531E-01  6.9255E-02  1
     H= 5.0000E-02  R= 2.7685E+02  AC= 4.7364E-04  NEVAL=   118
 DRAG VECTOR AT FINAL POINT -
  DIRECTION COSINES-   8.1378E-01   4.0887E-02   5.7973E-01   ANGLES A AND GA
 AIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE     1.14496E+00    9.73502E-0
```


FOLDOUT FRAME

```
0E-01   9.4863E-01  2.2692E-02  9.6505E-03  8.7890E-01  9.4679E-02  1.0508E-01
5E-04   NEVAL=     42
5E-01   9.4614E-01  2.5428E-02  1.3140E-02  8.7412E-01  1.0920E-01  1.2612E-01
9E-04   NEVAL=     62
5E-01   9.4614E-01  2.5428E-02  1.3140E-02  8.7418E-01  1.1472E-01  1.3465E-01
0E-04   NEVAL=     64
8E-01   9.3711E-01  5.2784E-02  5.5842E-02  9.6504E-01  1.5739E-01  2.6271E-01
5E-04   NEVAL=     86
4E-01   9.4038E-01  5.9353E-02  6.9706E-02  1.0176E+00  1.4059E-01  2.7074E-01
5E-04   NEVAL=     94
7E-01   9.6385E-01  6.9443E-02  1.0389E-01  1.1154E+00  8.2849E-02  2.2593E-01
3E-04   NEVAL=    117
9E-01   9.6528E-01  6.9554E-02  1.0497E-01  1.1215E+00  7.7790E-02  2.1679E-01
1E-04   NEVAL=    119

2    5.8156E-01    ANGLES A AND GAMMA-    3.0184E+00    5.4440E+01
ARE     1.14489E+00     9.73459E-01



PSTAR = -1.499765      YPSTAR =  1.096728      ZPSTAR =    .800000 (FLOW SYSTEM)
                       YPSTARP=  -.003280      ZPSTARP=    .000000 (FLUX TUBE SYSTEM)

     YINIT         ZINIT         ERROR  (FLUX TUBE SYSTEM)
  -.3891E-02  -.3977E-03    .1033E-02

Z               VPX          VPY          VPZ          VX          VY          VZ
0E-01   9.5996E-01  1.3530E-02 -1.6213E-03  9.5996E-01  1.3530E-02  1.2582E-02
        NEVAL=      1
7E-01   9.5923E-01  1.3941E-02 -1.0773E-03  9.3808E-01  2.6448E-02  2.5186E-02
8E-04   NEVAL=     13
7E-01   9.5813E-01  1.4628E-02 -1.9607E-04  9.1978E-01  4.0466E-02  3.9694E-02
4E-04   NEVAL=     17
9E-01   9.4856E-01  2.2624E-02  9.7440E-03  8.7866E-01  9.4430E-02  1.0556E-01
5E-04   NEVAL=     42
5E-01   9.4606E-01  2.5356E-02  1.3253E-02  8.7459E-01  1.0891E-01  1.2671E-01
4E-04   NEVAL=     62
5E-01   9.4606E-01  2.5356E-02  1.3253E-02  8.7396E-01  1.1442E-01  1.3528E-01
8E-04   NEVAL=     64
5E-01   9.3704E-01  5.2642E-02  5.6158E-02  9.6537E-01  1.5667E-01  2.6346E-01
7E-04   NEVAL=     86
5E-01   9.4034E-01  5.9173E-02  7.0049E-02  1.0180E+00  1.3981E-01  2.7122E-01
5E-04   NEVAL=     94
7E-01   9.6387E-01  6.9148E-02  1.0418E-01  1.1156E+00  8.2154E-02  2.2576E-01
E-04    NEVAL=    116
E-01    9.6531E-01  6.9255E-02  1.0526E-01  1.1216E+00  7.7109E-02  2.1662E-01
E-04    NEVAL=    118

     5.7973E-01    ANGLES A AND GAMMA-    2.8763E+00    5.4568E+01
RE      1.14496E+00     9.73502E-01
```

FOLDOUT FRAME 2

FLUX TUBE CROSS SECTION COORDINATES IN THE -

	INITIAL PLANE			TARGET PLANE	
IP	XP	YP	ZP	XP	YP
CENTER	-5.0000E+00	9.8110E-01	6.9829E-01	-1.5000E+00	1.1000E+00
1	1.5884E-14	7.2555E-04	4.2635E-03	-5.2934E-15	-3.0215E-04
2	1.1492E-14	4.1278E-03	-3.8912E-04	-1.0963E-15	3.9506E-03
3	2.8054E-14	4.4517E-04	-1.8950E-03	-2.9064E-15	3.9710E-04
4	9.7370E-15	-3.8913E-03	-3.9756E-04	1.6757E-15	-4.3100E-03

FLUX TUBE CROSS SECTION AREA IN THE INITIAL PLANE= 2.47114E-05

CONCENTRATION FACTOR= 1.08337

AT THE POINT (X,Y,Z)= -1.50000 1.10000 .80000
FOR A PARTICLE OF DIAMETER= 300.00000 WITH DIAMETER TO LENGTH RATIO= 1.
NORMALIZED AIR SPEED AT FINAL POINT= 1.14339
PARTICLE CONCENTRATION RATIO= 1.11288

FOLDOUT FRAME

ROSS SECTION COORCINATES IN THE -

TARGET PLANE

ZP	XP	YP	ZP	
9829E-01	-1.5000E+00	1.1000E+00	8.0000E-01	(FLCW SYSTEM)
2685E-03	-5.2934E-15	-3.0215E-04	3.6111E-03	(FLUX TUBE SYSTEM)
8912E-04	-1.0963E-15	3.9506E-03	-1.2361E-03	(FLUX TUBE SYSTEM)
8950E-03	-2.9064E-15	3.9710E-04	-2.0225E-03	(FLUX TUBE SYSTEM)
9756E-04	1.6757E-15	-4.3100E-03	7.5786E-05	(FLUX TUBE SYSTEM)

THE INITIAL PLANE= 2.47114E-05   IN THE TARGET PLANE= 2.28097E-05

1.10000   .80000
000   WITH DIAMETER TO LENGTH RATIO= 1.00000E+00   AND DENSITY= 1.00000E+03
1.14339
1288

FOLDOUT FRAME 2

TANTRA

BODY IDENTIFIER IS TEST NUMBER CF SYMMETRY PLANES= 0 NUMBER OF QUADRALA

FOLDOUT FRAM

YMMETRY PLANES= 0   NUMBER OF QUADRALATERALS= 189   MACH NUMBER= 0.

FOLDOUT FRAME 2

```
TANGENT TRAJECTORY CODE RUN ID -
   TEST PROBLEM WITH TEST BODY

PHYSICAL INPUT DATA -
 AIR SPEED= 9.000000E+01   CHARACTERISTIC DIMENSION OF THE BODY= 1.000000E
 DENSITY AND TEMPERATURE OF AIR ARE  9.092500E-01 AND  2.686590E+02   AIR

NUMERICAL INTEGRATOR INPUTS -
 TIME STEP= 1.0000E-01   MINIMUM TIME STEP= 5.0000E-03   PRINT TIME INTERV

 LOCAL ERROR TOLERANCES FOR DVDQ -    1.0000E-05    1.0000E-05    1.0000E-


TRAJECTORY DATA ARE WRITTEN ON UNIT 10 FOR PLOTTING
```


FOLDOUT FRAME /

C DIMENSION OF THE BODY= 1.000000E+00
92500E-01 AND 2.686590E+02 AIR VISCOSITY IS 1.693764E-05

EP= 5.0000E-03 PRINT TIME INTERVAL= 1.0000E+00 X COORD. OF FINAL PLANE= 0.

0000E-05 1.0000E-05 1.0000E-05

OR PLOTTING

FOLDOUT FRAME 2

```
          WATER DROP DIAMETER = 2.00000E+02 MICROMETERS

                    PARTICLE SETTLING SPEED= 7.69093E-01 M/SEC



     TRAJECTORIES ARE TO BEGIN ALONG A LINE DEFINED BY THE POINTS (X1,Y1,Z1,) AND
         (     -5.00000E+00      0.                 -4.50000E-01 )    AND    (      -5.00000E+
     WITH DIRECTION COSINES -(COS(ALPHA),COS(BETA),COS(GAMMA)) -        0.

     STARTING POINT INCREMENTS ARE - COARSE INCREMENT= 5.00000E-02    FINE INCREMEN


  *     *     *     *   INITIAL COORDINATES   X=-5.00000E+00     Y= 0.                Z=-4.50000E
     IFLAG= 7 FOR KSTEP=      27   NEVAL=      58              HMIN IS SET TO 3.1250E-03
     IFLAG= 7 FOR KSTEP=      27   NEVAL=      59              HMIN IS SET TO 1.5625E-03
          INSIDE QUAD  185       I2=  1
          ZNP,ROSQ,TSQ,H=  -5.4665E-03    2.4343E-01    1.0355E+00    2.5000E-02
          INSIDE QUAD  188       I2=  1
          ZNP,ROSQ,TSQ,H=  -7.1977E-03    2.5035E-01    1.0355E+00    2.5000E-02
          THE BODY SURFACE IS PENETRATED.  PARTICLE COORDINATES ARE (X,Y,Z)-2.5523
          TRIAL INITIAL COORDINATES ARE (YINIT,ZINIT)  0.             -4.5000E-01

               AFTER    0 ATTEMPTS PARTICLE STILL PENETRATES THE BODY.


  KSTEP         T               X             Y              Z            VPX            VPY
      0   0.           -5.0000E+00   0.           -4.5000E-01   9.4971E-01 -1.0353E-03 -1.
          H= 1.0000E-01   R= 8.2573E+00   AC= 1.9004E-17   NEVAL=       1
     10   5.0000E-01 -4.5253E+00 -5.2030E-04 -4.5857E-01   9.4686E-01 -1.0526E-03 -1.
          H= 5.0000E-02   R= 2.1823E+01   AC= 1.6453E-03   NEVAL=      17
     19   1.0000E+00 -4.0517E+00 -1.0637E-03 -4.6742E-01   9.4439E-01 -1.1384E-03 -1.
          H= 1.0000E-01   R= 6.8350E+01   AC= 6.6054E-04   NEVAL=      35
     29   1.8406E+00 -3.2695E+00 -2.2201E-03 -4.8800E-01   9.0566E-01 -1.7706E-03 -3.
          H= 1.5625E-03   R= 2.0070E+02   AC= 4.9963E-04   NEVAL=      63
     39   1.8750E+00 -3.2385E+00 -2.2817E-03 -4.8936E-01   9.0255E-01 -1.8174E-03 -4.
          H= 1.2500E-02   R= 2.1011E+02   AC= 4.9009E-04   NEVAL=      83
     47   2.0000E+00 -3.1264E+00 -2.5204E-03 -4.9505E-01   8.8980E-01 -2.0074E-03 -5.
          H= 5.0000E-02   R= 2.6029E+02   AC= 4.1124E-04   NEVAL=      99
     57   2.5750E+00 -2.6346E+00 -3.9965E-03 -5.5196E-01   8.2481E-01 -3.1898E-03 -1.
          H= 2.5000E-02   R= 3.9701E+02   AC= 3.9795E-04   NEVAL=     121


  *     *     *     *   INITIAL COORDINATES   X=-5.00000E+00     Y= 0.                Z=-5.00000E
     IFLAG= 7 FOR KSTEP=      28   NEVAL=      60              HMIN IS SET TO 3.1250E-03
     IFLAG= 7 FOR KSTEP=      29   NEVAL=      63              HMIN IS SET TO 1.5625E-03
     IFLAG= 7 FOR KSTEP=     108   NEVAL=     235              HMIN IS SET TO 7.8125E-04


  KSTEP         T               X             Y              Z            VPX            VPY
      0   0.           -5.0000E+00   0.           -5.0000E-01   9.5022E-01 -1.0211E-03 -1.
          H= 1.0000E-01   R= 3.9701E+02   AC= 8.2203E-21   NEVAL=       1
     10   5.0000E-01 -4.5250E+00 -5.1313E-04 -5.0905E-01   9.4939E-01 -1.0379E-03 -1.
          H= 5.0000E-02   R= 2.1255E+01   AC= 1.6923E-03   NEVAL=      17
     20   1.0000E+00 -4.0512E+00 -1.0485E-03 -5.1842E-01   9.4510E-01 -1.1204E-03 -1.
          H= 1.0000E-01   R= 6.6581E+01   AC= 6.7263E-04   NEVAL=      37
     30   1.8797E+00 -3.2321E+00 -2.2468E-03 -5.4173E-01   9.0617E-01 -1.7668E-03 -4.
          H= 1.5625E-03   R= 1.9997E+02   AC= 5.3975E-04   NEVAL=      65
```


FOLDOUT FRAME

(X1,Y1,Z1,) AND (X2,Y2,Z2) -
(-5.00000E+00 0. 0.)
0. 0. 1.00000E+00

2 FINE INCREMENT= 5.00000E-03

Z=-4.50000E-01 FOR TRAJECTORY NUMBER 1
ET TO 3.1250E-03
ET TO 1.5625E-03

2.5000E-02

2.5000E-02
RE (X,Y,Z)-2.55232E+00-4.32804E-03-5.70585E-01
-4.5000E-01 ATTEMPT NUMBER 0

ODY.

	VPY	VPZ	VX	VY	VZ
1	-1.0353E-03	-1.7077E-02	9.4971E-01	-1.0353E-03	-8.5312E-03
1					
1	-1.0526E-03	-1.7267E-02	9.2635E-01	-1.5046E-03	-1.5595E-02
17					
1	-1.1384E-03	-1.8462E-02	8.7433E-01	-2.4196E-03	-3.7486E-02
35					
1	-1.7706E-03	-3.8358E-02	7.3501E-01	-4.3441E-03	-1.5675E-01
63					
1	-1.8174E-03	-4.0613E-02	7.2694E-01	-4.4526E-03	-1.6882E-01
83					
1	-2.0074E-03	-5.1080E-02	6.9105E-01	-4.9664E-03	-2.4430E-01
99					
1	-3.1898E-03	-1.6851E-01	7.4570E-01	-6.1109E-03	-5.7168E-01
121					

ORIGINAL PAGE IS
OF POOR QUALITY

Z=-5.00000E-01 FOR TRAJECTORY NUMBER 0
ET TO 3.1250E-03
ET TO 1.5625E-03
ET TO 7.8125E-04

	VPY	VPZ	VX	VY	VZ
	-1.0211E-03	-1.8037E-02	9.5022E-01	-1.0211E-03	-9.4917E-03
1					
	-1.0379E-03	-1.8253E-02	9.2743E-01	-1.4781E-03	-1.7214E-02
17					
	-1.1204E-03	-1.9572E-02	8.7764E-01	-2.3594E-03	-4.0720E-02
37					
	-1.7668E-03	-4.2684E-02	7.4593E-01	-4.2808E-03	-1.7362E-01
65					

FOLDOUT FRAME 2

```
  48  1.9063E+00 -3.2081E+00 -2.2942E-03 -5.4294E-01   9.0393E-01 -1.8018E-03
         H= 6.2500E-03  R= 2.0666E+02  AC= 4.9383E-04   NEVAL=    85
  49  2.0000E+00 -3.1237E+00 -2.4692E-03 -5.4747E-01   8.9545E-01 -1.9350E-03
         H= 2.5000E-02  R= 2.3735E+02  AC= 4.4684E-04   NEVAL=   103
  59  2.5250E+00 -2.6674E+00 -3.7260E-03 -5.9541E-01   8.4607E-01 -2.8990E-03
         H= 5.0000E-02  R= 3.5235E+02  AC= 4.1138E-04   NEVAL=   124
  69  2.7125E+00 -2.5091E+00 -4.3054E-03 -6.2775E-01   8.4692E-01 -3.2768E-03
         H= 1.2500E-02  R= 3.6565E+02  AC= 4.0703E-04   NEVAL=   147
  79  2.8750E+00 -2.3701E+00 -4.8572E-03 -6.6323E-01   8.6379E-01 -3.4910E-03
         H= 2.5000E-02  R= 2.7019E+02  AC= 4.4649E-04   NEVAL=   167
  84  3.0000E+00 -2.2614E+00 -5.3004E-03 -6.9338E-01   8.7616E-01 -3.5962E-03
         H= 2.5000E-02  R= 2.2479E+02  AC= 4.9517E-04   NEVAL=   178
  94  3.2687E+00 -2.0226E+00 -6.2920E-03 -7.6277E-01   9.0165E-01 -3.7829E-03
         H= 6.2500E-03  R= 2.2802E+02  AC= 4.7372E-04   NEVAL=   202
 104  3.3750E+00 -1.9261E+00 -6.6963E-03 -7.9148E-01   9.1405E-01 -3.8160E-03
         H= 2.5000E-02  R= 2.0274E+02  AC= 4.9549E-04   NEVAL=   222
 114  3.3937E+00 -1.9089E+00 -6.7679E-03 -7.9658E-01   9.1608E-01 -3.8177E-03
         H= 1.5625E-03  R= 1.9867E+02  AC= 5.3852E-04   NEVAL=   247
 124  3.4500E+00 -1.8572E+00 -6.9827E-03 -8.1193E-01   9.2214E-01 -3.8205E-03
         H= 1.2500E-02  R= 1.8939E+02  AC= 5.4795E-04   NEVAL=   267
 134  3.8000E+00 -1.5285E+00 -8.3154E-03 -9.0780E-01   9.5632E-01 -3.7791E-03
         H= 5.0000E-02  R= 1.9086E+02  AC= 5.4461E-04   NEVAL=   288
 144  4.0000E+00 -1.3352E+00 -9.0641E-03 -9.6181E-01   9.7643E-01 -3.7025E-03
         H= 5.0000E-02  R= 1.8499E+02  AC= 5.4930E-04   NEVAL=   311
 145  4.0000E+00 -1.3352E+00 -9.0641E-03 -9.6181E-01   9.7643E-01 -3.7025E-03
         H= 2.5000E-02  R= 1.8398E+02  AC= 5.5533E-04   NEVAL=   314
 155  4.3500E+00 -9.8803E-01 -1.0328E-02 -1.0523E+00   1.0069E+00 -3.5092E-03
         H= 2.5000E-02  R= 1.9043E+02  AC= 5.4239E-04   NEVAL=   335
 165  4.7750E+00 -5.5306E-01 -1.1753E-02 -1.1520E+00   1.0387E+00 -3.1772E-03
         H= 5.0000E-02  R= 1.8739E+02  AC= 5.4448E-04   NEVAL=   356
 170  5.0000E+00 -3.1772E-01 -1.2444E-02 -1.1993E+00   1.0528E+00 -2.9619E-03
         H= 5.0000E-02  R= 1.8378E+02  AC= 5.5173E-04   NEVAL=   367
 175  5.2995E+00  1.1102E-16 -1.3284E-02 -1.2559E+00   1.0682E+00 -2.6446E-03
         H= 1.0000E-01  R= 1.7534E+02  AC= 5.5777E-04   NEVAL=   377


* * * * * * * * * * * * * * * * * * * * * * * * SWITCH TO FINE STEPSIZE * *


*    *    *    *  INITIAL COORDINATES  X=-5.00000E+00    Y= 0.              Z=-4.95000
     IFLAG= 7 FOR KSTEP=     30  NEVAL=      57            HMIN IS SET TO 3.1250E-03
     IFLAG= 7 FOR KSTEP=     30  NEVAL=      58            HMIN IS SET TO 1.5625E-03
         INSIDE QUAD  187      I2=  1
         ZNP,ROSQ,TSQ,H=  -3.2026E-04   1.6737E-01   6.7553E-01   2.5003E-02
         THE BODY SURFACE IS PENETRATED.  PARTICLE COORDINATES ARE (X,Y,Z)-2.414
         TRIAL INITIAL COORDINATES ARE (YINIT,ZINIT)  0.           -4.9500E-01

              AFTER   0 ATTEMPTS PARTICLE STILL PENETRATES THE BODY.


KSTEP        T              X             Y            Z          VPX          VPY
   0  0.          -5.0000E+00  0.          -4.9500E-01   9.5017E-01 -1.0226E-03 -1
         H= 1.0000E-01  R= 1.7534E+02  AC= 4.2147E-20   NEVAL=     1
  10  5.0000E-01 -4.5250E+00 -5.1385E-04 -5.0401E-01   9.4934E-01 -1.0394E-03 -1
         H= 5.0000E-02  R= 2.1313E+01  AC= 1.6874E-03   NEVAL=    13
  20  1.0000E+00 -4.0512E+00 -1.0501E-03 -5.1333E-01   9.4502E-01 -1.1222E-03 -1
         H= 1.0000E-01  R= 5.6799E+01  AC= 9.2763E-04   NEVAL=    31
  21  1.0000E+00 -4.0512E+00 -1.0501E-03 -5.1333E-01   9.4502E-01 -1.1222E-03 -1
         H= 1.0000E-01  R= 6.6762E+01  AC= 6.7141E-04   NEVAL=    33
  31  1.8766E+00 -3.2352E+00 -2.2457E-03 -5.3643E-01   9.0602E-01 -1.7688E-03 -4
         H= 1.5625E-03  R= 2.0029E+02  AC= 5.0043E-04   NEVAL=    60
  41  1.9063E+00 -3.2083E+00 -2.2988E-03 -5.3772E-01   9.0350E-01 -1.8081E-03 -4
         H= 6.2500E-03  R= 2.0786E+02  AC= 4.9263E-04   NEVAL=    80
```

FOLDOUT FRAME

```
5E-01 -1.8018E-03 -4.4579E-02  7.4102E-01 -4.3561E-03 -2.0313E-01
=     85
5E-01 -1.9350E-03 -5.2476E-02  7.2203E-01 -4.6783E-03 -2.3124E-01
=    103
7E-01 -2.8990E-03 -1.4541E-01  7.7503E-01 -5.6161E-03 -5.0306E-01
=    124
2E-01 -3.2768E-03 -2.0033E-01  9.5347E-01 -5.6300E-03 -5.6342E-01
=    147
9E-01 -3.4910E-03 -2.3312E-01  1.0317E+00 -5.0500E-03 -4.5671E-01
=    167
6E-01 -3.5962E-03 -2.4746E-01  1.0474E+00 -4.9247E-03 -4.0973E-01
=    178
5E-01 -3.7829E-03 -2.6766E-01  1.1074E+00 -5.0931E-03 -3.8329E-01
=    202
5E-01 -3.8160E-03 -2.7199E-01  1.1195E+00 -4.0114E-03 -3.1470E-01
=    222
8E-01 -3.8177E-03 -2.7241E-01  1.1183E+00 -3.9671E-03 -3.0931E-01
=    247
4E-01 -3.8205E-03 -2.7338E-01  1.1168E+00 -3.8600E-03 -2.9616E-01
=    267
2E-01 -3.7791E-03 -2.7288E-01  1.1511E+00 -3.2909E-03 -2.4028E-01
=    288
3E-01 -3.7025E-03 -2.6648E-01  1.1507E+00 -2.8540E-03 -1.8720E-01
=    311
3E-01 -3.7025E-03 -2.6648E-01  1.1506E+00 -2.8140E-03 -1.8361E-01
=    314
9E+00 -3.5092E-03 -2.4919E-01  1.1656E+00 -2.2839E-03 -1.3240E-01
=    335
7E+00 -3.1772E-03 -2.1923E-01  1.1649E+00 -1.4809E-03 -7.1961E-02
=    356
8E+00 -2.9619E-03 -2.0115E-01  1.1603E+00 -1.0059E-03 -4.1299E-02
=    367
2E+00 -2.6446E-03 -1.7707E-01  1.1631E+00 -4.1830E-04 -1.9720E-02
=    377


O FINE STEPSIZE * * * * * * * * * * * * * * * * * * * * * * * * *



        Z=-4.95000E-01    FOR TRAJECTORY NUMBER    1
IS SET TO 3.1250E-03
IS SET TO 1.5625E-03

E-01   2.5000E-02
ES ARE (X,Y,Z)-2.41459E+00-4.70245E-03-6.47195E-01
     -4.9500E-01      ATTEMPT NUMBER    0

HE BODY.


PX             VPY            VPZ             VX             VY             VZ
7E-01 -1.0226E-03 -1.7943E-02  9.5017E-01 -1.0226E-03 -9.3971E-03
=      1
4E-01 -1.0394E-03 -1.8156E-02  9.2731E-01 -1.4808E-03 -1.7056E-02
=     13
2E-01 -1.1222E-03 -1.9463E-02  8.8821E-01 -2.1833E-03 -3.4500E-02
=     31
2E-01 -1.1222E-03 -1.9463E-02  8.7730E-01 -2.3654E-03 -4.0409E-02
=     33
2E-01 -1.7688E-03 -4.2313E-02  7.4457E-01 -4.2901E-03 -1.7230E-01
=     60
0E-01 -1.8081E-03 -4.4423E-02  7.3895E-01 -4.3746E-03 -1.8295E-01
=     80
```

ORIGINAL PAGE IS
OF POOR QUALITY

FOLDOUT FRAME 2

```
    48  2.0000E+00 -3.1240E+00 -2.4745E-03 -5.4224E-01  8.9490E-01 -1.9425E-03 -
          H= 2.5000E-02  R= 2.3887E+02  AC= 4.4563E-04  NEVAL=    94
    58  2.4750E+00 -2.7105E+00 -3.5943E-03 -5.8330E-01  8.4764E-01 -2.8141E-03 -
          H= 5.0000E-02  R= 3.4415E+02  AC= 4.1413E-04  NEVAL=   115
    68  2.7125E+00 -2.5103E+00 -4.3208E-03 -6.2286E-01  8.4491E-01 -3.3024E-03 -2
          H= 1.2500E-02  R= 3.7292E+02  AC= 4.0480E-04  NEVAL=   137


* * * * * * * * * * * * * * * * * * * * * * * * TANGENT TRAJECTORY IS AS FOLLO


*   *   *   *  INITIAL COORDINATES  X=-5.00000E+00    Y= 0.           Z=-5.00000
      IFLAG= 7 FOR KSTEP=     28  NEVAL=    60                HMIN IS SET TO 3.1250E-03
      IFLAG= 7 FOR KSTEP=     29  NEVAL=    63                HMIN IS SET TO 1.5625E-03
      IFLAG= 7 FOR KSTEP=    108  NEVAL=   235                HMIN IS SET TO 7.8125E-04


 KSTEP        T             X             Y             Z            VPX          VPY
     0  0.            -5.0000E+00  0.            -5.0000E-01  9.5022E-01 -1.0211E-03 -1
          H= 1.0000E-01  R= 3.7292E+02  AC= 9.3174E-21  NEVAL=     1
    10  5.0000E-01 -4.5250E+00 -5.1313E-04 -5.0905E-01  9.4939E-01 -1.0379E-03 -1
          H= 5.0000E-02  R= 2.1255E+01  AC= 1.6923E-03  NEVAL=    17
    20  1.0000E+00 -4.0512E+00 -1.0485E-03 -5.1842E-01  9.4510E-01 -1.1204E-03 -1
          H= 1.0000E-01  R= 6.6581E+01  AC= 6.7263E-04  NEVAL=    37
    30  1.8797E+00 -3.2321E+00 -2.2468E-03 -5.4173E-01  9.0617E-01 -1.7668E-03 -4
          H= 1.5625E-03  R= 1.9997E+02  AC= 5.3975E-04  NEVAL=    65
    40  1.9063E+00 -3.2081E+00 -2.2942E-03 -5.4294E-01  9.0393E-01 -1.8018E-03 -4
          H= 6.2500E-03  R= 2.0666E+02  AC= 4.9383E-04  NEVAL=    85
    49  2.0000E+00 -3.1237E+00 -2.4692E-03 -5.4747E-01  8.9545E-01 -1.9350E-03 -5
          H= 2.5000E-02  R= 2.3735E+02  AC= 4.4684E-04  NEVAL=   103
    59  2.5250E+00 -2.6674E+00 -3.7260E-03 -5.9541E-01  8.4607E-01 -2.8990E-03 -1
          H= 5.0000E-02  R= 3.5235E+02  AC= 4.1138E-04  NEVAL=   124
    69  2.7125E+00 -2.5091E+00 -4.3054E-03 -6.2775E-01  8.4692E-01 -3.2768E-03 -2
          H= 1.2500E-02  R= 3.6565E+02  AC= 4.0703E-04  NEVAL=   147
    79  2.8750E+00 -2.3701E+00 -4.8572E-03 -6.6323E-01  8.6379E-01 -3.4910E-03 -2
          H= 2.5000E-02  R= 2.7019E+02  AC= 4.4643E-04  NEVAL=   167
    84  3.0000E+00 -2.2614E+00 -5.3004E-03 -6.9338E-01  8.7616E-01 -3.5962E-03 -2
          H= 2.5000E-02  R= 2.2479E+02  AC= 4.9517E-04  NEVAL=   178
    94  3.2687E+00 -2.0226E+00 -6.2920E-03 -7.6277E-01  9.0165E-01 -3.7829E-03 -2
          H= 6.2500E-03  R= 2.2802E+02  AC= 4.7372E-04  NEVAL=   202
   104  3.3750E+00 -1.9261E+00 -6.6963E-03 -7.9148E-01  9.1405E-01 -3.8160E-03 -2
          H= 2.5000E-02  R= 2.0274E+02  AC= 4.9549E-04  NEVAL=   222
   114  3.3937E+00 -1.9089E+00 -6.7679E-03 -7.9658E-01  9.1608E-01 -3.8177E-03 -2
          H= 1.5625E-03  R= 1.9867E+02  AC= 5.3852E-04  NEVAL=   247
   124  3.4500E+00 -1.8572E+00 -6.9827E-03 -8.1193E-01  9.2214E-01 -3.8205E-03 -2
          H= 1.2500E-02  R= 1.8939E+02  AC= 5.4795E-04  NEVAL=   267
   134  3.8000E+00 -1.5285E+00 -8.3154E-03 -9.0780E-01  9.5632E-01 -3.7791E-03 -2
          H= 5.0000E-02  R= 1.9086E+02  AC= 5.4461E-04  NEVAL=   288
   144  4.0000E+00 -1.3352E+00 -9.0641E-03 -9.6181E-01  9.7643E-01 -3.7025E-03 -2
          H= 5.0000E-02  R= 1.8499E+02  AC= 5.4930E-04  NEVAL=   311
   145  4.0000E+00 -1.3352E+00 -9.0641E-03 -9.6181E-01  9.7643E-01 -3.7025E-03 -2
          H= 2.5000E-02  R= 1.8398E+02  AC= 5.5533E-04  NEVAL=   314
   155  4.3500E+00 -9.8803E-01 -1.0328E-02 -1.0523E+00  1.0069E+00 -3.5092E-03 -2
          H= 2.5000E-02  R= 1.9043E+02  AC= 5.4239E-04  NEVAL=   335
   165  4.7750E+00 -5.5306E-01 -1.1753E-02 -1.1520E+00  1.0387E+00 -3.1772E-03 -2
          H= 5.0000E-02  R= 1.8739E+02  AC= 5.4448E-04  NEVAL=   356
   170  5.0000E+00 -3.1772E-01 -1.2444E-02 -1.1993E+00  1.0528E+00 -2.9619E-03 -2
          H= 5.0000E-02  R= 1.8378E+02  AC= 5.5173E-04  NEVAL=   367
   175  5.2995E+00  1.1102E-16 -1.3284E-02 -1.2559E+00  1.0682E+00 -2.6446E-03 -1
          H= 1.0000E-01  R= 1.7534E+02  AC= 5.5777E-04  NEVAL=   377
```


FOLDOUT FRAME

```
1 -1.9425E-03 -5.2553E-02  7.1946E-01 -4.6997E-03 -2.3140E-01
 94
1 -2.8141E-03 -1.3307E-01  7.4906E-01 -5.5837E-03 -4.7531E-01
115
1 -3.3024E-03 -2.0236E-01  9.5275E-01 -5.7009E-03 -5.7291E-01
137


TORY IS AS FOLLOWS * * * * * * * * * * * * * * * * * * * * * * *



      Z=-5.00000E-01    FOR TRAJECTORY NUMBER    0
ET TO 3.1250E-03
ET TO 1.5625E-03
ET TO 7.8125E-04


       VPY          VPZ           VX          VY          VZ
1 -1.0211E-03 -1.8037E-02  9.5022E-01 -1.0211E-03 -9.4917E-03
  1
1 -1.0379E-03 -1.8253E-02  9.2743E-01 -1.4781E-03 -1.7214E-02
 17
1 -1.1204E-03 -1.9572E-02  8.7764E-01 -2.3594E-03 -4.0720E-02
 37
1 -1.7668E-03 -4.2684E-02  7.4593E-01 -4.2808E-03 -1.7362E-01
 65
1 -1.8018E-03 -4.4579E-02  7.4102E-01 -4.3561E-03 -1.8313E-01
 85
1 -1.9350E-03 -5.2476E-02  7.2203E-01 -4.6783E-03 -2.3124E-01
103
1 -2.8990E-03 -1.4541E-01  7.7503E-01 -5.6161E-03 -5.0306E-01
124
1 -3.2768E-03 -2.0033E-01  9.5347E-01 -5.6300E-03 -5.6342E-01
147
1 -3.4910E-03 -2.3312E-01  1.0317E+00 -5.0500E-03 -4.5671E-01
167
1 -3.5962E-03 -2.4746E-01  1.0474E+00 -4.9247E-03 -4.0973E-01
178
1 -3.7829E-03 -2.6766E-01  1.1074E+00 -5.0931E-03 -3.8329E-01
202
1 -3.8160E-03 -2.7199E-01  1.1195E+00 -4.0114E-03 -3.1470E-01
222
1 -3.8177E-03 -2.7241E-01  1.1143E+00 -3.9671E-03 -3.0931E-01
247
1 -3.8205E-03 -2.7338E-01  1.1168E+00 -3.8600E-03 -2.9616E-01
267
1 -3.7791E-03 -2.7288E-01  1.1511E+00 -3.2909E-03 -2.4028E-01
288
1 -3.7025E-03 -2.6648E-01  1.1507E+00 -2.8540E-03 -1.8720E-01
311
1 -3.7025E-03 -2.6648E-01  1.1506E+00 -2.8140E-03 -1.8361E-01
314
1 -3.5092E-03 -2.4919E-01  1.1656E+00 -2.2839E-03 -1.3240E-01
335
1 -3.1772E-03 -2.1923E-01  1.1649E+00 -1.4809E-03 -7.1961E-02
356
1 -2.9619E-03 -2.0115E-01  1.1603E+00 -1.0059E-03 -4.1299E-02
367
1 -2.6446E-03 -1.7707E-01  1.1631E+00 -4.1830E-04 -1.9720E-02
377
```

FOLDOUT FRAME 2

STEREO

PLOT TANGENT TRAJECTORY TO THE TEST BODY

NUMBER OF SYMMETRY PLANES= 0   NUMBER OF TRAJECTORIES= 1   XSTART=

MINIMUM AND MAXIMUM COORDINATES -

X AXIS=	-5.00000E+00	2.00000E+00
Y AXIS=	-2.00000E+00	2.00000E+00
Z AXIS=	-1.25593E+00	1.00000E+00

COORDINATE TRANSLATIONS USED TO CENTER THE PLOTS - DELX, DELY, DELZ -
-1.50000E+00   0.   -1.27964E-01

CRT PLOTS

THETA = 0.00   PSI = 160.00   DELTA = 3.50
PLOT LABEL - THETA=0, PSI=160, DELTA=3.5
PEMSF = 1.5466E+00

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.2158E+01	-.5754E+00
-.5000E+01	0.	-.5000E+00	-.2158E+01	-.5754E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1865E+01	-.5894E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1572E+01	-.6039E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.1065E+01	-.6400E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.1050E+01	-.6418E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.9978E+00	-.6488E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.7146E+00	-.7229E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.6162E+00	-.7729E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.5297E+00	-.8279E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.4620E+00	-.8744E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.3133E+00	-.9818E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.2533E+00	-.1026E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.2426E+00	-.1034E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.2104E+00	-.1058E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.5772E-02	-.1206E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1145E+00	-.1290E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1145E+00	-.1290E+01
-.9880E+00	-.1033E-01	-.1052E+01	.3304E+00	-.1429E+01
-.5531E+00	-.1175E-01	-.1152E+01	.6006E+00	-.1584E+01
-.3177E+00	-.1244E-01	-.1199E+01	.7468E+00	-.1657E+01
.1110E-15	-.1328E-01	-.1256E+01	.9439E+00	-.1744E+01

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.1537E+01	-.5754E+00
-.5000E+01	0.	-.5000E+00	-.1537E+01	-.5754E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1328E+01	-.5894E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1119E+01	-.6039E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.7575E+00	-.6400E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.7469E+00	-.6418E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.7096E+00	-.6488E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.5073E+00	-.7229E+00

FOLDOUT FRAME

1 XSTART=-5.00000E+00

DELY, DELZ -
27964E-01

YPLOT

-.5754E+00
-.5754E+00
-.5894E+00
-.6039E+00
-.6400E+00
-.6418E+00
-.6488E+00
-.7229E+00
-.7729E+00
-.8279E+00
-.8744E+00
-.9818E+00
-.1026E+01
-.1034E+01
-.1058E+01
-.1206E+01
-.1290E+01
-.1290E+01
-.1429E+01
-.1584E+01
-.1657E+01
-.1744E+01

YPLOT

-.5754E+00
-.5754E+00
-.5894E+00
-.6039E+00
-.6400E+00
-.6418E+00
-.6488E+00
-.7229E+00

FOLDOUT FRAME 2

-.2509E+01	-.4305E-02	-.6277E+00	-.4369E+00	-.7729E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.3750E+00	-.8279E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.3266E+00	-.8744E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.2202E+00	-.9818E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.1772E+00	-.1026E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.1696E+00	-.1034E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.1466E+00	-.1058E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.1809E-03	-.1206E+01
-.1335E+01	-.9064E-02	-.9618E+00	.8585E-01	-.1290E+01
-.1335E+01	-.9064E-02	-.9618E+00	.8585E-01	-.1290E+01
-.9880E+00	-.1033E-01	-.1052E+01	.2402E+00	-.1429E+01
-.5531E+00	-.1175E-01	-.1152E+01	.4334E+00	-.1584E+01
-.3177E+00	-.1244E-01	-.1199E+01	.5378E+00	-.1657E+01
.1110E-15	-.1328E-01	-.1256E+01	.6786E+00	-.1744E+01

THETA = 0.00 PSI = 160.00 DELTA = 3.00
PLOT LABEL - THETA=0, PSI=160, DELTA=3.0
PEMSF = 1.5568E+00

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.2129E+01	-.5792E+00
-.5000E+01	0.	-.5000E+00	-.2129E+01	-.5792E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1839E+01	-.5933E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1550E+01	-.6079E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.1050E+01	-.6442E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.1036E+01	-.6460E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.9841E+00	-.6531E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.7048E+00	-.7277E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.6076E+00	-.7780E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.5223E+00	-.8334E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.4555E+00	-.8802E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.3088E+00	-.9882E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.2496E+00	-.1033E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.2390E+00	-.1041E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.2073E+00	-.1065E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.5410E-02	-.1214E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1133E+00	-.1298E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1133E+00	-.1298E+01
-.9880E+00	-.1033E-01	-.1052E+01	.3262E+00	-.1439E+01
-.5531E+00	-.1175E-01	-.1152E+01	.5928E+00	-.1594E+01
-.3177E+00	-.1244E-01	-.1199E+01	.7370E+00	-.1668E+01
.1110E-15	-.1328E-01	-.1256E+01	.9315E+00	-.1756E+01

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.1593E+01	-.5792E+00
-.5000E+01	0.	-.5000E+00	-.1593E+01	-.5792E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1376E+01	-.5933E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1160E+01	-.6079E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.7850E+00	-.6442E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.7740E+00	-.6460E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.7354E+00	-.6531E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.5258E+00	-.7277E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.4529E+00	-.7780E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.3888E+00	-.8334E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.3387E+00	-.8802E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.2285E+00	-.9882E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.1840E+00	-.1033E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.1761E+00	-.1041E+01

-.1909E+01	-.6768E-02	-.7966E+00	-.1761E+00	-.1041E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.1522E+00	-.1065E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.5852E-03	-.1214E+01
-.1335E+01	-.9064E-02	-.9618E+00	.8853E-01	-.1298E+01
-.1335E+01	-.9064E-02	-.9618E+00	.8853E-01	-.1298E+01
-.9880E+00	-.1033E-01	-.1052E+01	.2484E+00	-.1439E+01
-.5531E+00	-.1175E-01	-.1152E+01	.4485E+00	-.1594E+01
-.3177E+00	-.1244E-01	-.1199E+01	.5566E+00	-.1668E+01
.1110E-15	-.1328E-01	-.1256E+01	.7025E+00	-.1756E+01

THETA = 0.00 PSI = 160.00 DELTA = 2.50
PLOT LABEL - THETA=0, PSI=160, DELTA=2.5
PEMSF = 1.5672E+00

TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.2099E+01	-.5831E+00
-.5000E+01	0.	-.5000E+00	-.2099E+01	-.5831E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1814E+01	-.5973E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1529E+01	-.6119E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.1036E+01	-.6485E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.1021E+01	-.6504E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.9703E+00	-.6575E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.6948E+00	-.7326E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.5990E+00	-.7833E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.5148E+00	-.8390E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.4490E+00	-.8861E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.3043E+00	-.9949E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.2459E+00	-.1040E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.2355E+00	-.1048E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.2041E+00	-.1072E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.5043E-02	-.1222E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1120E+00	-.1307E+01
-.1335E+01	-.9064E-02	-.9618E+00	.1120E+00	-.1307E+01
-.9880E+00	-.1033E-01	-.1052E+01	.3220E+00	-.1449E+01
-.5531E+00	-.1175E-01	-.1152E+01	.5849E+00	-.1605E+01
-.3177E+00	-.1244E-01	-.1199E+01	.7271E+00	-.1679E+01
.1110E-15	-.1328E-01	-.1256E+01	.9189E+00	-.1768E+01

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TRAJ. NO. 1 OF 22 POINTS

XTRAJ	YTRAJ	ZTRAJ	XPLOT	YPLOT
-.5000E+01	0.	-.5000E+00	-.1649E+01	-.5831E+00
-.5000E+01	0.	-.5000E+00	-.1649E+01	-.5831E+00
-.4525E+01	-.5131E-03	-.5091E+00	-.1425E+01	-.5973E+00
-.4051E+01	-.1049E-02	-.5184E+00	-.1201E+01	-.6119E+00
-.3232E+01	-.2247E-02	-.5418E+00	-.8129E+00	-.6485E+00
-.3208E+01	-.2294E-02	-.5429E+00	-.8015E+00	-.6504E+00
-.3124E+01	-.2469E-02	-.5475E+00	-.7615E+00	-.6575E+00
-.2667E+01	-.3726E-02	-.5954E+00	-.5446E+00	-.7326E+00
-.2509E+01	-.4305E-02	-.6277E+00	-.4691E+00	-.7833E+00
-.2370E+01	-.4857E-02	-.6633E+00	-.4028E+00	-.8390E+00
-.2261E+01	-.5300E-02	-.6934E+00	-.3509E+00	-.8861E+00
-.2023E+01	-.6292E-02	-.7628E+00	-.2369E+00	-.9949E+00
-.1926E+01	-.6696E-02	-.7915E+00	-.1908E+00	-.1040E+01
-.1909E+01	-.6768E-02	-.7966E+00	-.1826E+00	-.1048E+01
-.1857E+01	-.6983E-02	-.8119E+00	-.1579E+00	-.1072E+01
-.1528E+01	-.8315E-02	-.9078E+00	-.9949E-03	-.1222E+01
-.1335E+01	-.9064E-02	-.9618E+00	.9124E-01	-.1307E+01
-.1335E+01	-.9064E-02	-.9618E+00	.9124E-01	-.1307E+01
-.9880E+00	-.1033E-01	[illegible]	[illegible]	[illegible]

-.9860E+00	-.1033E-01	-.1052E+01	.2567E+00	-.1449E+01
-.5531E+00	-.1175E-01	-.1152E+01	.4638E+00	-.1605E+01
-.3177E+00	-.1244E-01	-.1199E+01	.5758E+00	-.1679E+01
.1110E-15	-.1328E-01	-.1256E+01	.7268E+00	-.1768E+01

CODE LISTINGS

```
      PROGRAM PBOXC(INPUT,TAPE6, TAPE5=INPUT, OUTPUT,
     1 TAPE8 , TAPE9, TAPE39, PUNCH, TAPE1=PUNCH)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     THIS CODE HAS THREE PRINCIPAL USES -
C          1. DEBUG HESS-SMITH CODE INPUT DATA.
C          2. PLOT 3-DIMENSIONAL BODY SURFACE DESCRIPTION.
C          3. TRANSFER QUADRALATERAL ELEMENT DATA TO UNIT 9 FOR LATER
C             USE BY PROGRAM STEREO.
C
C     PERFORMS  PRELIMINARY PROCESSING (IPROS=TRUE) (SCALING,
C     TRANSLATING, ROTATING) OF INPUT DATA FOR THE HESS-SMITH
C     NON-LIFTING CODE (RPT. E.S. 40622).   PRELIMINARY PROCESSED DATA
C     MAY BE PUNCHED (IPUNCH=TRUE).   AFTER PRELIMINARY PROCESSING, DATA
C     ALSO MAY BE PROCESSED INTO QUADRALATERAL ELEMENTS AND THE HESS-
C     SMITH FIRST OUTPUT (E.S. 40622 SEC. 9.4) MAY BE PRINTED (IPRNT=
C     TRUE).   DATA ALSO MAY BE PLOTTED (IPICT=TRUE).   IN ANY CASE THE
C     DATA ARE WRITTEN ON TO UNIT 9, WHICH MAY BE SAVED FOR USE LATER
C     BY SR STEREO WHICH PLOTS THE BODY ALONG WITH TRAJECTORIES.
C
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IPRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      REAL MACH
      LOGICAL IPROS, IPUNCH, IPRNT, IPICT, ICRT
      COMMON /M/ MACH, BETA, RBETA
C     READ IN CONTROL DATA
    1 READ ( 5, 9000 )(HEDR(I),I=1,15),IFLAG,NSYM, KMACH, KASE
 9000 FORMAT( 15A4, I1, 10X,I1, 1X, I1, 2X, A4)
      MACH = 0.0
      IF(KMACH .NE. 0) READ(5,6) MACH
    6 FORMAT (F10.6)
      BETA = SQRT(1.0 - MACH * MACH)
      RBETA = 1.0 / BETA
      READ(5,8000)IPROS, IPUNCH, IPRNT, IPICT, ICRT
 8000 FORMAT(5L1)
      IF( IPROS ) READ(5,7000) ANGLE, XSCALE, YSCALE, ZSCALE,XTRANS,
     1  YTRANS, ZTRANS
 7000 FORMAT( 7F10.0)
      IF(.NOT. IPROS) GO TO 50
      IF(XSCALE .EQ. 0.0) XSCALE=1.0
      IF(YSCALE .EQ. 0.0) YSCALE=1.0
      IF(ZSCALE .EQ. 0.0) ZSCALE=1.0
      COSA = COS(  0.0174533 * ANGLE)
      SINA = SIN(  0.0174533 * ANGLE)
   50 REWIND 8
      REWIND 9
      CALL PINPUT
      IF(IPICT ) CALL PICTUR
      IF( ICRT ) CALL FRAME(0.5,0.5)
      IF(IPICT .AND.  .NOT. ICRT) CALL PLOT(15.0, 0.0,-3)
      IF(IPICT .AND.  .NOT. ICRT) CALL ENDCC
      IF(IPICT .AND.ICRT) CALL ENDPLT
      REWIND 9
      STOP
      END
```

```
*DECK,PEADER
      SUBROUTINE PEADER
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IPRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      LOGICAL IPROS, IPUNCH, IPRNT, IPICT, ICRT
      DATA IPAGE/0/
    1 FORMAT( 1H1, 4X, 14H PROGRAM PBOXC, 15X, 30HATMOSPHERIC SCIENCE AS
     1SOCIATES/           38X, 22HBEDFORD, MASSACHUSETTS, 22X, 4HPAGEI5/
     2 7X, 8HBODY ID., 2X, A4/ 30X, 15A4)
   10 IPAGE = IPAGE + 1
      WRITE (6,1) IPAGE, KASE, (HEDR(I),I=1,15)
      RETURN
      END
```

```
*DECK,PATPROS
      SUBROUTINE PATPROS( X, Y, Z, XX, YY, ZZ )
C
C     THIS IS A SIMPLE SCALING AND ORIGIN TRANSLATION CODE FOR THE
C     DOUGLAS BOXC POTENTIAL FLOW  CODE DATA INPUT
C        XTRANS, YTRANS, ZTRANS ARE ORIGIN TRANSLATIONS
C        XSCALE, YSCALE, ZSCALE ARE SCALE FACTORS
C     THE CODE ALSO ALLOWS FOR ROTATION IN THE X - Z PLANE TO ADJUST
C     FOR ARBITRARY ANGLE OF ATTACK
C        SINA, COSA ARE SINE AND COSINE OF ANGLE
C        ANGLE IS THE ANGLE( INPUT IN DEGREES)  THAT THE AIRPLANE AXIS
C        MAKES WITH THE NEGATIVE X AXIS (POSITIVE COUNTERCLOCKWISE
C        FROM THE-X AXIS) AFTER SCALING ( NOTE - AFTER SCALING THE
C        AIRPLANE NOSE POINTS DOWN THE NEGATIVE X AXIS)
C
C     THIS VERSION FOR USE WITH PBOXC
C
C
      LOGICAL IPROS, IPUNCH, IPRNT, IPICT, ICRT
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IPRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      X = ( X - XTRANS ) * XSCALE
      Y = ( Y - YTRANS ) * YSCALE
      Z = ( Z - ZTRANS ) * ZSCALE
      XX= ( XX- XTRANS ) * XSCALE
      YY= ( YY- YTRANS ) * YSCALE
      ZZ= ( ZZ- ZTRANS ) * ZSCALE
      XP = X
      X = XP * COSA - Z * SINA
      Z = XP * SINA + Z * COSA
      XP = XX
      XX= XP * COSA - ZZ* SINA
      ZZ= XP * SINA + ZZ* COSA
      RETURN
      END
```

```
*DECK,PINPUT
      SUBROUTINE PINPUT
C
C     PROCESSES THE HESS-SMITH CODE INPUT DATA
C
      REAL NX, NY, NZ , MACH
      LOGICAL IPROS, IPUNCH, IFRNT, IPICT, ICRT, RFLAG, AFLAG, BFLAG
      INTEGER  STAT, STATT, CONV
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IFRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     2 ZTRANS
      COMMON /M/ MACH, BETA, RBETA
      DIMENSION  SPH ( 200 ),  CPH ( 200 ), XINP ( 200 ), ZINP ( 200 )
      DIMENSION LAXIS(8), RAXIS(6), L45(6), L(5)
      DIMENSION XA (   500 ), XB (   500 ), YA (   500 ), YB (   500 ),
     1   ZA (   500 ), ZB (   500 ), NLINE(500 ), NLT (   500 ), CFLAG(3),
     2   XI (4), ETA (4), XIN (4), YIN (4),   ZIN (4),
     4                                  RX (4), R (4), RY (4)
      EQUIVALENCE (NULL,NQUAD)
      DATA   CFLAG                          / 2H 1, 2H 2, 2H    /
      DATA PI/3.141593E0/, HAFPI/1.570796E0/, EPS/.0001/
      DATA LAXIS / 4HVIEW, 4H CF , 4HBODY, 4H LOO, 4HKING, 4H DOW,
     1 4HN TH, 1HE/
      DATA RAXIS/ 4H AXI, 4HS TO, 4HWARD,4H THE, 4H ORI,  4HGIN /
      DATA L45/ 4H45-D, 4HEGRE, 4HE VI, 4HEW F, 4HROM , 4HTHE /
      DATA R45/ 4HSIDE/, L/5*4H    /
      DATA PLUSX, MINUSX, PLUSY, MINUSY, PLUSZ, MINUSZ
     1  / 4H +X , 4H -X , 4H +Y , 4H -Y , 4H +Z , 4H -Z /
    1 FORMAT (        3E10.0, I2 / 3F10.0, I2)
 4002 FORMAT ( 1H0, 6X 5HN    M, 7X, 4 ( 1HX, 11X ), 2HNX, 11X, 3HNPX,
     1   11X, 1HD / 19X, 4 ( 1HY, 11X ), 2HNY, 11X, 3HNPY, 11X, 1HT /
     2   19X, 4(1HZ, 11X ), 2HNZ, 11X, 3HNPZ, 11X, 1HA          )
 4005 FORMAT ( 1H0, 7X, I4, 4F12.6, 2F13.6, E14.4,A2/(12X,4F12.6,
     1   2F13.6, E14.4 )  )
 4010 FORMAT ( 1H0, 3X , 2I4, 4F12.6, 2F13.6, E14.4,A2/(12X, 4F12.6,
     1   2F13.6,  E14.4   )  )
 4015 FORMAT ( 1H0, 3 ( 20X,  12H************ ))

C  INPUT -- SECTION 9.1  INPUT SCHEME
      KLCT = 0
      NULL = 0
      NPRT = 13
      CALL PEADER
      WRITE (6, 40)
   40 FORMAT (1H0,16X,44HP A R A M E T R I C    I N F O R M A T I O N//)
      IF (NSYM - 1) 54, 56, 58
   54 WRITE (6, 55)
   55 FORMAT (1H0,16X,21HNO SYMMETRY SPECIFIED)
      GO TO 61
   56 WRITE (6, 57)
   57 FORMAT (1H0,16X,30HTHERE IS ONE PLANE OF SYMMETRY)
      GO TO 61
   58 WRITE (6, 59) NSYM
   59 FORMAT (1H0,16X,9HTHERE ARE,I2, 19H PLANES OF SYMMETRY)
   61 IF ( MACH .NE. 0.0 ) WRITE (6, 21) MACH
   21 FORMAT (1H0,16X,13HMACH NUMBER =,F10.5)
      IF (IFLAG .EQ. 0) GO TO 29
      READ (5, 20) NLM1, MMIN, B, C
      IF (B .EQ. 0.0) B = 1.0
      IF (C .EQ. 0.0) C = 1.0
```

```
20 FORMAT ( 2I5, 2F10.5 )
 4 FORMAT ( 8F10.0 )
   WRITE (6, 62) NLM1, MMIN, B, C
62 FORMAT (1H0,16X,10HGENERATE A,I3, 2H X,I3, 12H SPHERE. B =,F10.5,
  1 4X,3HC =,F10.5 )
   MLINES = MMIN + 1
   NLINES = NLM1 + 1
   N = 0
   IF ( NSYM .EQ. 0 ) GO TO 2
   IF ( NSYM - 2 ) 3, 5, 6
 2 PITH = PI
   PIPHI = PI + PI
   GO TO 7
 3 PITH = PI
   PIPHI = PI
   GO TO 7
 5 PITH = PI
   PIPHI = HAFPI
   GO TO 7
 6 PITH = HAFPI
   PIPHI = PITH
 7 SPH ( MLINES ) = SIN ( PIPHI )
   SPH ( 1 ) = 0.0
   CPH ( MLINES ) = COS ( PIPHI )
   CPH ( 1 ) = 1.0
   EKM = MMIN
   EKN = NLM1
   EMM = 0.0
   DO 8  I = 2, MMIN
   EMM = EMM + 1.0
   PHI = EMM / EKM * PIPHI
   SPH ( I ) = SIN ( PHI )
 8 CPH ( I ) = COS ( PHI )
   IF ( IFLAG .EQ. 2 ) GO TO 10
   ENN = 1.0
   DO 9  I = 1, MLINES
   XA ( I ) = 1.0
   YA ( I ) = 0.0
 9 ZA ( I ) = 0.0
   GO TO 18
10 READ ( 5, 4 ) ( XINP ( I ), ZINP ( I ), I = 1, NLINES )
   DO 11 I = 1, MLINES
   XA ( I ) = XINP ( 1 )
   YA ( I ) = B * ZINP ( 1 ) * SPH ( I )
   ZA ( I ) = - C * ZINP ( 1 ) * CPH ( I )
   XB ( I ) = XINP ( 2 )
   YB ( I ) = B * ZINP ( 2 ) * SPH ( I )
11 ZB ( I ) = - C * ZINP ( 2 ) * CPH ( I )
   NLCT = 2
   GO TO 250
12 DO 14 I = 1, MLINES
   XA ( I ) = XB ( I )
   YA ( I ) = YB ( I )
14 ZA ( I ) = ZB ( I )
   IF ( IFLAG .EQ. 1 ) GO TO 16
   NLCT = NLCT + 1
   DO 15  I = 1, MLINES
   XB ( I ) =  XINP ( NLCT )
   YB ( I ) =  B * ZINP ( NLCT ) * SPH ( I )
15 ZB ( I ) =  - C * ZINP ( NLCT ) * CPH ( I )
```

```
      GO TO 250
   16 ENN = ENN + 1.0
   18 THETA = ENN / EKN * PITH
      STH = SIN ( THETA )
      CTH = COS ( THETA )
      DO 17  I = 1, MLINES
      XB  ( I ) = CTH
      YB  ( I ) =     B * STH * SPH ( I )
   17 ZB  ( I ) =  - C * STH * CPH ( I )
      GO TO 250
   29 N = -1
      IF(IPROS) WRITE(6,101)
      IF(IPROS) WRITE(6,102) XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS,
     1 ZTRANS, COSA, SINA
      IF(IPICT) WRITE(6,103)
      IF(IPUNCH) WRITE(6,104)
C
  101 FORMAT( 1H0, 16X, 61HINPUT DATA ARE PROCESSED BY SCALING, ROTATING
     1 AND TRANSLATING)
  102 FORMAT( 18X, 58HXSCALE, YSCALE, ZSCALE, XTRANS, YTRANS, ZTRANS, CO
     1SA, SINA/ 15X, 8(1PE14.4))
  103 FORMAT( 1H0, 16X,18HPLOTS ARE PREPARED)
  104 FORMAT( 1H0, 16X, 16HDATA ARE PUNCHED)
      XMIN =  1.0E6
      XMAX = -1.0E6
      YMIN =  1.0E6
      YMAX = -1.0E6
      ZMIN =  1.0E6
      ZMAX = -1.0E6
      GO TO 50
   30 IF ( RFLAG ) GO TO 50
      RFLAG = .TRUE.
      X = XX
      Y = YY
      Z = ZZ
      STAT = STATT
      GO TO 66
   50 RFLAG = .FALSE.
   51 READ ( 5, 1 )  X, Y, Z, STAT, XX, YY, ZZ, STATT
      IF ( IPROS ) CALL FATPROS( X, Y, Z, XX, YY, ZZ )
      IF(IPUNCH ) WRITE(1,5100) X, Y, Z, STAT, XX, YY, ZZ, STATT
 5100 FORMAT( 3(  F10.7), I2/ 3(  F10.7), I2)
      WRITE (9) X,Y,Z,STAT,XX,YY,ZZ,STATT
C
   64 XMIN = AMIN1(XMIN, X * RBETA)
      YMIN = AMIN1(YMIN,Y)
      ZMIN = AMIN1(ZMIN,Z)
      XMAX = AMAX1(XMAX, X * RBETA)
      YMAX = AMAX1(YMAX,Y)
      ZMAX = AMAX1(ZMAX,Z)
      IF(STAT .EQ. 3) GO TO 164
      XMIN = AMIN1(XMIN, XX* RBETA)
      YMIN = AMIN1(YMIN,YY)
      ZMIN = AMIN1(ZMIN,ZZ)
      XMAX = AMAX1(XMAX, XX* RBETA)
      YMAX = AMAX1(YMAX,YY)
      ZMAX = AMAX1(ZMAX,ZZ)
  164 IF( NSYM .EQ. 0 ) GO TO 65
      YMIN = AMIN1( YMIN, -Y)
      YMAX = AMAX1( YMAX, -Y)
```

```
      IF(STAT .EQ. 3) GO TO 165
      YMIN = AMIN1( YMIN, -YY)
      YMAX = AMAX1( YMAX, -YY)
  165 IF( NSYM .EQ. 1 ) GO TO 65
      ZMIN = AMIN1( ZMIN, -Z)
      ZMAX = AMAX1( ZMAX, -Z)
      IF(STAT .EQ. 3) GO TO 65
      ZMIN = AMIN1( ZMIN, -ZZ)
      ZMAX = AMAX1( ZMAX, -ZZ)
   65 IF (N .EQ.(-1))GO TO 80
   66 IF (STAT .EQ. 0 .OR. STAT .EQ. 3) GO TO 180
      IF ( STAT .EQ. 2 ) GO TO 200
      IF ( .NOT. AFLAG ) GO TO 200
      MC = M
   80 M = 1
      IF ( STAT .EQ. 2 )  GO TO 150
      IF ( .NOT. BFLAG ) GO TO 84
   75 DO 81 J = 1, MC
      XA ( J ) = XB ( J )
      YA ( J ) = YB ( J )
   81 ZA ( J ) = ZB ( J )
   83 XB ( 1 ) = X
      YB ( 1 ) = Y
      ZB ( 1 ) = Z
      GO TO 30
   84 IF ( AFLAG ) GO TO 85
      BFLAG = .TRUE.
      GO TO 75
   85 AFLAG = .FALSE.
      GO TO 83
  150 AFLAG = .TRUE.
      BFLAG = .FALSE.
      IF (N .EQ.(-1))N = 0
  160 XA ( M ) = X
      YA ( M ) = Y
      ZA ( M ) = Z
      GO TO 30
  180 M = M + 1
      IF ( AFLAG ) GO TO 160
      XB (M ) = X
      YB ( M ) = Y
      ZB ( M ) = Z
      IF ( STAT .NE. 3 )  GO TO 30
  200 MMIN = MIN0(M, MC) - 1
      MC = M
  250 N = N + 1
      KLCT = KLCT + 1
      IF( .NOT. IPRNT) GO TO 2100

C  BEGIN COMPUTATION OF NULL POINTS AND 28 QUANTITIES

      DO 2000 I = 1, MMIN
      NULL = NULL + 1
      XIN(1) = XA( I ) * RBETA
      XIN(2) = XA(I+1) * RBETA
      XIN(3) = XB(I+1) * RBETA
      XIN(4) = XB( I ) * RBETA
      YIN(1) = YA(I)
      YIN(2) = YA(I+1)
      YIN(3) = YB(I+1)
```

```
      YIN(4) = YB(I)
      ZIN(1) = ZA(I)
      ZIN(2) = ZA(I+1)
      ZIN(3) = ZB(I+1)
      ZIN(4) = ZB(I)

C   FORM DIAGONAL VECTORS
C   EQUATION  ( 64 )

      T1X = XIN(3) - XIN(1)
      T2X = XIN(4) - XIN(2)
      T1Y = YIN(3) - YIN(1)
      T2Y = YIN(4) - YIN(2)
      T1Z = ZIN(3) - ZIN(1)
      T2Z = ZIN(4) - ZIN(2)

C   FORM CROSS PRODUCT  N = T2 X T1
C   EQUATION  ( 65 )

      NX = T2Y*T1Z - T1Y*T2Z
      NY = T1X*T2Z - T2X*T1Z
      NZ = T2X*T1Y - T1X*T2Y
      VN = SQRT (  NX* NX +  NY* NY +  NZ* NZ )

C   FORM UNIT NORMAL VECTOR
C   EQUATION  ( 66 )

      NX = NX / VN
      NY = NY / VN
      NZ = NZ / VN

C   COMPUTE AVERAGE POINT
C   EQUATION  ( 68 )

      AVX = .25 * ( XIN(1) + XIN(2) + XIN(3) + XIN(4) )
      AVY = .25 * ( YIN(1) + YIN(2) + YIN(3) + YIN(4) )
      AVZ = .25 * ( ZIN(1) + ZIN(2) + ZIN(3) + ZIN(4) )

C   COMPUTE PROJECTION DISTANCE
C   EQUATIONS ( 69 ) AND ( 71 )

      D =  NX*( AVX - XIN(1) ) +  NY*( AVY - YIN(1) ) +  NZ*(AVZ-ZIN(1))
      PD = ABS( D )

C   EQUATIONS ( 73 ) AND ( 74 )

      T = SQRT ( T1X*T1X + T1Y*T1Y + T1Z*T1Z )
      T1X = T1X / T
      T1Y = T1Y / T
      T1Z = T1Z / T

C   EQUATION  ( 75 )

      T2X = NY*T1Z - NZ*T1Y
      T2Y = NZ*T1X - NX*T1Z
      T2Z = NX*T1Y - NY*T1X

C   COMPUTE COORDINATES OF CORNER POINTS IN REFERENCE COORD. SYSTEM
C   EQUATION  ( 72 )

```

```
      DO 1000 J = 1, 4
      XP = XIN(J) + NX * D
      YP = YIN(J) + NY * D
      ZP = ZIN(J) + NZ * D
      D =  - D
      XDIF = XP - AVX
      YDIF = YP - AVY
      ZDIF = ZP - AVZ

C  TRANSFORM CORNER POINTS TO ELEMENT COORDINATE SYSTEM  ( XI, ETA )
C  WITH AVERAGE POINT AS ORIGIN
C  EQUATION  ( 80 )

      XI(J) = T1X*XDIF + T1Y*YDIF + T1Z*ZDIF
 1000 ETA(J) = T2X*XDIF + T2Y*YDIF + T2Z*ZDIF

C  COMPUTE CENTROID
C  EQUATION  ( 81 )

      XI0 = .3333333E0 * ( XI (4) * ( ETA (1) - ETA (2) ) + XI ( 2 )
     1  * ( ETA (4) - ETA ( 1) ) ) / ( ETA (2 )  - ETA (4) )
      ETA0 = -.3333333E0 * ETA(1)


C  OBTAIN CORNER POINTS IN SYSTEM WITH CENTROID AS ORIGIN
C  EQUATION  ( 82 )

      DO 1020 J = 1, 4
      XI(J) = XI(J) - XI0
 1020 ETA(J) = ETA(J) - ETA0

C  COMPUTATION AIDS
      ETA2M1 = ETA ( 2 ) - ETA ( 1 )
      ETA3M2 = ETA ( 3 ) - ETA ( 2 )
      ETA4M3 = ETA ( 4 ) - ETA ( 3 )
      ETA1M4 = ETA ( 1 ) - ETA ( 4 )
      XI1M2 = XI ( 1 ) - XI ( 2 )
      XI2M3 = XI ( 2 ) - XI ( 3 )
      XI3M4 = XI ( 3 ) - XI ( 4 )
      XI4M1 = XI ( 4 ) - XI ( 1 )
      ETA2P4 = ETA ( 2 ) + ETA ( 4 )
      XI3M1 = XI ( 3 ) - XI ( 1 )
      XI4M2 = XI ( 4 ) - XI ( 2 )
      ETA2M4 = ETA ( 2 ) - ETA ( 4 )
      XI1234 = XI ( 1 ) + XI ( 2 ) + XI ( 3 ) + XI ( 4 )

C  TRANSFORM CENTROID TO REFERENCE COORDINATE SYSTEM
C  EQUATION  ( 83 )
      XCENT = AVX + T1X*XI0 + T2X*ETA0
      YCENT = AVY + T1Y*XI0 + T2Y*ETA0
      ZCENT = AVZ + T1Z*XI0 + T2Z*ETA0

C  COMPUTE LARGER DIAGONAL VECTOR
C  EQUATION  ( 84 )
      TSQ = AMAX1 ( XI3M1 ** 2, XI4M2 ** 2 + ETA2M4 ** 2  )
      T = SQRT ( TSQ )


C  COMPUTE AREA
C  EQUATION  ( 85 )
```

```
      AREA              = .5 * XI3M1 * ETA2M4
C   COMPUTE CONSTANTS FOR EQUATIONS ( 42 ) AND ( 43 )
C   EQUATION  ( 45 )
      D12SQ = XI1M2 ** 2 + ETA2M1 ** 2
      D12 = SQRT ( D12SQ )
      D23SQ = XI2M3 **2  + ETA3M2 ** 2
      D23 = SQRT ( D23SQ )
      D34SQ = XI3M4 ** 2 + ETA4M3 ** 2
      D34 = SQRT ( D34SQ )
      D41SQ = XI4M1 ** 2 + ETA1M4 ** 2
      D41 = SQRT ( D41SQ )
      C1 = 0.0
      C2 = 0.0
      C3 = 0.0
      C4 = 0.0
      C5 = 0.0
      C6 = 0.0
      C7 = 0.0
      C8 = 0.0
      XNP = 0.0
      YNP = 0.0
      IF ( D12 ) 1030, 1040, 1030
 1030 C1 = ETA2M1 / D12
      C5 = XI1M2 / D12
 1040 IF ( D23 ) 1050, 1060, 1050
 1050 C2 = ETA3M2 / D23
      C6 = XI2M3 / D23
 1060 IF ( D34 ) 1070, 1080, 1070
 1070 C3 = ETA4M3 / D34
      C7 = XI3M4 / D34
 1080 IF ( D41 ) 1090, 1100, 1090
 1090 C4 = ETA1M4 / D41
      C8 = XI4M1 / D41
 1100 CONV = 3


C BEGIN NULL POINT ITERATICN

      DO 1590  ITR = 1, 30
      DO 1580  K = 1,4
C   EQUATION  ( 47 )
      R ( K ) = SQRT ( ( XNP - XI ( K ) ) ** 2 + ( YNP - ETA(K))** 2 )
      RX (K ) = ( XNP - XI ( K ) ) / R ( K )
 1580 RY (K ) = ( YNP - ETA ( K ) ) / R ( K )
      R1PR2   =  R ( 1 )   + R ( 2 )
      R2PR3   =  R ( 2 )   + R ( 3 )
      R3PR4   =  R ( 3 )   + R ( 4 )
      R4PR1   =  R ( 4 )   + R ( 1 )
      ARG1 = ALOG ( ( R1PR2 - D12 ) / ( R1PR2 + D12 ) )
      ARG2 = ALOG ( ( R2PR3 - D23 ) / ( R2PR3 + D23 ) )
      ARG3 = ALOG ((R3PR4 - D34 ) / ( R3PR4 + D34 ) )
      ARG4 = ALOG ((R4PR1 - D41 ) / ( R4PR1 + D41 ) )


C   COMPUTE INDUCED VELOCITY COMPONENTS
C   EQUATIONS  ( 42 ) AND ( 43 )
      VX = C1 * ARG1 + C2 * ARG2 + C3 * ARG3 + C4 * ARG 4
      VY = C5 * ARG1 + C6 * ARG2 + C7 * ARG 3 + C8 * ARG4
```

```
C   COMPUTE PARTIAL DERIVATIVES OF INDUCED VELOCITIES
C   EQUATION ( 90 ), USING EQUATIONS ( 91 ) - ( 93 )


      D12P=   ( R1PR2 ** 2 - D12 SQ    ) * .5
      D23P=   ( R2PR3 ** 2 - D23 SQ    ) * .5
      D34P=   ( R3PR4 ** 2 - D34 SQ    ) * .5
      D41P=   ( R4PR1 ** 2 - D41 SQ    ) * .5
      C1P = ETA2M1 / D12P
      C2P = ETA3M2 / D23P
      C3P = ETA4M3 / D34P
      C4P = ETA1M4 / D41P
      C5P = XI1M2 / D12P
      C6P = XI2M3 / D23P
      C7P = XI3M4 / D34P
      C8P = XI4M1 / D41P
      R12Y = RY ( 1 ) + RY ( 2 )
      R23Y = RY ( 2 ) + RY ( 3 )
      R34Y = RY ( 3 ) + RY ( 4 )
      R41Y = RY ( 4 ) + RY ( 1 )
      VXX = C1P* ( RX ( 1 ) + RX ( 2 ) ) + C2P* ( RX ( 2 ) + RX ( 3 )) +
     1      C3P* ( RX ( 3 ) + RX ( 4 ) ) + C4P* ( RX ( 4 ) + RX ( 1 ) )
      VXY = C1P* R12Y + C2P* R23Y + C3P* R34Y + C4P* R41Y
      VYY = C5P* R12Y + C6P* R23Y + C7P* R34Y + C8P* R41Y


C   COMPUTE NEW NULL POINT ( XNP, YNP )
C   EQUATION ( 94 )

      XMXP = ( VY * VXY - VX * VYY ) / ( VXX * VYY - VXY ** 2 )
      XNP = XMXP + XNP
      YNP = YNP - ( VX + VXX * XMXP ) / VXY

C     TEST NULL POINT CONVERGENCE
      IF ( ABS ( VX ) .LT. EPS .AND. ABS ( VY ) .LT. EPS ) GO TO 1600
 1590 CONTINUE
C     NO CONVERGENCE , USE 30TH ITERATION
      CONV = 2

C     TEST IF THIS POINT IS OUTSIDE THE ELEMENT
 1600 IF ( XNP ** 2 + YNP ** 2  .LE. TSQ )  GO TO 1620

C     CONVERGES TO POINT AT INFINITY
      CONV = 1
      XNULL          = XCENT
      YNULL          = YCENT
      ZNULL          = ZCENT
      GO TO 1700

C     TRANSFORM NULL POINT TO REFERENCE COORDINATE SYSTEM
C   EQUATION ( 79 )  NOTE THAT Z - COORDINATE IS ZERO
 1620 XNULL          = XCENT + T1X * XNP + T2X * YNP
      YNULL          = YCENT + T1Y * XNP + T2Y * YNP
      ZNULL          = ZCENT + T1Z * XNP + T2Z * YNP


C   PRINT RESULTS -- SECTION 9.4 THE FIRST OUTPUT

 1700 IF ( NPRT .GE. 11 ) GO TO 1750
      NPRT = NPRT + 1
```

```
      IF ( I .EQ. 1 ) GO TO 1760                                        PINP 481
      WRITE (6, 4005) I, XIN, NX, XNULL          , PD, CFLAG (CONV),     PINP 482
     1  YIN, NY, YNULL        , T, ZIN, NZ, ZNULL          , AREA        PINP 483
      GO TO 1770                                                         PINP 484
 1750 NPRT = 0                                                           PINP 485
      CALL PEADER                                                        PINP 486
      WRITE ( 6, 4002 )                                                  PINP 487
 1760 WRITE ( 6, 4010) N    , I, XIN, NX, XNULL          , PD, CFLAG (CONVPINP 488
     1    ), YIN, NY, YNULL        , T, ZIN, NZ, ZNULL          , AREA   PINP 489
 1770 CONTINUE                                                           PINP 490
 2000 CONTINUE                                                           PINP 491
 2100 NLT ( KLCT ) = MMIN                                                PINP 492
      NLINE ( KLCT ) = N                                                 PINP 493
      IF ( IFLAG .EQ. 0 ) GO TO 2001                                     PINP 494
      IF ( N .LT. NLM1 ) GO TO 12                                        PINP 495
      IF( IPRNT ) WRITE(6,4015)                                          PINP 496
      GO TO 2025                                                         PINP 497
 2001 IF ( STAT .LT. 2 ) GO TO 80                                        PINP 498
      NLT(KLCT) = -NLT(KLCT)                                             PINP 499
      NPRT = NPRT + 1                                                    PINP 500
      IF( IPRNT ) WRITE(6,4015)                                          PINP 501
                                                                         PINP 502
C  TEST FOR END OF CASE                                                  PINP 503
 2020 IF ( STAT .NE. 3 ) GO TO 80                                        PINP 504
 2025 NN1 = MOD ( 3 * NQUAD, 255 )                                       PINP 505
      NQNN1 = NQUAD                                                      PINP 506
      IF ( NN1 .LT. 5 .AND. NN1 .GT. 0  ) NQNN1 = NQUAD + 2              PINP 507
      DELX = -0.5 * (XMIN + XMAX)                                        PINP 508
      DELY = -0.5 * (YMIN + YMAX)                                        PINP 509
      DELZ = -0.5 * (ZMIN + ZMAX)                                        PINP 510
      WRITE (9) XMIN, XMAX, YMIN, YMAX, ZMIN, ZMAX, DELX, DELY, DELZ,    PINP 511
     1 NSYM                                                              PINP 512
      ENDFILE 9                                                          PINP 513
      REWIND 9                                                           PINP 514
      IF ( .NOT. IPICT ) GO TO 8500                                      PINP 515
C     SET UP PERSPECTIVE ANGLES FOR PLOTS                                PINP 516
      WRITE (8) XMIN, XMAX, YMIN, YMAX, ZMIN, ZMAX, DELX, DELY, DELZ     PINP 517
      LAST = 0                                                           PINP 518
      PHI = 0.0                                                          PINP 519
C     THE OPERATION OF ANGLES THETA AND PSI ARE AS FOLLOWS FOR A RIGHT   PINP 520
C     HANDED COORDINATE SYSTEM WITH THE Z AXIS DIRECTED UPWARD.   FIRST  PINP 521
C     ROTATE THE COORDINATE SYSTEM BY ANGLE THETA ABOUT THE Y AXIS SUCH  PINP 522
C     THAT FOR POSITIVE THETA THE POSITIVE X AXIS TILTS UPWARD.   THEN   PINP 523
C     ROTATE BY ANGLE PSI ABOUT THE NEW Z AXIS SUCH THAT FOR POSITIVE    PINP 524
C     PSI THE ROTATION IS CLOCKWISE WHEN VIEWED FROM ABOVE.              PINP 525
      IF (NSYM .GT. 0) IF (NSYM - 2) 2028, 2029, 2030                    PINP 526
 2027 PSI = 90.                                                          PINP 527
      THETA = 0.0                                                        PINP 528
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, MINUSY, RAXIS              PINP 529
      PSI = 45.                                                          PINP 530
      THETA = 45.                                                        PINP 531
      WRITE (8) PSI, THETA, PHI, LAST, L45, PLUSX, MINUSY, PLUSZ, R45 ,LPINP 532
      THETA = -45.                                                       PINP 533
      WRITE (8) PSI, THETA, PHI, LAST, L45, PLUSX, MINUSY, MINUSZ, R45,LPINP 534
      PSI = 135.                                                         PINP 535
      WRITE (8) PSI, THETA, PHI, LAST, L45, MINUSX, MINUSY, PLUSZ, R45,LPINP 536
      THETA = 45.                                                        PINP 537
      WRITE (8) PSI, THETA, PHI, LAST, L45, MINUSX, MINUSY, MINUSZ,R45,LPINP 538
 2028 PSI = 0.                                                           PINP 539
      THETA = -90.                                                       PINP 540
```

```
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, MINUSZ, RAXIS
      THETA= 45.
      PSI=-135.
      WRITE (8) PSI, THETA, PHI, LAST, L45, MINUSX, PLUSY,MINUSZ, R45,L
      THETA=-45.
      PSI=-45.
      WRITE (8) PSI, THETA, PHI, LAST, L45,  PLUSX, PLUSY,MINUSZ, R45,L
 2029 PSI = 180.
      THETA = 0.
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, MINUSX, RAXIS
      PSI = -135.
      THETA =-45.
      WRITE (8) PSI, THETA, PHI, LAST, L45, MINUSX, PLUSY, PLUSZ, R45,L
 2030 THETA = 0.0
      PSI = 0.
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, PLUSX, RAXIS
      THETA = 0.0
      PSI = -90.
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, PLUSY, RAXIS
      THETA = 90.
      PSI = 0.
      WRITE (8) PSI, THETA, PHI, LAST, LAXIS, PLUSZ, RAXIS
      THETA = 45.
      PSI =-45.
      LAST = 1
      WRITE (8) PSI, THETA, PHI, LAST, L45, PLUSX, PLUSY, PLUSZ, R45, L
 8500 REWIND 8
C
      IF(IPRNT) WRITE(6,9999) NQUAD
 9999 FORMAT( 1H0, 16X, I5, 26H BASIC ELEMENTS WERE INPUT)
      RETURN
      END
```

```
*DECK,PICTURE
      SUBROUTINE PICTUR
C
C     PLOTS SURFACE ELEMENTS ON A 3-DIMENSIONAL BODY

      LOGICAL IPROS, IPUNCH, IFRNT, IPICT, ICRT, RFLAG, AFLAG, BFLAG
      COMMON HEDR( 15), NQUAD, KASE, NSYM, IFLAG, IPROS, IPUNCH, IFRNT,
     1 IPICT, ICRT, SINA, COSA, XSCALE, YSCALE, ZSCALE, XTRANS, YTFANS,
     2 ZTRANS
      DIMENSION  XA(250),XB(250),YA(250),YB(250),ZA(250),ZB( 250),
     1                 XIN(4),YIN(4),ZIN(4),HLABEL(15), PROGID( 3),
     2 YIN2(4),ZIN2(4),          YPLTSC( 4), ZPLTSC( 4),HLINE2(7),
     3 HLINE1(7), XM(2), YM(2), ZM(2)
      REAL  NX,NY,NZ,NXO
      INTEGER  STAT,STATT
      DATA PROGID/ 7HNORMENT, 4H3840, 3HLYC/
      DATA          ISHAD,IFRAME/0,0/   ,  XSC,YSC,ZSC/3*1.0/

      FIRST(QX,QY,QZ,Q1,Q2,Q3) = QX*Q1 + QY*Q2 + QZ*Q3

      THIRD(QX,QY,QZ,QPSI,QTHETA,QPHI) = QX*(COS(QTHETA)*COS(QPSI)) +
     1  QY*(-SIN(QPSI)*COS(QPHI)+SIN(QTHETA)*COS(QPSI)*SIN(QPHI)) +
     2  QZ*(SIN(QPSI)*SIN(QPHI)+SIN(QTHETA)*COS(QPSI)*COS(QPHI))

      IREFL = NSYM
      IF( IREFL .GT. 2 ) IREFL = 2
      IPIC = 1
      IF( ICRT ) GO TO 750
      CALL PLOTID
C     CALL PLTID3( PROGID, 200.0, 11.0, 1.0)
      CALL PLOT( 5.0, 0.0, -3 )
      GO TO 2
  750 CALL  MICRO(PROGID, 1.0, 14.0)
      READ(5,3000) HLINE1, HLINE2
 3000 FORMAT(7A6/7A6)
      CALL TITL(HLINE1,HLINE2)
      WRITE( 6, 5201 )
 5201 FORMAT( 1H-, 12H   CRT PLOTS)
    2 REWIND 9
  301 READ (8) XM(1),XM(2),YM(1),YM(2),ZM(1),ZM(2),DELX,DELY,DELZ
      WRITE(6,7400) XM(1),XM(2),YM(1),YM(2),ZM(1),ZM(2)
      WRITE(6,7500)
      WRITE(6,7700) DELX,DELY,DELZ
 7400 FORMAT( 1H0, 9X, 81HMINIMUM AND MAXIMUM COORDINATES IN THE   SCALE
     1D,   TRANSLATED,   ROTATED SYSTEM -/12X,    7HX AXIS=2(1PE15.5)/
     2 12X, 7HY AXIS=2(1PE15.5)/ 12X, 7HZ AXIS=2(1PE15.5))
 7500 FORMAT(1H0, 9X, 69HCOORDINATE TRANSLATIONS USED TO CENTER THE PLOT
     1S - DELX, DELY, DELZ -)
 7700 FORMAT(12X,39H AFTER SCALING, TRANSLATING, ROTATING -3(1PE15.5)/)
    4 IPIC = IPIC + 1

C  READ PLOTTING INSTRUCTIONS
      READ ( 8 ) PSI,THETA,PHI,LAST, HLABEL
      WRITE(6,5205)HLABEL
 5205 FORMAT(5X, 15A4)

    8 IF( IPIC .GT. 2 .AND.  .NOT.  ICRT ) CALL PLOT( 10.0, -5.5, -3 )
      IF( IPIC .GT. 2 .AND.         ICRT ) CALL FRAME( 0.5, 0.5 )

C     SET UP STARTING CONSTANTS
```

```
      IFADV = 1
      PSI   =  PSI  / 57.29578E0
      THETA = THETA / 57.29578E0
      PHI   =  PHI  / 57.29578E0
      SINTH = SIN(THETA)
      COSTH = COS(THETA)
      SINPSI= SIN(PSI)
      COSPSI= COS(PSI)
      SINPHI= SIN(PHI)
      COSPHI= COS(PHI)
      A1 = COSTH * SINPSI
      A2 = COSPSI*COSPHI + SINTH*SINPSI*SINPHI
      A3 =-COSPSI*SINPHI + SINTH*SINPSI*COSPHI
      A4 =-SINTH
      A5 = COSTH*SINPHI
      A6 = COSTH*COSPHI
      A7 = COSTH*COSPSI
      A8 =-SINPSI*COSPHI + SINTH*COSPSI*SINPHI
      A9 = SINPSI*SINPHI + SINTH*COSPSI*COSPHI
C     SET SCALE FACTOR FOR THE PLOT
      YSM= 1.E50
      ZSM= 1.E50
      YLG=-1.E50
      ZLG=-1.E50
      DO 20 I=1,2
      X=XM(I)+DELX
      DO 20 J=1,2
      Y=YM(J)+DELY
      DO 20 K=1,2
      Z=ZM(K)+DELZ
      YNR=FIRST(X,Y,Z,A1,A2,A3)
      ZNR=FIRST(X,Y,Z,A4,A5,A6)
      YSM=AMIN1(YSM,YNR)
      ZSM=AMIN1(ZSM,ZNR)
      YLG=AMAX1(YLG,YNR)
   20 ZLG=AMAX1(ZLG,ZNR)
      PENSF=9.99/AMAX1(YLG-YSM,ZLG-ZSM)
       N = -1
      NN = - 1


C     READ IN     SURFACE DATA
  29  READ (9) X,Y,Z,STAT, XX,YY,ZZ,STATT
      IF (STAT .EQ. 3 .OR. STATT .EQ. 3) REWIND 9
       RFLAG = .FALSE.
       GO TO 80
  30  IF (RFLAG) GO TO 50
       RFLAG = .TRUE.
       X = XX
       Y = YY
       Z = ZZ
       STAT = STATT
       GO TO 60
  50  RFLAG = .FALSE.
      READ (9) X,Y,Z,STAT, XX,YY,ZZ,STATT
      IF (STAT .EQ. 3 .OR. STATT .EQ. 3) REWIND 9
  60  IF (STAT .EQ. 0 .OR. STAT .EQ. 3) GO TO 180
      IF (STAT .EQ. 2) GO TO 200
  70  IF (.NOT. AFLAG) GO TO 200
       MC = M
```

```
 80   M = 1
       IF (STAT .EQ. 2) GO TO 150
       IF (.NOT. BFLAG) GO TO 84
 75   DO 81 J =1,MC
        XA(J) = XB(J)
        YA(J) = YB(J)
 81     ZA(J) = ZB(J)
 83   XB(1) = X
      YB(1) = Y
      ZB(1) = Z
      GO TO 30
 84   IF (AFLAG) GO TO 85
       BFLAG = .TRUE.
       GO TO 75
 85   AFLAG = .FALSE.
       GO TO 83
150   AFLAG = .TRUE.
       BFLAG = .FALSE.
       N = N+1
160   XA(M) = X
      YA(M) = Y
      ZA(M) = Z
      GO TO 30
180   M = M + 1
      IF (AFLAG) GO TO 160
       XB(M) = X
       YB(M) = Y
       ZB(M) = Z
      IF (STAT .NE. 3) GO TO 30
200   MMIN = MIN0 (M,MC) - 1
       MC = M
250   N = N + 1
      NN = NN + 1


C  BEGIN COMPUTATION OF SURFACE ELEMENT CHARACTERISTICS

450   DO 2000 I= 1,MMIN
        XIN(1) = XA(I) * XSC + DELX
        XIN(2) = XA(I+1) * XSC + DELX
        XIN(3) = XB(I+1) * XSC + DELX
        XIN(4) = XB(I) * XSC + DELX
        YIN(1) = YA(I) * YSC + DELY
        YIN(2) = YA(I+1) * YSC + DELY
        YIN(3) = YB(I+1) * YSC + DELY
        YIN(4) = YB(I) * YSC + DELY
        ZIN(1) = ZA(I) * ZSC + DELZ
        ZIN(2) = ZA(I+1) * ZSC + DELZ
        ZIN(3) = ZB(I+1) * ZSC + DELZ
        ZIN(4) = ZB(I) * ZSC + DELZ
        IRFLG = 0

C  FORM DIAGONAL VECTORS - EQUATION (64)
       T1X = XIN(3) - XIN(1)
       T2X = XIN(4) - XIN(2)
       T1Y = YIN(3) - YIN(1)
       T2Y = YIN(4) - YIN(2)
       T1Z = ZIN(3) - ZIN(1)
       T2Z = ZIN(4) - ZIN(2)
```

```
C  FORM CROSS PRODUCT  N=T2 X T1  - EQUATION (65)
        NX = T2Y*T1Z - T1Y*T2Z
        NY = T1X*T2Z - T2X*T1Z
        NZ = T2X*T1Y - T1X*T2Y
        VN = SQRT ( NX*NX + NY*NY + NZ*NZ )

C  FORM UNIT NORMAL VECTOR - EQUATION (66)
        NX = NX /  VN
        NY = NY / VN
        NZ = NZ / VN

      IF (IFADV .EQ. 0) GO TO 471

C     A NEW VIEW OF THE BODY IS TO BE PLOTTED.  PLOT THE LEGEND AND
C     INITIALIZE FOR THE BODY PLOT.
      IF( ICRT ) GO TO 524
      CALL PLOT( 2.5, 0.0, 3 )
      CALL SYMBOL( 2.5, 0.0, 0.150, HLABEL, 0.0, 60)
      CALL PLOT( 7.5, 5.5, -3)
      GO TO 525
  524 CALL STBEAM(24)
      CALL SYMBOL( 3.0, 0.0, 0.150, HLABEL, 0.0, 60)
      CALL STBEAM(18)
      CALL PLOT( 8.0, 5.5, -3)
 525  IFADV = 0

 471  NXO = THIRD(NX,NY,NZ,PSI,THETA,PHI)
      IF (NXO.LE.0.0 .AND. ISHAD.EQ.0) GO TO 571


C  CALCULATE POINTS TO BE PLOTTED
 530  YO1 = FIRST(XIN(1),YIN(1),ZIN(1),A1,A2,A3)
      YO2 = FIRST(XIN(2),YIN(2),ZIN(2),A1,A2,A3)
      YO3 = FIRST(XIN(3),YIN(3),ZIN(3),A1,A2,A3)
      YO4 = FIRST(XIN(4),YIN(4),ZIN(4),A1,A2,A3)
      ZO1 = FIRST(XIN(1),YIN(1),ZIN(1),A4,A5,A6)
      ZO2 = FIRST(XIN(2),YIN(2),ZIN(2),A4,A5,A6)
      ZO3 = FIRST(XIN(3),YIN(3),ZIN(3),A4,A5,A6)
      ZO4 = FIRST(XIN(4),YIN(4),ZIN(4),A4,A5,A6)

      YIN2(1) = YO1
      YIN2(2) = YO2
      YIN2(3) = YO3
      YIN2(4) = YO4
      ZIN2(1) = ZO1
      ZIN2(2) = ZO2
      ZIN2(3) = ZO3
      ZIN2(4) = ZO4

C     SCALE AND PLOT A SINGLE QUADRALATERAL
      DO 540 II=1,4
      YPLTSC(II) = YIN2(II) * PENSF
      ZPLTSC(II) = ZIN2(II) * PENSF
      IF(                             ABS(ZPLTSC(II)) .LE. 5.000)
     1                   GO TO 540
      WRITE(6,5000) N, M
 5000 FORMAT( 1H0, 10X, 21HSCALE TROUBLE FOR N =I4, 3X, 3HM =I4)
      GO TO 2000
  540 CONTINUE
      CALL PLOT( YPLTSC( 1), ZPLTSC( 1), 3)
```

```
      DO 550 II=2,4
  550 CALL PLOT( YPLTSC(II), ZPLTSC(II), 2)
      CALL PLOT( YPLTSC( 1), ZPLTSC( 1), 2)

 571  IF (IREFL .EQ. 0 .OR. IRFLG .EQ. 3) GO TO 2000
      IF (IREFL .EQ. 2 .AND. IRFLG .EQ. 1) GO TO 600
      IF (IREFL .EQ. 2 .AND. IRFLG .EQ. 2) GO TO 602
C
C     REFLECT QUADRANT I ELEMENTS TO QUADRANT II
      DO 580 II = 1,4
 580   YIN(II) = -YIN(II)
       NY = -NY
       GO TO 604
C
C     REFLECT QUADRANT II ELEMENTS TO QUADRANT IV
 600  DO 601 II = 1,4
       YIN(II) = -YIN(II)
 601   ZIN(II) = -ZIN(II)
       NY = -NY
       NZ = -NZ
       GO TO 604
C
C     REFLECT QUADRANT IV ELEMENTS TO QUADRANT III
 602  DO 603 II = 1,4
 603   YIN(II) = -YIN(II)
       NY = -NY
C
C
 604  IRFLG = IRFLG + 1
      IF (IREFL .EQ. 1) IRFLG = 3
      GO TO 471


 2000 CONTINUE
 2001 IF (STAT .LT. 2) GO TO 480
      NN = NN - 1
      N = - 1
 475  IF (IFRAME .EQ. 2) IFADV = 1
 480  IF (IFRAME .EQ. 1) IFADV = 1
 485  IF (IFADV .EQ. 1) CALL PLOT(10.0,-5.5, -3)


C  TEST FOR END OF CASE
 2020 IF (STAT .NE. 3) GO TO 80
      IF (LAST .EQ. 1) RETURN
      GO TO 4
      END
```

```
      OVERLAY(BOXC,0,0)
      PROGRAM MAIN( INPUT,TAPE6, TAPE5=INPUT, OUTPUT,
     1 TAPE1, TAPE3, TAPE8, TAPE9, TAPE11, TAPE12, TAPE13,
     2              TAPE4, TAPE10, TAPE14)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - DECEMBER 1979
C
C     THIS IS ESSENTIALLY THE NON-LIFTING POTENTIAL FLOW CODE OF HESS
C     AND SMITH AS DESCRIBED IN DOUGLAS AIRCRAFT CO. RPT. E.S. 40622
C     (15 MARCH 1962), AD-282 255.   THAT REPORT SHOULD BE CONSULTED FOR
C     DETAILS OF THE METHOD AND COMPUTATION.
C
C     EIGHT OVERLAYS ARE USED.   THE FINAL OVERLAY WRITES THE 28
C     QUANTITIES ON UNIT 14 FOR USE BY SR FLOVEL IN CALCULATING FLOW
C     VELOCITIES.
C
C     ALSO REQUIRED, IN ADDITION TO THE SYSTEM INPUT, OUTPUT AND PUNCH
C     UNITS, ARE THE FOLLOWING UNITS - 1,3,8,9,10,11,12,13.
C
      LOGICAL IPROS
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      REAL MACH
      COMMON /SPACER/ DUMMY (14000)
      COMMON / ATAPE / NATAPE
      COMMON /M/ MACH, BETA, RBETA
      LOGICAL  AFLOW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      COMMON/SOLVE/ N1,N2,N3,KORE,NFL
      COMMON /INPT/ LIST, IPROS
      COMMON /PROS/      SINA,COSA, XSCALE, YSCALE, ZSCALE, XTRANS,
     1 YTRANS, ZTRANS
      COMMON /FLOWP/ NU,NNON
      COMMON /SIG/ NFLCOM
      COMMON /TAPES/ MN
      COMMON /PRINTO/ KMAT,NSEQ,KTP14
      COMMON /CLEAK/ LEAK, FRACT
    6 FORMAT (F10.6)
 7000 FORMAT( 7F10.0)
 7500 FORMAT(   18X, 55HANGLE, XSCALE, YSCALE, ZSCALE, XTRANS, YTRANS, Z
     1TRANS =/ 16X, 7(1PE13.4))
 8000 FORMAT(  L1)
 9000 FORMAT (15A4,2I1,3L1,4I1,I2,4I1,1X,A4)
 9300 FORMAT( I4, F10.0 )
 9400 FORMAT( 1H0, 17X,31HNUMBER OF LEAKY QUADRALATERALS=I4, 3X,
     1 40HFRACTION OF FREE-STREAM VELOCITY LEAKED=1PE11.4)
 9500 FORMAT( 1H0, 17X, 61HINPUT DATA ARE PROCESSED BY SCALING, ROTATING
     1 AND TRANSLATING)
      DATA KORE /14000/
      NSEQ = 0
C     READ IN CONTROL DATA
    1 READ ( 5, 9000 ) HEDR, IFLAG, LIST, AFLOW, BFLOW, CFLOW, ISIG,
     1 IPRS, MPR, NCODE, NNON, NSYM, NOFF, KMACH, KTP14, KASE
      READ(5,8000) IPROS
      IF( IPROS ) READ(5,7000) ANGLE, XSCALE, YSCALE, ZSCALE,XTRANS,
     1  YTRANS, ZTRANS
      IF(.NOT. IPROS) GO TO 2
```

```
      IF(XSCALE .EQ. 0.0) XSCALE=1.0
      IF(YSCALE .EQ. 0.0) YSCALE=1.0
      IF(ZSCALE .EQ. 0.0) ZSCALE=1.0
    2 CONTINUE
      READ( 5,9300 ) LEAK, FRACT
      REWIND 1
      REWIND 3
      REWIND 8
      REWIND 9
      REWIND 10
      REWIND 11
      REWIND 12
      REWIND 13
      IF (LIST .EQ. 0) REWIND 4
      MACH = 0.0
      IF (KMACH .LE. 0) GO TO 7
      NNON = 0
      READ (5, 6) MACH
      AFLOW = .TRUE.
      BFLOW = .FALSE.
      CFLOW = .FALSE.
    7 BETA = SQRT(1.0 - MACH * MACH)
      RBETA = 1.0 / BETA
      NU = 0
      CALL HEADER
      WRITE(6,9200) IFLAG, LIST, ISIG, IPRS, MPR, NCODE, NNON,
     1 NOFF, KMACH, KTP14
 9200 FORMAT( 1H0, 17X, 17HINPUT PARAMETERS-// 20X, 6HIFLAG=I2, 5X,
     1 5HLIST=I2, 5X, 5HISIG=I3, 6X, 5HIPRS=I2, 7X, 4HMPR=I2//
     2 20X, 6HNCODE=I2, 5X, 5HNNON=I2, 5X, 5HNOFF=I3, 5X, 6HKMACH=I2,
     3 5X, 6HKTP14=I2)
      IF( .NOT. IPROS) GO TO 40
      WRITE(6,9500)
      WRITE(6,7500) ANGLE,XSCALE,YSCALE,ZSCALE,XTRANS,YTRANS,ZTRANS
   40 WRITE( 6,9400 ) LEAK, FRACT
      IF(.NOT. IPROS) GO TO 50
      COSA = COS(  0.0174533 * ANGLE)
      SINA = SIN(  0.0174533 * ANGLE)
   50 IF (AFLOW .OR. BFLOW .OR. CFLOW)  NU = 1
C     CALL INPUT (LIST)
      CALL OVERLAY(4HBOXC,1,0)
      IF (LIST .NE. 0) GO TO 10
C     CALL FLOWS (NU, NNON)
      CALL OVERLAY(4HBOXC,1,1)
      IF(KTP14 .EQ. 1) CALL OVERLAY(4HBOXC,8,0)
      GO TO 1000
   10 CONTINUE
      GO TO 5000
C
C     FORM  XIJ , YIJ , AND  ZIJ MATRICES
C
C1000 CALL VFORM
 1000 CALL OVERLAY(4HBOXC,2,0)
      IF (NCODE) 5000, 1500, 2000
 1500 NCODE = 1
      IF (NQUAD .GT. 500 ) NCODE = 2
 2000 IF (NMAT .EQ. 3) NCODE = 2
```

```
C     CALL  AFCRM
      CALL OVERLAY(4HBOXC,3,0)                                          BOXC 115
      IF ( NAFLOW ) 2100, 2100, 2050                                    BOXC 116
 2050 KMAT = 1                                                          BOXC 117
      NFL = NAFLOW                                                      BOXC 118
      GO TO 2300                                                        BOXC 119
 2100 IF ( NBFLOW ) 2200, 2200, 2150                                    BOXC 120
 2150 KMAT = 2                                                          BOXC 121
      NFL = NBFLOW                                                      BOXC 122
      GO TO 2300                                                        BOXC 123
 2200 IF ( NCFLOW ) 5000, 5000, 2250                                    BOXC 124
 2250 KMAT = 3                                                          BOXC 125
      NFL = NCFLOW                                                      BOXC 126
 2300 NQ = NQUAD + 1                                                    BOXC 127
      MN = 1                                                            BOXC 128
      NM = MOD ( NQ, 255 )                                              BOXC 129
      IF ( NM .LT. 5 .AND. NM .GT. 0 ) NQ = NQ + 5                      BOXC 130
      NFLCOM = 0                                                        BOXC 131
      NSOL = MINO( 6000 / NQUAD, 100)                                   BOXC 132
      IF (NCODE .NE. 1) GO TO 2500                                      BOXC 133
 2400 N1 = 8                                                            BOXC 134
      N2 = 9                                                            BOXC 135
      N3 = 13                                                           BOXC 136
 2450 NCFLG = NFL                                                       BOXC 137
C     CALL SCLVIT (DUMMY(1), NQUAD, NFL, KORE, N1, N2, N3, 3, &2475)    BOXC 138
      CALL OVERLAY(4HBOXC,4,0)                                          BOXC 139
      REWIND 3                                                          BOXC 140
C     IF (MN .EQ. 1) CALL ATAPES (MN)                                   BOXC 141
      IF (MN .EQ. 1)                                                    BOXC 142
     1CALL OVERLAY(4HBOXC,6,0)                                          BOXC 143
      GO TO 3300                                                        BOXC 144
C2500 CALL ATAPES (MN)                                                  BOXC 145
 2500 CALL OVERLAY(4HBOXC,6,0)                                          BOXC 146
      NSKIP = 0                                                         BOXC 147
 2900 NCFLG = MINO (NSOL, NFL - NSKIP)                                  BOXC 148
C     CALL SIGMA (NFLCOM )                                              BOXC 149
      CALL OVERLAY(4HBOXC,5,0)                                          BOXC 150
      ITER = 0                                                          BOXC 151
C3300 CALL PRINT1 (NFLCOM, MN, KMAT, NSEQ)                              BOXC 152
 3300 CALL OVERLAY(4HBOXC,7,0)                                          BOXC 153
      NFLCOM = NFLCOM + NCFLG                                           BOXC 154
      NSKIP = NSKIP + NCFLG                                             BOXC 155
      IF (NCODE .EQ. 1) GO TO 3700                                      BOXC 156
      IF( NSKIP .NE. NFL   ) GO TO 2900                                 BOXC 157
      MN = MN + 1                                                       BOXC 158
      IF ( KMAT -  2 ) 3500, 3600, 5000                                 BOXC 159
 3500 IF ( NBFLOW ) 3600, 3600, 3550                                    BOXC 160
 3550 NFL = NBFLOW                                                      BOXC 161
      KMAT = 2                                                          BOXC 162
      GO TO 2500                                                        BOXC 163
 3600 IF ( NCFLOW ) 5000, 5000, 3650                                    BOXC 164
 3650 NFL = NCFLOW                                                      BOXC 165
      KMAT = 3                                                          BOXC 166
      GO TO 2500                                                        BOXC 167
 3700 IF (MN .EQ. 2 .OR. NMAT .EQ. 1) GO TO 5000                        BOXC 168
      N1 = 10                                                           BOXC 169
      N2 = 13                                                           BOXC 170
                                                                        BOXC 171
```

```
      N3 = 8
      MN = 2
C **   POSITION THE TAPE FOR THE SIGMAS.
      JJ = 2
      IF (ISIG .NE. 0) JJ = 3
      JJ = NFLOW * JJ  + NFL
      DO 3750 J = 1, JJ
 3750 READ (3)
      NFL = NFLOW - NFL
1      (KMAT - 2) 3800, 3900, 5000
 3800 IF (NBFLOW) 3900, 3900, 3850
 3850 KMAT = 2
      GO TO 2450
 3900 KMAT = 3
      GO TO 2450
 5000 CONTINUE
      WRITE (6, 5100)
 5100 FORMAT(1H0, 10X, 12HLEAVING MAIN)



      CALL EXIT
C     IF (LIST .NE. 0) STOP
      GO TO 1
      END
```

```
*DECK,HEADER
      SUBROUTINE HEADER
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      DATA IPAGE/0/
    1 FORMAT( 1H1, 5X, 13HPROGRAM BOXC , 15X, 30HATMOSPHERIC SCIENCE ASS
     1OCIATES/  38X, 22HBEDFORD, MASSACHUSETTS, 22X, 4HPAGE, I5/
     2 7X, 8HBODY ID., 2X, A4/ 30X, 15A4)
   10 IPAGE = IPAGE + 1
      WRITE (6,1) IPAGE, KASE,HEDR
      RETURN
      END
```

```
*DECK,ROWV
      SUBROUTINE ROWV( XIJ, YIJ, ZIJ, III, KSKIP )
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      LOGICAL AFLOW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
       DIMENSION XIJ(1), YIJ(1), ZIJ(1)
      INTEGER CKFLG
      DIMENSION NT(3)
      DATA  NT                / 1, 11, 12 /
    5 CKFLG = 0
      N1 = 1
      N2 = NQUAD/ 3
      N3 = NQUAD - N2 - N2
      NN = N2
C        READ IN ONE ROW OF THE VX, VY, VZ
      DO 50 I1 = 1, 3
      NTAPE = NT(I1)
   10 READ(NTAPE)         (XIJ(I2) , YIJ(I2) , ZIJ(I2) , I2 = N1 , NN )
      N1 = NN + 1
      IF( I1 .EQ. 2 ) GO TO 35
      NN = NN + N2
      GO TO 50
   35 NN = NN + N3
   50 CONTINUE
      NER = 0
      IF ( III .NE. (NQUAD + NOFF))  IF ( KSKIP ) 80, 80, 100
      REWIND 1
      REWIND 11
      REWIND 12
   80 RETURN
  100 IF ( NMATM1 .EQ. 0 ) RETURN
      DO 110 N1 = 1, NMATM1
      READ ( 1 )
      READ ( 11 )
  110 READ ( 12 )
      RETURN
      END
```

```
*DECK, INPUT
      SUBROUTINE INPUT
C     SUBROUTINE INPUT (LIST)
      LOGICAL IPROS
      COMMON /INPT/ LIST, IPROS
      REAL NX, NY, NZ , IXX, IXY, IYY, MACH
      LOGICAL AFLOW, BFLOW, CFLOW, RFLAG, AFLAG, BFLAG
      INTEGER  STAT, STATT, CONV
      DIMENSION  SPH ( 200 ),   CPH ( 200 ), XINP ( 200 ), ZINP ( 200 )
      DIMENSION  XOFF(1000), YOFF (1000), ZOFF (1000)
      DIMENSION XA (   500 ), XB (   500 ), YA (   500 ), YB (   500 ),
     1  ZA (   500 ), ZB (   500 ), NLINE(500 ), NLT (   500 ), CFLAG(3),
     2  XI (4), ETA (4), XIN (4), YIN (4),  ZIN (4), XNULL (1000),
     3  YNULL(1000), ZNULL(1000),            XNORM(1000),
     4  YNORM ( 1000), ZNORM (1000),  RX (4), R (4), RY (4)
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /M/ MACH, BETA, RBETA
       COMMON /NORMS/ XNORM, YNORM, ZNORM
      EQUIVALENCE (XNULL,          XOFF), ( YNULL,         YOFF),
     1 (ZNULL, ZOFF), (NULL, NQUAD)
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      DATA   CFLAG                    / 2H 1, 2H 2, 2H   /
      DATA PI/3.141593E0/, HAFPI/1.570796E0/, EPS/.0001/
 3030 FORMAT (1H1)
    1 FORMAT (     3E10.0, I2 / 3F10.0, I2)
 4002 FORMAT ( 1H0, 6X,5HN   M, 7X, 4 ( 1HX, 11X ), 2HNX, 11X, 3HNPX,
     1  11X, 1HD / 19X, 4 ( 1HY, 11X ), 2HNY, 11X, 3HNPY, 11X, 1HT /
     2  19X, 4(1HZ, 11X ), 2HNZ, 11X, 3HNPZ, 11X, 1HA         )
 4005 FORMAT ( 1H0, 7X, I4, 4F12.6, 2F13.6, E14.4,A2/(12X,4F12.6,
     1  2F13.6, E14.4 )  )
 4010 FORMAT ( 1H0, 3X, 2I4, 4F12.6, 2F13.6, E14.4,A2/(12X, 4F12.6,
     1  2F13.6,  E14.4  )  )
 4015 FORMAT ( 1H0, 3 ( 20),  12H************ ))

C  INPUT -- SECTION 9.1  INPUT SCHEME
      KLCT = 0
      NULL = 0
      NPRT = 13
      WRITE (6, 40)
   40 FORMAT (1H0,16X,44HP A R A M E T R I C    I N F O R M A T I O N
     1 /// 38X,23HGENERATED UNIFORM FLOWS //)
      IF ( AFLOW ) WRITE (6, 41)
   41 FORMAT (46X,6HX-FLOW)
      IF ( BFLOW ) WRITE (6, 42)
   42 FORMAT (46X,6HY-FLOW)
      IF ( CFLOW ) WRITE (6, 43)
   43 FORMAT (46X,6HZ-FLOW)
      IF (IPRS .NE. 0) WRITE (6, 44)
   44 FORMAT (1H0,16X,22HPRINT SIGMA ITERATIONS )
      IF (MPR .EQ. 0) GO TO 52
      IF (MPR - 2) 45, 47, 49
   45 WRITE (6, 46)
   46 FORMAT (1H0,16X,18HPRINT VIJ MATRICES)
      GO TO 52
   47 WRITE (6, 48)
   48 FORMAT (1H0,16X,18HPRINT AIJ MATRICES )
      GO TO 52
   49 WRITE (6, 51)
   51 FORMAT (1H0,16X,31HPRINT BOTH VIJ AND AIJ MATRICES )
```

```
52 IF (ISIG .NE. 0) WRITE (6, 53)
53 FORMAT (1H0,16X,19HINPUT SIGMA GUESSES )
   IF (NSYM - 1) 54, 56, 58
54 WRITE (6, 55)
55 FORMAT (1H0,16X,21HNC SYMMETRY SPECIFIED )
   GO TO 61
56 WRITE (6, 57)
57 FORMAT (1H0,16X,30HTHERE IS ONE PLANE OF SYMMETRY )
   GO TO 61
58 WRITE (6, 59) NSYM
59 FORMAT (1H0,16X,9HTHERE ARE,I2, 19H PLANES OF SYMMETRY )
61 IF ( MACH .NE. 0.0 ) WRITE (6, 21) MACH
21 FORMAT (1H0,16X,13HMACH NUMBER =,F10.5)
   IF (IFLAG .EQ. 0) GO TO 29
   READ (5, 20) NLM1, MMIN, B, C
   IF (B .EQ. 0.0) B = 1.0
   IF (C .EQ. 0.0) C = 1.0
20 FORMAT ( 2I5, 2F10.5 )
 4 FORMAT ( 8F10.0 )
   WRITE (6, 62) NLM1, MMIN, B, C
62 FORMAT (1H0,16X,10HGENERATE A,I3, 2H X,I3, 12H SPHERE. B =,F10.5,
  1 4X,3HC =,F10.5 )
   MLINES = MMIN + 1
   NLINES = NLM1 + 1
   N = 0
   IF ( NSYM .EQ. 0 ) GO TO 2
   IF ( NSYM - 2 ) 3, 5, 6
 2 PITH = PI
   PIPHI = PI + PI
   GO TO 7
 3 PITH = PI
   PIPHI = PI
   GO TO 7
 5 PITH = PI
   PIPHI = HAFPI
   GO TO 7
 6 PITH = HAFPI
   PIPHI = PITH
 7 SPH ( MLINES ) = SIN ( PIPHI )
   SPH ( 1 ) = 0.0
   CPH ( MLINES ) = CCS ( PIPHI )
   CPH ( 1 ) = 1.0
   EKM = MMIN
   EKN = NLM1
   EMM = 0.0
   DO 8  I = 2, MMIN
   EMM = EMM + 1.0
   PHI = EMM / EKM * PIFHI
   SPH ( I ) = SIN ( PHI )
 8 CPH ( I ) = COS ( PHI )
   IF ( IFLAG .EQ. 2 ) GO TO 10
   ENN = 1.0
   DO 9  I = 1, MLINES
   XA ( I ) = 1.0
   YA ( I ) = 0.0
 9 ZA ( I ) = 0.0
   GO TO 18
10 READ ( 5, 4 ) ( XINP ( I ), ZINP ( I ), I = 1, NLINES )
   DO 11 I = 1, MLINES
   XA ( I ) = XINP ( 1 )
```

```
      YA ( I ) = B * ZINP ( 1 ) * SPH ( I )
      ZA ( I ) = - C * ZINP ( 1 ) * CPH ( I )
      XB ( I ) = XINP ( 2 )
      YB ( I ) = B * ZINP ( 2 ) * SPH ( I )
   11 ZB ( I ) = - C * ZINP ( 2 ) * CPH ( I )
      NLCT = 2
      GO TO 250
   12 DO 14 I = 1, MLINES
      XA ( I ) = XB ( I )
      YA ( I ) = YB ( I )
   14 ZA ( I ) = ZB ( I )
      IF ( IFLAG .EQ. 1 ) GO TO 16
      NLCT = NLCT + 1
      DO 15  I = 1, MLINES
      XB ( I ) =  XINP ( NLCT )
      YB ( I ) =  B * ZINP ( NLCT ) * SPH ( I )
   15 ZB ( I ) =  - C * ZINP ( NLCT ) * CPH ( I )
      GO TO 250
   16 ENN = ENN + 1.0
   18 THETA = ENN / EKN * PITH
      STH = SIN ( THETA )
      CTH = COS ( THETA )
      DO 17  I = 1, MLINES
      XB ( I ) = CTH
      YB ( I ) =    B * STH * SPH ( I )
   17 ZB ( I ) =  - C * STH * CPH ( I )
      GO TO 250
   29 N = -1
      IF (LIST .EQ. 0) GO TO 50
      WRITE (6, 19)
   19 FORMAT (1H0 16X 28HBASIC DATA CALCULATIONS ONLY)
      GO TO 50
   30 IF ( RFLAG ) GO TO 50
      RFLAG = .TRUE.
      X = XX
      Y = YY
      Z = ZZ
      STAT = STATT
      IF (LIST) 66, 66, 65
   50 RFLAG = .FALSE.
      READ ( 5, 1 )  X, Y, Z, STAT, XX, YY, ZZ, STATT
      IF ( IPROS ) CALL DATPROS( X, Y, Z, XX, YY, ZZ )
   65 IF (N .EQ.(-1))GO TO 80
   66 IF (STAT .EQ. 0 .OR. STAT .EQ. 3) GO TO 180
      IF ( STAT .EQ. 2 ) GO TO 200
      IF ( .NOT. AFLAG ) GO TO 200
      MC = M
   80 M = 1
      IF ( STAT .EQ. 2 )  GO TO 150
      IF ( .NOT. BFLAG ) GO TO 84
   75 DO 81 J = 1, MC
      XA ( J ) = XB ( J )
      YA ( J ) = YB ( J )
   81 ZA ( J ) =  ZB ( J )
   83 XB ( 1 ) = X
      YB ( 1 ) = Y
      ZB ( 1 ) = Z
      GO TO 30
   84 IF ( AFLAG ) GO TO 85
      BFLAG = .TRUE.
```

```
      GO TO 75
   85 AFLAG = .FALSE.
      GO TO 83
  150 AFLAG = .TRUE.
      BFLAG = .FALSE.
      IF (N .EQ.(-1))N = 0
  160 XA ( M ) = X
      YA ( M ) = Y
      ZA ( M ) = Z
      GO TO 30
  180 M = M + 1
      IF ( AFLAG ) GO TO 160
      XB (M ) = X
      YB ( M ) = Y
      ZB ( M ) = Z
      IF ( STAT .NE. 3 )  GO TO 30
  200 MMIN = MIN0(M, MC) - 1
      MC = M
  250 N = N + 1
      KLCT = KLCT + 1

C  BEGIN COMPUTATION OF NULL POINTS AND 28 QUANTITIES

      DO 2000 I = 1, MMIN
      NULL = NULL + 1
      XIN(1) = XA( I ) * RBETA
      XIN(2) = XA(I+1) * RBETA
      XIN(3) = XB(I+1) * RBETA
      XIN(4) = XB( I ) * RBETA
      YIN(1) = YA(I)
      YIN(2) = YA(I+1)
      YIN(3) = YB(I+1)
      YIN(4) = YB(I)
      ZIN(1) = ZA(I)
      ZIN(2) = ZA(I+1)
      ZIN(3) = ZB(I+1)
      ZIN(4) = ZB(I)

C  FORM DIAGONAL VECTORS
C  EQUATION  ( 64 )

      T1X = XIN(3) - XIN(1)
      T2X = XIN(4) - XIN(2)
      T1Y = YIN(3) - YIN(1)
      T2Y = YIN(4) - YIN(2)
      T1Z = ZIN(3) - ZIN(1)
      T2Z = ZIN(4) - ZIN(2)

C  FORM CROSS PRODUCT  N = T2 X T1
C  EQUATION  ( 65 )

      NX = T2Y*T1Z - T1Y*T2Z
      NY = T1X*T2Z - T2X*T1Z
      NZ = T2X*T1Y - T1X*T2Y
      VN = SQRT (  NX* NX +  NY* NY +  NZ* NZ )

C  FORM UNIT NORMAL VECTOR
C  EQUATION  ( 66 )

      NX = NX / VN
```

```
      NY = NY / VN
      NZ = NZ / VN

C   COMPUTE AVERAGE POINT
C   EQUATION  ( 68 )

      AVX = .25 * ( XIN(1) + XIN(2) + XIN(3) + XIN(4) )
      AVY = .25 * ( YIN(1) + YIN(2) + YIN(3) + YIN(4) )
      AVZ = .25 * ( ZIN(1) + ZIN(2) + ZIN(3) + ZIN(4) )

C   COMPUTE PROJECTION DISTANCE
C   EQUATIONS ( 69 ) AND ( 71 )

      D =  NX*( AVX - XIN(1) ) +  NY*( AVY - YIN(1) ) +  NZ*(AVZ-ZIN(1))
      PD = ABS( D )

C   EQUATIONS ( 73 ) AND ( 74 )

      T = SQRT ( T1X*T1X + T1Y*T1Y + T1Z*T1Z )
      T1X = T1X / T
      T1Y = T1Y / T
      T1Z = T1Z / T

C   EQUATION  ( 75 )

      T2X = NY*T1Z - NZ*T1Y
      T2Y = NZ*T1X - NX*T1Z
      T2Z = NX*T1Y - NY*T1X

C   COMPUTE COORDINATES OF CORNER POINTS IN REFERENCE COORD. SYSTEM
C   EQUATION  ( 72 )

      DO 1000 J = 1, 4
      XP = XIN(J) + NX * D
      YP = YIN(J) + NY * D
      ZP = ZIN(J) + NZ * D
      D =   - D
      XDIF = XP - AVX
      YDIF = YP - AVY
      ZDIF = ZP - AVZ

C   TRANSFORM CORNER POINTS TO ELEMENT COORDINATE SYSTEM  ( XI, ETA )
C   WITH AVERAGE POINT AS ORIGIN
C   EQUATION  ( 80 )

      XI(J) = T1X*XDIF + T1Y*YDIF + T1Z*ZDIF
 1000 ETA(J) = T2X*XDIF + T2Y*YDIF + T2Z*ZDIF

C   COMPUTE CENTROID
C   EQUATION  ( 81 )

      XI0 = .3333333E0 * ( XI (4) * ( ETA (1) - ETA (2) ) + XI ( 2 )
     1  * ( ETA (4) - ETA ( 1) ) ) / ( ETA (2 )  - ETA (4) )
      ETA0 = -.3333333E0 * ETA(1)


C   OBTAIN CORNER POINTS IN SYSTEM WITH CENTROID AS ORIGIN
C   EQUATION  ( 82 )

      DO 1020 J = 1, 4
```

```
      XI(J) = XI(J) - XI0
 102C ETA(J) = ETA(J) - ETA0

C  COMPUTATION AIDS
      ETA2M1 = ETA ( 2 ) - ETA ( 1 )
      ETA3M2 = ETA ( 3 ) - ETA ( 2 )
      ETA4M3 = ETA ( 4 ) - ETA ( 3 )
      ETA1M4 = ETA ( 1 ) - ETA ( 4 )
      XI1M2 = XI ( 1 ) - XI ( 2 )
      XI2M3 = XI ( 2 ) - XI ( 3 )
      XI3M4 = XI ( 3 ) - XI ( 4 )
      XI4M1 = XI ( 4 ) - XI ( 1 )
      ETA2P4 = ETA ( 2 ) + ETA ( 4 )
      XI3M1 = XI ( 3 ) - XI ( 1 )
      XI4M2 = XI ( 4 ) - XI ( 2 )
      ETA2M4 = ETA ( 2 ) - ETA ( 4 )
      XI1234 = XI ( 1 ) + XI ( 2 ) + XI ( 3 ) + XI ( 4 )

C  TRANSFORM CENTROID TO REFERENCE COORDINATE SYSTEM
C  EQUATION  ( 83 )
      XCENT = AVX + T1X*XI0 + T2X*ETA0
      YCENT = AVY + T1Y*XI0 + T2Y*ETA0
      ZCENT = AVZ + T1Z*XI0 + T2Z*ETA0

C  COMPUTE LARGER DIAGONAL VECTOR
C  EQUATION  ( 84 )
      TSQ = AMAX1 ( XI3M1 ** 2, XI4M2 ** 2 + ETA2M4 ** 2  )
      T = SQRT ( TSQ )


C  COMPUTE AREA
C  EQUATION  ( 85 )
      AREA             = .5 * XI3M1 * ETA2M4

C  COMPUTE 2ND MOMENTS  IXX, IXY, IYY
C  EQUATIONS ( 86 ) - ( 88 )
      IXX =            8.333333E-2 * XI3M1 * ( ETA ( 1 ) * XI4M2 *
     1 XI1234 + ETA2M4 * ( XI (1) * ( XI(1) + XI (3 )  )  +
     2 XI ( 3 ) ** 2 ) + XI ( 2 ) * ETA ( 2 ) * ( XI1234 - XI ( 4 ) )
     3 - XI ( 4 ) *  ETA ( 4 ) * ( XI1234 - XI ( 2 ) )  )
      IXY =            4.166667E-2 * XI3M1 * ( 2. * XI ( 4 ) * ( ETA (1)
     1 ** 2 - ETA ( 4 ) ** 2  ) - 2. * XI ( 2 ) * ( ETA ( 1 ) ** 2  -
     2 ETA ( 2 ) ** 2 ) + ( XI ( 1 ) + XI ( 3 ) ) * ETA2M4 * ( 2. *
     3 ETA ( 1 ) + ETA2P4 ) )
      IYY =            8.333333E-2 * XI3M1 * ETA2M4 * ((ETA ( 1 ) +
     1 ETA2P4 ) ** 2 - ETA ( 1 ) * ETA2P4 - ETA ( 2 ) * ETA ( 4 )  )

C  COMPUTE CONSTANTS FOR EQUATIONS ( 42 ) AND ( 43 )
C  EQUATION  ( 45 )
      D12SQ = XI1M2 ** 2 + ETA2M1 ** 2
      D12 = SQRT ( D12SQ )
      D23SQ = XI2M3 **2  + ETA3M2 ** 2
      D23 = SQRT ( D23SQ )
      D34SQ = XI3M4 ** 2 + ETA4M3 ** 2
      D34 = SQRT ( D34SQ )
      D41SQ = XI4M1 ** 2 + ETA1M4 ** 2
      D41 = SQRT ( D41SQ )
      C1 = 0.0
      C2 = 0.0
      C3 = 0.0
```

```
      C4 = 0.0
      C5 = 0.0
      C6 = 0.0
      C7 = 0.0
      C8 = 0.0
      XNP = 0.0
      YNP = 0.0
      IF ( D12 ) 1030, 1040, 1030
 1030 C1 = ETA2M1 / D12
      C5 = XI1M2 / D12
 1040 IF ( D23 ) 1050, 1060, 1050
 1050 C2 = ETA3M2 / D23
      C6 = XI2M3 / D23
 1060 IF ( D34 ) 1070, 1080, 1070
 1070 C3 = ETA4M3 / D34
      C7 = XI3M4 / D34
 1080 IF ( D41 ) 1090, 1100, 1090
 1090 C4 = ETA1M4 / D41
      C8 = XI4M1 / D41
 1100 CONV = 3

C BEGIN NULL POINT ITERATION

      DO 1591  ITR = 1, 30
      DO 1580  K = 1,4
C  EQUATION  ( 47 )
      R ( K ) = SQRT ( ( XNP - XI ( K ) ) ** 2 + ( YNP - ETA(K))** 2 )
      RX (K ) = ( XNP - XI ( K ) ) / R ( K )
 1580 RY (K ) = ( YNP - ETA ( K ) ) / R ( K )
      R1PR2  =  R ( 1 )  + R ( 2 )
      R2PR3  =  R ( 2 )  + R ( 3 )
      R3PR4  =  R ( 3 )  + R ( 4 )
      R4PR1  =  R ( 4 )  + R ( 1 )
      ARG1 = ALOG ( ( R1PR2 - D12 ) / ( R1PR2 + D12 ) )
      R4PR1  =  R ( 4 )  + R ( 1 )
      ARG1 = ALOG ( ( R1PR2 - D12 ) / ( R1PR2 + D12 ) )
      ARG2 = ALOG ( ( R2PR3 - D23 ) / ( R2PR3 + D23 ) )
      ARG3 = ALOG ((R3PR4 - D34 ) / ( R3PR4 + D34 ) )
      ARG4 = ALOG ((R4PR1 - D41 ) / ( R4PR1 + D41 ) )

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 42 ) AND ( 43 )
      VX = C1 * ARG1 + C2 * ARG2 + C3 * ARG3 + C4 * ARG 4
      VY = C5 * ARG1 + C6 * ARG2 + C7 * ARG 3 + C8 * ARG4

C  COMPUTE PARTIAL DERIVATIVES OF INDUCED VELOCITIES
C  EQUATION ( 90 ), USING EQUATIONS ( 91 ) - ( 93 )


      D12P=  ( R1PR2 ** 2 - D12SQ  ) * .5
      D23P=  ( R2PR3 ** 2 - D23SQ  ) * .5
      D34P=  ( R3PR4 ** 2 - D34SQ  ) * .5
      D41P=  ( R4PR1 ** 2 - D41SQ  ) * .5
      C1P = ETA2M1 / D12P
      C2P = ETA3M2 / D23P
      C3P = ETA4M3 / D34P
      C4P = ETA1M4 / D41P
      C5P = XI1M2 / D12P
```

```
      C6P = XI2M3 / D23P
      C7P = XI3M4 / D34P
      C8P = XI4M1 / D41P
      R12Y = RY ( 1 ) + RY ( 2 )
      R23Y = RY ( 2 ) + RY ( 3 )
      R34Y = RY ( 3 ) + RY ( 4 )
      R41Y = RY ( 4 ) + RY ( 1 )
      VXX = C1P* ( RX ( 1 ) + RX ( 2 ) ) + C2P* ( RX ( 2 ) + RX ( 3 )) +
     1        C3P* ( RX ( 3 ) + RX ( 4 ) ) + C4P* ( RX ( 4 ) + RX ( 1 ) )
      VXY = C1P* R12Y + C2P* R23Y + C3P* R34Y + C4P* R41Y
      VYY = C5P* R12Y + C6P* R23Y + C7P* R34Y + C8P* R41Y


C  COMPUTE NEW NULL POINT ( XNP, YNP )
C  EQUATION ( 94 )

      XMXP = ( VY * VXY - VX * VYY ) / ( VXX * VYY - VXY ** 2 )
      XNP = XMXP + XNP
      YNP = YNP - ( VX + VXX * XMXP ) / VXY

C     TEST NULL POINT CONVERGENCE
 1590 IF ( ABS ( VX ) .LT. EPS .AND. ABS ( VY ) .LT. EPS ) GO TO 1600
 1591 CONTINUE
C     NO CONVERGENCE , USE 30TH ITERATION
      CONV = 2

C     TEST IF THIS POINT IS OUTSIDE THE ELEMENT
 1600 IF ( XNP ** 2 + YNP ** 2  .LE. TSQ )  GO TO 1620

C     CONVERGES TO POINT AT INFINITY
      CONV = 1
      XNULL ( NULL ) = XCENT
      YNULL ( NULL ) = YCENT
      ZNULL ( NULL ) = ZCENT
      GO TO 1700

C     TRANSFORM NULL POINT TO REFERENCE COORDINATE SYSTEM
C  EQUATION ( 79 )  NOTE THAT Z - COORDINATE IS ZERO
 1620 XNULL ( NULL ) = XCENT + T1X * XNP + T2X * YNP
      YNULL ( NULL ) = YCENT + T1Y * XNP + T2Y * YNP
      ZNULL ( NULL ) = ZCENT + T1Z * XNP + T2Z * YNP


C  PRINT RESULTS -- SECTION 9.4 THE FIRST OUTPUT

 1700 IF ( NPRT .GE. 11 ) GO TO 1750
      NPRT = NPRT + 1
      IF ( I .EQ. 1 ) GO TO 1760
      WRITE (6, 4005) I, XIN, NX, XNULL ( NULL), PD, CFLAG (CONV),
     1  YIN, NY, YNULL (NULL), T, ZIN, NZ, ZNULL ( NULL ), AREA
      GO TO 1770
 1750 NPRT = 0
      CALL HEADER
      WRITE ( 6, 4002 )
 1760 WRITE ( 6, 4010) N   , I, XIN, NX, XNULL ( NULL ), PD, CFLAG (CONV
     1   ), YIN, NY, YNULL (NULL), T, ZIN, NZ, ZNULL ( NULL ), AREA
 1770 XNORM ( NULL ) = NX
      YNORM ( NULL ) = NY
      ZNORM ( NULL ) = NZ
```

```
C  WRITE 28 QUANTITIES ON TAPE 4 AS ONE LOGICAL RECORD
 2000 IF (LIST .EQ. 0) WRITE (4) XCENT, YCENT, ZCENT, T1X, T1Y, T1Z,
     1 T2X, T2Y, T2Z, NX, NY, NZ, XI(1), ETA(1), XI(2), ETA(2), XI(3),
     2 XI(4), ETA(4), TSQ, AREA, IXX, IXY, IYY, D12, D23, D34, D41
      NLT ( KLCT ) = MMIN
      NLINE ( KLCT ) = N
      IF ( IFLAG .EQ. 0 ) GO TO 2001
      IF ( N .LT. NLM1 ) GO TO 12
      WRITE ( 6, 4015 )
      GO TO 2025
 2001 IF ( STAT .LT. 2 ) GO TO 80
      NLT(KLCT) = -NLT(KLCT)
      NPRT = NPRT + 1
      WRITE ( 6, 4015  )
C  TEST FOR END OF CASE
 2020 IF ( STAT .NE. 3 ) GO TO 80
 2025 NN1 = MOD ( 3 * NQUAD, 255 )
      NQNN1 = NQUAD
      IF ( NN1 .LT. 5 .AND. NN1 .GT. 0  ) NQNN1 = NQUAD + 2
      IF (LIST.NE. 0) GO TO 8500
C     WRITE UNIT NORMALS ON TAPE 4 AS ONE LOGICAL RECORD
 2031 WRITE (4) (XNORM(J), YNORM(J), ZNORM(J), J = 1, NQNN1)
C  WRITE CONTROL TABLES ON TAPE 4 AS ONE LOGICAL RECORD
      WRITE ( 4 ) KLCT, ( NLINE (J), NLT(J), J = 1, KLCT )
C  **  WRITE NULL POINTS AND NORMALS (1 RECORD)
 3032 WRITE (4)(XNULL(J), YNULL(J), ZNULL(J),XNORM(J), YNORM(J),ZNORM(J)
     1 , J = 1, NQUAD)
      WRITE ( 6, 3030 )
C  WRITE ALL NULL POINTS ON TAPE 8 (1 LOGICAL RECORD / POINT)
      DO 2058 I = 1, NQUAD
 2058 WRITE  (8)  XNULL (I), YNULL(I), ZNULL(I)
C
C     READ IN OFF-BODY POINTS
C
      IF ( NOFF .LE. 0 ) GO TO 8000
      NOFF = 0
 5000 NOFF = NOFF + 1
      READ (5, 1) XOFF(NOFF), YOFF(NOFF),ZOFF(NOFF),STAT, X,Y,Z,STATT
      IF (STAT .EQ. 3) GO TO 5100
      NOFF = NOFF + 1
      XOFF(NOFF) = X
      YOFF(NOFF) = Y
      ZOFF(NOFF) = Z
      IF (STATT .NE. 3) GO TO 5000
C     WRITE OFF-BODY POINTS ON  8  ( 1 RECORD / POINT )
 5100 DO 7020 I = 1, NOFF
      XOFF(I) = XOFF(I) * RBETA
 7020 WRITE ( 8) XOFF(I), YOFF(I), ZOFF(I)
C     WRITE OFF-BODY POINTS ON 4 (1 RECORD)
C
      WRITE (4)(XOFF(I), YOFF(I), ZOFF(I), I = 1, NOFF)
      WRITE (6, 63) NOFF
   63 FORMAT (1H0,16X,9HTHERE ARE,I4, 15H OFF-BODY POINTS )
 8000 REWIND 4
```

```
 8500 REWIND 8
C
      WRITE(6, 9999) NQUAD
 9999 FORMAT( 1H0 , 5X, I5,  26H BASIC ELEMENTS WERE INPUT)
C     RETURN
      END
```

```
*DECK,DATPR
      SUBROUTINE DATPROS( X, Y, Z, XX, YY, ZZ )
C
C     THIS IS A SIMPLE SCALING AND ORIGIN TRANSLATION CODE FOR THE
C     DOUGLAS BOXC POTENTIAL FLOW  CODE DATA INPUT
C        XTRANS, YTRANS, ZTRANS ARE ORIGIN TRANSLATIONS
C        XSCALE, YSCALE, ZSCALE ARE SCALE FACTORS
C     THE CODE ALSO ALLOWS FOR ROTATION IN THE X - Z PLANE TO ADJUST
C     FOR ARBITRARY ANGLE OF ATTACK
C        SINA, COSA ARE SINE AND COSINE OF ANGLE
C        ANGLE IS THE ANGLE( INPUT IN DEGREES)  THAT THE AIRPLANE AXIS
C        MAKES WITH THE NEGATIVE X AXIS (POSITIVE COUNTERCLOCKWISE
C        FROM THE-X AXIS) AFTER SCALING ( NOTE - AFTER SCALING THE
C        AIRPLANE NOSE POINTS DOWN THE NEGATIVE X AXIS)
C
C     THIS VERSION FOR USE WITH BOXC
C
C
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /PROS/      SINA,COSA, XSCALE, YSCALE, ZSCALE, XTRANS,
     1 YTRANS, ZTRANS
       X = ( X - XTRANS ) * XSCALE
       Y = ( Y - YTRANS ) * YSCALE
       Z = ( Z - ZTRANS ) * ZSCALE
       XX= ( XX- XTRANS ) * XSCALE
       YY= ( YY- YTRANS ) * YSCALE
       ZZ= ( ZZ- ZTRANS ) * ZSCALE
       XP = X
       X = XP * COSA - Z * SINA
       Z = XP * SINA + Z * COSA
       XP = XX
       XX= XP * COSA - ZZ* SINA
       ZZ= XP * SINA + ZZ* COSA
      RETURN
      END
```

```
*DECK,FLOWS
      SUBROUTINE FLOWS
C     SUBROUTINE FLOWS (NU, NNON )
      COMMON /FLOWP/ NU,NNON
      COMMON HEDR(15),MPR,IER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      LOGICAL  AFLOW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      COMMON / FLOW / NQ, NL, KFLOW, VX(2000), VY(2000), VZ(2000),
     1                                            VNC(1000)
       COMMON /NORMS/ XNORM(1000),YNORM(1000),ZNORM(1000)
   31 FORMAT ( 3I1 )
   40 FORMAT( 6F10.8 )
 9999 FORMAT (1H0,5X 16HFLOWS HAS SET UP,
     1 I3, 11H  X  FLOWS, I3, 15H  Y  FLOWS, AND I3, 11H  Z  FLOWS. )
      NAFLOW = 0
      NBFLOW = 0
      NCFLOW = 0
      NMAT = 0
      NQ = NQUAD + NOFF
      NL = NQUAD
      NN = MOD(3* NQ    , 255)
      IF ( NN .LT. 5 .AND. NN .GT. 0 ) NQ = NQ + 5
      KFLOW = 0
      NN = MOD( NQUAD, 255)
      IF ( NN .LT. 5 .AND. NN .GT. 0) NL = NL + 5
      IF (NNON .GT. 0) GO TO 140
      IF (NU .GT. 0) GO TO 50
      WRITE (6, 115)
  115 FORMAT (1H1,6X,24HNO ONSET FLOWS SPECIFIED )
      STOP
   50 IF ( .NOT. AFLOW ) GO TO 60
      KFLOW = 1
      GO TO 100
   60 IF ( .NOT. BFLOW ) GO TO 70
      KFLOW = 2
      GO TO 100
   70 IF ( CFLOW ) GO TO 90
      IF (KFLOW .NE. 0) GO TO 4000
      WRITE ( 6, 80 )
   80 FORMAT ( 1H1,6X,12HINPUT ERROR.,5X,25HNO FLOW MATRIX SPECIFIED. )
      STOP
   90 KFLOW = 3
  100 CALL UNIFRM
      IF (KFLOW - 2) 60, 70, 4000

C     THIS SECTION SETS UP THE NON-UNIFORM ONSET FLOWS

  140 DO 3000 N = 1, NNON
      IERR = 0
C
C - - THE FLAGS READ IN HERE HAVE THE FOLLOWING VALUES...
C
C         FLAG                      MEANING
C        ------                    ---------
C
C         KFL       . . . .        FLOW MATRIX-ASSOCIATION FLAG
C                                  1 X-FLOW, 2 Y-FLOW, 3 Z-FLOW
C
C         KUN       . . . .        0 NON-UNIFORM FLOW, 1 UNIFORM FLOW
```

```
C
C          KTYPE     . . . .        0 INPUT FLOW VELOCITY COMPONENTS,
C                                   1 INPUT FLOW NORMAL VELOCITY
C
      READ ( 5, 31 ) KFL, KUN, KTYPE
      KTEST = KFL - KFLOW
      IF (KTEST) 145, 220, 150
  145 WRITE (6, 146) KFLOW, KFL
  146 FORMAT (15H1*****NOTE***** / 25H0AN INPUT FLOW FOR MATRIX,I3,
     1 38H PHYSICALLY PRECEDED A FLOW FOR MATRIX,I3 /
     2 26H0THIS FLOW MUST BE SKIPPED //)
      IERR = 1
      GO TO 220
  150 IF (NU) 155, 155, 152
  152 IF (KTEST - 2) 170, 153, 160
  153 IF (KFL - 2) 145, 160, 161
  155 KFLOW = KFL
  156 IF (KFLOW - 2) 157, 158, 159
  157 AFLOW = .TRUE.
      GO TO 220
  158 BFLOW = .TRUE.
      GO TO 220
  159 CFLOW = .TRUE.
      GO TO 220
  160 IF (.NOT. AFLOW) GC TO 161
      KFLOW = 1
      CALL UNIFRM
  161 IF (.NOT. BFLOW) GO TO 162
      KFLOW = 2
      CALL UNIFRM
  162 KFLOW = KFL
      IF (KFLOW .EQ. 2) GO TO 158
      IF (CFLOW) GO TO 200
      GO TO 159
  170 KFLOW = KFL
      IF (NU .EQ. 0) GO TO 156
      IF (KFLOW - 2) 175, 180, 185
  175 IF (AFLOW) GO TO 200
      GO TO 157
  180 IF (BFLOW) GO TO 200
      GO TO 158
  185 IF (CFLOW) GO TO 200
      GO TO 159
  200 CALL UNIFRM
  220 NVREAD = NQUAD
      IF (KUN .GT. 0) NVREAD = 1
      IF ( KTYPE .NE. 0 ) GO TO 222
      READ ( 5, 40 ) ( VX(I), VY(I), VZ(I), I = 1, NVREAD )
      GO TO 224
  222 READ ( 5, 40 ) ( VNC(I), I = 1, NVREAD )
      DO 223 I = 1, NQUAD
      VX(I) = 0.0
      VY(I) = 0.0
  223 VZ(I) = 0.0
  224 IF ( IERR .NE. 0 ) GO TO 1200
      NVREAD = NQUAD + NOFF
      IF (KUN .LE. 0) IF (NOFF) 240, 240, 230
      DO 225 NV = 2, NVREAD
      VX(NV) = VX(1)
      VY(NV) = VY(1)
```

```
  225 VZ(NV) = VZ(1)
      GO TO 240
  230 NQP1 = NQUAD + 1
      DO 235 NV = NQP1, NVREAD
      VX(NV) = 0.0
      VY(NV) = 0.0
  235 VZ(NV) = 0.0
  240 IF ( KFLOW - 2 ) 600, 700, 800
  600 NAFLOW = NAFLOW + 1
      GO TO 900
  700 NBFLOW = NBFLOW + 1
      GO TO 900
  800 NCFLOW = NCFLOW + 1
  900 IF ( KTYPE .NE. 0 ) GO TO 1075
      DO 1050 J = 1, NQUAD
 1050 VNC (J) = VX(J)*XNORM(J) + VY(J)*YNORM(J) + VZ(J)*ZNORM(J)
 1075 WRITE ( 3 ) KFLOW, (VX(K), VY(K), VZ(K), K = 1, NQ)
 1100 WRITE (3) ( VNC(K), K = 1, NL )

C     READ IN FIRST GUESSES FOR THE SIGMAS
 1200 IF ( ISIG )  3000, 3000, 1600
 1600 READ (5, 40) ( VNC(K), K = 1, NQUAD )

C     WRITE SIGMA GUESSES ON TAPE 3 AS ONE LOGICAL RECORD

      IF (IERR .EQ. 0) WRITE (3) (VNC(J), J = 1, NL)
 3000 CONTINUE
      IF (NU .NE. 0) IF (KFLOW - 2) 60, 70, 4000
 4000 REWIND 3
      IF ( AFLOW ) NMAT = 1
      IF ( BFLOW ) NMAT = NMAT + 1
      IF ( CFLOW ) NMAT = NMAT + 1
      NMATM1 = NMAT - 1
      NFLOW = NAFLOW + NBFLOW + NCFLOW
      WRITE(6, 9999)     NAFLOW, NBFLOW, NCFLOW
C     RETURN
      END
```

```
*DECK,UNIFRM
      SUBROUTINE UNIFRM
C
C *****  SPECIAL FOR LEAKY QUADS  ******
C
      COMMON / FLOW / NQ, NL, KFLOW, VX(2000), VY(2000), VZ(2000),
     1 VNC(1000)
      LOGICAL AFLOW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      COMMON /NORMS/ XNORM(1000),YNORM(1000),ZNORM(1000)
      COMMON HEDR(15),MPR,IER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /QLEAK/ LEAK, FRACT

C     THIS ROUTINE SETS UP THE UNIFORM ONSET FLOWS.  FOR THESE FLOWS IT
C     IS ONLY NECESSARY TO HAVE TWO VELOCITY MATRICES, ONE ALL ZEROES
C     AND THE OTHER ALL ONES. WE SHALL FILL VX WITH 0'S AND VY WITH 1'S.

      DO 10 I = 1, NQ
      VX(I) = 0.0
   10 VY(I) = 1.0

C     NOW WE'LL TEST 'KFLOW' TO DETERMINE WHAT FLOW TO SET UP FOR.

      IF ( KFLOW - 2 ) 20, 30, 40

C     THIS PORTION SETS UP FOR 'A' FLOW.

   20 NAFLOW = 1
      WRITE (  3 ) KFLOW, ( VY(I), VX(I), VX(I), I = 1, NQ )
C
C     THIS IS A PATCH TO PROVIDE FOR LEAKY QUADS.  THESE MUST BE THE
C     FIRST QUADS IN THE TABLE.  THEY LEAK AT A FRACTION FRACT OF THE
C     FREE-STREAM RATE.  ONLY THE A FLOW IS PROVIDED FOR HERE.
C
C     LEAK = NO. OF LEAKY QUADS
C
      IF( LEAK .GT. 0 ) GO TO 21
      WRITE( 3) ( XNORM(I), I=1,NL )
      GO TO 50
   21 DO 22 I=1,LEAK
   22 VZ(I) = XNORM(I) + FRACT
      IF( LEAK .GE. NL ) GO TO 25
      LEAKP = LEAK + 1
      DO 24 I=LEAKP,NL
   24 VZ(I) = XNORM(I)
   25 WRITE( 3 ) ( VZ(I), I=1,NL )
      DO 26 I=1,NL
   26 VZ(I) = 0.0
      GO TO 50

C     THIS PORTION SETS UP FOR 'B' FLOW.

   30 NBFLOW = 1
      WRITE (  3 ) KFLOW, ( VX(I), VY(I), VX(I), I = 1, NQ )
      WRITE ( 3 ) ( YNORM(I), I = 1, NL )
      GO TO 50

C     THIS PORTION SETS UP FOR "C" FLOW.

```

```
   40 NCFLOW = 1
      WRITE (  3 ) KFLOW, ( VX(I), VX(I), VY(I), I = 1, NQ )
      WRITE ( 3 ) ( ZNORM(I), I = 1, NL )

C     CHECK FOR INPUT SIGMAS.

   50  IF ( ISIG .EQ. 0 ) RETURN

C     READ THE SIGMA GUESSES INTO VZ.

      READ ( 5, 60 ) ( VZ(I), I = 1, NQUAD )
   60 FORMAT ( 6F10.8 )

C     WRITE SIGMAS ON TAPE 3 AS ONE LOGICAL RECORD AND HANG IT UP. *TMR*

      WRITE ( 3 ) ( VZ(I), I = 1, NL )
      RETURN
      END
```

```
*DECK,VFORM
      SUBROUTINE VFORM
      REAL M12, M23, M34, M41 , IXX, IXY, IYY
      INTEGER TAPES
C
      LOGICAL  AFLOW, BFLOW, CFLOW
      DIMENSION NTAPE(3), D41(335),
     1 XIJ1 (335), XIJ2 (335), XIJ3 (335), YIJ1 (335), YIJ2 (335),
     2 YIJ3 (335), ZIJ1 (335), ZIJ2 (335), ZIJ3 (335), XX1 ( 1340),
     3 XX2 (1340), XX3(1340), YY1(1340),YY2(1340),YY3(1340),ZZ1(1340),
     4 ZZ2(1340), ZZ3(1340 ), X(8),Y(8),Z(8), XC(335), YC(335), ZC(335),
     5 A11(335), A12 (335), A13 (335), A21(335), A22(335), A23(335),
     6 A31(335), A32 (335), A33 (335), XI1(335), XI2(335), XI3(335),
     7 XI4(335), ETA1(335),ETA2 (335), ETA4(335),TSQ(335), A (335),
     8 IXX(335), IXY (335), IYY (335), D12 (335), D23(335), D34(335)
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      EQUIVALENCE  ( XIJ1, YY1 (1) ), ( XC, YY1 (336) ), ( YC,YY1(671)),
     1   ( ZC, YY1(1006) ), ( ETA4, XX1 ( 1 ) ), ( YIJ1, XX1 ( 336 ) ),
     2   ( XIJ2, YY2 (1) ), ( YIJ2, YY2 ( 336 )), ( A11, YY2 ( 671)),
     3   ( A12 , YY2 (1006)),  ( A13, XX1 (671)), ( TSQ, XX1 ( 1006 )),
     4   ( A21, YY3 (1) )    ,  ( A22, YY3 ( 336)), ( A23, YY3 ( 671)),
     5   ( A   ,   YY3 (1006)),  (XIJ3, XX2 ( 1)), ( YIJ3, XX2 ( 336) ),
     6   (ZIJ1,   ZZ1 (1) )  ,  (A31 , ZZ1 (336 )), (A32 , ZZ1 ( 671)),
     7   ( A33,   ZZ1 (1006)),  ( IXX, XX2 ( 671)), (  D12, XX2 (1006) ),
     8   (ZIJ2,   ZZ2 (1)   ) ,  ( XI1, ZZ2 (336 )), ( XI2, ZZ2 ( 671)),
     9   (XI3,    ZZ2 (1006)),  ( IXY, XX3 ( 1 )), ( D23, XX3 ( 336 )),
     A   (D34,  ZZ3 ( 1 ) ) ,  ( ZIJ3, ZZ3(336 )), (XI4, ZZ3 (  671)),
     B   ( ETA1,ZZ3 ( 1006)),  ( ETA2, XX3 (671)), ( IYY, XX3 ( 1006))
      COMMON /DFLOW/ AFLOW,BFLOW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      DATA  RHO1SQ, RHO2SQ / 6.0, 16.0 /
       DATA   NTAPE                 / 1 , 11 , 12 /
 4004 FORMAT ( 1H0,  3HROW,I5,5X, 6HX-FLOW)
 4005 FORMAT ( 1H0,  3HROW,I5,5X, 6HY-FLOW)
 4006 FORMAT ( 1H0,  3HROW,I5,5X, 6HZ-FLOW)
      INEAR = 0
      INTERM = 0
```

```
      IFAR = 0
   10 IF ( NSYM - 1 ) 58, 52, 54
   52 ASSIGN  2100 TO I29
      ASSIGN  910 TO I19
      GO TO 60
   54 ASSIGN 2200 TO I29
      IF ( NSYM .EQ. 3 ) GO TO 56
      ASSIGN  920 TO I19
      GO TO 60
   56 ASSIGN 930  TO I19
      GO TO 60
   58 ASSIGN 2000 TO I19
   60 LOOP = 2 ** NSYM + 1
      NEL = NQUAD / 3
      NELL = NEL
      NELP = NEL
      NREM = MOD ( 3 * NEL + 1, 255 )
      IF ( NREM .LT. 5 .AND. NREM .GT. 0 ) NELP = NEL + 5
      NON = NQUAD + NOFF
      DO 8000  M = 1, 3
      KROW = 0
  201 NT = NTAPE ( M )
  202 IF (M .NE. 3)    GO TO 300
      NEL = NQUAD - 2 * NEL
      NELP = NEL
      NREM = MOD ( 3 * NEL + 1 , 255 )
      IF ( NREM .LT. 5 .AND. NREM .GT. 0) NELP = NEL + 5

C  READ 28 QUANTITIES

  300 DO 500  J = 1, NEL
  500 READ (4) XC(J), YC (J), ZC(J), A11(J), A12(J), A13(J), A21(J),
     1 A22(J), A23(J), A31(J), A32(J), A33(J),       XI1(J),ETA1(J),XI2(
     2 J), ETA2(J), XI3(J), XI4(J), ETA4(J), TSQ(J), A (J), IXX (J),
     3 IXY (J), IYY(J), D12(J), D23(J), D34(J), D41(J)
  800 KROW = KROW + 1
      READ ( 8  ) XNPP, YNPP, ZNPP
      DO 2300 I1 = 1,  NEL
      DO 1700  I2 = 1, LOOP
      IF ( I2 .EQ. LOOP ) GO TO I19,( 2000, 910, 920, 930  )
      GO TO (1000, 910, 920, 910, 930, 910, 920, 910 ), I2
  910 YC ( I1 ) = - YC ( I1 )
      A12 ( I1 ) = - A12 ( I1 )
      A22 ( I1 ) = - A22 ( I1 )
      A31 ( I1 ) = - A31 ( I1 )
      A33 ( I1 ) = - A33 ( I1 )
      GO TO 932
  920 ZC ( I1 ) = - ZC ( I1 )
      A13 ( I1 ) = - A13 ( I1 )
      A23 ( I1 ) = - A23 ( I1 )
      A31 ( I1 ) = - A31 ( I1 )
      A32 ( I1 ) = - A32 ( I1 )
      GO TO 932
  930 XC ( I1 ) = - XC ( I1 )
      A11 ( I1 ) = - A11 ( I1 )
      A21 ( I1 ) = - A21 ( I1 )
      A32 ( I1 ) = - A32 ( I1 )
      A33 ( I1 ) = - A33 ( I1 )
  932 IF ( I2 .EQ. LOOP ) GO TO I29, (       2100, 2200    )
 1000 XDIF = XNPP- XC ( I1 )
```

```
      YDIF = YNPP- YC ( I1 )
      ZDIF = ZNPP- ZC ( I1 )

C  COMPUTE DISTANCE FROM NULL POINT TO ORIGIN OF J-TH ELEMENT COORDINATE
C     SYSTEM  ( J CORRESPONDS TO THE INDEX I1 )

C  INEQUALITY  ( 98 )

      ROSQ = XDIF ** 2 + YDIF ** 2 + ZDIF ** 2
      IF ( ROSQ .LT. RHO2SQ * TSQ ( I1 ) ) GO TO 1400

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATION  ( 97 )

      IFAR = IFAR + 1
      ARG1 = A ( I1) / SQRT ( ROSQ ) ** 3
      X   ( I2) = ARG1 * XDIF
      Y   ( I2 ) = ARG1 * YDIF
      Z   ( I2 ) = ARG1 * ZDIF
      GO TO 1700

C  TRANSFORM NULL POINT TO J - ELEMENT COORDINATE SYSTEM
C  EQUATION  ( 78 )


 1400 XNP = A11 ( I1 ) * XDIF + A12 ( I1 ) * YDIF + A13 ( I1 ) * ZDIF
      YNP =  A21 ( I1 ) * XDIF + A22 ( I1) * YDIF + A23 (I1)*ZDIF
      ZNP = A31 ( I1 ) * XDIF + A32 (I1) * YDIF + A33 (I1) * ZDIF

C  INEQUALITIES  ( 99) AND ( 100 )
      IF ( ROSQ .LT. RHO1SQ * TSQ ( I1 ) ) GO TO 1410

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 57 ) - ( 62 )

      INTERM = INTERM + 1
      P = YNP **2    + ZNP ** 2 - 4.0 * XNP ** 2
      QP= XNP **2    + ZNP ** 2 - 4.0 * YNP ** 2
      RO = SQRT ( ROSQ )
      ROP = RO ** (- 7)
      WXXX = XNP * ( 9.0 * P + 30.0 * XNP ** 2 ) * ROP
      WXXY = 3.0 * P * ROP * YNP
      WXYY = 3.0 * XNP * QP * ROP
      W YYY = YNP * ( 9.0 * QP + 30.0 * YNP ** 2 ) * ROP
      WXXZ = 3.0 * ZNP * P * ROP
      WXYZ      = - 15.0 * XNP * YNP * ZNP * ROP
      WYYZ = 3.0 * ZNP * QP * ROP
      ROP = - RO ** ( - 3)
      WX = ROP * XNP
      WY = ROP * YNP
      WZ = ROP * ZNP
      HIXX = .5 * IXX ( I1 )
      HIYY = .5 * IYY ( I1 )
      VX = - WXYY*HIYY - WXXY*IXY( I1) - WXXX*HIXX - WX*A( I1)
      VY = - WYYY*HIYY - WXYY*IXY( I1) - WXXY*HIXX - WY*A( I1)
      VZ = - WYYZ*HIYY - WXYZ*IXY( I1) - WXXZ*HIXX - WZ*A( I1)
      GO TO 1600

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 42 ) - ( 49 )
```

```
1410 ETA4M3 = ETA4 ( I1) - ETA1 ( I1 )
     INEAR = INEAR + 1
     RO = SQRT ( ROSQ )
     ETA2M1 = ETA2 ( I1 ) - ETA1 ( I1 )
     XI4M3 = XI4 ( I1 ) - XI 3 ( I1 )
     XI2M1 = XI2 (I1 ) - XI1 ( I1 )
     XI3M2 = XI3 ( I1 ) - XI2 ( I1 )
     XI1M4 = XI1 ( I1 ) - XI4 ( I1 )
     XMXI 1 = XNP - XI1 ( I1 )
     XMXI2 = XNP - XI2 ( I1 )
     XMXI3 = XNP - XI3 ( I1 )
     XMXI4 = XNP - XI4 ( I1 )
     YMETA1= YNP -  ETA1 ( I1 )
     YMETA 2 = YNP - ETA2 ( I1 )
     YMETA 4 = YNP - ETA4 ( I1 )
       ZNPSQ = ZNP * ZNP
     IF ( ZNPSQ .LT. TSQ ( I1 ) * 1.0E-6 ) ZNPSQ = 0.0
     E1 = ZNPSQ + XMXI1 **2
     E2 = ZNPSQ + XMXI2 **2
     E3 = ZNPSQ + XMXI3 **2
     E4 = ZNPSQ + XMXI4 **2
     H1 = YMETA1 * XMXI1
     H2 = YMETA2 * XMXI2
     H3 = YMETA1 * XMXI3
     H4 = YMETA4 * XMXI4
     M12 = 0.0
     IF ( XI2M1 .NE. 0.0) M12 = ETA2M1 / XI2M1
     M23 = 0.0
     IF ( XI3M2 .NE.0.0) M23 = - ETA2M1 / XI3M2
     M34 = 0.0
     IF ( XI4M3 .NE. 0.0) M34 = ETA4M3 / XI4M3
     M41 = 0.0
     IF ( XI1M4 .NE. 0.0) M41 = - ETA4M3 / XI1M4
     ANUM1 =  M12 * E1 - H1
     ANUM2 =  M12 * E2 - H2
     ANUM3 =  M23 * E2 - H2
     ANUM4 =  M23 * E3 - H3
     ANUM5 =  M34 * E3 - H3
     ANUM6 =  M34 * E4 - H4
     ANUM7 =  M41 * E4 - H4
     ANUM8 =  M41 * E1 - H1
     R 1 = SQRT ( XMXI1  ** 2 + YMETA1 ** 2 + ZNPSQ)
     R2  = SQRT ( XMXI2  ** 2 + YMETA2 ** 2 + ZNPSQ)
     R3  = SQRT ( XMXI3  ** 2 + YMETA1 ** 2 + ZNPSQ)
     R4  = SQRT ( XMXI4  ** 2 + YMETA4 ** 2 + ZNPSQ)
     Q25 = D12 ( I1 )
     Q26 = D23 ( I1 )
     Q27 = D34 ( I1 )
     Q28 = D41 ( I1 )
     VX = 0.0
     VY = 0.0
     VZ = 0.0
     IF ( Q25 ) 1420, 1430, 1420
1420 TEMP = R1 + R2
     TEMP1 = TEMP - Q25
     TEMP2 = TEMP + Q25
     ARG1 = 1.0
     IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG1=ALOG(TEMP1/TEMP2)
     TEMP = ARG1 / Q25
```

```
      VX = ETA2M1 * TEMP
      VY = - XI2M1 * TEMP
 1430 IF ( Q26 ) 1435, 1440, 1435
 1435 TEMP = R2 + R3
      TEMP1 = TEMP - Q26
      TEMP2 = TEMP + Q26
      ARG2 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG2=ALOG(TEMP1/TEMP2)
      TEMP = ARG2 / Q26
      VX = VX - ETA2M1 * TEMP
      VY = VY - XI3M2 * TEMP
 1440 IF ( Q27 ) 1450, 1460, 1450
 1450 TEMP = R3 + R4
      TEMP1 = TEMP - Q27
      TEMP2 = TEMP + Q27
      ARG3 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG3=ALOG(TEMP1/TEMP2)
      TEMP = ARG3 / Q27
      VX = VX + ETA4M3 * TEMP
      VY = VY - XI4M3 * TEMP
 1460 IF ( Q28 ) 1470, 1480, 1470
 1470 TEMP = R4 + R1
      TEMP1 = TEMP - Q28
      TEMP2 = TEMP + Q28
      ARG4 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG4=ALOG(TEMP1/TEMP2)
      TEMP = ARG4 / Q28
      VX = VX - ETA4M3 * TEMP
      VY = VY - XI1M4 * TEMP
 1480 IF ( ZNPSQ .NE. 0.0 ) GO TO 1510
      TEST = SQRT(TSQ(I1)* 1.0E-3)
      IF(Q25.GT.TEST) IF((XMXI1*ETA2M1-YMETA1*XI2M1)/Q25) 1600,1502,1502
 1502 IF(Q26.GT.TEST) IF((-XMXI2*ETA2M1-YMETA2*XI3M2)/Q26)1600,1504,1504
 1504 IF(Q27.GT.TEST) IF((XMXI3*ETA4M3-YMETA1*XI4M3)/Q27) 1600,1506,1506
 1506 IF(Q28.GT.TEST) IF((-XMXI4*ETA4M3-YMETA4*XI1M4)/Q28)1600,1508,1508
 1508 VZ = 6.28318531E0
      GO TO 1600
 1510 IF (XI2M1 .NE. 0.0) VZ = ATAN(ANUM1/(ZNP*R1))-ATAN(ANUM2/(ZNP*R2))
      IF (XI3M2 .NE. 0.0)VZ=VZ+ATAN(ANUM3/(ZNP*R2))-ATAN(ANUM4/(ZNP*R3))
      IF (XI4M3 .NE. 0.0)VZ=VZ+ATAN(ANUM5/(ZNP*R3))-ATAN(ANUM6/(ZNP*R4))
      IF (XI1M4 .NE. 0.0)VZ=VZ+ATAN(ANUM7/(ZNP*R4))-ATAN(ANUM8/(ZNP*R1))
C
C  TRANSFORM INDUCED VELOCITY COMPONENTS TO REFERENCE COORDINATE SYSTEM
C  EQUATION   ( 79 )

 1600 X   ( I2) = A11 (I1) * VX + A21 (I1) * VY + A31 (I1) * VZ
      Y   ( I2) = A12 (I1) * VX + A22 (I1) * VY + A32 (I1) * VZ
      Z   ( I2) = A13 (I1) * VX  + A23 (I1) * VY + A33 (I1) * VZ
 1700 CONTINUE

 2000 IF (.NOT. AFLOW) GO TO 2010
      XIJ1(I1) = X(1)
      YIJ1(I1) = Y(1)
      ZIJ1(I1) = Z(1)
 2010 IF (.NOT. BFLOW) GO TO 2020
      XIJ2(I1) = X(1)
      YIJ2(I1) = Y(1)
      ZIJ2(I1) = Z(1)
 2020 IF (.NOT. CFLOW) GO TO 2300
      XIJ3(I1) = X(1)
```

```
      YIJ3(I1) =  Y(1)
      ZIJ3(I1) = Z(1)
      GO TO 2300
 2100 IF ( .NOT. AFLOW) GO TO 2101
      XIJ1 ( I1 ) = X  ( 1 ) + X ( 2 )
      YIJ1 ( I1 ) = Y  ( 1 ) + Y ( 2 )
      ZIJ1 ( I1 ) = Z  ( 1 ) + Z ( 2 )
 2101 IF (.NOT. BFLOW) GO TO 2102
      XIJ2 ( I1 ) = X  ( 1 ) - X ( 2 )
      YIJ2 ( I1 ) = Y  ( 1 ) - Y ( 2 )
      ZIJ2 ( I1 ) = Z  ( 1 ) - Z ( 2 )
 2102 IF (.NOT. CFLOW) GO TO 2300
      XIJ3 ( I1 ) = X  ( 1 ) + X ( 2 )
      YIJ3 ( I1 ) = Y  ( 1 ) + Y ( 2 )
      ZIJ3 ( I1 ) = Z  ( 1 ) + Z ( 2 )
      GO TO 2300
 2200 IF (.NOT. AFLOW ) GO TO 2201
      XIJ1 (I1) = X ( 1 ) + X ( 2 ) + X ( 3 ) + X ( 4 )
      YIJ1 (I1) = Y ( 1 ) + Y ( 2 ) + Y ( 3 ) + Y ( 4 )
      ZIJ1 (I1) = Z ( 1 ) + Z ( 2 ) + Z ( 3 ) + Z ( 4 )
 2201 IF (.NOT. BFLOW ) GO TO 2202
      XIJ2 (I1) = X ( 1 ) - X ( 2 ) - X ( 3 ) + X ( 4 )
      YIJ2 (I1) = Y ( 1 ) - Y ( 2 ) - Y ( 3 ) + Y ( 4 )
      ZIJ2 (I1) = Z ( 1 ) - Z ( 2 ) - Z ( 3 ) + Z ( 4 )
 2202 IF (.NOT. CFLOW ) GO TO 2204
      XIJ3 (I1) = X ( 1 ) + X ( 2 ) - X ( 3 ) - X ( 4 )
      YIJ3 (I1) = Y ( 1 ) + Y ( 2 ) - Y ( 3 ) - Y ( 4 )
      ZIJ3 (I1) = Z ( 1 ) + Z ( 2 ) - Z ( 3 ) - Z ( 4 )
 2204 IF ( NSYM .EQ. 2 ) GO TO 2300
      IF (.NOT. AFLOW ) GO TO 2205
      XIJ1 ( I1 ) = XIJ1 (I1) - X ( 5 ) - X ( 6 ) - X ( 7 ) - X ( 8 )
      YIJ1 ( I1 ) = YIJ1 (I1) - Y ( 5 ) - Y ( 6 ) - Y ( 7 ) - Y ( 8 )
      ZIJ1 ( I1 ) = ZIJ1 (I1) - Z ( 5 ) - Z ( 6 ) - Z ( 7 ) - Z ( 8 )
 2205 IF (.NOT. BFLOW ) GO TO 2206
      XIJ2 ( I1 ) = XIJ2 (I1) + X ( 5 ) - X ( 6 ) - X ( 7 ) + X ( 8 )
      YIJ2 ( I1 ) = YIJ2 (I1) + Y ( 5 ) - Y ( 6 ) - Y ( 7 ) + Y ( 8 )
      ZIJ2 ( I1 ) = ZIJ2 (I1) + Z ( 5 ) - Z ( 6 ) - Z ( 7 ) + Z ( 8 )
 2206 IF ( .NOT. CFLOW ) GO TO 2300
      XIJ3 (I1) = XIJ3 (I1) - X ( 5 ) - X ( 6 ) + X ( 7 ) + X ( 8 )
      YIJ3 (I1) = YIJ3 (I1) - Y ( 5 ) - Y ( 6 ) + Y ( 7 ) + Y ( 8 )
      ZIJ3 (I1) = ZIJ3 (I1) - Z ( 5 ) - Z ( 6 ) + Z ( 7 ) + Z ( 8 )
 2300 CONTINUE
C  WRITE ONE ROW ON TAPE
C
      IF(AFLOW)WRITE(NT)       (XIJ1(J),YIJ1(J),ZIJ1(J),J=1, NELP)
      IF(BFLOW) WRITE(NT)        (XIJ2(J),YIJ2(J),ZIJ2(J),J=1,NELP)
      IF(CFLOW)WRITE(NT)       (XIJ3(J),YIJ3(J),ZIJ3(J),J=1, NELP)

      IF ( KROW .LT. NON   ) GO TO 800
      REWIND 8
 8000 REWIND NT
   42 FORMAT ( 1H0, 5X, 13HXIJ COMPONENT / ( 1H , 7F15.8))
   43 FORMAT ( 1H0, 5X, 13HYIJ COMPONENT / ( 1H , 7F15.8))
   44 FORMAT ( 1H0, 5X, 13HZIJ COMPONENT / ( 1H , 7F15.8))
      IF ( MPR .EQ. 0 .OR. MPR .EQ. 2 ) GO TO 9075
      CALL HEADER
      DO 9060  K = 1, KROW
      IND1 = 1 - NELL
      IND2 = 0
      I = 0
```

```
9003 IND1 = IND1 + NELL
     IND2 = IND2 + NELL
9002 I = I + 1
     NT = NTAPE ( I )
 004 IF(AFLOW)READ(NT)       (XX1(J), YY1(J), ZZ1(J),J = IND1, IND2 )
     IF(BFLOW) READ(NT)          (XX2(J),YY2(J), ZZ2(J),J=IND1,IND2)
     IF(CFLOW) READ (NT)         (XX3(J),YY3(J),ZZ3(J), J=IND1, IND2)
     IF ( I -  2   ) 9003, 9008, 9050
9008 IND1 = IND2 + 1
     IND2 = IND2 + NEL
     GO TO 9002
9050 IF (.NOT. AFLOW) GO TO 9051
     WRITE ( 6, 4004 ) K
     WRITE ( 6, 42 )   ( XX1 (J), J = 1, NQUAD)
     WRITE ( 6, 43 )   ( YY1 (J), J = 1, NQUAD)
     WRITE ( 6, 44 )   ( ZZ1 (J), J = 1, NQUAD)
9051 IF (.NOT. BFLOW ) GO TO 9052
     WRITE ( 6, 4005 ) K
     WRITE ( 6, 42 ) ( XX2 (J), J = 1, NQUAD )
     WRITE ( 6, 43 ) ( YY2 (J), J = 1, NQUAD )
     WRITE ( 6, 44 ) ( ZZ2 (J), J = 1, NQUAD )
9052 IF ( .NOT. CFLOW ) GO TO 9060
     WRITE ( 6, 4006 ) K
     WRITE ( 6, 42 ) ( XX3 (J), J = 1, NQUAD )
     WRITE ( 6, 43 ) ( YY3 (J), J = 1, NQUAD )
     WRITE ( 6, 44 ) ( ZZ3 (J), J = 1, NQUAD )
9060 CONTINUE
9070 REWIND 1
     REWIND 11
     REWIND 12
9075 WRITE ( 6, 4999 ) INEAR, INTERM, IFAR
4999 FORMAT ( 1H0,//16H0NEAR ELEMENTS =,I7/ 24H0INTERMEDIATE ELEMENTS =
    1, I7    / 15H0FAR ELEMENTS =, I7   )
     WRITE(6, 9999)
9999 FORMAT( 1H0 , 5X, 13HLEAVING VFORM)
C    RETURN
     END
```

```
*DECK,AFORM
      SUBROUTINE  AFORM
      REAL NX , NY , NZ
       LOGICAL          AFLCW, BFLOW, CFLOW
      COMMON /DFLOW/ AFLCW,BFLCW,CFLOW,NMAT,NMATM1,NAFLOW,NBFLOW,NCFLOW
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      DIMENSION C(6000)
      DIMENSION NX( 1000), NY( 1000), NZ( 1000), NTAPE(3)
      DIMENSION A( 1000), XIJ( 1000), YIJ( 1000), ZIJ( 1000)
      DATA  NTAPE                 / 9, 10, 13 /
   42 FORMAT ( 1H0, 5X, 13HXIJ COMPONENT / ( 1H , 7F15.8))
   43 FORMAT ( 1H0, 5X, 13HYIJ COMPONENT / ( 1H , 7F15.8))
   44 FORMAT ( 1H0, 5X, 13HZIJ COMPONENT / ( 1H , 7F15.8))
   45 FORMAT ( 1H0, 3HROW, I6 )
   46 FORMAT(1H0, 5X,  3HAIJ / (1H , 7F15.8 ))
      IF (MPR .NE. 0) CALL HEADER
      NQNN1 = NQUAD + 2
      NQNN = MOD(NQNN1, 255)
      IF (NQNN  .LT. 5 .AND. NCNN  .GT. 0) NQNN1 = NQUAD + 5
      IF (NCODE .NE. 1) GO TO 20
      IF (NAFLOW) 2, 2, 1
    1 NF1 = NAFLOW
      GO TO 5
    2 IF (NBFLOW) 4, 4, 3
    3 NF1 = NBFLOW
      GO TO 5
    4 NF1 = NCFLOW
    5 NF2 = NFLOW - NF1
      L2 = 0
      DO 6 KK = 1, NF1
      L1 = L2 + 1
      L2 = L2 + NQUAD
      READ (3)
    6 READ (3) (C(K), K = L1, L2)
      LAST1 = L2
      IF (NF2 .EQ. 0) GO TO 8
      DO 7 KK = 1, NF2
      L1 = L2 + 1
      L2 = L2 + NQUAD
      READ (3)
    7 READ (3) (C(K), K = L1, L2)
    8 DO 10 KK = 1, L2
   10 C(KK) = -C(KK)
C   **  READ IN UNIT NORMAL VECTORS
   20 READ(4) (NX(I), NY(I), NZ(I), I = 1, NQUAD)
C   FORM NORMAL VELOCITIES - EQUATION 102
   30 DO 1000 KK = 1, NQUAD
      DO 1000 NM = 1, NMAT
      CALL ROWV (XIJ, YIJ, ZIJ, (KK * NM) / NMAT + NOFF, 0)
      DO 60 K= 1, NQUAD
   60 A  (K)  = NX(KK)*XIJ(K)  + NY(KK)* YIJ(K)  + NZ(KK)*ZIJ(K)
      IF( MPR.EQ. 0 ) GO TO 70
      WRITE(6,45) KK
      IF ( MPR .EQ. 2 ) GO TO 65
      WRITE(6,42) ( XIJ(I4), I4 = 1,NQUAD )
      WRITE(6,43) ( YIJ(I4), I4 = 1,NQUAD )
      WRITE(6,44) ( ZIJ(I4), I4 = 1,NQUAD )
      IF ( MPR - 2 ) 70, 65, 65
   65 WRITE (6, 46) (A(I4), I4 = 1, NQUAD)
```

```
   70 IF (NCODE .NE. 1) GO TO 500
      IF (NM .NE. 1) GO TO 100
      WRITE(8 )              (A(I),I=1,NQUAD),(C(I),I=KK,LAST1,NQUAD)
      GO TO 1000
  100 NT = KK + LAST1
      WRITE (10)              (A(I),I=1,NQUAD),(C(I),I=NT,L2,NQUAD)
      GO TO 1000
  500 NT = NTAPE(NM)
      IF (NM .EQ. 1) WRITE (8) NQNN1,          (A(I), I = 1, NQNN1)
      WRITE ( NT ) NQNN1,          (A(I), I = 1, NQNN1)
 1000 CONTINUE
      REWIND 8
      REWIND 9
      REWIND 10
      REWIND 13
      WRITE(6, 9999)
 9999 FORMAT( 1H0 , 5X, 13HLEAVING AFORM)
C     RETURN
      END
```

```
*DECK,SOLVT
      SUBROUTINE SOLVIT
C     SUBROUTINE  SOLVIT (A, NI, MD, KD, NI, MM, NO, NW, *)
      COMMON/SOLVE/ NI,MM,NO,KD,MD
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,ND,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /SPACER/ A(14000)
C
C
C           ****    ***/  *******  *****  *        ***/        *
C           *   *  *  /*     *     *      *        *  /*     ******
C     **** ****    * / *     *     ***    *        * / * ****    *  *
C           *      */  *     *     *      *        */  *         ***
C           *      /***      *     *      *****   /***           *  *
C
C              D I R E C T   M A T R I X   S O L U T I O N
C
C     WRITTEN BY J. L. HESS * PROGRAMMED BY T. M. RIDDELL
C*****LANGUAGE
C
C         FORTRAN IV
C
C*****FUNCTIONAL DESCRIPTION
C
C         THIS ROUTINE SOLVES THE REAL MATRIX EQUATION
C
C                    --    --     --    --     --    --
C                    I      I     I      I     I      I
C                    I  A   I  *  I  B   I  =  I  C   I
C                    I      I     I      I     I      I
C                    --    --     --    --     --    --
C
C                        -1
C     FOR 'B' ( B = A    * C ) .  IF 'A' IS THE REAL COEFFICIENT MATRIX
C
C     FOR A SET OF SIMULTANEOUS EQUATIONS AND 'C' IS THE MATRIX OF
```

```
C
C     CONSTANTS ( RIGHT-SIDES ), THEN 'B' WILL BE THE SOLUTIONS OF THE
C
C     SET OF SIMULTANEOUS EQUATIONS.  NOTE THAT IF 'C' IS A UNIT MATRIX,
C
C     'B' WILL BE THE INVERSE OF 'A'.
C
C*****CALL STATEMENT
C
C        CALL SOLVIT ( AREA, N, M, KORE, NT1, NT2, NT3, NOUT, &NNN )
C
C     WHERE
C
C       'AREA' IS AN ARRAY ( DIMENSIONED FOR AT LEAST 'KORE' WORDS )
C              THAT IS USED BY 'SOLVIT' FOR SCRATCH PURPOSES.
C              AFTER A NORMAL RETURN FROM 'SOLVIT', THIS ARRAY WILL
C              CONTAIN THE 'B' MATRIX STORED IN COLUMNAR ORDER.
C
C       'N'    IS THE ORDER OF THE 'A' MATRIX
C
C       'M'    IS THE NUMBER OF COLUMNS IN 'B' AND 'C'
C
C       'KORE' IS THE DIMENSIONED SIZE OF 'AREA' IN WORDS
C
C       'NT1'  IS THE LOGICAL FILE NUMBER OF THE INPUT DATA SET
C              (THIS UNIT IS ALSO USED BY 'SOLVIT' AS A SCRATCH TAPE)
C              SEE BELOW FOR THE DESCRIPTION OF THE INPUT FORMAT
C
C       'NT2'  IS THE LOGICAL FILE NUMBER OF AN AVAILABLE SCRATCH UNIT
C
C       'NT3'  IS THE LOGICAL FILE NUMBER OF AN AVAILABLE SCRATCH UNIT
C              (NT1, NT2, AND NT3 MUST ALL HAVE DIFFERENT VALUES)
C
C       'NOUT' IS THE LOGICAL FILE NUMBER OF THE OUTPUT DATA SET
C              THE 'B' MATRIX IS WRITTEN ON 'NOUT' IN COLUMNAR ORDER,
C              ONE LOGICAL RECORD PER COLUMN
C              ('NOUT' MAY EQUAL NT1, NT2, OR NT3)
C
C       '&NNN' IS THE FORTRAN STATEMENT NUMBER WHERE CONTROL IS TO BE
C              TRANSFERRED IF 'SOLVIT' DETERMINES THAT THE VALUE OF
C              'KORE' IS TOO SMALL TO ALLOW THE COMPUTATION TO CONTINUE
C              (A FORTRAN VARIABLE RETURN)
C
C*****OUTPUT
C              -1
C        B = A    C      WRITTEN IN COLUMNAR ORDER (ONE LOGICAL RECORD
C                        PER COLUMN) ON 'NOUT' AND STORED IN 'AREA'
C
C*****STORAGE REQUIRED
C
C        F5E HEXADECIMAL BYTES
C
C*****METHOD
C
C        GAUSSIAN ELIMINATION
C              NOTE...THE ROWS ARE NOT NORMALIZED
C                     THE PIVOT IS ASSUMED TO BE THE DIAGONAL ELEMENT
C
C*****GENERAL NOTES
C
```

```
C         THE VALUE OF "KORE" MUST BE SUFFICIENT TO STORE
C              MAX0 ( 3 * (N + M), N * M ) REAL VALUES
C
C         THE 'A' AND 'C' MATRICES MUST BE INPUT IN ROW ORDER . . . .
C              ONE LOGICAL RECORD PER ROW OF THE 'A' AND 'C' MATRICES
C              I.E.,
C
C         .                            .                            .
C         .   1 ROW OF THE "A" MATRIX  .  1 ROW OF THE "C" MATRIX   .
C         ...........................................................
C         .      ("N" REAL VALUES)     .      ("M" REAL VALUES)     .
C         *                                                         *
C         ***********************************************************
C         *                  ONE LOGICAL RECORD                     *
C         *                ("N" + "M" REAL VALUES)                  *
C
C
C         'NOUT' IS NOT POSITIONED PRIOR TO THE WRITING OF 'B'
C
C
      DIMENSION  A ( KD )
C
      LOGICAL  LAST
C
      NW=3
      N = ND
      M = MD
      KORE = KD
      NPM = N + M
      IF (MAX0(3 * NPM, M * N) .LE. KORE) GO TO 5
 2475 WRITE (6, 2480) NQUAD, MD , KORE
 2480 FORMAT (4H1THE,I4, 2H X,I3, 15H MATRIX EXCEEDS,I6, 7H WORDS. )
      CALL EXIT
    5 MT = MM
      REWIND MT
      NIN = NI
      REWIND NIN
      NOUT = NO
      REWIND NOUT
      MP1 = M + 1
      NN = N
      NEL = NPM
C
C - - CALCULATE THE MAXIMUM NO. OF ROWS, 'K'
C
   10 K = (KORE - NEL) / NEL
C
C - - TEST TO SEE IF THE REST OF THE MATRIX WILL FIT IN CORE
C
      LAST = K .GE. NN
      IF (LAST) K = NN
C
C - - READ "K" ROWS OF THE AUGMENTED "A" MATRIX
C
   30 NT = 0
      DO 40 IB = 1, K
      NS = NT + 1
      NT = NT + NEL
   40 READ (NIN) (A(IO), IO = NS, NT)
C
```

```
C - - CHECK TO SEE IF WE WERE UNLUCKY ENOUGH TO END UP WITH ONLY ONE ROW
C
      IF (K .EQ. 1) GO TO 90
C
C - - 'K' IS GREATER THAN "1" SO WE CAN START THE TRIANGULARIZATION
C
      NELP1 = NEL + 1
      NS = - NEL
      NELP2 = NELP1 + 1
C
C - - FORM THE 'TRAPEZOICAL' ARRAY  (8)
C
      DO 50 IB = 2, K
      NP = NELP2 - IB
      NS = NS + NELP1
      NT = NS
      DO 50 IO = IB, K
      NT = NT + NEL
      MN = NT
      NB = NS
      A(NT) = (-A(NT)) / A(NS)
      DO 50 NF = 2, NP
      MN = MN + 1
      NB = NB + 1
   50 A(MN) = A(MN) + A(NT) * A(NB)
      IF (LAST) GO TO 90
C
C - - WRITE THE 'TRAPEZOIDAL' MATRIX ON TAPE
C
      NT = 0
      NP = NEL
      NS = - NEL
      DO 60 IO = 1, K
      NS = NS + NELP1
      NT = NT + NEL
      WRITE (MT) NP, (A(IB), IB = NS, NT)
   60 NP = NP - 1
      NP = NP - M
      NS = KORE - NEL + 1
C
C - - READ ANOTHER ROW
C
      DO 80 IO = 1, NP
      READ (NIN) (A(IB), IB = NS, KORE)
C
C - - MODIFY THIS ROW BY THE 'TRAPEZOIDAL' ARRAY
C
      NT = 1
      MN = NS
      DO 70 IB = 1, K
      NB = NT
      NF = MN + 1
      A(MN) = (-A(MN)) / A(NT)
      DO 65 NN = NF, KORE
      NB = NB + 1
   65 A(NN) = A(NN) + A(MN) * A(NB)
      MN = NF
   70 NT = NT + NELP1
C
C - - WRITE THE MODIFIED ROW ON TAPE
```

```
C
   80 WRITE (NOUT)      (A(NT), NT = MN, KORE)
      REWIND NOUT
      REWIND NIN
C
C - - SWITCH THE TAPES
C
      NT = NIN
      NIN = NOUT
      NOUT = NT
C
C - - RE-CALCULATE ROW LENGTH AND LOOP BACK
C
      NEL = NEL - K
      NN = NEL - M
      GO TO 10
C
C - - REWIND ALL TAPES
C
   90 REWIND MT
      REWIND NIN
      REWIND NOUT
C
C - - CONDENSE THE MATRIX
C
      NN = NEL
      NL = NELP1
      IF (K .EQ. 1) GO TO 105
      NS = 1
      NT = NEL
      DO 100 IB = 2, K
      NS = NS + NELP1
      NT = NT + NEL
      DO 100 IO = NS, NT
      A(NL) = A(IO)
  100 NL = NL + 1
  105 N1 = KORE - K * M + 1
C
C - - THERE, NOW WE CAN START THE BACK-SOLUTION
C * * NOTE..THE FIRST AVAILABLE LOCATION FOR THE SOLUTIONS IS A(N1)
C
      NREM = N
      NEL = NPM
      LAST = K .EQ. N
      NPASS = 0
C
C - - SOLVE FOR THE ANSWERS CORRESPONDING TO 'K' ROWS
C
  110 KM1 = K - 1
      KP1 = K + 1
      NS = NL - MP1
      NPASS = NPASS + 1
      DO 130 MN = 1, M
      NF = NS + MN
      A(NF) = A(NF) / A(NS)
      NT = NS
      IF (KM1 .EQ. 0) GO  TO 130
      DO 125 IB = 1, KM1
      NF = NF - IB - M
      NT = NT - MP1 - IB
```

```
      SUM = 0.0
      NP = NF
      N2 = MP1 + IB
      DO 120 IO = 1, IB
      NN = NT + IO
      NP = NP + N2 - IO
  120 SUM = SUM + A(NN) * A(NP)
  125 A(NF) = (A(NF) - SUM) / A(NT)
  130 CONTINUE
C
C - - MOVE THE SOLUTIONS TO CONTIGUOUS LOCATIONS STARTING AT A(N1)
C
      N1 = KORE + 1
      DO 140 NN = 1, K
      DO 135 MN = 1, M
      NL = NL - 1
      N1 = N1 - 1
  135 A(N1) = A(NL)
  140 NL = NL - NM
C
C - - WRITE THE SOLUTIONS ON TAPE
C
      WRITE (NIN) K
      NS = N1 - 1
      DO 145 MN = 1, M
      NT = NS + MN
  145 WRITE ( NIN ) (A(IO), IO = NT, KORE, M)
C
C - - TEST IF THIS IS THE LAST PASS
C
      IF (LAST) GO TO 200
C
C - - WE MUST NOW MODIFY THE TRIANGULAR MATRIX TO REFLECT THE EFFECT OF
C     THE SOLUTIONS OBTAINED SO FAR  (EQ 21)
C * * NOTE..LOCATIONS A(1) TO A(N1-1) ARE NOW FREE TO USE
C
C - - CALCULATE THE NEXT VALUES OF 'NEL' AND 'NREM'
C
      NELOLD = NEL
      KOLD = K
      NEL = NEL - K
      NREM = NREM - K
C
C - - NOW APPLY THE INCREDIBLE FORMULA FOR THE NEW 'K'
C
      K = (-4 * M - 1) / 2 + IFIX(SQRT(0.25 + FLOAT((4 * M + 2) * M +
     1 2 * (KORE - NELOLD))))
      NROW = NREM - K + 1
      IF (K .LT. NREM) GO TO 150
      LAST = .TRUE.
      NROW = 1
      K = NREM
  150 NS = 1
      NT = NELOLD + 1
C
C - - READ IN THE ROWS TO BE MODIFIED
C
      DO 190 IB = 1, NREM
      NT = NT - 1
      IF (IB .LE. NROW) GO TO 160
```

```
      NS = NS + NN
      NT = NT + NN
  160 READ ( MT ) NN, (A(IO), IO = NS, NT)
      NP = N1 - 1
      NF = NT - M - KM1
      NN = NN - KOLD
      DO 170 MN = 1, M
      N2 = NF
      NA = NP + MN
      NB = NA
      SUM = 0.0
      DO 165 IO = 1, KOLD
      SUM = SUM + A(N2) * A(NA)
      N2 = N2 + 1
  165 NA = NA + M
      N2 = N2 + MN - 1
  170 A(N2) = A(N2) - SUM
C
C - - WRITE THE MODIFIED ROW ON TAPE OR CONDENSE THE ROW
C
      NL = NT - M + 1
      IF (IB .GE. NROW) GO TO 175
      NF = NL - KP1
      WRITE (NOUT) NN, (A(IO), IO = NS, NF), (A(IO), IO = NL, NT)
      GO TO 190
  175 NF = NL - KOLD
      DO 180 MN = NL, NT
      A(NF) = A(MN)
  180 NF = NF + 1
  190 CONTINUE
      REWIND MT
      REWIND NOUT
C
C - - SWITCH THE TAPES
C
      NT = MT
      MT = NOUT
      NOUT = NT
C
C - - LOOP BACK THRU THE SOLUTION
C
      NL = NF
      GO TO 110
C
C - - START TO WRAP IT UP
C
  200 REWIND NIN
      N2 = N
C
C * * NOTE.. AT THIS POINT ALL LOCATIONS A(1) THRU A(KORE) ARE FREE
C
      DO 220 IB = 1, NPASS
      READ (NIN) K
      N1 = N2 - K + 1
      NS = N1
      NT = N2
C
C - - READ IN THE SOLUTIONS
C
      DO 210 IO = 1, M
```

```
      READ (NIN) (A(NN), NN = NS, NT)
      NT = NT + N
  210 NS = NS + N
  220 N2 = N1 - 1
C
C - - WRITE THE SOLUTIONS ON TAPE
C
      NT = 0
      DO 230 IO = 1, M
      NS = NT + 1
      NT = NT + N
  230 WRITE (NW) (A(NN), NN = NS, NT)
C
      WRITE (6, 300) N, N, M
  300 FORMAT (4H0THE,I5, 2H X,I5, 12H MATRIX WITH,I4, 33H RIGHT SIDES WA
     1S SOLVED DIRECTLY.)
C     RETURN
      END
```

```
*DECK,SIGMA
      SUBROUTINE SIGMA
C     SUBROUTINE SIGMA ( NSKIP )
      COMMON /SIG/ NSKIP
      DIMENSION L(100), C( 6000), DSIG1(100)
      DIMENSION A(1000)
      DIMENSION SIG(6000)
      COMMON HEDR(15),MPR,MER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON / ATAPE / NCOPY
       NT = NCOPY + 8
      NTAPE = NCOPY
      IF ( ISIG .NE. 0 ) GO TO 1
      M = 2
      GO TO 2
    1 M = 3
    2 IF (NSKIP .EQ. 0) GO TO 11
      N   = M * NSKIP
      DO 3 K = 1, N
    3 READ(3)
   11 N1 = 1
      N2 = NQUAD
      DO 5 I = 1, NCFLG
      READ (3)
      READ(3) ( C(K), K = N1, N2)
      IF( ISIG .NE. 0) READ (3) (SIG(K), K = N1, N2)
      N1 = N2 +1
    5 N2 = N2 + NQUAD
      N = (NFLOW - NSKIP - NCFLG) * M + NSKIP
      IF ( N .EQ. 0 ) GO TO 67
      DO 66 K = 1, N
   66 READ (3)
   67 ITER = 0
      NCONV = 0
      DO 12 J = 1, NCFLG
      L(J) = 0
      JN = NQUAD * ( J - 1 )
```

```
      DO 12  I = 1, NQUAD
      K1 = I + JN
   12 IF( ISIG .EQ. 0) SIG(K1) = 0.0
   20 DO 22 I = 1, NCFLG
   22 DSIG1 ( I ) = 0.0
      DO 80 I= 1, NQUAD
      READ ( NTAPE ) NQ, ( A(J), J = 1, NQUAD )
      DO 80 J = 1, NCFLG
      IF(    L(J)  .NE. 0) GO TO 80
      SUM = 0.0
      JN = NQUAD * ( J - 1 )
      DO 60 K = 1, NQUAD
      K2 = K + JN
   60 SUM = SUM + A(K) * SIG(K2)
      K1 = I + JN
      DSIG2 =(-C(K1) - SUM) / A(I)
      SIG(K1) = SIG(K1) + DSIG2
      DSIG1(J) = AMAX1(ABS(DSIG2), DSIG1(J))
   80 CONTINUE
       ITER = ITER + 1
      REWIND NTAPE
      IF( IPRS .EQ. 0) GO TO 85
       WRITE(6,9998) ITER
 9998 FORMAT(1H , 5X, 17H ITERATION NOS.    , I3)
      DO 82 K = 1, NCFLG
      K1 = NQUAD * ( K-1) + 1
      K2 = K1 + NQUAD
   82 WRITE(6, 10) K , (     SIG(I), I = K1, K2)
   10 FORMAT ( 1H , 5X, 12H FLOW NUMBER    , I4 / ( 5X, 6F15.8))
   85 DO 400 J = 1 , NCFLG
      IF( L(J) .NE. 0) GO TO 400
      IF(DSIG1(J) .GE. 1.0E-4) GO TO 400
      L ( J ) = ITER
      NCONV = NCONV + 1
      IF ( NCONV .EQ. NCFLG )  GO TO 500
  400 CONTINUE
      NTAPE = NT - NTAPE
      IF ( ITER - 100) 20, 500, 20
  500 DO 650 J = 1, NCFLG
      IF ( L ( J ) .EQ. 0 )  GO TO 550
      WRITE ( 6, 6 )  L ( J )
    6 FORMAT (1H0, 5X, I5, 2X, 35HITERATIONS REQUIRED FOR CONVERGENCE )
      GO TO 650
  550 WRITE ( 6, 7 )
    7 FORMAT (1H0, 8X, 35HNO CONVERGENCE AFTER 100 ITERATIONS )
      K1 = NQUAD * ( J-1) + 1
      K2 = K1 + NQUAD
      WRITE(6,8) (SIG(I), I = K1,K2)
    8 FORMAT( 1H , 5X, 8F12.7)
  650 CONTINUE
      NN = NQUAD
      M = MOD(NN, 255)
      IF (M .LT. 5 .AND. M .GT. 0)  NN = NN + 5
      N1 = 1
      DO 675 J = 1, NCFLG
      WRITE (3) (SIG(K), K = N1, NN)
      N1 = N1 + NQUAD
  675 NN = NN + NQUAD
      REWIND 3
      WRITE(6, 9999)
```

```
 9999 FORMAT( 1H0 , 5X, 13HLEAVING SIGMA)
C     RETURN
      END
```

```
*DECK,ATAPS
      SUBROUTINE ATAPES
C     SUBROUTINE ATAPES ( KFLOW )
      COMMON /TAPES/ KFLOW

C- - -DEFINITION OF ARGUMENTS

C     NQ             NUMBER OF VALUES OF 'A' PER RECORD
C     KFLOW          FLOW-FLAG, 1 = A-FLOW, 2 = B-FLOW, 3 = C-FLOW
C     NCOPY          TAPE NUMBER TO BE USED BY 'ROWA'

      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON / ATAPE / NCOPY
      DIMENSION A(1000),NLINE(500),NLT(500),XNULL(1000),YNULL(1000),
     1 ZNULL(1000),XNORM(1000),YNORM(1000),ZNORM(1000),XOFF(1000),
     2 YOFF(1000),ZOFF(1000)
      IF ( KFLOW - 2 ) 100, 200, 300
  100 NCOPY = 9
      GO TO 1000
  200 NCOPY = 10
      GO TO 400
  300 NCOPY = 13

C- - -START OF LOOP

  400 DO 900 N = 1, NQUAD
      NTRY = 0
  500 CKSUM = 0.0

C- - -READ THE 'A' MATRIX FROM THE APPROPRIATE TAPE

      READ ( NCOPY ) NQ,        (A(I), I = 1, NQ)

  900 WRITE ( 8 ) NQ,        (A(I), I = 1, NQ)
      GO TO 1400
C- - -THE PURPOSE OF THE FOLLOWING 'MICKEY MOUSE' IS TO RE-POSITION THE
C     CONTROL TABLES, NULL POINTS, AND UNIT NORMALS AT THE BEGINNING OF
C     THE TAPE.  THIS ELIMINATES SKIPPING THE '28 QUANTITIES' EACH TIME.
 1000 READ (4) KLCT, (NLINE(J),NLT(J), J = 1, KLCT)
      READ (4) (XNULL(J),YNULL(J),ZNULL(J),XNORM(J),YNORM(J),ZNORM(J),
     1 J = 1, NQUAD)
      IF (NOFF .GT. 0) READ (4) (XOFF(J), YOFF(J), ZOFF(J), J=1, NOFF)
      REWIND 4
      WRITE (4) KLCT, (NLINE(J), NLT(J), J = 1, KLCT)
      DO 1100 J = 1, NQUAD
 1100 WRITE (4) XNULL(J),YNULL(J),ZNULL(J),XNORM(J),YNORM(J),ZNORM(J)
      IF (NOFF .EQ. 0) GO TO 1300
      DO 1200 J = 1, NOFF
 1200 WRITE (4) XOFF(J),YOFF(J),ZOFF(J),XOFF(J),YOFF(J),ZOFF(J)
 1300 REWIND 4
 1400 REWIND 8
```

```
      REWIND NCOPY
      WRITE (6, 1500)
 1500 FORMAT (1H0, 5X, 14HLEAVING ATAPES)
C     RETURN
      END
```

```
*DECK,PRINT
      SUBROUTINE PRINT1
C     SUBROUTINE PRINT1( NSKIP, MN, KMAT, NSEQ)
      COMMON /PRINT0/ KMAT,NSEQ,KTP14
      COMMON /TAPES/ MN
      COMMON /SIG/ NSKIP
      COMMON HEDR(15),MPR,NER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      REAL NX , NY , NZ, MACH
      LOGICAL PUNCHV
      COMMON /M/ MACH, BETA, RBETA
      DIMENSION            FLOWID(3),
     1 VX(2000), VY(2000), VZ(2000),
     4 NST(500), NCL(500)
      DIMENSION SIG(1000), XIJ(1000), YIJ(1000), ZIJ(1000)
      DATA FLOWID / 2HX-, 2HY-, 2HZ- /, PROG / 4HBCXC /
      PUNCHV = .FALSE.
      NTIME = NQUAD + NOFF
      LCMAX = 12
C     READ IN IDENTIFYING INTEGERS
C
      READ(4) INSECT, ( NST(J) , NCL(J) , J = 1, INSECT)
      DO 2000 L = 1, NCFLG
      IF( ISIG .NE. 0) GO TO 1
      M = 2
      GO TO 2
    1 M = 3
    2 N = M * (NSKIP + L - 1)
      IF (N .EQ. 0) GO TO 4
      DO 3 J = 1, N
    3 READ (3)
    4 READ ( 3) KFLOW, (VX(IJ), VY(IJ), VZ(IJ), IJ = 1, NTIME )
      IF ( KFLOW .EQ. KMAT ) GO TO 9
      CALL HEADER
      WRITE (6, 8) KFLOW, KMAT
    8 FORMAT ( 1H0,6X,48HAN APPARENT FLOW MIS-MATCH HAS OCCURRED. KFLOW
     1=, I2, 7H KMAT =, I2 )
      CALL EXIT
    9 N = (NFLOW - NSKIP - L + 1) * M + NSKIP + L - 2
      DO 5 J = 1, N
    5 READ (3)
      READ (3) (SIG(J), J = 1, NQUAD)
      REWIND 3
      IF(KTP14 .EQ. 1) WRITE(14) (SIG(J), J=1,NQUAD)
      IF(KTP14 .EQ. 1) ENDFILE 14
      REWIND 14
      IF (MN .EQ. 1) GO TO 15
      NRSKIP = MN - 1
      DO 10 JM = 1, NRSKIP
      READ (1)
```

```
      READ (11)
   10 READ (12)
   15 LC = LCMAX
      INSECT  = 1
      M = 0
      IF (L .GT. 1) READ (4)
      DO  1000  IS  = 1, NTIME
      READ(4) XN, YN, ZN, NX, NY, NZ
      IF ( MACH .EQ. 0.0 ) GO TO 17
      CORR = 1.0 / SQRT(NX * NX + BETA * BETA * (NY * NY + NZ * NZ))
      NX = NX * CORR
      NY = NY * BETA * CCRR
      NZ = NZ * BETA * CORR
      XN = XN * BETA
   17 VIX = 0.0
      VIY =  0.0
      VIZ =  0.0
      CALL ROWV(XIJ, YIJ, ZIJ, IS, 1)
      DO  20 I1 =  1, NQUAD
C
C     VELOCITY COMPONENTS   EQ. (135) OR EQ. (140)
C
      VIX  = VIX  + XIJ( I1 ) *  SIG(I1)
      VIY  = VIY  + YIJ( I1 ) *  SIG(I1)
   20 VIZ  = VIZ  + ZIJ( I1 ) *  SIG(I1)
      VIX = VIX * RBETA * RBETA + VX(IS)
      VIY = VIY * RBETA + VY(IS)
      VIZ = VIZ * RBETA + VZ(IS)
C     IF ( PUNCHV ) GO TO 26
      IF ( IS .EQ. NQUAD .OR. IS .EQ. NTIME ) GO TO 22
      VIXT = VIX
      VIYT = VIY
      VIZT = VIZ
C     PUNCHV = .TRUE.
      GO TO 30
   22 NSEQ = NSEQ + 1
      IF(PUNCHV)
     1WRITE ( 7, 24 ) VIX, VIY, VIZ, KASE, PROG, NSEQ
   24 FORMAT ( 3F10.7, 36X,A4, 2X,A4, I4)
      GO TO 28
   26 NSEQ = NSEQ + 1
      WRITE ( 7, 27 ) VIXT, VIYT, VIZT, VIX, VIY, VIZ, KASE, PROG, NSEQ
   27 FORMAT ( 6F10.7, 6X,A4, 2X,A4, I4)
   28 PUNCHV = .FALSE.
C           TOTAL VELOCITY MAGNITUDE        EQ. ( 136 )
C
   30 VTSQ = VIX * VIX + VIY * VIY + VIZ * VIZ
      VT = SQRT ( VTSQ)
C
C     PRESSURE COEFFICIENT  EQ. (137)
C
      CPI =  1.0  -  VTSQ
C
C     DIRECTION COSINES OF THE TOTAL VELOCITY VECTOR  EQ. (138)
      GIX = VIX / VT
      GIY = VIY / VT
      GIZ = VIZ / VT
      LC = LC +1
      IF (IS .GT. NQUAD) GO TO 50
C     TOTAL NORMAL VELOCITY   EQ.  (139)
```

C-3

```
C
      VNI = VIX * NX + VIY * NY + VIZ * NZ
      N = NST ( INSECT )
      MMAX = IABS ( NCL ( INSECT ) )
      M = M + 1
      IF( LC .LT. LCMAX) IF (M - 1) 40, 35, 40
      WRITE (6, 3000)
 3000 FORMAT ( 1H0,  4X,1H.,84X,1H. )
      CALL HEADER
      LC  = 0
      WRITE (6, 4030) FLOWID(KFLOW)
 4030 FORMAT (1H0, 45X, A2, 4HFLOW)
      WRITE(6,4000)
   35 WRITE(6, 4005) N, M, XN, VT, VIX, GIX, NX, VNI
      GO TO 45
 4015 FORMAT(1H0, 3(17X , 2( 6H****** ) ) )
 4000 FORMAT(1H0, 6X ,5HN   M,8X, 3HNPX,10X, 2HVT , 12X, 2HVX , 10X ,
     1 3HDCX, 11X, 2HNX ,10X, 2HVN  /
     21H ,19X, 3HNPY , 9X, 4HVTSQ ,11X, 2HVY ,10X, 3HDCY,11X, 2HNY,10X,
     33HSIG/
     41H ,19X, 3HNPZ ,10X, 4HCP  , 10X, 2HVZ ,10X, 3HDCZ,11X, 2HNZ     )
 4005 FORMAT(1H0,3X, 2I4 , 6F13.6)
 4010 FORMAT(1H0,7X, I4  , 6F13.6)
 4020 FORMAT( 1H , 11X, 6F13.6)
   40 WRITE(6,4010) M, XN, VT, VIX, GIX, NX, VNI
   45 WRITE(6, 4020) YN, VTSQ, VIY, GIY, NY, SIG(IS), ZN,
     1 CPI , VIZ, GIZ, NZ
      IF( M .LT. MMAX) GO TO 1000
      IF (NCL(INSECT) .GT. 0) GO TO 48
      WRITE (6, 4015)
      LC = LC + 1
   48 M = 0
      INSECT = INSECT + 1
      GO TO 1000
   50 IF ( LC .LT. LCMAX .AND. IS .NE. (NQUAD + 1))  GO TO 60
      WRITE (6, 3000)
      CALL HEADER
      LC = 0
      WRITE (6, 4030) FLOWID(KFLOW)
      WRITE (6, 55)
   55 FORMAT (1H0,6X,5HPCINT,13X,2HX ,18X,2HVT,18X,2HVX,17X,3HDCX, /,
     125X,2HY ,17X,4HVTSQ,17X,2HVY,17X,3HDCY, /,
     225X,2HZ ,18X,2HCP,18X,2HVZ,17X,3HDCZ, // )
C
C     WRITE THE OFF-BODY ANSWERS
C
   60 N = IS - NQUAD
      WRITE (6,65) N,XN,VT,VIX,GIX,YN,VTSQ,VIY,GIY,ZN,CPI,VIZ,GIZ
   65 FORMAT (1H0, I9, 4F20.6, / (10X, 4F20.6))
C
 1000 CONTINUE
      REWIND 4
      IF (NOFF .GT. 0) WRITE (6, 4015)
 2000 CONTINUE
      WRITE(6, 9999)
 9999 FORMAT( 1H1 , 5X, 14HLEAVING PRINT1)
C     RETURN
      END
```

```
*DECK,WTAP14
      SUBROUTINE WTAP14
C
C     WRITES 28 QUANTITIES ON TAPE14 FOR USE BY THE PARTICLE TRAJECTORY
C     CODES.  REVISED 3/22/77.
C
      COMMON HEDR(15),MPR,MER,IPRS,ISIG,ITER,NCFLG,NFLOW,NQUAD,
     1 KASE,NOFF,NSYM,IFLAG,IFLOW,NCODE
      COMMON /SPACER/ DUMMY (14000)
      REAL IXX,IXY,IYY,MACH
      COMMON /M/ MACH, BETA, RBETA
      DIMENSION              D41(1000),    XC(1000),YC(1000),ZC(1000),
     1 A11(1000),A12 (1000),A13 (1000),A21(1000),A22(1000),A23(1000),
     2 A31(1000),A32 (1000),A33 (1000),XI1(1000),XI2(1000),XI3(1000),
     3 XI4(1000),ETA1(1000),ETA2(1000),ETA4(1000),TSQ(1000),A(1000),
     4 IXX(1000),IXY (1000),IYY (1000),D12 (1000),D23(1000),D34(1000)
      EQUIVALENCE (DUMMY(1), D41), (DUMMY(1001), XC), (DUMMY(2001), YC),
     1  (DUMMY(3001), ZC), (DUMMY(4001),  A11), (DUMMY(5001), A12),
     2  (DUMMY(6001),  A13), (DUMMY(7001),  A21), (DUMMY(8001), A22),
     3  (DUMMY(9001), A23), (DUMMY(10001),  A31), (DUMMY(11001), A32),
     4  (DUMMY(12001), A33), (DUMMY(13001), XI1)
C
      REWIND 14
      WRITE(14) KASE,NSYM,NQUAD,RBETA, MACH
      DO 100 J=1,NQUAD
  100 READ (4) XC(J), YC (J), ZC(J), A11(J), A12(J), A13(J), A21(J),
     1 A22(J), A23(J), A31(J), A32(J), A33(J),      XI1(J),ETA1(J),XI2(
     2 J), ETA2(J), XI3(J), XI4(J), ETA4(J), TSQ(J), A (J), IXX (J),
     3 IXY (J), IYY(J), D12(J), D23(J), D34(J), D41(J)
      WRITE(14)(XC(J),YC (J), ZC(J), A11(J), A12(J), A13(J), A21(J),
     1 A22(J), A23(J), A31(J), A32(J), A33(J),      XI1(J),ETA1(J),XI2(
     2 J), ETA2(J), XI3(J), XI4(J), ETA4(J), TSQ(J), A (J), IXX (J),
     3 IXY (J), IYY(J), D12(J), D23(J), D34(J), D41(J)  ,J=1,NQUAD)
      REWIND 4
      END
```

```
      PROGRAM FLOPNT( INPUT, TAPE6, TAPE5=INPUT, TAPE14, OUTPUT)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     CALLS FLOVEL TO COMPUTE AND PRINT FLOW VELOCITIES AT SPECIFIED
C     POINTS IN SPACE.  INPUT INTEGERS M(3) SPECIFY THE ORDER IN WHICH
C     INCREMENTING IS DONE - ALLOWED VALUES OF M ARE 1,2,3.  FOR EXAMPLE
C     SUPPOSE M(1)=2, M(2)=1, M(3)=3, THEN Y IS INCREMENTED FIRST, X IS
C     INCREMENTED SECOND AND Z IS INCREMENTED LAST.
C     OTHER INPUT DATA ARE (IN ORDER OF X AXIS FIRST, Y AXIS SECOND,
C     Z AXIS THIRD)- INITIAL COORDINATE, INCREMENT, NUMBER OF INCREMENTS
C     DESIRED (INCLUDING THE INITIAL COORDINATE VALUE).
C
C     NOTE - POINTS THAT ARE INSIDE THE BODY ARE MARKED WITH AN ASTERIX
C     IN THE PRINTOUT.
C
      DIMENSION HOLL(18), X(3), D(3), N(3), M(3), SX(3), SD(3), NS(3),
     1 SXI(3), SEQ(6)
      DATA SEQ/ 4HFIRS, 4HT   , 4HSECO, 4HND  , 4HTHIR, 4HD   /
      DATA STAR, BLNK / 3H  *, 3H   /
      READ( 5, 2600) KASE
      CALL SETFLO( KASE )
      READ( 5, 1300 ) HOLL
      WRITE( 6, 1400) HOLL
    5 READ(5,1100)M
      IF(IABS(M(1))+IABS(M(2))+IABS(M(3)).EQ. 0) STOP
      IF(M(1)+M(2)+M(3) .EQ. 6) GO TO 10
      WRITE(6,1200)
      STOP
   10 DO 20 L=1,3
   20 READ(5,1000) X(L), D(L), N(L)
      WRITE( 6, 1700)
      WRITE(6,2000) X(1), D(1), N(1)
      WRITE(6,3000) X(2), D(2), N(2)
      WRITE(6,4000) X(3), D(3), N(3)
      WRITE(6,9000)
      WRITE(6,5000) SEQ(2*M(1)-1), SEQ(2*M(1))
      WRITE(6,6000) SEQ(2*M(2)-1), SEQ(2*M(2))
      WRITE(6,7000) SEQ(2*M(3)-1), SEQ(2*M(3))
      WRITE( 6, 1600 )
      DO 40 L=1,3
      LL=4-M(L)
      SD(LL)=D(L)
      SXI(LL)=X(L)-D(L)
   40 NS(LL)=N(L)
      N1=NS(1)
      N2=NS(2)
      N3=NS(3)
      SX(1)=SXI(1)
      DO 500 I=1,N1
      SX(1)=SX(1)+SD(1)
      SX(2)=SXI(2)
      DO 500 J=1,N2
      WRITE( 6,1900)
      SX(2)=SX(2)+SD(2)
      SX(3)=SXI(3)
      DO 500 K=1,N3
```

```
PROGRAM FLOPNT( INPUT, TAPE6, TAPE5=INPUT, TAPE14, OUTPUT)

H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979

CALLS FLOVEL TO COMPUTE AND PRINT FLOW VELOCITIES AT SPECIFIED
POINTS IN SPACE.  INPUT INTEGERS M(3) SPECIFY THE ORDER IN WHICH
INCREMENTING IS DONE - ALLOWED VALUES OF M ARE 1,2,3.  FOR EXAMPLE
SUPPOSE M(1)=2, M(2)=1, M(3)=3, THEN Y IS INCREMENTED FIRST, X IS
INCREMENTED SECOND AND Z IS INCREMENTED LAST.
OTHER INPUT DATA ARE (IN ORDER OF X AXIS FIRST, Y AXIS SECOND,
Z AXIS THIRD)- INITIAL COORDINATE, INCREMENT, NUMBER OF INCREMENTS
DESIRED (INCLUDING THE INITIAL COORDINATE VALUE).

NOTE - POINTS THAT ARE INSIDE THE BODY ARE MARKED WITH AN ASTERIX
IN THE PRINTOUT.

DIMENSION HOLL(18), X(3), D(3), N(3), M(3), SX(3), SD(3), NS(3),
 SXI(3), SEQ(6)
DATA SEQ/ 4HFIRS, 4HT   , 4HSECO, 4HND  , 4HTHIR, 4HD   /
DATA STAR, BLNK / 3H  *, 3H   /
READ( 5, 2600) KASE
CALL SETFLO( KASE )
READ( 5, 1300 ) HOLL
WRITE( 6, 1400) HOLL
READ(5,1100)M
IF(IABS(M(1))+IABS(M(2))+IABS(M(3)).EQ. 0) STOP
IF(M(1)+M(2)+M(3) .EQ. 6) GO TO 10
WRITE(6,1200)
STOP
DO 20 L=1,3
READ(5,1000) X(L), D(L), N(L)
WRITE( 6, 1700)
WRITE(6,2000) X(1), D(1), N(1)
WRITE(6,3000) X(2), D(2), N(2)
WRITE(6,4000) X(3), D(3), N(3)
WRITE(6,9000)
WRITE(6,5000) SEQ(2*M(1)-1), SEQ(2*M(1))
WRITE(6,6000) SEQ(2*M(2)-1), SEQ(2*M(2))
WRITE(6,7000) SEQ(2*M(3)-1), SEQ(2*M(3))
WRITE( 6, 1600 )
DO 40 L=1,3
LL=4-M(L)
SD(LL)=D(L)
SXI(LL)=X(L)-D(L)
NS(LL)=N(L)
N1=NS(1)
N2=NS(2)
N3=NS(3)
SX(1)=SXI(1)
DO 500 I=1,N1
SX(1)=SX(1)+SD(1)
SX(2)=SXI(2)
DO 500 J=1,N2
WRITE( 6,1900)
SX(2)=SX(2)+SD(2)
SX(3)=SXI(3)
DO 500 K=1,N3
```

FOLDOUT FRAME 2

```
      SX(3)=SX(3)+SD(3)
      DO 50 L=1,3
      LL=4-M(L)
   50 X(L)=SX(LL)
      CALL FLOVEL( X(1), X(2), X(3), VX, VY, VZ, 0.10, INBDY)
      V = SQRT( VX**2 + VY**2 + VZ**2 )
      IF( INBDY ) 100, 200, 100
  100 WRITE(6,1500) X(1), X(2), X(3), VX, VY, VZ, V, STAR
      GO TO 500
  200 WRITE(6,1500) X(1), X(2), X(3), VX, VY, VZ, V, BLNK
  500 CONTINUE
      WRITE( 6, 1600 )
      GO TO 5
 1000 FORMAT( 2E10.0,I4)
 1100 FORMAT(3I2)
 1200 FORMAT(///10X, 47HINCREMENTING SEQUENCE IS ERRONIOUS.  TRY AGAIN.)
 1300 FORMAT( 18A4)
 1400 FORMAT( 1H1, 9X, 15HFLOPNT RUN ID -/ 15X, 18A4//)
 1500 FORMAT( 3X, 3F12.7, 2X, 4(1PE13.4),A3)
 1600 FORMAT(1H0,20X,40H* INDICATES THE POINT IS INSIDE THE BODY)
 1700 FORMAT( 1H0, 5X, 12HINPUT DATA -/)
 1900 FORMAT(  // 10X, 1HX, 11X, 1HY, 11X, 1HZ, 13X, 2HVX, 11X, 2HVY,
     1 11X, 2HVZ, 11X, 1HV)
 2600 FORMAT( A4)
 2000 FORMAT( 10X, 10HINITIAL X=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 3000 FORMAT( 10X, 10HINITIAL Y=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 4000 FORMAT( 10X, 10HINITIAL Z=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 5000 FORMAT( 10X, 22HX AXIS IS INCREMENTED 2A4)
 6000 FORMAT( 10X, 22HY AXIS IS INCREMENTED 2A4)
 7000 FORMAT( 10X, 22HZ AXIS IS INCREMENTED 2A4)
 9000 FORMAT(1H0)
      END
```

```
*DECK,PRFUN
      FUNCTION PRFUN(R, DLR, COF)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     RETURNS THE COEFFICIENT WHICH WHEN MULTIPLIED BY FLUID VELOCITY
C     RELATIVE TO THE PARTICLE YIELDS THE PARTICLE ACCELERATION.
C
C     FOR WATER DROPS IN AIR
C
C     FOR REYNOLDS NUMBERS LARGER THAN 200 USE CDRR VS R DATA OF GUNN
C     AND KINZER FOR WATER DROPS IN AIR.   FOR SMALLER REYNOLDS NUMBERS
C     USE DATA FOR RIGID SPHERES.
C
      IF( R .LE. 200. ) GO TO 100
      PRFUN = WCDRR(R)/R/COF
      RETURN
  100 PRFUN =  CDRR(R)/R/COF
      RETURN
      END
```

```
*DECK,IMPACT
      SUBROUTINE IMPACT(YI,ZI)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES      APRIL 1979
C
C **********************************************************************
C
C     CALLED BY S.R. TRAJECT AFTER IMPACT ON THE BODY.   ADJUSTS INITIAL
C     Y AND Z COORDINATES OF PARTICLE TRAJECTORY TO AVOID FURTHER IMPACT
C
C     THE ADJUSTMENT IS CASE DEPENDENT SO THIS S.R. SHOULD BE REVISED
C     FOR EACH STUDY.
C
C **********************************************************************
C
      RETURN
      END
```

```
*DECK,PARTCL
      SUBROUTINE PARTCL(V,ELL,RHO,VIS,TEMP,DIAM,DLR,RHOP,VT,RF,PT,ACC,N)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     CALLED BY CONFAC, ARYTRJ OR TANTRA  TO READ PARTICLE SPECS. AND
C     COMPUTE GRAVITY SETTLING SPEED AND OTHER PARAMETERS.  SEE CONFAC
C
C     FOR WATER DROPS IN AIR
C
C     CALLS FALWAT TO COMPUTE SETTLING SPEED VIA BEARDS EQUATIONS.
C
C     REYNOLDS NUMBER(R)-DAVIES NUMBER(CORR) RELATIONS ARE AS FOLLOWS -
C     FOR REYNOLDS NUMBERS LARGER THAN 200 USE CORR VS R DATA OF GUNN
C     AND KINZER FOR WATER DROPS IN AIR.  FOR SMALLER REYNOLDS NUMBERS
C     USE DATA FOR RIGID SPHERES.
C
C                           GLOSSARY
C     ACC       DIAM/ELL - USED TO COMPUTE ACCELERATION MODULUS
C     DIAM      DIAMETER OF A WATER DROP
C     DLR       NOT RELEVANT TO WATER DROPS
C     ELL       CHARACTERISTIC DIMENSION OF THE BODY ( METERS )
C     PT        DRAG COEFFICIENT*ABS(REYNOLDS NUMBER) FOR GRAVITY SETTLING
C               OF PARTICLES
C     RF        FACTOR TO CONVERT VELOCITY DIFFERENCE TO REYNOLDS NUMBER
C     RHO       AIR DENSITY (SI)
C     RHOP      PARTICLE DENSITY (SI)
C     TEMP      AIR TEMPERATURE (DEG. KELVIN)
C     V         AIR SPEED (SI)
C     VIS       AIR VISCOSITY (SI)
C     VT        GRAVITY SETTLING SPEED OF PARTICLE
C
      READ (5,1100) DIAM
      IF(DIAM .NE. 0.0) GO TO 6
      N = 1
      RETURN
    6 WRITE (6,2500) DIAM
      RHOP = 1.0E3
      DLR=1.0
      RF = DIAM*RHO /VIS * 1.0E-6
      ACC = DIAM/ELL * 1.0E-6
C     COMPUTE GRAVITY SETTLING SPEED OF PART.AND PARAMETERS DERIVED
C     FROM IT
      CALL FALWAT(DIAM*1.0E-6,RHO,VIS,TEMP,287.04*RHO*TEMP,VT)
      R = RF*VT
      PT = CORR(R)/R
      IF(R .GT. 200.) PT = WCORR( R )/R
    7 WRITE(6, 3500) VT
      VT = VT/V
      RF = RF*V
      RETURN
 1100 FORMAT(7F10.0)
 2500 FORMAT( 1H1, 9X, 21HWATER DROP DIAMETER =1PE12.5,12H MICROMETERS/)
 3500 FORMAT(      20X, 24HPARTICLE SETTLING SPEED=1PE12.5, 6H M/SEC)
      END
```

```
*DECK,CONFAC
      SUBROUTINE CONFAC
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     EXECUTIVE FOR COMPUTATION OF CONCENTRATION FACTORS FOR PARTICLES
C     IN A FLOW ABOUT A 3-DIMENSIONAL BODY.  CROSS SECTIONAL AREAS OF A
C     PARTICLE FLUX TUBE ARE CALCULATED ABOUT THE POINT OF INTEREST AND
C     ABOUT A POINT FAR UPSTREAM.  CONCENTRATION FACTOR IS THE RATIO OF
C     THESE AREAS.
C     SINGLE TRAJECTORIES TO A TARGET POINT MAY BE COMPUTED (NW=0)
C     FLOW DATA PREPARED BY THE HESS-SMITH CODE ARE READ FROM UNIT 14
C     VIA SR SETF10.
C     UNIT 9 IS A SCRATCH UNIT USED FOR TRAJECTORY DATA STORAGE.
C     UNIT 10 IS USED FOR TRAJECTORY DATA OUTPUT FOR PLOTTING.
C     SR PARTCL IS CALLED TO READ, PROCESS AND PRINT PARTICLE DATA.
C     THIS SR CAN BE ONE OF SEVERAL THAT TREATS WATER DROPS OR ONE OF
C     VARIOUS TYPES OF ICE CRYSTALS.
C
C     GLOSSARY
C
C  DISTINGUISH TWO COORDINATE SYSTEMS - 1. THE FLOW SYSTEM IS THE SYSTEM
C  IN WHICH THE AIRCRAFT AND FLOW ARE DEFINED, AND 2. THE FLUX TUBE
C  SYSTEM WHICH HAS ITS Y-Z PLANE IN THE PLANE OF A FLUX TUBE CROSS
C  SECTION WITH ORIGIN AT THE FLUX TUBE CENTER.
C
C     ALL COORDINATES AND TIMES ARE NORMALIZED (DIMENSIONLESS)
C
C     ACC      DIAM/ELL - USED TO COMPUTE ACCELERATION MODULUS
C     ALPHA0   ANGLE BETWEEN PROJECTION OF INITIAL VELOCITY VECTOR IN
C              X-Y PLANE AND X AXIS
C     ALPHAR   ANGLE BETWEEN PROJECTION OF FINAL VELOCITY VECTOR IN X-Y
C              PLANE AND X AXIS
C     BETA0    ANGLE BETWEEN INITIAL VELOCITY VECTOR AND ITS PROJECTION
C              IN THE X-Y PLANE
C     BETAR    ANGLE BETWEEN FINAL VELOCITY VECTOR AND ITS PROJECTION
C              IN THE X-Y PLANE
C     CONRTO   RATIO OF PARTICLE CONCENTRATION AT TARGET POINT TO CONC.
C              AT INITIAL POINT
C     DIAM     DIAMETER OF A WATER DROP OR ICE AGGREGATE
C              BASE DIAMETER FOR A PLATE OR CYLINDER (MICROMETERS)
C     DLR      BASE DIAMETER TO LENGTH (CYLINDER) OR THICKNESS (PLATE)
C              RATIO
C     ELL      CHARACTERISTIC DIMENSION OF THE BODY ( METERS )
C     EPSI( )  PARAMETERS USED TO CONTROL LOCAL ERROR IN THE NUMERICAL
C              INTEGRATION (SEE DVDQ GLOSSARY)
C     FN       FROUDE NUMBER
C     FNR      RECIPROCAL OF THE FROUDE NUMBER
C     HI       INITIAL TIME STEP FOR NUMERICAL INTEGRATION (SEE DVDQ)
C     HMAX     MAXIMUM TIME STEP (SEE DVDQ)
C     HMIN     MINIMUM ALLOWED TIME STEP (SEE DVDQ)
C     IPLOT    IF TRUE, TRAJECTORY DATA ARE COPIED TO UNIT 10 FOR PLOTTNG
C     NW       NUMBER OF TRAJECTORIES USED TO DEFINE THE FLUX TUBE
C              PERIPHERY.  IF(NW .EQ. 0) SINGLE TRAJECTORIES ARE COMPUTED
C     P( )     CURRENT VALUES OF INDEPENDENT VARIABLES -
C                 P(1) = X
C                 P(2) = DX/DT
C                 P(3) = Y
C                 P(4) = DY/DT
C                 P(5) = Z
```

```
C               P(6) = DZ/DT
C     PACT     (SPARE)
C     PT       DRAG COEFFICIENT*ABS(REYNOLDS NUMBER) FOR GRAVITY SETTLING
C              OF PARTICLES
C     RF       FACTOR TO CONVERT VELOCITY DIFFERENCE TO REYNOLDS NUMBER
C     RHO      AIR DENSITY (KG/M**3)
C     RHOP     PARTICLE DENSITY (KG/M**3)
C     RW       RADIUS OF PARTICLE FLUX TUBE IN TARGET PLANE (NORMALIZED)
C     TEMP     AIR TEMPERATURE (DEG. KELVIN)
C     TOL      TOLERANCE FOR REACHING A POINT ON TARGET PLANE WINDOW
C              (FRACTION OF RW)
C     TPRINT   OUTPUT TIME INTERVAL
C     V        AIR SPEED (M/SEC)
C     VIS      AIR VISCOSITY (KG/(M-SEC))
C     VPGT     PARTICLE SPEED AT TARGET POINT
C     VT       GRAVITY SETTLING SPEED OF PARTICLE
C     VTGT     AIR SPEED AT TARGET POINT
C     XI3P,YI3P,ZI3P   INITIAL PLANE FLUX TUBE CENTER COORDINATES IN
C                      THE FLOW SYSTEM
C     XSTART   TRAJECTORY INITIAL X COORDINATE
C     XP,YP,ZP  TARGET POINT COORDINATES IN THE FLUX TUBE SYSTEM
C     XW,YW,ZW  COORDINATES OF CENTER OF FLUX TUBE AT THE TARGET PLANE
C               IN THE FLOW SYSTEM
C     YE(),ZE()     TARGET POINT COORDINATES OF THE LAST THREE GUESSES
C                   (FLOW SYSTEM)
C     YI(),ZI()     INITIAL POINT COORDINATES OF THE LAST THREE GUESSES
C                   (FLOW SYSTEM)
C     YPSTAR, ZPSTAR   TARGET POINT COORDINATES (FLOW SYSTEM)
C     YPSTARP, ZPSTARP   TARGET POINT COORDINATES (FLUX TUBE SYSTEM)
      COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
     1RF,REO,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHA0,BETA0,IREC,
     2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
     3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XWP,XPP,ACC,DLR,JLIM
      DIMENSION HOLL(18),XINIT(100), XEXIT(100)
      DIMENSION YINIT(100), ZINIT(100),YEXIT(100),ZEXIT(100)
       DIMENSION YI(3), ZI(3), YE(3), ZE(3)
      LOGICAL        IPLOT
      DATA PI/3.1415926536/
      NFIN=0
C                       READ AND WRITE DATA
      READ (5,2600) KASE
      CALL SETFLO(KASE)
      READ(5,1000)HOLL,          IPLOT
      READ(5,1100)V, ELL, RHO, TEMP, XSTART
      READ(5,1100) TPRINT, HI, HMINI, EPSI
C     SET DEFAULT VALUES FOR NUMERICAL INTEGRATION AND PRINT PARAMETERS
      IF(TPRINT .EQ. 0.0) TPRINT=0.1
      IF(HI .EQ. 0.0) HI=0.1
      IF(HMINI .EQ. 0.0) HMINI=0.005
      IF(EPSI(1) .EQ. 0.0) EPSI(1)=1.0E-5
      IF(EPSI(2) .EQ. 0.0) EPSI(2)=1.0E-5
      IF(EPSI(3) .EQ. 0.0) EPSI(3)=1.0E-5
      READ (5,1150) NW, RW, TOL
      JLIM=25
      IF(NW .EQ. 0) JLIM=0
      DO 3 J=2,3
    3 READ (5,1100) YE(J), ZE(J), YI(J), ZI(J)
      VIS = 145.8E-8 * TEMP**(3.0/2.0)/(110.4 + TEMP)
      WRITE(6,1200) HOLL
      WRITE(6,1300) V, ELL, RHO, TEMP, VIS
```

```
      WRITE(6,1400) HI,HMINI,TPRINT, XSTART
      WRITE(6,1500) EPSI(1), EPSI(2), EPSI(3)
      WRITE (6,1520) NW, RW, TOL
      WRITE (6,1540)
      DO 4 J=2,3
      I=J-1
    4 WRITE (6,1550) I, YE(J), ZE(J), YI(J) ,ZI(J)
C     INITIALIZE
      FN = V**2/(9.8*ELL)
      FNR = 1.0/FN
       IF (.NOT. IPLOT) GO TO 5
      REWIND 10
      WRITE (6,1800)
C     ENTER TRAJECTORY CALCULATION LOOP
    5 CALL PARTCL(V,ELL,RHC,VIS,TEMP,DIAM,DLR,RHOP,VT,RF,PT,ACC,NFIN)
      IF(NFIN .EQ. 0) GO TO 6
      IF( .NOT. IPLOT) RETURN
      ENDFILE 10
      REWIND 10
      RETURN
    6 READ(5,1100) XW, YW, ZW
      WRITE(6,3500) XW, YW, ZW
C     IF NECESSARY SET DEFAULT VALUES FOR INITIAL AND FINAL TRAJECTORY
C     POINT GUESSES
      IF(ABS(YE(2))+ABS(YE(3))+ABS(ZE(2))+ABS(ZE(3))+ABS(YI(2))+
     1 ABS(YI(3))+ABS(ZI(2))+ABS(ZI(3)) .NE. 0.0) GO TO 7
      YE(2) = YW + SIGN(1.5*RW*TOL, YW)
      ZE(2) = ZW + SIGN(1.5*RW*TOL, ZW)
      YE(3) = YW - SIGN(1.5*RW*TOL, YW)
      ZE(3) = ZW - SIGN(1.5*RW*TOL, ZW)
      YI(2) = YW
      ZI(2) = ZW
      YI(3) = YE(2)
      ZI(3) = ZE(2)
    7 COF = PT*VT*FN
      R = RF * VT
      XPSTAR = XW
      YPSTAR = YW
      ZPSTAR = ZW
      YPSTARP=YW
      ZPSTARP=ZW
      XI3P = 0.0
      YI3P = 0.0
      ZI3P = 0.0
      XWP=XSTART
      XPP = XW
      XP = 0.0
      YP = 0.0
      ZP = 0.0
      IP = 0
C
C     COMPUTE TRAJECTORY THAT PASSES THROUGH THE CENTER OF THE FLUX TUBE
C
      ALPHA0 = 0.0
      BETA0 = 0.0
      ALPHAR=0.0
      BETAR=0.0
      WRITE (6,2800) IP,XPSTAR,YPSTAR, ZPSTAR, YPSTARP, ZPSTARP
      CALL MAP (YI,ZI,TOL,RW,YE,ZE)
      IF( IT .LT. 0 ) GO TO 5
```

```
C           COMPUTE INITIAL AND FINAL TRAJECTORY ANGLES
      CALL FLOVEL(XI3,YI3,ZI3,VX,VY,VZ,HI,INBODY)
      ALPHA0 = ATAN(VY/VX) * 180./PI
      BETA0 = ATAN((VZ-VT)/SQRT(VX**2 + VY**2)) * 180./PI
      ALPHAR = ATAN(P(4)/P(2))*180./PI
      BETAR = ATAN(P(6)/SQRT(P(2)**2+P(4)**2))*180./PI
      WRITE (6,2000) ALPHA0, BETA0, ALPHAR, BETAR
      IF(NW .EQ. 0) GO TO 5
      ALPHA0 = ALPHA0*PI/180.
      BETA0 = BETA0*PI/180.
      ALPHAR = ALPHAR*PI/180.
      BETAR = BETAR*PI/180.
C     COMPUTE AIR AND PARTICLE SPEEDS AT FINAL POINT OF TRAJECTORY
      CALL FLOVEL( P(1), P(3), P(5), VX, VY, VZ, HI, INBODY)
      VTGT = SQRT( VX**2 + VY**2 + VZ**2 )
      VPGT = SQRT(P(2)**2 + P(4)**2 + P(6)**2)
      XI3P = XI3
      YI3P = YI3
      ZI3P = ZI3
      CALL TRANSFM( 0.0, YI(2) - YI3, ZI(2) - ZI3, ALPHA0, BETA0,
     1 XP, YP, ZP, 1)
      YI(2) = YP
      ZI(2) = ZP
      CALL TRANSFM(P(1) - XPSTAR, YE(2) - YPSTAR, ZE(2) - ZPSTAR,
     1 ALPHAR, BETAR, XP, YP, ZP, 1)
      YE(2) = YP
      ZE(2) = ZP
      YI(3) = 0.0
      ZI(3) = 0.0
      CALL TRANSFM(P(1) - XPSTAR, YE(3) - YPSTAR, ZE(3) - ZPSTAR,
     1 ALPHAR, BETAR, XP, YP, ZP, 1)
      YE(3) = YP
      ZE(3) = ZP
      XP = XW
      YP = YW
      ZP = ZW
      XWP=0.0
C                 LOOP FOR EACH POINT ON FLUX TUBE PERIPHERY
      DO 500  IP=1,NW
      THETA = FLOAT(IP-1)/FLOAT(NW)  *3.1415926536 *2.
C            CALCULATE TARGET  COORDINATES IN FLUX TUBE SYSTEM
      YPSTARP = RW * SIN(THETA)
      ZPSTARP = RW * COS(THETA)
        IPSTAR = IP
C           TRANSFORM TARGET COORDINATES TO FLOW SYSTEM
      CALL TRANSFM(0.0,YPSTARP, ZPSTARP, ALPHAR, BETAR,XPSTAR,YPSTAR,
     1 ZPSTAR,-1)
      XPSTAR = XW + XPSTAR
      YPSTAR = YW + YPSTAR
      ZPSTAR = ZW + ZPSTAR
C           GUESS INITIAL COORDINATES AND COMPUTE TRAJECTORY
      WRITE (6,2800) IP,XPSTAR,YPSTAR, ZPSTAR, YPSTARP, ZPSTARP
      CALL MAP (YI,ZI,TOL,RW,YE,ZE)
      IF( IT .LT. 0 ) GO TO 5
C           TRANSFORM FINAL AND INITIAL COORDINATES TO FLUX TUBE SYS.
      CALL TRANSFM (P(1) - XW , P(3) - YW  ,P(5) - ZW  ,ALPHAR,BETAR,
     1XEXIT(IP),YEXIT(IP),ZEXIT(IP),1)
      CALL TRANSFM (XI3-XI3P,YI3-YI3P,ZI3-ZI3P,ALPHA0,BETA0,XINIT(IP),
     1YINIT(IP),ZINIT(IP),1)
      IF ( ABS(XINIT(IP)) . LE . RW * TOL ) GO TO 500
```

```
      WRITE (6, 2900) XINIT(IP),XI3P
  500 CONTINUE
C     COMPUTE  FLUX TUBE CROSS SECTION AREAS IN THE INITIAL AND TARGET
C     PLANES, AND COMPUTE CONCENTRATION FACTOR, ETC.
      WRITE (6,2200) XI3P,YI3P,ZI3P,XW,YW,ZW
      DO 600  IP=1,NW
  600 WRITE (6,2300) IP, XINIT(IP), YINIT(IP), ZINIT(IP), XEXIT(IP),
     1 YEXIT(IP), ZEXIT(IP)
      CALL POLYGON (YINIT,ZINIT, NW, AREA)
      CALL POLYGON (YEXIT,ZEXIT,NW,DENOM)
      CONFAK = AREA/DENOM
      CONRTO = CONFAK / VPGT
      WRITE (6,3000) AREA, DENOM, CONFAK, XW, YW, ZW, DIAM
      WRITE(6,3400)DLR,RHOP
      WRITE( 6, 3200 ) VTGT, CONRTO
C
C
C
C     SET UP TRIAL COORDINATES FOR NEXT PARTICLE
C
      YI(3) = YI3
      ZI(3) = ZI3
      YE(3) = P(3)
      ZE(3) = P(5)
      CALL TRANSFM( 0.0, YI(2), ZI(2),  ALPHA0, BETA0, XI3,YI3, ZI3, -1)
      YI(2) = YI3 + YI3P
      ZI(2) = ZI3 + ZI3P
      CALL TRANSFM( 0.0, YE(2), ZE(2),  ALPHAR, BETAR, XI3,YI3, ZI3, -1)
      YE(2) = YI3 + YW
      ZE(2) = ZI3 + ZW
      GO TO 5
 1000 FORMAT(18A4, 7X,L1)
 1100 FORMAT(8F10.5)
 1150 FORMAT (I10,7F10.5)
 1200 FORMAT(1H1,5X,  15HCONFAC RUN ID -/ 8X, 18A4)
 1300 FORMAT(1H0, 5X, 21HPHYSICAL INPUT DATA -/7X,10HAIR SPEED=1PE13.6,
     1 3X, 37HCHARACTERISTIC DIMENSION OF THE BODY=1PE13.6/ 7X,35HDENSIT
     2Y AND TEMPERATURE OF AIR ARE 1PE13.6, 5H AND 1PE13.6,20H   AIR VIS
     3COSITY IS 1PE13.6)
 1400 FORMAT( 1H0, 5X, 29HNUMERICAL INTEGRATOR INPUTS -/ 7X, 10HTIME STE
     1P=1PE11.4, 3X, 18HMINIMUM TIME STEP=1PE11.4, 3X, 20HPRINT TIME INT
     2ERVAL=1PE11.4, 3X, 24HUPSTREAM START DISTANCE=1PE11.4)
 1500 FORMAT( 1H0, 6X, 33HLOCAL ERROR TOLERANCES FOR DVDQ -, 3(1PE14.4))
 1520 FORMAT( 1H0, 5X, 35HPARTICLE FLUX TUBE SPECIFICATIONS -/
     1          7X, 46HNUMBER OF TRAJECTORIES ON FLUX TUBE PERIPHERY=I3,
     2 3X, 27HFLUX TUBE RADIUS AT TARGET=F9.5, 3X, 10HTOLERANCE=F8.4 )
 1540 FORMAT( 1H0, 5X, 40HTARGET AND INITIAL COORDINATE ESTIMATES-/ 10X,
     1 6HJGUESS, 9X, 2HYT, 13X, 2HZT, 13X, 2HYI, 13X, 2HZI)
 1550 FORMAT( I14, 4(5X, F10.5))
 1800 FORMAT( ///6X, 51HTRAJECTORY DATA ARE WRITTEN ON UNIT 10 FOR PLOTT
     1ING//)
 2000 FORMAT( ///20X, 47HINITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
     1/ 22X,  7HALPHA0=F10.4, 5X, 6HBETA0=F10.4/ 22X, 7HALPHAR=F10.4, 5X
     2,  6HBETAR=F10.4)
 2200 FORMAT( 1H1, 35X, 44HFLUX TUBE CROSS SECTION COORDINATES IN THE -/
     1/ 28X,   13HINITIAL PLANE, 33X, 12HTARGET PLANE//
     2     8X, 2HIP,  2(9X, 2HXP, 13X, 2HYP, 13X, 2HZP, 4X)/ 4X, 6HCENTE
     3R6(1PE15.4),14H (FLOW SYSTEM))
 2300 FORMAT (I10,6(1PE15.4),19H (FLUX TUBE SYSTEM))
 2600 FORMAT (A4)
```

```
2800 FORMAT( ///    18H TRAJECTORY NUMBER,I3,5X,20HTARGET COORDINATES -
    1,10H  XPSTAR =F10.6, 4X, 8HYPSTAR =F10.6,5X, 8HZPSTAR =F10.6,
    2 14H (FLOW SYSTEM)/   70X,  8HYPSTARP=F10.6, 5X, 8HZPSTARP=F10.6,
    3 19H (FLUX TUBE SYSTEM)//
    4   15X, 6HYFINAL, 6X, 6HZFINAL,6X,10HITERATIONS,5X, 5HYINIT, 7X,
    5 5HZINIT, 7X, 25HERROR  (FLUX TUBE SYSTEM))
2900 FORMAT(// 30X,49HINITIAL POINT IS NOT IN CORRECT TRANSFORMED PLANE
    1/ 32X, 6HXINIT=1PE12.5, 5X, 5HXI3P=1PE12.5)
3000 FORMAT(// 15X, 50HFLUX TUBE CROSS SECTION AREA IN THE INITIAL PLAN
    1E=1PE12.5,  8X, 20HIN THE TARGET PLANE=1PE12.5// 15X, 21HCONCENTRA
    2TION FACTOR=0PF11.5//
    3 10X, 21HAT THE POINT (X,Y,Z)=,3F12.5/10X,27HFOR A PARTICLE OF DIA
    4METER=,F12.5)
3200 FORMAT( 10X, 36HNORMALIZED AIR SPEED AT FINAL POINT=F12.5/
    1   10X, 29HPARTICLE CONCENTRATION RATIO=F12.5)
3400 FORMAT( 1H+, 52X, 30HWITH DIAMETER TO LENGTH RATIO=1PE12.5, 3X,
    1 12HAND DENSITY=1PE12.5)
3500 FORMAT( 1H0, 9X, 22HTARGET COORDINATES  X=1PE12.5,  5X, 2HY=1PE12.
    15, 5X, 2HZ=1PE12.5)
     END
```

```
*DECK,MAP
      SUBROUTINE  MAP (YI,ZI,TOL,RW,YE,ZE)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C        MAP GUESSES THE INITIAL COORDINATES OF A TRAJECTORY THAT IS
C        AIMING FOR A POINT IN THE TARGET PLANE.  AFTER THE TRAJECTORY
C        IS COMPUTED, THE DISTANCE FROM THE TARGET IS COMPARED TO
C        THE ALLOWABLE TOLERANCE.  THE PROCESS IS REPEATED UNTIL DISTANC
C        FROM THE TARGET IS BELOW THE TOLERANCE.
C        ONCE A HISTORY OF GREATER THAN THREE TRAJECTORIES HAS BEEN
C        COMPUTED, LEAST SQUARES IS USED TO DETERMINE TRIAL INITIAL
C        COORDINATES
C              GLOSSARY
C     A        MATRIX OF COEFFICIENTS INVERTED IN MATINV
C     AA,C     INTERMEDIATE STORAGE FOR LEAST SQUARES NORMAL MATRIX TERMS
C     AC       ACCELERATION MODULUS
C     ANG      ANGLE OF DRAG VECTOR PROJECTED IN THE X-Y PLANE RELATIVE
C              TO THE X AXIS
C     B        ENTERS MATINV AS CONSTANT MATRIX AND RETURNS AS SOLUTION M
C     COSA,COSB,COSC  DIRECTION COSINES OF DRAG VECTOR
C     CNG      ANGLE OF DRAG VECTOR RELATIVE TO Z AXIS
C     DIST     DISTANCE BETWEEN END OF TRAJECTORY AND TARGET POINT
C     DV       VELOCITY OF PARTICLE RELATIVE TO AIR
C     IT       ITERATION NUMBER
C     VA       AIR SPEED AT TARGET POINT
C     VP       PARTICLE SPEED AT TARGET POINT
C     W        LEAST SQUARES SUMMAND WEIGHT
C     YE       ARRAY OF FINAL   Y COORD FOR LAST  3 GUESSES
C     YI       ARRAY OF INITIAL Y COORD FOR LAST  3 GUESSES
C     YI3      NEXT GUESS FOR INITIAL Y COORD (FLOW SYSTEM)
C     ZE       ARRAY OF FINAL   Z COORD FOR LAST  3 GUESSES
C     ZI       ARRAY OF INITIAL Z COORD FOR LAST  3 GUESSES
C     ZI3      NEXT GUESS FOR INITIAL Z COORD  (FLOW SYSTEM)
      LOGICAL IPLOT
```

```
      COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
     1RF,REO,R,XPSTAR,YPSTAR,ZFSTAR,P(6),TPRINT,IT,ALPHAO,BETAO,IREC,
     2IPLOT,IPLT,XPLOT(60),YPLCT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
     3ZPSTARP,XI3P,ZI3F,XP,YF,ZP,XWP,XPP,ACC,DLR,JLIM
      DIMENSION YI(3), ZI(3), A(4,4), B(4), YE(3), ZE(3), DY(3), DZ(3),
     1AA( 6), C(3), PSTR(3)
      DATA ILIM/ 25/
      DO 50 J=2,3
      DY(J) = YE(J) - YPSTARP
   50 DZ(J) = ZE(J) - ZPSTARP
      IT = 0
      N = 4
C                  GENERAL ITERATION CALCULATICN OF NEXT GUESS
C              GENERATE CONSTANT ARRAY (B) FOR MATINV IF IT . LE . 3
  100 DO 120 J=2,3
      I = J - 1
      B(2*I-1) = YI(J)
      B(2*I) = ZI(J)
  120 CONTINUE
C              GENERATE COEFFICIENT ARRAY (A) FOR MATINV
      DO 140 J=2,3
      I = J - 1
      JROW = 2*I-1
      JROW2 = 2*I
      A(JROW,1) = 1.
      A(JROW,2) = 0.
      A(JROW,3) = DY(J)
      A(JROW,4) = -DZ(J)
      A(JROW2,1) = 0.
      A(JROW2,2) = 1.
      A(JROW2,3) = DZ(J)
      A(JROW2,4) = DY(J)
  140 CONTINUE
      GO TO 280
C     IF IT . GE . 3 SOLVE FCR THE NEXT INITIAL COORDINATES GUESS BY
C     LEAST SQUARES
  200 CONTINUE
C
C     INCREMENT LEAST SQUARES NORMAL EQJATIONS
C
      W = 1.0
      G = DY(3) / DIST**2
      Q = DZ(3) / DIST**2
      S = G * YI(3) + Q * ZI(3)
      AA(1) = AA(1) + G**2 * W
      AA(2) = AA(2) + G * Q * W
      AA(3) = AA(3) + G * W
      AA(4) = AA(4) + Q**2 * W
      AA(5) = AA(5) + Q * W
      AA(6) = AA(6) + W
      C(1) = C(1) + G * S * W
      C(2) = C(2) + Q * S * W
      C(3) = C(3) + S * W
C
C     SET-UP LEAST SQUARES NORMAL EQUATIONS
C
  220 A(1,1) = AA(1)
      A(1,2) = AA(2)
      A(1,3) = AA(3)
      A(2,2) = AA(4)
```

```
      A(2,3) = AA(5)
      A(3,3) = AA(6)
      DO 250 I=2,3
      K = I-1
      DO 250 J=I,3
  250 A(J,K) = A(K,J)
      DO 260 I=1,3
  260 B(I) = C(I)
      DO 265 I=1,3
      A(4,I) = 0.0
  265 A(I,4) = 0.0
      A(4,4) = 1.0
      B(4) = 0.0
C                 SOLVE MATRIX EQNS TO GET NEXT GUESS
  280 CALL MATINV(A,N,B,1,DETERM)
      CALL TRANSFM(XWP,B(1),B(2),ALPHA0,BETA0,XI3,YI3,ZI3,-1)
      XI3 = XI3 + XI3P
      YI3 = YI3 + YI3P
      ZI3 = ZI3 + ZI3P
      CALL TRAJECT
      IF (IT .LT. 0) RETURN
      IT = IT + 1
C     IF (IT . GT . 3) GO TO 305
C                 UPDATE ARRAYS OF INITIAL AND FINAL COORDS.
  290 DO 300 J=1,2
      YI(J) = YI(J+1)
      ZI(J) = ZI(J+1)
      DY(J) = DY(J+1)
      DZ(J) = DZ(J+1)
      YE(J) = YE(J+1)
      ZE(J) = ZE(J+1)
      PSTR(J) = PSTR(J+1)
  300 CONTINUE
  305 CONTINUE
      YI(3) = B(1)
      ZI(3) = B(2)
      CALL TRANSFM(P(1) - XP , P(3) - YP , P(5) - ZP , ALPHAR, BETAR,
     1XDUM,YE(3),ZE(3),1)
      IF ( ABS(XP) . EQ . 0.0 ) XDUM = XDUM - XPP
      IF (ABS (XDUM) . GT . RW * TOL ) WRITE(6, 3000 )
      DY(3) = YE(3)-YPSTARP
      DZ(3) = ZE(3)-ZPSTARP
      DIST = SQRT( DY(3)**2 + DZ(3)**2 )
      PSTR(3) = DIST
C                  GUESS AGAIN OR GO ON TO NEXT POINT ON WINDOW?
      WRITE (6,2700) YE(3),ZE(3),IT,YI(3),ZI(3),DIST
      IF (DIST .LE.  RW*TOL ) GO TO 490
      IF( IT .LE. ILIM)IF( IT -  3) 100,310,200
      WRITE (6,2900) ILIM
      IT = -ILIM
      RETURN
C
C     INITIALIZE FOR LEAST SQUARES
C
  310 DO 320 I=1,3
  320 C(I) = 0.0
      DO 325 I=1,6
  325 AA(I) = 0.0
      DO 330 I = 1,3
      W = 1.0
```

```
      G = DY(I) / PSTR(I)**2
      Q = DZ(I) / PSTR(I)**2
      S = G * YI(I) + Q * ZI(I)
      AA(1) = AA(1) + G**2 * W
      AA(2) = AA(2) + G * Q * W
      AA(3) = AA(3) + G * W
      AA(4) = AA(4) + Q**2 * W
      AA(5) = AA(5) + Q * W
      AA(6) = AA(6) + W
      C(1) = C(1) + G * S * W
      C(2) = C(2) + Q * S * W
  330 C(3) = C(3) + S * W
      GO TO 100
C                           PRINT TRAJECTORY OUTPUT
  490 REWIND 9
      WRITE (6,1700)
      DO 494 IWRITE = 1,IREC
      READ (9)NEVAL,KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R,AC
      WRITE(6,1600) KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R, AC, NEVAL
  494 CONTINUE
C     COMPUTE AND PRINT DRAG VECTOR AT TARGET POINT
      DV = SQRT( (VX - P(2))**2 + (VY - P(4))**2 + (VZ - P(6))**2 )
      COSA = (VX - P(2))/DV
      COSB = (VY - P(4))/DV
      COSC = (VZ - P(6))/DV
      ANG = ATAN( COSB/COSA ) * 57.29577951
      CNG = ACOS( COSC ) * 57.29577951
      WRITE( 6, 3100 ) COSA, COSB, COSC, ANG, CNG
C     COMPUTE AND PRINT AIR AND PARTICLE SPEEDS AT TARGET POINT
      VA    = SQRT( VX**2 + VY**2 + VZ**2 )
      VP    = SQRT(P(2)**2 + P(4)**2 + P(6)**2)
      WRITE(6, 3200) VA, VP
      IF (IPLOT)  WRITE (10) IPLT, (XPLOT(J),YPLOT(J),ZPLOT(J),J=1,IPLT)
       RETURN
 1600 FORMAT(I6, 10(1X,1PE11.4)/10X,  2HH=1PE11.4,4H  R=1PE11.4, 5H  AC=
     11PE11.4, 8H  NEVAL=I6)
 1700 FORMAT( 6H0KSTEP, 7X, 1HT, 11X, 1HX, 11X, 1HY, 11X, 1HZ, 10X,
     1 3HVPX, 9X, 3HVPY, 9X, 3HVPZ, 10X, 2HVX, 10X, 2HVY, 10X, 2HVZ)
 2700 FORMAT (10X,  2E12.4,7X,I3,5X,3E12.4)
 2900 FORMAT(///20X, 28HTOLERANCE NOT SATISIFIED IN I4, 58H TRAJECTORY I
     1TERATIONS.  GIVE UP AND TRY THE NEXT PARTICLE)
 3000 FORMAT(///20X, 57HFINAL PARTICLE POSITION IS NOT IN THE ROTATED TA
     1GET PLANE)
 3100 FORMAT( 5X, 28HDRAG VECTOR AT FINAL POINT -/  6X, 18HDIRECTION COS
     1INES-3(1PE13.4), 3X, 19HANGLES A AND GAMMA-2(1PE13.4))
 3200 FORMAT(5X, 47HAIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE2(1PE
     115.5))
      END
```

```
*DECK,TRAJECT
      SUBROUTINE TRAJECT
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C              TRAJECT CALCULATES 3-D PARTICLE TRAJECTORIES
C              EMBEDDED IN A FLOW FIELD DETERMINED BY FLOVEL.
C              THE PREDICTOR-CORRECTOR SUBROUTINE DVDQ IS USED
C              TO INTEGRATE THE EQUATIONS OF MOTION.  OUTPUT AT TIME
C              INTERVAL TPRINT IS WRITTEN ON UNIT 9.
C     DRAG PARAMETERS ARE CALCULATED BY FUNCTION PRFUN WHICH IS PARTICLE
C     TYPE-SPECIFIC.   S.R.IMPACT IS A PROBLEM-SPECIFIC CODE THAT, AFTER
C     PARTICLE IMPACT ON THE BODY, ADJUSTS INITIAL PARTICLE COORDINATES
C     SUCH THAT ON THE NEXT TRIAL IMPACTION SHOULD NOT OCCUR.
C
C              GLOSSARY
C     AC       ACCELERATION MODULUS
C     DT( )    STORAGE FOR DVDQ
C     EPS( )   LOCAL ERROR TOLERANCE FOR THE NUMERICAL INTEGRATION
C     F( )     EQUATION OF MOTION OF THE PARTICLE -
C                 F(1) - X DIRECTION
C                 F(2) - Y DIRECTION
C                 F(3) - Z DIRECTION
C     G        GSTOP  FUNCTION (SEE DVDQ GLOSSARY)
C     H        TIME STEP
C     IFLAG    DVDQ STATUS FLAG (SEE DVDQ GLOSSARY)
C     INBODY   FLAG TO INDICATE WHEN TRAJECTORY HAS
C              PENETRATED THE BODY
C     KD(I)    ORDER OF THE ITH DIFFERENTIAL EQUATION
C     KQ(I)    THE HIGHEST ORDER DIFFERENCE USED IN THE INTEGRATION OF
C              THE ITH EQUATION
C     NEQ      NUMBER OF EQUATIONS
C     NG       NUMBER OF GSTOP FUNCTIONS (SEE DVDQ GLOSSARY)
C     NGE      SEE DVDQ GLOSSARY
C     P( )     CURRENT VALUE OF THE DEPENDENT VARIABLES (SEE CONFAC)
C     PN( )    STORAGE FOR DVDQ
C     R        REYNOLDS NUMBER
C     T        TIME
C     TFINAL   INTEGRATION CUT-OFF TIME
C     VX       AIR VELOCITY IN X DIRECTION
C     VY       AIR VELOCITY IN Y DIRECTION
C     VZ       AIR VELOCITY IN Z DIRECTION
      DIMENSION  F(3),EPS(3),KD(3),PN(6),KQ(3), DT(20,3)
      LOGICAL IPLOT
      COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
     1RF,RED,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHA0,BETA0,IREC,
     2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
     3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XWP,XPP,ACC,DLR,JLIM
      DATA MXSTEP,NEQ,NG,NGE/10,3,1,0/, KD/3*2/
C     INITIALIZE FOR THE NUMERICAL INTEGRATOR
      JT = 0
  100 IFLAG = 0
      TFINAL = (XPSTAR-XI3)*2.0
      HMAX = TFINAL
      A11 = COS( ALPHAR ) * COS( BETAR )
      A12 = SIN( ALPHAR ) * COS( BETAR )
      A13 = SIN( BETAR )
      T = 0.0
      EPS(1) = EPSI(1)
      EPS(2) = EPSI(2)
```

```
      EPS(3) = EPSI(3)
      H = HI
      HMIN = HMINI
      XPLOT(1) = XI3
      YPLOT(1) = YI3
      ZPLOT(1) = ZI3
      IPLT = 1
C     COMPUTE INITIAL AIR FLOW  VELOCITIES
  110 CALL FLOVEL(XI3,YI3,ZI3,VX,VY,VZ,H,INBODY)
      P(1) = XI3
      P(2) = VX
      P(3) = YI3
      P(4) = VY
      P(5) = ZI3
      P(6) = VZ - VT
  120 F(1) = 0.0
      F(2) = 0.0
      F(3) = VT*PT/COF - FNR
      G = A11*(P(1) - XPP) + A12 * (P(3) - YP) + A13 * (P(5) - ZP)
      CALL        DVDQ(NEQ,T,P,F,KD,EPS,IFLAG,H,HMIN,
     * HMAX,TPRINT,TFINAL,MXSTEP,KSTEP,KEMAX,EMAX,
     * KQ,PN,DT,NEVAL,NG,NGE,NSTOP,G,GT)
C     COMPUTE THE TRAJECTORY
      REWIND 9
      IREC = 0
      GO TO 200
  150 AC = ACC * SQRT( F(1)**2 + F(2)**2 + F(3)**2 ) * (RF/R)**2
      WRITE(9)NEVAL,KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R, AC
      IREC = IREC + 1
      IF (.NOT. IPLOT  .AND.  IFLAG .LE. 10 ) GO TO 200
      IPLT = IPLT + 1
      XPLOT(IPLT) = P(1)
      YPLOT(IPLT) = P(3)
      ZPLOT(IPLT) = P(5)
      IF( IFLAG .GT. 10 ) RETURN
  200 CALL        DVDQ(NEQ,T,P,F,KD,EPS,IFLAG,H,HMIN,
     * HMAX,TPRINT,TFINAL,MXSTEP,KSTEP,KEMAX,EMAX,
     * KQ,PN,DT,NEVAL,NG,NGE,NSTOP,G,GT)
      GO TO( 210, 210, 150, 250, 150, 220, 230, 250, 260, 260, 150,
     1  150 ), IFLAG
  210 CALL FLOVEL(P(1),P(3),P(5),VX,VY,VZ,H,INBODY)
       IF (INBODY .EQ. 0) GO TO 215
      WRITE (6,2200) P(1), P(3), P(5), YI3, ZI3, JT
      CALL IMPACT(YI3,ZI3)
      JT = JT + 1
      IF(JT.LT. JLIM) GO TO 100
      WRITE (6,2500) JLIM
      IT=-JLIM
      RETURN
  215 R = RF*SQRT((VX - P(2))**2 + (VY - P(4))**2 + (VZ - P(6))**2 )
      PR = PRFUN(R, DLR, COF)
      F(1) = (VX - P(2))*PR
      F(2) = (VY - P(4))*PR
      F(3) = (VZ - P(6))*PR - FNR
      GO TO 200
  220 EPS(KEMAX) = 32.*EMAX*EPS(KEMAX)
      WRITE(6,1900) IFLAG, KSTEP,NEVAL
      WRITE(6,2000) EPS(KEMAX), KEMAX
      GO TO 210
```

```
  230 HMIN = H
      WRITE(6,1900) IFLAG, KSTEP,NEVAL
      WRITE(6,2100) HMIN
      GO TO 200
  260 G = A11*(P(1) - XPP) + A12 * (P(3) - YP) + A13 * (P(5) - ZP)
      GO TO 200
  250 WRITE(6,1900) IFLAG, KSTEP,NEVAL
      AC = ACC * SQRT( F(1)**2 + F(2)**2 + F(3)**2 ) * (RF/R)**2
      WRITE(6,1600) KSTEP, T, F(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     1 VZ, H, R, AC
      RETURN
C
C
 1600 FORMAT(I6, 10(1X,1PE11.4)/ 10X, 2HH=1PE11.4, 4H  R=1PE11.4, 5H  AC
     1=1PE11.4)
 1900 FORMAT( 5X, 6HIFLAG=I2, 11H FOR KSTEP=I6, 8H  NEVAL=I6)
 2000 FORMAT( 1H+, 55X, 23HEPS HAS BEEN CHANGED TO1PE11.4, 11H FOR KEMAX
     1=I2)
 2100 FORMAT( 1H+, 55X, 14HHMIN IS SET TO1PE11.4)
 2200 FORMAT( 10X, 65HTHE BODY SURFACE IS PENETRATED.  PARTICLE COORDINA
     1TES ARE (X,Y,Z),3(1PE12.5)/ 10X, 43HTRIAL INITIAL COORDINATES ARE
     2(YINIT,ZINIT)2(1PE12.4), 5X, 14HATTEMPT NUMBERI4)
 2500 FORMAT(  / 15X,  5HAFTERI4, 45H ATTEMPTS PARTICLE STILL PENETRATES
     1 THE BODY.)
      END
```

```
*DECK,POLYGON
      SUBROUTINE POLYGON(XIN,YIN,N,AREA)
C
C     COMPUTES AREA OF A PLANE POLYGON WITH N VERTICES
C
      DIMENSION XIN(N), YIN(N)
      DIMENSION X(100), Y(100)
      DATA PI/3.1415926536/
C                     CALCULATE CENTER OF POLYGON
      XSUM = 0.
      YSUM = 0.
      DO 2 I=1,N
      XSUM  = XSUM  + XIN(I)
      YSUM = YSUM + YIN(I)
    2 CONTINUE
      XCEN = XSUM/FLOAT(N)
      YCEN = YSUM/FLOAT(N)
C                 REORDER POINTS IN ASCENDING VALUES OF THETA
      TPIM1 = 0.
      DO 8 IP=1,N
      THETAP = 2.*PI
      DO 4 I=1,N
      THETA = ATAN2( YIN(I)-YCEN, XIN(I)-XCEN)
      IF (THETA .LT. 0.) THETA = 2.*PI + THETA
      IF (THETA .LE. TPIM1 .OR. THETA .GT. THETAP) GO TO 4
      THETAP = THETA
      X(IP)= XIN( I)
      Y(IP) = YIN(I)
    4 CONTINUE
      TPIM1 = THETAP
```

```
    8 CONTINUE
      ASUM = 0.
      DO 40 IN=1,N
      INM1 = IN - 1
      IF (IN.EQ.1) INM1 = N
      BASE = SQRT((X(IN)-X(INM1))**2 +(Y(IN)-Y(INM1))**2)
      DENOM = X(IN) - X(INM1)
      IF (ABS(DENOM) .GT. 1.E-10) GO TO 31
      ALT = ABS(XCEN-X(INM1))
      GO TO 32
   31 SLOPE = (Y(IN)-Y(INM1))/(X(IN)-X(INM1))
      ALT = ABS(YCEN-Y(INM1)-SLOPE*(XCEN-X(INM1)))/SQRT(1.+SLOPE**2)
   32 ASUM = ASUM + ALT*BASE/2.
   40 CONTINUE
  200 AREA = ASUM
      RETURN
      END
```

```
*DECK,TRANSFM
      SUBROUTINE TRANSFM (X,Y,Z,ALPHA,BETA,XT,YT,ZT,IGO)
C
C     TRANSFORMS COORDINATES FROM THE FLOW SYSTEM TO THE PARTICLE FLUX
C     TUBE CROSS SECTION SYSTEM, OR VISE VERSA.
C     IF( IGO .GT. 0) TRANSFORM FROM FLOW TO FLUX TUBE SYSTEM
C     IF( IGO .LT. 0) TRANSFORM FROM FLUX TUBE TO FLOW SYSTEM
C
      COSA = COS(ALPHA)
      SINA = SIN(ALPHA)
       COSB = COS(BETA)
      SINB = SIN(BETA)
      IF (IGO .LT. 0) GO TO 20
      A11  = COSA*COSB
      A12 = SINA*COSB
      A13 = SINB
      A21 = -SINA
      A22 = COSA
      A23 = 0.
      A31 = -COSA*SINB
      A32 = -SINB*SINA
      A33 = COSB
      GO TO 30
C             GOING THE OTHER WAY
   20 A11= COSA*COSB
       A12 = -SINA
       A13 = -COSA*SINB
      A21 = SINA*COSB
      A22 = COSA
      A23 = -SINA*SINB
      A31 = SINB
      A32 = 0.
      A33=COSB
   30 XT = A11*X + A12*Y + A13*Z
      YT = A21*X + A22*Y + A23*Z
        ZT = A31*X + A32*Y + A33*Z
      RETURN
      END
```

```
*DECK,MATINV
      SUBROUTINE MATINV(A,N,B,M,DETERM)
C
C     MATRIX INVERSION WITH ACCOMPANYING SOLUTION OF LINEAR EQUATIONS
C
C     THIS CODE SOLVES THE MATRIX EQUATION
C               A*X=B
C     FOR X.    A IS AN N*N INPUT MATRIX.   B IS  AN N*1 INPUT VECTOR.
C     A IS REPLACED BY ITS INVERSE.   B IS REPLACED BY THE VECTOR X.
C     THE CODE CAN BE USED FOR  MATRIX INVERSION ALONE.  IN THIS MODE
C     SET M=0 IN THE INPUT.   FOR MATRIX INVERSION  PLUS LINEAR EQUATION
C     SOLUTION, SET M=1 IN THE INPUT.    THE VALUE OF THE DETERMINANT
C     OF A, DETERM, IS RETURNED FROM BOTH MODES.
C
      DIMENSION IPIVOT(30), A( N, N), B( N,1), INDEX(30,2), PIVOT(30)
      EQUIVALENCE (IROW,JROW), (ICOLUM,JCOLUM), (AMAX, T, SWAP)
C
C     INITIALIZATION
C
   10 DETERM=1.0
   15 DO 20 J=1,N
   20 IPIVOT(J)=0
   30 DO 550 I=1,N
C
C     SEARCH FOR PIVOT ELEMENT
C
   40 AMAX=0.0
   45 DO 105 J=1,N
   50 IF (IPIVOT(J)-1) 60, 105, 60
   60 DO 100 K=1,N
   70 IF (IPIVOT(K)-1) 80, 100, 740
   80 IF (ABS (AMAX)-ABS (A(J,K))) 85, 100, 100
   85 IROW=J
   90 ICOLUM=K
   95 AMAX=A(J,K)
  100 CONTINUE
  105 CONTINUE
  110 IPIVOT(ICOLUM)=IPIVOT(ICOLUM)+1
C
C     INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL
C
  130 IF (IROW-ICOLUM) 140, 260, 140
  140 DETERM=-DETERM
  150 DO 200 L=1,N
  160 SWAP=A(IROW,L)
  170 A(IROW,L)=A(ICOLUM,L)
  200 A(ICOLUM,L)=SWAP
  205 IF(M) 260, 260, 210
  210 DO 250 L=1, M
  220 SWAP=B(IROW,L)
  230 B(IROW,L)=B(ICOLUM,L)
  250 B(ICOLUM,L)=SWAP
  260 INDEX(I,1)=IROW
  270 INDEX(I,2)=ICOLUM
  310 PIVOT(I)=A(ICOLUM,ICOLUM)
  320 DETERM=DETERM*PIVOT(I)
C
C     DIVIDE PIVOT ROW BY PIVOT ELEMENT
C
  330 A(ICOLUM,ICOLUM)=1.0
```

```
  340 DO 350 L=1,N
  350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT(I)
  355 IF(M) 380, 380, 360
  360 DO 370 L=1,M
  370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT(I)
C
C     REDUCE NON-PIVOT RCWS
C
  380 DO 550 L1=1,N
  390 IF(L1-ICOLUM) 400, 550, 400
  400 T=A(L1,ICOLUM)
  420 A(L1,ICOLUM)=0.0
  430 DO 450 L=1,N
  450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T
  455 IF(M) 550, 550, 460
  460 DO 500 L=1,M
  500 B(L1,L)=B(L1,L)-B(ICCLUM,L)*T
  550 CONTINUE
C
C     INTERCHANGE COLUMNS
C
  600 DO 710 I=1,N
  610 L=N+1-I
  620 IF (INDEX(L,1)-INDEX(L,2)) 630, 710, 630
  630 JROW=INDEX(L,1)
  640 JCOLUM=INDEX(L,2)
  650 DO 705 K=1,N
  660 SWAP=A(K,JROW)
  670 A(K,JROW)=A(K,JCOLUM)
  700 A(K,JCOLUM)=SWAP
  705 CONTINUE
  710 CONTINUE
  740 RETURN
      END
```

```
*DECK,SETFLO
      SUBROUTINE SETFLO( KASE )
C     INITIALIZES FOR FLOVEL CALCULATION BY READING IN DATA PREPARED
      REAL IXX, IXY, IYY, MACH
      COMMON /VELDAT/ NSYM,  NQUAD,  I19,  I29,  LOOP,  RBETA
      COMMON/COM29/ SIG(1000), D41(1000),    XC(1000),YC(1000),ZC(1000),
     1 A11(1000),A12 (1000),A13 (1000),A21(1000),A22(1000),A23(1000),
     2 A31(1000),A32 (1000),A33 (1000),XI1(1000),XI2(1000),XI3(1000),
     3 XI4(1000),ETA1(1000),ETA2(1000),ETA4(1000),TSQ(1000),A(1000),
     4 IXX(1000),IXY (1000),IYY (1000),D12 (1000),D23(1000),D34(1000)
      REWIND 14
      READ(14) KASETP, NSYM, NQUAD, RBETA, MACH
      WRITE(6,3000)        KASE ,NSYM, NQUAD, MACH
      IF( KASE .EQ. KASETP) GO TO 100
      REWIND 14
      WRITE(6,2000) KASE, KASETP
      STOP
  100 READ (14)(XC(J),YC (J), ZC(J), A11(J), A12(J), A13(J), A21(J),
     1 A22(J), A23(J), A31(J), A32(J), A33(J),       XI1(J),ETA1(J),XI2(
     2 J), ETA2(J), XI3(J), XI4(J), ETA4(J), TSQ(J), A (J), IXX (J),
     3 IXY (J), IYY(J), D12(J), D23(J), D34(J), D41(J) ,J=1,NQUAD)
      READ(14)(SIG(I), I=1,NQUAD)
      REWIND 14
   10 IF ( NSYM - 1 ) 58, 52, 54
   52               I29 = 1
                    I19 = 2
      GO TO 60
   54              I29  = 2
      IF ( NSYM .EQ. 3 ) GO TO 56
                   I19  = 3
      GO TO 60
   56              I19  = 4
      GO TO 60
   58              I19  = 1
   60 LOOP = 2 ** NSYM + 1
      RETURN
 2000 FORMAT( 1H-, 5X, 50HTAPE AND CARD IDENTIFIERS DO NOT MATCH.  TRY A
     1GAIN/ 10X, 9HCARD ID= A4, 5X,9HTAPE ID= A4)
 3000 FORMAT( 1H1,      19HBODY IDENTIFIER IS A4, 5X, 26HNUMBER OF SYMME
     1TRY PLANES=I3, 5X, 25HNUMBER OF QUADRALATERALS=I5, 5X, 12HMACH NUM
     2BER=E12.5)
      END
```

```
*DECK,FLOVEL
      SUBROUTINE FLOVEL( XNPP, YNPP, ZNPP, VXPP, VYPP, VZPP, H, INBODY)
C     REVISED 5/11/79
C
C     GIVEN SPACE COORDINATES, XNPP,YMPP,ZNPP, POTENTIAL FLOW VELOCITY
C     COMPONENTS, VXPP,VYPP,VZPP, ARE COMPUTED AND RETURNED.
C     THE HESS-SMITH METHOD IS USED.  THE 28 QUANTITIES PLUS THE
C     SOURCE STRENGTHS, SIG(), ARE STORED IN COMMON/COM29/.
C     CONTRIBUTIONS FROM NQUAD SURFACE ELEMENTS ARE SUMMED.
C     UP TO THREE PLANES OF SYMMETRY CAN BE ACCOMODATED.
C
      REAL M12, M23, M34, M41 , IXX, IXY, IYY
      COMMON /VELDAT/ NSYM,  NQUAD,  I19,  I29,  LOOP,  RBETA
      DIMENSION                X(8),Y(8),Z(8)
      COMMON/COM29/ SIG(1000), D41(1000),     XC(1000),YC(1000),ZC(1000),
     1 A11(1000),A12 (1000),A13 (1000),A21(1000),A22(1000),A23(1000),
     2 A31(1000),A32 (1000),A33 (1000),XI1(1000),XI2(1000),XI3(1000),
     3 XI4(1000),ETA1(1000),ETA2(1000),ETA4(1000),TSQ(1000),A(1000),
     4 IXX(1000),IXY (1000),IYY (1000),D12 (1000),D23(1000),D34(1000)
      DATA RHO1SQ, RHO2SQ/ 6.0, 16.0 /
      VXPP=0.0
      VYPP=0.0
      VZPP=0.0
       INBODY = 0
      DO 2300 I1 = 1,  NQUAD
      DO 1700  I2 = 1, LOOP
      IF ( I2 .EQ. LOOP ) GO TO     ( 2000, 910, 920, 930  ),I19
      GO TO (1000, 910, 920, 910, 930, 910, 920, 910 ), I2
  910 YC ( I1 ) = - YC ( I1 )
      A12 ( I1 ) = - A12 ( I1 )
      A22 ( I1 ) = - A22 ( I1 )
      A31 ( I1 ) = - A31 ( I1 )
      A33 ( I1 ) = - A33 ( I1 )
      GO TO 932
  920 ZC ( I1 ) = - ZC ( I1 )
      A13 ( I1 ) = - A13 ( I1 )
      A23 ( I1 ) = - A23 ( I1 )
      A31 ( I1 ) = - A31 ( I1 )
      A32 ( I1 ) = - A32 ( I1 )
      GO TO 932
  930 XC ( I1 ) = - XC ( I1 )
      A11 ( I1 ) = - A11 ( I1 )
      A21 ( I1 ) = - A21 ( I1 )
      A32 ( I1 ) = - A32 ( I1 )
      A33 ( I1 ) = - A33 ( I1 )
  932 IF ( I2 .EQ. LOOP ) GO TO      (       2100, 2200    ) ,I29
 1000 XDIF = XNPP- XC ( I1 )
      YDIF = YNPP- YC ( I1 )
      ZDIF = ZNPP- ZC ( I1 )

C  COMPUTE DISTANCE FROM NULL POINT TO ORIGIN OF J-TH ELEMENT COORDINATE
C     SYSTEM  ( J CORRESPONDS TO THE INDEX I1 )

C  INEQUALITY  ( 98 )

      ROSQ = XDIF ** 2 + YDIF ** 2 + ZDIF ** 2
      IF ( ROSQ .LT. RHO2SQ * TSQ ( I1 ) ) GO TO 1400

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATION  ( 97 )
```

```
      ARG1 = A ( I1) / SQRT ( ROSQ ) ** 3
      X    ( I2) = ARG1 * XDIF
      Y    ( I2 ) = ARG1 * YDIF
      Z    ( I2 ) = ARG1 * ZDIF
      GO TO 1700

C  TRANSFORM NULL POINT TO J - ELEMENT COORDINATE SYSTEM
C  EQUATION  ( 78 )


 1400 XNP = A11 ( I1 ) * XDIF + A12 ( I1 ) * YDIF + A13 ( I1 ) * ZDIF
      YNP =  A21 ( I1 ) * XDIF + A22 ( I1) * YDIF + A23 (I1)*ZDIF
      ZNP = A31 ( I1 ) * XDIF + A32 (I1) * YDIF + A33 (I1) * ZDIF

C  INEQUALITIES  ( 99) AND ( 100 )
      IF ( ROSQ .LT. RHO1SQ * TSQ ( I1 ) ) GO TO 1410

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 57 ) - ( 62 )

      P = YNP **2    + ZNP ** 2 - 4.0 * XNP ** 2
      QP= XNP **2    + ZNP ** 2 - 4.0 * YNP ** 2
      RO = SQRT ( ROSQ )
      ROP = RO ** (- 7)
      WXXX = XNP * ( 9.0 * P + 30.0 * XNP ** 2 ) * ROP
      WXXY = 3.0 * P * ROP * YNP
      WXYY = 3.0 * XNP * QP * ROP
      WYYY = YNP * ( 9.0 * QP + 30.0 * YNP ** 2 ) * ROP
      WXXZ = 3.0 * ZNP * P * ROP
      WXYZ      = - 15.0 * XNP * YNP * ZNP * ROP
      WYYZ = 3.0 * ZNP * QP * ROP
      ROP = - RO ** ( - 3)
      WX = ROP * XNP
      WY = ROP * YNP
      WZ = ROP * ZNP
      HIXX = .5 * IXX ( I1 )
      HIYY = .5 * IYY ( I1 )
      VX = - WXYY*HIYY - WXXY*IXY( I1) - WXXX*HIXX - WX*A( I1)
      VY = - WYYY*HIYY - WXYY*IXY( I1) - WXXY*HIXX - WY*A( I1)
      VZ = - WYYZ*HIYY - WXYZ*IXY( I1) - WXXZ*HIXX - WZ*A( I1)
      GO TO 1600

C  COMPUTE INDUCED VELOCITY COMPONENTS
C  EQUATIONS  ( 42 ) - ( 49 )

C                 CHECK TO SEE IF POINT IS INSIDE BODY
 1410 GO TO ( 1300, 1310, 1300, 1310, 1300, 1310, 1300, 1310 ), I2
 1300 IF(ZNP .GT. 0.0 .OR. ROSQ .GT. 0.25*TSQ(I1) .OR. ABS(ZNP) .GT. H)
     1 GO TO 1411
      WRITE (6,5000) I1, I2, ZNP, ROSQ, TSQ(I1), H
 5000 FORMAT(10X,11HINSIDE QUADI5,5X,3HI2=I3/10X,15HZNP,ROSQ,TSQ,H=4(1PE
     113.4))
      INBODY = 1
      GO TO 1411
 1310 IF(ZNP .LT. 0.0 .OR. ROSQ .GT. 0.25*TSQ(I1) .OR. ABS(ZNP) .GT. H)
     1 GO TO 1411
      WRITE (6,5000) I1, I2, ZNP, ROSQ, TSQ(I1), H
      INBODY = 1
 1411 ETA4M3 = ETA4 ( I1) - ETA1 ( I1 )
```

```
      RO = SQRT ( ROSQ )
      ETA2M1 = ETA2 ( I1 ) - ETA1 ( I1 )
      XI4M3 = XI4 ( I1 ) - XI 3 ( I1 )
      XI2M1 = XI2 (I1 ) - XI1 ( I1 )
      XI3M2 = XI3 ( I1 ) - XI2 ( I1 )
      XI1M4 = XI1 ( I1 ) - XI4 ( I1 )
      XMXI 1 = XNP - XI1 ( I1 )
      XMXI2 = XNP - XI2 ( I1 )
      XMXI3 = XNP - XI3 ( I1 )
      XMXI4 = XNP - XI4 ( I1 )
      YMETA1= YNP -  ETA1 ( I1 )
      YMETA 2 = YNP - ETA2 ( I1 )
      YMETA 4 = YNP - ETA4 ( I1 )
        ZNPSQ = ZNP * ZNP
      IF ( ZNPSQ .LT. TSQ ( I1 ) * 1.0E-6 ) ZNPSQ = 0.0
      E1 = ZNPSQ + XMXI1 **2
      E2 = ZNPSQ + XMXI2 **2
      E3 = ZNPSQ + XMXI3 **2
      E4 = ZNPSQ + XMXI4 **2
      H1 = YMETA1 * XMXI1
      H2 = YMETA2 * XMXI2
      H3 = YMETA1 * XMXI3
      H4 = YMETA4 * XMXI4
      M12 = 0.0
      IF ( XI2M1 .NE. 0.0) M12 = ETA2M1 / XI2M1
      M23 = 0.0
      IF ( XI3M2 .NE.0.0) M23 = - ETA2M1 / XI3M2
      M34 = 0.0
      IF ( XI4M3 .NE. 0.0) M34 = ETA4M3 / XI4M3
      M41 = 0.0
      IF ( XI1M4 .NE. 0.0) M41 = - ETA4M3 / XI1M4
      ANUM1 =  M12 * E1 - H1
      ANUM2 =  M12 * E2 - H2
      ANUM3 =  M23 * E2 - H2
      ANUM4 =  M23 * E3 - H3
      ANUM5 =  M34 * E3 - H3
      ANUM6 =  M34 * E4 - H4
      ANUM7 =  M41 * E4 - H4
      ANUM8 =  M41 * E1 - H1
      R 1 = SQRT ( XMXI1  ** 2 + YMETA1 ** 2 + ZNPSQ)
      R2  = SQRT ( XMXI2  ** 2 + YMETA2 ** 2 + ZNPSQ)
      R3  = SQRT ( XMXI3  ** 2 + YMETA1 ** 2 + ZNPSQ)
      R4  = SQRT ( XMXI4  ** 2 + YMETA4 ** 2 + ZNPSQ)
      Q25 = D12 ( I1 )
      Q26 = D23 ( I1 )
      Q27 = D34 ( I1 )
      Q28 = D41 ( I1 )
      VX = 0.0
      VY = 0.0
      VZ = 0.0
      IF ( Q25 ) 1420, 1430, 1420
 1420 TEMP = R1 + R2
      TEMP1 = TEMP - Q25
      TEMP2 = TEMP + Q25
      ARG1 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG1=ALOG(TEMP1/TEMP2)
      TEMP = ARG1 / Q25
      VX = ETA2M1 * TEMP
      VY = - XI2M1 * TEMP
 1430 IF ( Q26 ) 1435, 1440, 1435
```

```
 1435 TEMP = R2 + R3
      TEMP1 = TEMP - Q26
      TEMP2 = TEMP + Q26
      ARG2 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG2=ALOG(TEMP1/TEMP2)
      TEMP = ARG2 / Q26
      VX = VX - ETA2M1 * TEMP
      VY = VY - XI3M2 * TEMP
 1440 IF ( Q27 ) 1450, 1460, 1450
 1450 TEMP = R3 + R4
      TEMP1 = TEMP - Q27
      TEMP2 = TEMP + Q27
      ARG3 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG3=ALOG(TEMP1/TEMP2)
      TEMP = ARG3 / Q27
      VX = VX + ETA4M3 * TEMP
      VY = VY - XI4M3 * TEMP
 1460 IF ( Q28 ) 1470, 1480, 1470
 1470 TEMP = R4 + R1
      TEMP1 = TEMP - Q28
      TEMP2 = TEMP + Q28
      ARG4 = 1.0
      IF ( TEMP1 .NE. 0.0 .AND. TEMP2 .NE. 0.0 ) ARG4=ALOG(TEMP1/TEMP2)
      TEMP = ARG4 / Q28
      VX = VX - ETA4M3 * TEMP
      VY = VY - XI1M4 * TEMP
 1480 IF ( ZNPSQ .NE. 0.0 ) GO TO 1510
      TEST = SQRT(TSQ(I1)* 1.0E-3)
      IF(Q25.GT.TEST) IF((XMXI1*ETA2M1-YMETA1*XI2M1)/Q25) 1600,1502,1502
 1502 IF(Q26.GT.TEST) IF((-XMXI2*ETA2M1-YMETA2*XI3M2)/Q26)1600,1504,1504
 1504 IF(Q27.GT.TEST) IF((XMXI3*ETA4M3-YMETA1*XI4M3)/Q27) 1600,1506,1506
 1506 IF(Q28.GT.TEST) IF((-XMXI4*ETA4M3-YMETA4*XI1M4)/Q28)1600,1508,1508
 1508 VZ = 6.28318531E0
      GO TO 1600
 1510 IF (XI2M1 .NE. 0.0) VZ = ATAN(ANUM1/(ZNP*R1))-ATAN(ANUM2/(ZNP*R2))
      IF (XI3M2 .NE. 0.0)VZ=VZ+ATAN(ANUM3/(ZNP*R2))-ATAN(ANUM4/(ZNP*R3))
      IF (XI4M3 .NE. 0.0)VZ=VZ+ATAN(ANUM5/(ZNP*R3))-ATAN(ANUM6/(ZNP*R4))
      IF (XI1M4 .NE. 0.0)VZ=VZ+ATAN(ANUM7/(ZNP*R4))-ATAN(ANUM8/(ZNP*R1))
C
C  TRANSFORM INDUCED VELOCITY COMPONENTS TO REFERENCE COORDINATE SYSTEM
C  EQUATION   ( 79 )

 1600 X    ( I2) = A11 (I1) * VX + A21 (I1) * VY + A31 (I1) * VZ
      Y    ( I2) = A12 (I1) * VX + A22 (I1) * VY + A32 (I1) * VZ
      Z    ( I2) = A13 (I1) * VX  + A23 (I1) * VY + A33 (I1) * VZ
 1700 CONTINUE

 2000 VXPP = VXPP + SIG(I1) * X(1)
      VYPP = VYPP + SIG(I1) * Y(1)
      VZPP = VZPP + SIG(I1) * Z(1)
      GO TO 2300
 2100 VXPP = VXPP + SIG(I1) * (X(1) + X(2))
      VYPP = VYPP + SIG(I1) * (Y(1) + Y(2))
      VZPP = VZPP + SIG(I1) * (Z(1) + Z(2))
      GO TO 2300
 2200 VXPP = VXPP + SIG(I1) * (X(1) + X(2) + X(3) + X(4))
      VYPP = VYPP + SIG(I1) * (Y(1) + Y(2) + Y(3) + Y(4))
      VZPP = VZPP + SIG(I1) * (Z(1) + Z(2) + Z(3) + Z(4))
 2204 IF ( NSYM .EQ. 2 ) GO TO 2300
      VXPP = VXPP - SIG(I1) * (X(5) + X(6) + X(7) + X(8))
```

```
      VYPP = VYPP - SIG(I1) * (Y(5) + Y(6) + Y(7) + Y(8))
      VZPP = VZPP - SIG(I1) * (Z(5) + Z(6) + Z(7) + Z(8))
 2300 CONTINUE
      VXPP = VXPP * RBETA**2 + 1.0
      VYPP = VYPP * RBETA
      VZPP = VZPP * RBETA
      RETURN
      END
```

```
*DECK,FLOAIR
      SUBROUTINE FLOAIR( X, Z, ECC, VX, VZ, PSI, IFLAG)
C     THIS CODE RETURNS AIRFLOW VELOCITY (VX, VZ) FOR A GIVEN POINT
C     (X, Z) EXTERIOR TO AN ELLIPSOID OF REVOLUTION IN AN AIRSTREAM.
C     THE ELLIPSOID IS PROLATE WITH MAJOR AXIS PARALLEL WITH THE FREE
C     STREAM FLOW.  FLOW IS TOWARD THE POSITIVE X AXIS.  PSI IS THE
C     STREAM FUNCTION VALUE AT X,Z.  ECC IS THE ELLIPSOID ECCENTRICITY.
      IF(IFLAG)100,100,200
C     INITIALIZE
  100 E2 = ECC**2
      OME2 = 1.0 - E2
      TEC = 2.0 * ECC
      CX =-ECC/( ALOG((1.0 + ECC)/(1.0 - ECC)) - TEC/OME2)
      CZ = TEC*CX
      CPSI = ECC*CX
C     COMPUTE FLOW VELOCITIES AND STREAMFUNCTION VALUE
  200 SQRM = SQRT((X + ECC)**2 + Z**2)
      SQRN = SQRT((X - ECC)**2 + Z**2)
      VX =CX*(ALOG(( SQRM + SQRN + TEC)/ (SQRM + SQRN - TEC))/ECC
     1  - 1.0/SQRM - 1.0/SQRN) + 1.0
      VZ =   CZ*Z*( 1.0/SQRM - 1.0/SQRN)/ (X**2 + Z**2 + SQRM*SQRN - E2)
      COSH = (SQRM + SQRN)/TEC
      COS  = (SQRM - SQRN)/TEC
      PSI =  CPSI*( COSH + 0.5*( COSH**2 - 1.0)*
     1  ALOG((COSH - 1.0)/( COSH + 1.0))) * ( 1.0 - COS**2) - Z**2/2.0
      RETURN
      END
```

```
*DECK,ARYTRJ
      SUBROUTINE ARYTRJ
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     CALLS TRAJECT TO COMPUTE TRAJECTORIES OF PARTICLES TO OR ABOUT
C     AN ARBITRARY 3-DIMENSIONAL BODY.  TRAJECTORIES BEGIN AT AN ARRAY
C     OF POINTS IN SPACE.  THE ARRAY POINTS, AND CORRESPONDING
C     TRAJECTORIES, ARE DEFINED BY SPECIFYING AN INITIAL POINT,INCREMENT
C     VALUES IN THE THREE  COORDINATE DIRECTIONS, AND THE ORDER OF
C     INCREMENTING.      INPUT INTEGERS M(3) SPECIFY THE ORDER IN WHICH
C     INCREMENTING IS DONE - ALLOWED VALUES OF M ARE 1,2,3.  FOR EXAMPLE
C     SUPPOSE M(1)=2, M(2)=1, M(3)=3, THEN Y IS INCREMENTED FIRST, X IS
C     INCREMENTED SECOND AND Z IS INCREMENTED LAST.
C     IF TRAJECTORIES ARE NOT DESIRED FROM ALL OF THE ARRAY POINTS, THE
C     PARAMETER NSKIP CAN BE SET GREATER THAN ZERO, AND AFTER THE FIRST
C     TRAJECTORY ONLY EVERY NSKIP+1 TH TRAJECTORY IS COMPUTED.
C     ALSO REQUIRED ARE -  (IN ORDER OF X AXIS FIRST, Y AXIS SECOND,
C     Z AXIS THIRD)- INITIAL COORDINATE, INCREMENT, NUMBER OF INCREMENTS
C     DESIRED (INCLUDING THE INITIAL COORDINATE VALUE).
C
C     SR PARTCL IS CALLED TO READ, PROCESS AND PRINT PARTICLE DATA.
C     THIS SR CAN BE ONE OF SEVERAL THAT TREATS WATER DROPS OR ONE OF
C     VARIOUS TYPES OF ICE CRYSTALS.
C
C     UNIT 9 IS A SCRATCH UNIT USED FOR TRAJECTORY DATA STORAGE.
C     UNIT 10 IS USED FOR TRAJECTORY DATA OUTPUT FOR PLOTTING.
C
C     FLOW DATA PREPARED BY THE HESS-SMITH CODE ARE READ FROM UNIT 14
C     VIA SR SETFLO.
C
C     ALL COORDINATES AND TIMES ARE NORMALIZED (DIMENSIONLESS)
C
C     GLOSSARY
C     ACC     DIAM/ELL - USED TO COMPUTE ACCELERATION MODULUS
C     ALPHAO  ANGLE BETWEEN PROJECTION OF INITIAL VELOCITY VECTOR IN
C             X-Y PLANE AND X AXIS
C     ALPHAR  ANGLE BETWEEN PROJECTION OF FINAL VELOCITY VECTOR IN X-Y
C             PLANE AND X AXIS
C     BETAO   ANGLE BETWEEN INITIAL VELOCITY VECTOR AND ITS PROJECTION
C             IN THE X-Y PLANE
C     BETAR   ANGLE BETWEEN FINAL VELOCITY VECTOR AND ITS PROJECTION
C             IN THE X-Y PLANE
C     D       COORDINATE INCREMENT ARRAY
C     DIAM    DIAMETER OF A WATER DROP OR ICE AGGREGATE
C             BASE DIAMETER FOR A PLATE OR CYLINDER (MICROMETERS)
C     DLR     BASE DIAMETER TO LENGTH (CYLINDER) OR THICKNESS (PLATE)
C             RATIO
C     ELL     CHARACTERISTIC DIMENSION OF THE BODY ( METERS )
C     EPSI( ) PARAMETERS USED TO CONTROL LOCAL ERROR IN THE NUMERICAL
C             INTEGRATION (SEE DVDQ GLOSSARY)
C     FN      FROUDE NUMBER
C     FNR     RECIPROCAL OF THE FROUDE NUMBER
C     HI      INITIAL TIME STEP FOR NUMERICAL INTEGRATION (SEE DVDQ)
C     HMAX    MAXIMUM TIME STEP (SEE DVDQ)
C     HMIN    MINIMUM ALLOWED TIME STEP (SEE DVDQ)
C     IPLOT   IF TRUE, TRAJECTORY DATA ARE COPIED TO UNIT 10 FOR PLOTTNG
C     N       NUMBER OF COORDINATE INCREMENT STEPS ARRAY (INCLUDING THE
C             FIRST COORDINATE VALUE)
C     NPOINT  ARRAY POINT TALLY
```

```
C      NSKIP   NUMBER OF ARRAY POINTS SKIPPED BETWEEN TRAJECTORIES
C      P( )    CURRENT VALUES OF INDEPENDENT VARIABLES -
C                  P(1) = X
C                  P(2) = DX/DT
C                  P(3) = Y
C                  P(4) = DY/DT
C                  P(5) = Z
C                  P(6) = DZ/DT
C      PT      DRAG COEFFICIENT*ABS(REYNOLDS NUMBER) FOR GRAVITY SETTLING
C              OF PARTICLES
C      RF      FACTOR TO CONVERT VELOCITY DIFFERENCE TO REYNOLDS NUMBER
C      RHO     AIR DENSITY (KG/M**3)
C      RHOP    PARTICLE DENSITY (KG/M**3)
C      TEMP    AIR TEMPERATURE (DEG. KELVIN)
C      TPRINT  OUTPUT TIME INTERVAL
C      V       AIR SPEED (M/SEC)
C      VIS     AIR VISCOSITY (KG/(M-SEC))
C      VPGT    PARTICLE SPEED AT TARGET POINT
C      VT      GRAVITY SETTLING SPEED OF PARTICLE
C      VTGT    AIR SPEED AT TARGET POINT
C      X       INITIAL COORDINATE ARRAY
C      XFINAL  X COORDINATE OF THE FINAL PLANE
C      XI3,YI3,ZI3  INITIAL COORDINATES PASSED TO TRAJECT
C
C
       COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
      1RF,REO,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHA0,BETA0,IREC,
      2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
      3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XWP,XPP,ACC,DLR,JLIM
       DIMENSION HOLL(18), X(3), D(3), N(3), M(3), SX(3), SD(3), NS(3),
      1 SXI(3), SEQ(6)
       LOGICAL        IPLOT
       DATA SEQ/ 4HFIRS, 4HT    , 4HSECO, 4HND  , 4HTHIR, 4HD    /
       DATA STAR, BLNK / 3H  *, 3H    / , PI/3.1415926536/
       JLIM=0
       NFIN=0
C                        READ AND WRITE DATA
       READ (5,2600) KASE
       CALL SETFLO(KASE)
       READ(5,1000)HOLL,          IPLOT
       READ(5,1100)V, ELL, RHO, TEMP, XFINAL
       READ(5,1100) TPRINT, HI, HMINI, EPSI
C      SET DEFAULT VALUES FOR NUMERICAL INTEGRATION AND PRINT PARAMETERS
       IF(TPRINT .EQ. 0.0) TPRINT=0.1
       IF(HI .EQ. 0.0) HI=0.1
       IF(HMINI .EQ. 0.0) HMINI=0.005
       IF(EPSI(1) .EQ. 0.0) EPSI(1)=1.0E-5
       IF(EPSI(2) .EQ. 0.0) EPSI(2)=1.0E-5
       IF(EPSI(3) .EQ. 0.0) EPSI(3)=1.0E-5
       VIS = 145.8E-8 * TEMP**(3.0/2.0)/(110.4 + TEMP)
       WRITE(6,1200) HOLL
       WRITE(6,1300) V, ELL, RHO, TEMP, VIS
       WRITE(6,1400) HI,HMINI,TPRINT,XFINAL
       WRITE(6,1500) EPSI(1), EPSI(2), EPSI(3)
C      INITIALIZE
       FN = V**2/(9.8*ELL)
       FNR = 1.0/FN
        IF (.NOT. IPLOT) GO TO 5
       REWIND 10
       WRITE (6,1800)
```

```
C     ENTER PARTICLE LOOP                                               ARYT 121
    5 CALL PARTCL(V,ELL,RHO,VIS,TEMP,DIAM,DLR,RHOP,VT,RF,PT,ACC,NFIN)   ARYT 122
      IF(NFIN .EQ. 0) GO TO 6                                           ARYT 123
      IF( .NOT. IPLOT) RETURN                                           ARYT 124
      ENDFILE 10                                                        ARYT 125
      REWIND 10                                                         ARYT 126
      RETURN                                                            ARYT 127
    6 COF = PT*VT*FN                                                    ARYT 128
      R = RF * VT                                                       ARYT 129
      READ(5,8100)M, NSKIP                                              ARYT 130
      IF(M(1)+M(2)+M(3) .EQ. 6) GO TO 10                                ARYT 131
      WRITE(6,8200)                                                     ARYT 132
      STOP                                                              ARYT 133
   10 DO 20 L=1,3                                                       ARYT 134
   20 READ(5,8000) X(L), D(L), N(L)                                     ARYT 135
      WRITE(6,2000) X(1), D(1), N(1)                                    ARYT 136
      WRITE(6,3000) X(2), D(2), N(2)                                    ARYT 137
      WRITE(6,4000) X(3), D(3), N(3)                                    ARYT 138
      WRITE(6,9000)                                                     ARYT 139
      WRITE(6,5000) SEQ(2*M(1)-1), SEQ(2*M(1))                          ARYT 140
      WRITE(6,6000) SEQ(2*M(2)-1), SEQ(2*M(2))                          ARYT 141
      WRITE(6,7000) SEQ(2*M(3)-1), SEQ(2*M(3))                          ARYT 142
      DO 40 L=1,3                                                       ARYT 143
      LL=4-M(L)                                                         ARYT 144
      SD(LL)=D(L)                                                       ARYT 145
      SXI(LL)=X(L)-D(L)                                                 ARYT 146
   40 NS(LL)=N(L)                                                       ARYT 147
      N1=NS(1)                                                          ARYT 148
      N2=NS(2)                                                          ARYT 149
      N3=NS(3)                                                          ARYT 150
      NPOINT=0                                                          ARYT 151
      SX(1)=SXI(1)                                                      ARYT 152
      DO 500 I=1,N1                                                     ARYT 153
      SX(1)=SX(1)+SD(1)                                                 ARYT 154
      SX(2)=SXI(2)                                                      ARYT 155
      DO 500 J=1,N2                                                     ARYT 156
      SX(2)=SX(2)+SD(2)                                                 ARYT 157
      SX(3)=SXI(3)                                                      ARYT 158
      DO 500 K=1,N3                                                     ARYT 159
      SX(3)=SX(3)+SD(3)                                                 ARYT 160
      NPOINT=NPOINT+1                                                   ARYT 161
      IF(MOD(NPOINT, NSKIP+1) .NE. 1) GO TO 500                         ARYT 162
      DO 50 L=1,3                                                       ARYT 163
      LL=4-M(L)                                                         ARYT 164
   50 X(L)=SX(LL)                                                       ARYT 165
C     INITIALIZE FOR TRAJECT                                            ARYT 166
      XI3=X(1)                                                          ARYT 167
      YI3=X(2)                                                          ARYT 168
      ZI3=X(3)                                                          ARYT 169
      XPSTAR=XFINAL                                                     ARYT 170
      XPP = XFINAL                                                      ARYT 171
      ALPHAR=0.0                                                        ARYT 172
      BETAR=0.0                                                         ARYT 173
      YP = 0.0                                                          ARYT 174
      ZP = 0.0                                                          ARYT 175
      WRITE(6,1600) XI3, YI3, ZI3                                       ARYT 176
      CALL TRAJECT                                                      ARYT 177
C                         PRINT TRAJECTORY OUTPUT                       ARYT 178
      REWIND 9                                                          ARYT 179
      WRITE (6,8700)                                                    ARYT 180
```

```
      DO 494 IWRITE = 1,IREC
      READ (9)NEVAL,KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R,AC
      WRITE(6,8600) KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R, AC, NEVAL
  494 CONTINUE
C               COMPUTE INITIAL AND FINAL TRAJECTORY ANGLES
      CALL FLOVEL(XI3,YI3,ZI3,VX,VY,VZ,HI,INBODY)
      ALPHA0 = ATAN(VY/VX) * 180./PI
      BETA0 = ATAN((VZ-VT)/SQRT(VX**2 + VY**2)) * 180./PI
      ALPHAR = ATAN(P(4)/P(2))*180./PI
      BETAR = ATAN(P(6)/SQRT(P(2)**2+P(4)**2))*180./PI
      WRITE (6,8800) ALPHA0, BETA0, ALPHAR, BETAR
C     COMPUTE AND PRINT DRAG VECTOR AT FINAL POINT
      CALL FLOVEL(P(1), P(3), P(5), VX, VY, VZ, HI, INBODY)
      DV = SQRT( (VX - P(2))**2 + (VY - P(4))**2 + (VZ - P(6))**2 )
      COSA = (VX - P(2))/DV
      COSB = (VY - P(4))/DV
      COSC = (VZ - P(6))/DV
      ANG = ATAN( COSB/COSA ) * 57.29577951
      CNG = ACOS( COSC ) * 57.29577951
      WRITE( 6, 3100 ) COSA, COSB, COSC, ANG, CNG
C     COMPUTE AND PRINT AIR AND PARTICLE SPEEDS AT FINAL POINT
      VA    = SQRT( VX**2 + VY**2 + VZ**2 )
      VP    = SQRT(P(2)**2 + P(4)**2 + P(6)**2)
      WRITE(6, 3200) VA, VP
      IF (IPLOT)  WRITE (10) IPLT, (XPLOT(L),YPLOT(L),ZPLOT(L),L=1,IPLT)
C
  500 CONTINUE
      GO TO 5
 1000 FORMAT(18A4, 7X,L1)
 1100 FORMAT(8F10.5)
 1200 FORMAT(1H1,5X, 15HARYTRJ RUN ID -/ 8X, 18A4)
 1300 FORMAT(1H0, 5X, 21HPHYSICAL INPUT DATA -/7X,10HAIR SPEED=1PE13.6,
     1 3X, 37HCHARACTERISTIC DIMENSION OF THE BODY=1PE13.6/ 7X,35HDENSIT
     2Y AND TEMPERATURE OF AIR ARE 1PE13.6, 5H AND 1PE13.6,20H   AIR VIS
     3COSITY IS 1PE13.6)
 1400 FORMAT( 1H0, 5X, 29HNUMERICAL INTEGRATOR INPUTS -/ 7X, 10HTIME STE
     1P=1PE11.4, 3X, 18HMINIMUM TIME STEP=1PE11.4, 3X, 20HPRINT TIME INT
     2ERVAL=1PE11.4, 3X, 24HX COORD. OF FINAL PLANE=1PE11.4)
 1500 FORMAT( 1H0, 6X, 33HLOCAL ERROR TOLERANCES FOR DVDQ -, 3(1PE14.4))
 1600 FORMAT(//1H0,  38H* * * * * * *  INITIAL COORDINATES  X=1PE12.5,
     2 3X, 2HY=1PE12.5, 3X, 2HZ=1PE12.5)
 1800 FORMAT( ///6X, 52HTRAJECTORY DATA ARE WRITTEN ON UNIT 10 FOR PLOT\
     1TING//)
 2000 FORMAT( 10X, 10HINITIAL X=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 2600 FORMAT (A4)
 3000 FORMAT( 10X, 10HINITIAL Y=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 3100 FORMAT(/5X, 29HDRAG VECTOR AT FINAL  POINT -/ 6X, 18HDIRECTION COS
     1INES-3(1PE13.4), 3X, 19HANGLES A AND GAMMA-2(1PE13.4))
 3200 FORMAT(5X, 47HAIR AND PARTICLE SPEEDS AT THE FINAL  POINT ARE2(1PE
     115.5))
 4000 FORMAT( 10X, 10HINITIAL Z=1PE11.4, 12H  INCREMENT=1PE11.4,
     1 19H  NUMBER OF VALUES=I4)
 5000 FORMAT( 10X, 22HX AXIS IS INCREMENTED 2A4)
 6000 FORMAT( 10X, 22HY AXIS IS INCREMENTED 2A4)
 7000 FORMAT( 10X, 22HZ AXIS IS INCREMENTED 2A4)
 8000 FORMAT( 2F10.0, I4)
```

```
 8100 FORMAT(4I4)
 8200 FORMAT(///10X, 47HINCREMENTING SEQUENCE IS ERRONIOUS.  TRY AGAIN.)
 8600 FORMAT(I6, 10(1X,1PE11.4)/10X,  2HH=1PE11.4,4H   R=1PE11.4, 5H  AC=
     11PE11.4, 8H   NEVAL=I6)
 8700 FORMAT(/6H0KSTEP, 7X, 1HT, 11X, 1HX, 11X, 1HY, 11X, 1HZ, 10X,
     1 3HVPX, 9X, 3HVPY, 9X, 3HVPZ, 10X, 2HVX, 10X, 2HVY, 10X, 2HVZ)
 8800 FORMAT(   /20X, 47HINITIAL AND FINAL TRAJECTORY ANGLES (DEGREES) -
     1/ 22X,  7HALPHA0=F10.4, 5X, 6HBETA0=F10.4/ 22X, 7HALPHAR=F10.4, 5X
     2,  6HBETAR=F10.4)
 9000 FORMAT(1H0)
      END
```

```
*DECK,TANTRA
      SUBROUTINE TANTRA
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - NOVEMBER 1979
C
C     DETERMINES TANGENT PARTICLE TRAJECTORIES TO AN ARBITRARY
C     3-DIMENSIONAL BODY.
C
C     CALLS TRAJECT TO COMPUTE TRAJECTORIES OF PARTICLES TO OR ABOUT
C     AN ARBITRARY 3-DIMENSIONAL BODY.  TRAJECTORIES BEGIN AT POINTS
C     ON A CURVE AS SPECIFIED BY  SR. STRPNT, AND THE INITIAL POINTS ARE
C     STEPPED TOWARD THE BODY USING FIRST A COARSE STEP SIZE UNTIL
C     IMPACTION OCCURS.  THEN INITIAL COORDINATES ARE BACKED-UP ONE
C     STEP, AND A FINE STEP SIZE IS USED UNTIL IMPACTION REOCCURS.
C     THE TANGENT TRAJECTORY IS TAKEN TO BE THE ONE CALCULATED
C     IMMEDIATELY PRIOR TO THE SECOND IMPACTION.  POINTS ON THE TANGENT
C     TRAJECTORY ONLY ARE STORED FOR PLOTTING LATER IF DESIRED.
C     ALL TRAJECTORIES ARE PRINTED.
C
C     SR PARTCL IS CALLED TO READ, PROCESS AND PRINT PARTICLE DATA.
C     THIS SR CAN BE ONE OF SEVERAL THAT TREATS WATER DROPS OR ONE OF
C     VARIOUS TYPES OF ICE CRYSTALS.
C
C     UNIT 9 IS A SCRATCH UNIT USED FOR TRAJECTORY DATA STORAGE.
C     UNIT 10 IS USED FOR TRAJECTORY DATA OUTPUT FOR PLOTTING.
C
C     FLOW DATA PREPARED BY THE HESS-SMITH CODE ARE READ FROM UNIT 14
C     VIA SR SETFLO.
C
C     ALL COORDINATES AND TIMES ARE NORMALIZED (DIMENSIONLESS)
C
C     GLOSSARY
C     ACC      DIAM/ELL - USED TO COMPUTE ACCELERATION MODULUS
C     ALPHAR   ANGLE BETWEEN PROJECTION OF FINAL VELOCITY VECTOR IN X-Y
C              PLANE AND X AXIS
C     BETAR    ANGLE BETWEEN FINAL VELOCITY VECTOR AND ITS PROJECTION
C              IN THE X-Y PLANE
C     DCORS    COARSE VALUE OF DEL USED FOR ROUGH DETERMINATION OF
C              TANGENT TRAJECTORY
C     DEL      CURRENT VALUE OF STEP SIZE USED IN INCREMENTING INITIAL
C              COORDINATES TOWARD THE BODY
C     DFINE    FINE VALUE OF DEL USED FOR PRECISE DETERMINATION OF
C              TANGENT TRAJECTORY
C     DIAM     DIAMETER OF A WATER DROP OR ICE AGGREGATE
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C            BASE DIAMETER FOR A PLATE OR CYLINDER (MICROMETERS)
C      DLR   BASE DIAMETER TO LENGTH (CYLINDER) OR THICKNESS (PLATE)
C            RATIO
C      ELL   CHARACTERISTIC DIMENSION OF THE BODY ( METERS )
C      EPSI( ) PARAMETERS USED TO CONTROL LOCAL ERROR IN THE NUMERICAL
C            INTEGRATION (SEE OVDQ GLOSSARY)
C      FN    FROUDE NUMBER
C      FNR   RECIPROCAL OF THE FROUDE NUMBER
C      HI    INITIAL TIME STEP FOR NUMERICAL INTEGRATION (SEE OVDQ)
C      HMAX  MAXIMUM TIME STEP (SEE OVDQ)
C      HMIN  MINIMUM ALLOWED TIME STEP (SEE OVDQ)
C      IPLOT IF TRUE, TRAJECTORY DATA ARE COPIED TO UNIT 10 FOR PLOTTNG
C      IT    WHEN RETURNED FROM TRAJECT
C            WITH A VALUE OF ZERO, INDICATES IMPACTION HAS OCCURED.
C      KT    TRAJECTORY TALLY
C      P( )  CURRENT VALUES OF INDEPENDENT VARIABLES -
C               P(1) = X
C               P(2) = DX/DT
C               P(3) = Y
C               P(4) = DY/DT
C               P(5) = Z
C               P(6) = DZ/DT
C      PT    DRAG COEFFICIENT*ABS(REYNOLDS NUMBER) FOR GRAVITY SETTLING
C            OF PARTICLES
C      RF    FACTOR TO CONVERT VELOCITY DIFFERENCE TO REYNOLDS NUMBER
C      RHO   AIR DENSITY (KG/M**3)
C      RHOP  PARTICLE DENSITY (KG/M**3)
C      TEMP  AIR TEMPERATURE (DEG. KELVIN)
C      TPRINT OUTPUT TIME INTERVAL
C      V     AIR SPEED (M/SEC)
C      VIS   AIR VISCOSITY (KG/(M-SEC))
C      VT    GRAVITY SETTLING SPEED OF PARTICLE
C      XFINAL X COORDINATE OF THE FINAL PLANE
C      XI3,YI3,ZI3  INITIAL COORDINATES PASSED TO TRAJECT
C
      COMMON XI3,YI3,ZI3,YI3P,EPSI(3),HI,HMINI,VT,PT,COF,FNR,PACT,
     1RF,RE0,R,XPSTAR,YPSTAR,ZPSTAR,P(6),TPRINT,IT,ALPHA0,BETA0,IREC,
     2IPLOT,IPLT,XPLOT(60),YPLOT(60),ZPLOT(60),ALPHAR,BETAR,YPSTARP,
     3ZPSTARP,XI3P,ZI3P,XP,YP,ZP,XWP,XPP,ACC,DLR,JLIM
      DIMENSION HOLL(18)
      LOGICAL IPLOT
      DATA SIGNAL/999999./, KTLIM/ 25/
      JLIM=0
      NFIN=0
C                          READ AND WRITE DATA
      READ (5,2600) KASE
      CALL SETFLO(KASE)
      READ(5,1000)HOLL,        IPLOT
      READ(5,1100)V, ELL, RHO, TEMP, XFINAL
      READ(5,1100) TPRINT, HI, HMINI, EPSI
C     SET DEFAULT VALUES FOR NUMERICAL INTEGRATION AND PRINT PARAMETERS
      IF(TPRINT .EQ. 0.0) TPRINT=0.1
      IF(HI .EQ. 0.0) HI=0.1
      IF(HMINI .EQ. 0.0) HMINI=0.005
      IF(EPSI(1) .EQ. 0.0) EPSI(1)=1.0E-5
      IF(EPSI(2) .EQ. 0.0) EPSI(2)=1.0E-5
      IF(EPSI(3) .EQ. 0.0) EPSI(3)=1.0E-5
      VIS = 145.8E-8 * TEMP**(3.0/2.0)/(110.4 + TEMP)
      WRITE(6,1200) HOLL
      WRITE(6,1300) V, ELL, RHO, TEMP, VIS
```

```
      WRITE(6,1400) HI,HMINI,TPRINT,XFINAL
      WRITE(6,1500) EPSI(1), EPSI(2), EPSI(3)
C     INITIALIZE
      FN = V**2/(9.8*ELL)
      FNR = 1.0/FN
       IF (.NOT. IPLOT) GO TO 5
      REWIND 10
      WRITE (6,1800)
C     ENTER PARTICLE LOOP
    5 CALL PARTCL(V,ELL,RHO,VIS,TEMP,DIAM,DLR,RHOP,VT,RF,PT,ACC,NFIN)
      IF(NFIN .EQ. 0) GO TO 6
      IF( .NOT. IPLOT) RETURN
      ENDFILE 10
      REWIND 10
      RETURN
    6 COF = PT*VT*FN
      R = RF * VT
      MFIN=0
C     SET INITIAL COORDINATES
   10 DFINE=SIGNAL
      IT=1
      KT=0
   20 CALL STRPNT(XI3, YI3, ZI3, DEL, DCORS, DFINE, MFIN)
      IF(MFIN .GT. 0) GO TO 5
      KT=KT+1
      IF(KT .GT. KTLIM) GO TO 60
      XPSTAR=XFINAL
      XPP = XFINAL
      ALPHAR=0.0
      BETAR=0.0
      YP = 0.0
      ZP = 0.0
      WRITE(6,1600) XI3, YI3, ZI3, KT
      CALL TRAJECT
C                         PRINT TRAJECTORY OUTPUT
      REWIND 9
      WRITE (6,8700)
      DO 30  IWRITE = 1,IREC
      READ (9)NEVAL,KSTEP, T, P(1), P(3) , P(5), P(2) , P(4) , P(6),VX, VY,
     2 VZ, H, R,AC
      WRITE(6,8600) KSTEP, T, P(1), P(3), P(5), P(2), P(4), P(6),VX, VY,
     2 VZ, H, R, AC, NEVAL
   30 CONTINUE
C     CHECK FOR IMPACTION AND ADJUST DEL IF NECESSARY
      IF(IT .LE. 0) GO TO 40
      IF(DEL .EQ. -DFINE) GO TO 50
      IF(DEL .NE. -DCORS) GO TO 20
      DEL=DFINE
      WRITE(6,3000)
      GO TO 20
C     IMPACTION HAS OCCURED
   40 IT=1
      IF(DEL .EQ. -DCORS) GO TO 20
      IF(DEL .EQ. DFINE) WRITE(6,4000)
      KT=KT-2
      DEL=-DEL
      GO TO 20
   50 IF( .NOT. IPLOT) GO TO 10
      IF (IPLOT)  WRITE (10) IPLT, (XPLOT(L),YPLOT(L),ZPLOT(L),L=1,IPLT)
      GO TO 10
```

```
   60 WRITE(6,2000) ITLIM
      GO TO 10
C
 1000 FORMAT(18A4, 7X,L1)
 1100 FORMAT(8F10.5)
 1200 FORMAT( 1H1, 5X, 32HTANGENT TRAJECTORY CODE RUN ID -/ 8X, 18A4)
 1300 FORMAT(1H0, 5X, 21HPHYSICAL INPUT DATA -/7X,10HAIR SPEED=1PE13.6,
     1 3X, 37HCHARACTERISTIC DIMENSION OF THE BODY=1PE13.6/ 7X,35HDENSIT
     2Y AND TEMPERATURE OF AIR ARE 1PE13.6, 5H AND 1PE13.6,20H   AIR VIS
     3COSITY IS 1PE13.6)
 1400 FORMAT( 1H0, 5X, 29HNUMERICAL INTEGRATOR INPUTS -/ 7X, 10HTIME STE
     1P=1PE11.4, 3X, 18HMINIMUM TIME STEP=1PE11.4, 3X, 20HPRINT TIME INT
     2ERVAL=1PE11.4, 3X, 24HX COORD. OF FINAL PLANE=1PE11.4)
 1500 FORMAT( 1H0, 6X, 33HLOCAL ERROR TOLERANCES FOR DVDQ -, 3(1PE14.4))
 1600 FORMAT(//1H0,  38H*   *   *   *  INITIAL COORDINATES  X=1PE12.5,
     1 3X, 2HY=1PE12.5, 3X, 2HZ=1PE12.5, 3X,  21HFOR TRAJECTORY NUMBER,
     2 I4)
 1800 FORMAT( ///6X, 51HTRAJECTORY DATA ARE WRITTEN ON UNIT 10 FOR PLOTT
     1ING//)
 2000 FORMAT(///5X, I4, 66H TRAJECTORIES HAVE BEEN COMPUTED.   GIVE UP A
     1ND TRY THE NEXT CASE.//)
 2600 FORMAT (A4)
 3000 FORMAT( //128H0* * * * * * * * * * * * * * * * * * * * * * * * * *
     1 SWITCH TO FINE STEPSIZE * * * * * * * * * * * * * * * * * * * * *
     2 * * * * */)
 8600 FORMAT(I6, 10(1X,1PE11.4)/10X,  24H=1PE11.4,4H  R=1PE11.4, 5H  AC=
     11PE11.4, 8H  NEVAL=I6)
 8700 FORMAT(/6H0KSTEP, 7X, 1HT, 11X, 1HX, 11X, 1HY, 11X, 1HZ, 10X,
     1 3HVPX, 9X, 3HVPY, 9X, 3HVPZ, 10X, 2HVX, 10X, 2HVY, 10X, 2HVZ)
 4000 FORMAT( /// 129H * * * * * * * * * * * * * * * * * * * * * * * * *
     1 TANGENT TRAJECTORY IS AS FOLLOWS * * * * * * * * * * * * * * * *
     2* * * * * * */)
      END
```

```
*DECK,STRPNT
      SUBROUTINE STRPNT( X, Y, Z, D, DCORS, DFINE, M)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - DECEMBER 1979
C
C     CALLED BY TANTRA TO DEFINE TRAJECTORY STARTING COORDINATES FOR
C     DETERMINATION OF TANGENT TRAJECTORIES OF PARTICLES TO A THREE-
C     DIMENSIONAL BODY.  THIS VERSION STARTS ALL TRAJECTORIES ON A
C     POINTS ARE STEPPED ALONG THE LINE TOWARD THE BODY USING
C     FIRST A COARSE STEP SIZE, AND AFTER IMPACTION AND BACK-UP A FINE
C     STEP SIZE UNTIL IMPACTION REOCCURS.
C
C     GLOSSARY
C     COSA,COSB,COSG   DIRECTION COSINES OF THE STARTING POINT LINE
C     D        CURRENT VALUE OF STEP SIZE USED IN INCREMENTING INITIAL
C              COORDINATES TOWARD THE BODY
C     DCORS    COARSE VALUE OF  D  USED FOR ROUGH DETERMINATION OF
C              TANGENT TRAJECTORY
C     DFINE    FINE VALUE OF  D  USED FOR PRECISE DETERMINATION OF
C              TANGENT TRAJECTORY
C     X,Y,Z    STARTING COORDINATES
C     X1,Y1,Z1  POINT USED, ALONG WITH FIRST STARTING POINT, TO DEFINE
C                THE STARTING POINT LINE
C
      DATA SIGNAL/999999./
      IF(DFINE .LT. SIGNAL) GO TO 200
COPY IN STEP SIZE INCREMENTS AND INITIALIZE FOR A NEW TANGENT LOCATION
      READ(5,1100) DCORS, DFINE
CHECK IF TRAJECTORIES FOR THIS PARTICLE SIZE ARE FINISHED
      M=0
      IF(ABS(DCORS) + ABS(DFINE) .NE. 0.0) GO TO 100
      M=1
      RETURN
COPY IN A PAIR OF POINT COORDINATES TO DEFINE THE STARTING POINT LINE.
C     THE FIRST COORDINATES SPECIFY THE START POINT FOR THE FIRST
C     TRAJECTORY, AND THE SECOND COORDINATES ARE FOR ANY POINT ON THE
C     LINE WHICH IS CLOSER TOWARD THE BODY.
  100 READ(5,1100) X, Y, Z, X1, Y1, Z1
COMPUTE DIRECTION COSINES OF THE STARTING POINT LINE
      R = SQRT((X1-X)**2 + (Y1-Y)**2 + (Z1-Z)**2)
      COSA = (X1-X)/R
      COSB = (Y1-Y)/R
      COSG = (Z1-Z)/R
      D = DCORS
      WRITE(6,1000) X, Y, Z, X1, Y1, Z1
      WRITE(6,1200) COSA, COSB, COSG
      WRITE(6,1300) DCORS, DFINE
      RETURN
COMPUTE NEXT SET OF STARTING COORDINATES
  200 X = X + D*COSA
      Y = Y + D*COSB
      Z = Z + D*COSG
      RETURN
 1000 FORMAT(/////5X,89HTRAJECTORIES ARE TO BEGIN ALONG A LINE DEFINED B
     1Y THE POINTS (X1,Y1,Z1,) AND (X2,Y2,Z2) -/  9X,2H( ,3(1PE15.5),
     2 13H )   AND   ( , 3(1PE15.5), 2H ))
 1100 FORMAT(8F10.0)
 1200 FORMAT(5X, 60HWITH DIRECTION COSINES -(COS(ALPHA),COS(BETA),COS(GA
     1MMA)) - 3(1PE15.5)/)
 1300 FORMAT( 5X, 49HSTARTING POINT INCREMENTS ARE - COARSE INCREMENT=1P
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```
     1E12.5, 3X, 15HFINE INCREMENT=1PE12.5)
      END
```

```
*DECK,FALWAT
      SUBROUTINE FALWAT(D, RHO, ETA, T, P, V)
C
C     H. G. NORMENT, ATMOSPHERIC SCIENCE ASSOCIATES - DECEMBER 1979
C
C     COMPUTES STILL-AIR, TERMINAL SETTLING SPEED OF WATER DROPS
C     ACCORDING TO THE EQUATIONS OF BEARD (JAS 33, 852(1976))
C
C     GLOSSARY (SI UNITS)
C     C         4.0*G/3.0   WHERE G IS ACCELERATION OF GRAVITY (9.8)
C     CDRR      DAVIES NUMBER
C     D         DROP DIAMETER
C     ETA       VISCOSITY
C     P         PRESSURE
C     PN        PHYSICAL PROPERTY NUMBER TO 1/6 POWER
C     RHO       FLUID DENSITY
C     RHOP      WATER DENSITY
C     SIG       WATER SURFACE TENSION
C     T         TEMPERATURE
C     V         SETTLING SPEED
C
      DATA C/13.066667/, RHOP/1000./, EX/0.16666666667/
C
COMPUTE DAVIES NUMBER
      CDRR = C*(RHOP-RHO)*RHO*D**3/ETA**2
CHECK DAVIES NUMBER VALUE FOR ROUTING
      IF(CDRR .GT. 0.3261) IF(CDRR-58249.) 100,100,200
COMPUTE VIA STOKES-LAW EQUATION
      V = CDRR*ETA/(24.0*RHO*D)
      GO TO 300
COMPUTE VIA BEARDS EQUATION FOR MEDIUM SIZE DROPS
 100  Y = ALOG(CDRR)
      V = ETA/(RHO*D)*EXP(-3.18657 + Y*(0.992696 + Y*(-0.153193E-2
     1+Y*(-0.987059E-3 + Y*(-0.578878E-3 + Y*(0.855176E-4
     2-Y*0.327815E-5))))))
      GO TO 300
COMPUTE VIA BEARDS EQUATION FOR LARGE DROPS
 200  SIG = 7.570E-2 - 1.535E-4*(T - 273.0)
      PN = (SIG**3 * RHO**2/(9.8 * (RHOP-RHO) * ETA**4))**EX
      Y = ALOG(PN*C*(RHOP- RHO) * D**2/SIG)
      V = ETA*PN/(RHO*D) * EXP(-5.00015 + Y*(5.23778 + Y*(-2.04914 +
     1 Y*(0.475294 + Y*(-0.0542819 + Y*0.00238449)))))
      RETURN
CORRECT SETTLING SPEED FOR SLIP
 300  V = V*(1.0 + 54.088*ETA*SQRT(T)/P/D)
      RETURN
      END
```

```
*DECK,WCDRR
      FUNCTION WCDRR( R )
C
C     GIVEN THE REYNOLDS NUMBER, R,  THE PRODUCT OF THE DRAG COEFFICIENT
C     AND THE THE SQUARE OF THE REYNOLDS NUMBER IS RETURNED FOR A WATER
C     DROP IN AIR.  THIS FUNCTION SHOULD BE USED ONLY FOR R .GT. 200.
C     ( SEE BEARD AND PRUPPACHER, JAS 25, 1066(1969)).
C     THE DATA OF GUNN AND KINZER, J. METEOR. 6, 243(1949), ARE USED.
C
      IF( R .GT. 200. ) GO TO 100
      WCDRR = -1.0E20
      RETURN
  100 ALGR = ALOG10( R )
      WCDRR = 10.0**( 21.38446 + ALGR * ( -28.81245 + ALGR * (
     1 16.83269 + ALGR * ( -4.152207 +  ALGR * 0.3872735 ))))
      RETURN
      END
```

```
*DECK,CDRR
      FUNCTION CDRR(R)
C
C     GIVEN THE REYNOLDS NUMBER, R, THE PRODUCT OF THE DRAG COEFFICIENT
C     AND THE SQUARE OF R IS RETURNED FOR A SPHERE.  SEE NORMENT, TO-B
C     64-102 (1 NOV. 1964).
C
      IF(R .GT. 0.05) IF(R-3.) 100,100,200
      CDRR = 24. * R
      RETURN
  100 CDRR = R*( 24.167 + R*( 3.254 - R*0.23564))
      RETURN
  200 IF(R .GT. 330.) GO TO 300
      CDRR = -28.339 + R*( 38.969 + R * (0.73204 - R * 0.56084E-3))
      RETURN
  300 CDRR = R * ( 93.462 + F * 0.37576)
      RETURN
      END
```

```
*DECK,DVDQ
      SUBROUTINE DVDQ(NEQ,T,Y,F,KD,EPS,IFLAG,H,HMIN,
     * HMAX,TPRINT,TFINAL,MXSTEP,KSTEP,KEMAX,EMAX,
     * KQ,YN,DT,NEVAL,NG,NGE,NSTOP,G,GT)
C
C
C     VARIABLE ORDER INTEGRATION SUBROUTINE
C     FOR THE SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS.
C
C     ANALYSIS AND CODING BY FRED T. KROGH,  JET PROPULSION
C     LABORATORY, PASADENA, CALIF.  APRIL 1, 1969.
C     MODIFIED BY CLEVE MOLER, UNIV. NEW MEXICO, OCT. 1972
C
C     VARIABLES IN THE CALLING SEQUENCE HAVE THE FOLLOWING
C     DIMENSIONS WHERE N=NEQ AND K=KD(1)+KD(2)+...+KD(N)
C               Y(K),F(N),KD(N),EPS(N),KQ(N),YN(K),
C               DT(20,N),G(NG),GT(NG)
C
C     PARAMETERS WHICH MUST BE ASSIGNED VALUES BEFORE THE INITIAL
C     ENTRY ARE  IFLAG, NG, NEQ, T, Y, KD, H, HMIN, HMAX,
C                TPRINT, TFINAL, MXSTEP, AND (USUALLY) EPS.
C
C     THE USER MUST ALSO PROVIDE CODE WHICH ASSIGNS
C     VALUES TO F (ONCE PER STEP INITIALLY, AND TWICE PER STEP
C     AFTER GETTING STARTED) AND EPS (EITHER INITIALLY, OR DURING
C     THE INTEGRATION IF A RELATIVE ERROR TEST IS USED).
C
C     THE FOLLOWING PARAMETERS GIVE ADDITIONAL INFORMATION ABOUT THE
C     INTEGRATION AND ARE USED FOR STORAGE. THEY SHOULD NOT BE
C     CHANGED BY THE USER.  IFLAG,KSTEP,KEMAX,EMAX,KQ,YN, AND DT.
C
C
C
C     THE USAGE OF THE VARIABLES IS GIVEN BELOW.
C
C     NEQ=NUMBER OF EQUATIONS (INPUT)
C
C     T=INDEPENDENT VARIABLE (INITIAL VALUE SUPPLIED BY THE USER)
C
C     Y(J)=CURRENT VALUE OF A DEPENDENT VARIABLE OR DERIVATIVE.
C       THE INITIAL VALUE MUST BE SPECIFIED BY THE USER BEFORE
C       THE FIRST ENTRY. THE DIMENSION OF Y MUST BE
C       AT LEAST AS GREAT AS THE SUM OF THE ORDERS OF
```

```
C         THE DIFFERENTIAL EQUATIONS WHICH ARE BEING
C         INTEGRATED.
C         THE J-TH DERIVATIVE OF THE I-TH DEPENDENT VARIABLE IS
C         STORED IN  Y(K+J+1)  WHERE  K=KD(1)+...+KD(I-1),
C         I=1,....,NEQ,  J=0,...,KD(I)-1 .
C         (FOR EXAMPLE, FOR THE SYSTEM  F(1)=UPP, F(2)=VPP, WHERE P
C         DENOTES A PRIME, Y(1)=U, Y(2)=UP, Y(3)=V, Y(4)=VP.)
C
C      F(I)=KD(I)-TH DERIVATIVE OF THE I-TH COMPONENT WITH RESPECT
C         TO T, I=1,2,...,NEQ. THE USER MUST PROVIDE
C         THE CODE WHICH COMPUTES F GIVEN Y AND T.
C
C      KD(I)=THE ORDER OF THE I-TH DIFFERENTIAL EQUATION IN
C          THE SYSTEM. KD(I) MUST BE LESS THAN OR EQUAL TO 4.
C
C      EPS(I) IS A PARAMETER USED TO CONTROL THE LOCAL ERROR.
C          THE ESTIMATED LOCAL ERROR IS KEPT LESS THAN EPS(I) IN
C          THE (KD(I)-1)-ST DERIVATIVE OF THE I-TH COMPONENT. THUS
C          FOR EQUATIONS WITH ORDER GREATER THAN ONE, THE ERROR
C          IN A DERIVATIVE IS ESTIMATED. IN THIS CASE THE VALUE OF
C          EPS(I) REQUIRED TO OBTAIN A GIVEN ACCURACY IN THE DEPENDENT
C          VARIABLE DEPENDS ON THE SCALING.
C          IF ONE WANTS A RELATIVE ERROR TEST THEN ONE SHOULD SET EPS(I)
C          WHEN IFLAG=1 .
C          IF EPS(I)=0 AND HMAX.NE.0, IFLAG IS SET EQUAL 8.
C          IF EPS(I)=0 AND HMAX=0, NO ERROR TESTS ARE PERFORMED
C          AND THE ORDER(S) AND STEPSIZE ARE NOT CHANGED.
C          THIS OPTION SHOULD NOT BE USED IF KQ(I)=1 FOR ANY I.
C
C      IFLAG IS USED FOR COMMUNICATION BETWEEN THE INTEGRATOR
C          AND THE PROGRAM WHICH CALLS IT.  TO BEGIN THE INTEGRATION THE
C          USER SHOULD SET IFLAG=0 AND CALL DVDQ.  THIS WILL CAUSE
C          INITIALIZATION OF INTERNAL VARIABLES AND A RETURN WITH
C          IFLAG=1.  AFTER THIS INITIAL ENTRY THE VALUE OF IFLAG
C          SHOULD NOT BE CHANGED BY THE USER.
C
C          THE FOLLOWING VALUES OF IFLAG HAVE THE FOLLOWING MEANINGS.
C      =0  USED TO INITIALIZE THE INTEGRATOR.
C      =1  THE VALUE OF Y FOR THE CURRENT STEP HAS BEEN
C          PREDICTED. THE USER SHOULD COMPUTE F AND CALL DVDQ AGAIN.
C          IF A RELATIVE ERROR TEST IS USED THE NEW VALUE
C          OF EPS SHOULD ALSO BE COMPUTED HERE.
C      =2  THE VALUE OF Y FOR THE CURRENT STEP HAS BEEN
C          CORRECTED. THE USER SHOULD COMPUTE F AND CALL DVDQ.
C      =3  AN OUTPUT POINT HAS BEEN REACHED (SEE DESCRIPTION
C          OF TPRINT), PRINT RESULTS AND CALL DVDQ.
C      =4  T=TFINAL     IF DVDQ IS CALLED WITH T=TFINAL AND
C          IFLAG=4, IFLAG IS SET EQUAL TO 8. IF THE VALUE OF
C          TFINAL IS CHANGED THE INTEGRATION WILL CONTINUE.
C      =5  KSTEP=KSOUT   (SEE THE DESCRIPTION OF MXSTEP).
C      =6  EMAX.GT..1 AND IT APPEARS TO THE SUBROUTINE THAT
C          REDUCING H WILL NOT HELP BECAUSE OF ROUND-OFF ERROR.
C          IF THIS OCCURS A LARGER VALUE OF   EPS(KEMAX)   SHOULD
C          PROBABLY BE USED. IF  EPS(KEMAX)  IS NOT INCREASED, TOO
C          SMALL A STEPSIZE IS LIABLE TO BE USED. (WE HAVE FOUND THAT
C          REPLACING EPS(KEMAX) WITH 32.*EMAX*EPS(KEMAX) WORKS WELL.)
C          INCREASING EPS IN THIS WAY WILL NOT DEGRADE THE ACCURACY,
C          HOWEVER IF THE NATURE OF THE PROBLEM CHANGES IT MAY PAY TO
C          USE A SMALLER VALUE OF EPS LATER IN THE INTEGRATION.
C      =7  ABS(H).LT.HMIN.  TO CONTINUE WITH THE CURRENT
```

```
C           VALUE OF H, SET HMIN.LE.ABS(H) AND CALL DVDQ.
C           IF THE INTEGRATOR HAS JUST HALVED H ONE MAY CONTINUE
C           WITH TWICE THE STEPSIZE BY SIMPLY CALLING DVDQ. (SUCH
C           AN ACTION IS RISKY WITHOUT A CAREFUL ANALYSIS OF THE
C           SITUATION.) IF THE STEPSIZE HAS NOT JUST BEEN HALVED
C           (ABS(H).LT.HMIN MAY BE DUE TO THE USER INCREASING THE
C           VALUE OF HMIN OR TO HAVING TOO SMALL AN H AT THE END
C           OF THE STARTING PHASE.) THE INTEGRATION WILL CONTINUE
C           WITH THE CURRENT VALUE OF H AND A RETURN TO THE USER WITH
C           IFLAG=7 WILL BE MADE ON EVERY STEP UNTIL ABS(H).GE.HMIN.
C       =8  ILLEGAL PARAMETER IN THE CALLING SEQUENCE. IF DVDQ
C           IS CALLED WITH IFLAG=8 THE PROGRAM IS STOPPED.
C
C       H=CURRENT VALUE OF THE STEPSIZE. IN SELECTING THE INITIAL
C         VALUE FOR H, THE USER SHOULD REMEMBER THE FOLLOWING--
C        1. THE INTEGRATOR IS CAPABLE OF CHANGING H QUITE QUICKLY AND
C           THUS THE INITIAL CHOICE IS NOT CRITICAL.
C        2. IF IT DOES NOT LEAD TO PROBLEMS IN COMPUTING THE DERIVATIVES
C           (E.G. BECAUSE OF OVERFLOW OR TRYING TO EXTRACT THE SQUARE.
C           ROOT OF A NEGATIVE NUMBER), IT IS BETTER TO CHOOSE H MUCH
C           TOO LARGE THAN MUCH TOO SMALL.
C        3. IF H*TPRINT.LE.0 INITIALLY, AN IMMEDIATE RETURN IS MADE
C           WITH IFLAG=8. THE SIGN OF H IS WHAT DETERMINES THE
C           DIRECTION OF INTEGRATION.
C        4. IF TPRINT=H*(2**K) K A NONNEGATIVE INTEGER THEN OUTPUT
C           VALUES WILL BE OBTAINED WITHOUT DOING AN INTERPOLATION.
C
C       HMIN   AFTER GETTING STARTED, AND WHENEVER H
C               IS HALVED, ABS(H) IS COMPARED WITH HMIN.
C               IF ABS(H).LT.HMIN CONTROL IS RETURNED TO
C               THE USER WITH IFLAG=7.
C
C       HMAX   THE STEPSIZE IS NOT DOUBLED IF
C               DOING SO WOULD MAKE ABS(H).GT.HMAX
C
C       TPRINT  ENABLES THE USER TO SPECIFY THE POINTS WHERE
C         OUTPUT IS DESIRED. LET TOUT=TPRINT + THE VALUE OF T THE LAST
C         TIME CONTROL WAS RETURNED TO THE USER WITH IFLAG=3. (INITIALLY
C         TOUT=THE INITIAL VALUE OF T.) CONTROL IS RETURNED TO THE
C         USER WITH IFLAG=3 WHENEVER T=TOUT. IF TOUT DOES NOT FALL
C         ON AN INTEGRATION STEP, OUTPUT VALUES ARE OBTAINED BY
C         INTERPOLATION ON THE FIRST STEP THAT (T-TOUT)*H.GT.0.
C         INTERPOLATED VALUES FOR BOTH Y AND F ARE COMPUTED.
C         (NOTE THAT A RETURN WITH IFLAG=3 IS ALWAYS MADE
C         BEFORE TAKING THE FIRST STEP.)
C
C       TFINAL   CONTROL IS RETURNED TO THE USER WITH IFLAG=4 WHEN
C         T REACHES TFINAL. IF TFINAL DOES NOT FALL ON AN INTEGRATION
C         STEP VALUES AT TFINAL ARE OBTAINED BY EXTRAPOLATION.
C
C       MXSTEP   ON THE INITIAL ENTRY, AND ON ENTRIES
C         WITH  2.LT.IFLAG.LT.6  KSOUT IS SET EQUAL TO
C         KSTEP+MXSTEP. AT THE END OF EACH STEP KSTEP IS INCREMENTED
C         AND COMPARED WITH KSOUT. IF KSTEP.GE.KSOUT CONTROL IS
C         RETURNED TO THE USER WITH IFLAG=5. (THUS IF TPRINT IS
C         SUFFICIENTLY LARGE, CONTROL WILL BE RETURNED TO THE USER
C         WITH IFLAG=5 EVERY MXSTEP STEPS.)
C
C       KSTEP=NUMBER OF INTEGRATION STEPS TAKEN (COMPUTED
C         BY THE INTEGRATOR.)
```

```
C
C     KEMAX=INDEX OF COMPONENT RESPONSIBLE FOR THE
C           VALUE OF EMAX (SEE BELOW).
C
C     EMAX=LARGEST VALUE IN ANY COMPONENT OF (ESTIMATED ERROR)/EPS(I)
C       ORDINARILY THE STEPSIZE IS HALVED IF EMAX.GT..1. WITH A
C       RECENT HISTORY OF LOCAL ROUND-OFF PROBLEMS VALUES OF EMAX AS
C       LARGE AS 1 ARE PERMITTED. THE STEPSIZE IS NOT HALVED ON ANY
C       STEP THAT ROUND OFF ERROR APPEARS TO BE LIMITING THE PRECISION.
C
C     KQ(I)=HIGHEST ORDER DIFFERENCE USED IN INTEGRATING
C       THE I-TH EQUATION. (COMPUTED BY THE INTEGRATOR)
C
C     YN=A VECTOR WITH THE DIMENSION OF Y USED TO STORE
C       THE VALUE OF Y AT THE END OF EACH INTEGRATION STEP.
C
C     DT=AN ARRAY WITH DIMENSION DT(20,NEQ) USED TO
C       STORE THE DIFFERENCE TABLE.
C
C     NEVAL=NUMBER OF TIMES F IS EVALUATED (= NUMBER OF
C       RETURNS MADE WITH IFLAG=1 OR 2).  (COMPUTED BY DVDQ.)
C
C     NG MUST BE SET = 0 BY THE USER IF THE GSTOP FEATURE IS
C       NOT USED.  OTHERWISE SEE BELOW.
C
C
C     A GSTOP IS DEFINED AS A RETURN WHICH IS MADE TO THE USER WHEN A
C     USER SPECIFIED FUNCTION G PASSES THROUGH ZERO. THE USER MAY
C     SPECIFY ANY NUMBER OF FUNCTIONS G OF TWO TYPES. ZEROS OF THE FIRST
C     TYPE ARE LOCATED WITHOUT REQUIRING A DERIVATIVE EVALUATION
C     BEYOND THE ZERO. THIS TYPE OF GSTOP REQUIRES THAT G BE EVALUATED
C     BEFORE EACH DERIVATIVE EVALUATION. ZEROS OF THE SECOND TYPE ARE
C     LOCATED USING INTERPOLATION, WHICH IS MORE ACCURATE THAN THE
C     EXTRAPOLATION USED IN THE PRECEDING CASE AND ONLY REQUIRES ONE
C     EVALUATION OF G PER STEP. THUS ONE SHOULD USE THE SECOND TYPE OF
C     GSTOP IF POSSIBLE. USERS NOT USING THE GSTOP FEATURE NEED READ
C     NO FURTHER.
C
C     THE GSTOP FEATURE IS INVOKED BY USING A NONZERO VALUE OF  NG .
C     IT IS TURNED OFF BY SETTING NG=0 .  IT IS NOT NECESSARY TO
C     MAKE SEPARATE CALLS TO DVDQ TO DO THIS.
C
C     NG=   THE NUMBER OF COMPONENTS IN G TO BE EXAMINED FOR A ZERO.
C
C     NGE=THE NUMBER OF COMPONENTS OF G THAT MUST BE EXAMINED FOR
C           A ZERO BEFORE COMPUTING THE DERIVATIVES (FIRST TYPE OF
C           GSTOP). IF NGE.LT.0 OR NGE.GT.NG, IFLAG IS SET
C           EQUAL 8 AND AN IMMEDIATE RETURN IS MADE. IF NGE.GT.0,
C           G(1),G(2),...,G(NGE) ARE EXAMINED FOR A ZERO BEFORE EACH
C           DERIVATIVE EVALUATION, THE REMAINING COMPONENTS (IF ANY)
C           ARE EXAMINED AT THE END OF EACH STEP.
C
C     NSTOP= THE COMPONENT OF G RESPONSIBLE FOR A GSTOP (COMPUTED BY
C            THE INTEGRATOR).
C
C     G=    A VECTOR CONTAINING THE CURRENT VALUES OF THE FUNCTIONS
C           WHOSE ZEROS ARE TO BE DETERMINED.
C
C     GT=   A VECTOR WITH THE SAME DIMENSION AS G USED BY THE
C           SUBROUTINE FOR TEMPORARY STORAGE.
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C
C     RETURNS FROM CALLING DVDQ WITH IFLAG.GT.8 SHOULD BE INTERPETED
C     AS FOLLOWS.
C     IFLAG
C     = 9 COMPUTE G(NGE+1),....,G(NG) (THE COMPONENTS OF G WITH
C         ZEROS TO BE LOCATED USING INTERPOLATION). THEN CALL DVDQ.
C         NO RETURN IS MADE WITH IFLAG=9 IF NGE=NG.
C     =10 COMPUTE G(1),G(2),....,G(NGE) (THE COMPONENTS OF G WITH
C         ZEROS TO BE LOCATED USING EXTRAPOLATION). THEN CALL DVDQ.
C         NO RETURN IS MADE WITH IFLAG=10 IF NGE=0.
C     =11 A GSTOP HAS BEEN FOUND.  G(NSTOP)=0.  PRINT RESULTS. IF THEIR
C         ARE NO DISCONTINUITIES CALL DVDQ TO CONTINUE THE INTEGRATION.
C     =12 G(NSTOP) CHANGES SIGN, BUT THERE IS DIFFICULTY IN CONVERGING
C         TO A ZERO. THE USER MAY WISH TO MAKE A SPECIAL CHECK TO BE
C         CERTAIN THAT EVERYTHING IS ALL RIGHT. TO CONTINUE THE
C         INTEGRATION CALL DVDQ.
C
C
C     SUBROUTINE DVDQ(NEQ,T,Y,F,KD,EPS,IFLAG,H,HMIN,
C    * HMAX,TPRINT,TFINAL,MXSTEP,KSTEP,KEMAX,EMAX,
C    * KQ,YN,DT,NEVAL,NG,NGE,NSTOP,G,GT)
      INTEGER  NEQ,KD,IFLAG,MXSTEP,KSTEP,KEMAX,KQ,NEVAL,NG,NGE,NSTOP
      REAL  T,Y,F,EPS,H,HMIN,HMAX,TPRINT,TFINAL,EMAX,
     2    YN,DT,G,GT
      DIMENSION Y(1),F(1),YN(1),DT(20,1),KD(1),KQ(1),EPS(1),G(1),GT(1)
      INTEGER  IB,IFL,IFLG,IFLS,IFLGS,IGK,IGKM,KBIT2,KDMAX,KDD,KDC,
     2    LDOUB,LFD,LGSS,LGSL,LGSE,NE,NGA,IM1,KK,JM2,KMAXO,KM,KMD,KM1,
     3    KQMAX,KQM,KQQ,KQ1,KQQ2,LRND,JS,KSOUT,LSC,LSTC,NV,I,J,K,L
      REAL  FAC,GAM,GAS,DD,EIGHTH,GI,HH,EPSGS,ERRMX,ERND,
     2    TWO,FRND,RG,ETA,TG,ONEP1,RND,RNDC,RQMAX,TL,E2HAVE,
     3    E2HMAX,E2HFAC,E2H,TOLT,PT,TP,PTS1,PTS2,PTS3,PTS4,PTS5,TPS1,
     4    TPD,TPD1,TPS3,TPS5,TPS4,TPS2,TPS6,TPD2,D,P01,P075,E,P1,
     5    P25,P5,P75,S,ABS,AMOD,AMIN1,AMAX1,SIGN
      DIMENSION GAM(20,4),GAS(20),ETA(18,18)
      DIMENSION DD(26),D(25),PT(21),FAC(3),GI(2),RG(3)
      EQUIVALENCE (DD(2),D(1))
      DATA KBIT2 /0/
C
C
C     CHECK IFLAG
C
      IF (IFLAG) 1190, 10, 60
C
C     CHECK TO INITIALIZE CONSTANTS
C
   10 IF (KBIT2) 50,12,50
C
C     DETERMINE MACHINE PRECISION
C
   12 RND=1.
   14 RND=RND/2.
      KBIT2=KBIT2+1
      IF(1.+RND .GT. 1.) GO TO 14
      RND=8.*RND
      KQMAX=0.3*FLOAT(KBIT2+1)
      IF(KQMAX.GT.19) KQMAX=19
      KBIT2=2*KBIT2+2
C
C     KQMAX GIVES THE MAXIMUM ORDER OF POLYNOMIAL APPROXIMATION USED.
C     THERE IS LITTLE POINT IN HAVING KQMAX MUCH BIGGER THAN THE NUMBER
```

```
C     . OF DECIMAL DIGITS IN THE MANTISSA.
C
C       RND IS APPROXIMATELY 2**(3-B) WHERE B IS
C       THE NUMBER OF BITS IN THE MANTISSA.
C       KBIT2=2*B+2 WHERE B IS THE NUMBER OF BITS IN THE MANTISSA.
C       IF THE DERIVATIVES ARE NOT COMPUTED TO THE ACCURACY EXPECTED
C       FROM THE WORD LENGTH OF THE COMPUTER (FOR EXAMPLE BECAUSE OF
C       CANCELLATION PROBLEMS OR TABULAR DATA), THEN THESE CONSTANTS
C       CAN BE CHANGED TO REFLECT THE NUMBER OF BITS WHICH ARE
C       SIGNIFICANT IN THE COMPUTED DERIVATIVES. (THIS IS NOT NECESSARY,
C       BUT IS WISE IF THE ACCURACY REQUESTED IS DIFFICULT TO OBTAIN
C       BECAUSE THE DERIVATIVES HAVE SO FEW SIGNIFICANT DIGITS.)
C
C       ON IBM360, KQMAX WILL = 16, RND = 8.88D-16, KBIT2 = 108
C       ON CDC6600, KQMAX WILL = 14, RND = 2.84E-14, KBIT2 = 98
C       ON UNIVAC 1108, KQMAX WILL = 18, RND = 6.94D-18, KBIT2 = 122
C
C
      KMAXO=4
C       KMAXO IS THE MAXIMUM ORDER DIFFERENTIAL EQUATION THIS
C       IMPLEMENTATION WILL INTEGRATE.
C
      FAC(1)=1.
      FAC(2)=FAC(1)/2.
      FAC(3)=FAC(2)/3.
      TWO=2.
      P1=.1
      P01=.01
      P25=.25
      P5=.5
      P75=.75
      P075=.075
      ONEP1=1.1
      PT(1)=1.
      KM=KQMAX+1
      DO 16 I=1,KM
        PT(I+1)=2.*PT(I)
   16 CONTINUE
C
C       COMPUTE GAS AND GAM
C
C       GAS(I) IS THE I-TH ADAMS-MOULTON CORRECTOR COEFFICIENT AND
C       GAM(I,J) IS THE I-TH ADAMS-FALKNER PREDICTOR COEFFICIENT
C       FOR INTEGRATING J-TH ORDER DIFFERENTIAL EQUATIONS,
C       I = 1,2,...,KQMAX+1,  J = 1,2,...,KMAXO.
C
      KMD=KM+KMAXO
      DO 20 K=1,KMD
        S=K
        D(K)=1./S
   20 CONTINUE
      GAM(1,1)=D(1)
      DO 22 J=2,KMAXO
        GAM(1,J)=D(J)*FAC(J-1)
   22 CONTINUE
      DO 26 I=2,KM
        KK=KMD+1-I
        DO 24 K=1,KK
          S=I-1
          D(K)=D(K)-D(K+1)/S
```

```
 24   CONTINUE
      GAM(I,1)=D(1)
      DO 26 J=2,KMAXO
        GAM(I,J)=D(J)*FAC(J-1)
 26 CONTINUE
    GAS(1)=1.
    DO 28 I=2,KM
      GAS(I)=GAM(I,1)-GAM(I-1,1)
 28 CONTINUE
C
C   GENERATE ETA
C
C   ETA(I,J), I=1,2,...,J IS USED IN THE FIRST MODIFICATION OF THE
C   I-TH DIFFERENCE OF A J-TH ORDER METHOD AFTER THE STEPSIZE IS
C   HALVED.
C   ETA(I,J), J=1,2,....,I-1 IS USED IN THE SECOND MODIFICATION OF
C   THE (J+1)-ST DIFFERENCE OF AN I-TH ORDER METHOD
C
    K=KQMAX-1
    EIGHTH=FAC(2)*FAC(2)*FAC(2)
    ETA(1,1)=EIGHTH
    ETA(2,1)=EIGHTH
    TP=FAC(2)*FAC(2)
    DO 33 J=2,K
      TP=TP/2.
      ETA(J,J)=(TP+ETA(J-1,J-1))/2.
      IF(J.EQ.2) GO TO 32
      JM2=J-2
      DO 30 IB=1,JM2
        I=J-IB
        ETA(I,J)=(ETA(I+1,J)+ETA(I-1,J-1))/2.
 30   CONTINUE
 32   ETA(1,J)=ETA(2,J)/2.
 33 CONTINUE
    DO 34 I=1,K
      TP=0.
      DO 34 J=1,I
        TP=TP+ETA(J,I)
        ETA(I+1,J)=TP
 34 CONTINUE
    TP=FAC(2)
    DO 36 J=1,K
      TP=TP/2.
      D(J)=ETA(J+1,J)+TP
 36 CONTINUE
    DO 38 J=1,K
      DO 38 I=1,J
        ETA(I,J)=ETA(I,J)/D(J)
 38 CONTINUE
    KM1=K-1
    DO 40 J=1,KM1
      D(J)=D(J+1)/D(J)
 40 CONTINUE
    DO 42 I=2,KM1
      DO 42 J=1,I
        ETA(I+1,J)=-ETA(I+2,J)+ETA(I+1,J)*D(I)
 42 CONTINUE
    TP=EIGHTH
    DO 46 I=2,KM1
      TP=TP/2.
```

```
      S=TP
      DO 44 J=1,I
        S=S+ETA(I+1,J)
   44   CONTINUE
      IM1=I-1
      DO 46 J=1,IM1
        ETA(I,J)=ETA(I+1,J)/S
   46 CONTINUE
C
C     INITIALIZE VARIABLES
C
   50 PTS1=PT(1)
      PTS2=PT(2)
      PTS3=PT(3)
      PTS4=PT(4)
      PTS5=PT(5)
      LGSS=0
      LGSD=0
      LGSE=0
      LFD=0
      E2HAVE=0.
      E2HMAX=0.
      DO 52 I=1,KMD
        DD(I)=0.
   52 CONTINUE
      KSTEP=-1
      NE=NEQ
      IF (NE.LE.0) GO TO 1190
      HH=H
      NV=0
      KDMAX=0
      DO 56 J=1,NE
        KQ(J)=1
        DO 54 I=1,KQMAX
          DT(I,J)=0.
   54   CONTINUE
        KDD=KD(J)
        IF ((KDD.EQ.0).OR.(KDD.GT.KMAXO)) HH=0.
        IF (KDD.GT.KDMAX) KDMAX=KDD
        NV=NV+KDD
   56 CONTINUE
C
      IF ((TPRINT*HH).LE.0.) GO TO 1190
      ERRMX=P1
      ERND=0.
      EMAX=ERND
      RNDC=RND*P25
      LDOUB=0
      E2HFAC=P25
      LSC=8
      LSTC=4
C     LSC AND LSTC ARE USED IN COMBINATION AS FOLLOWS
C       LSTC=4,  LSC=4      FIRST TIME THROUGH THE FIRST STEP
C       LSTC=3,  LSC=4      SECOND TIME THROUGH THE FIRST STEP
C                           (NECESSARY TO CHECK STABILITY)
C       LSTC=2,  LSC=4      THIRD TIME THROUGH THE FIRST STEP
C                           (ONLY OCCURS IF INSTABILITY POSSIBLE)
C       LSTC=2,  LSC=2      SECOND STEP  (IF KQ(I)=2 , I=1,...,NEQ)
C       LSTC=1,  LSC=0      STARTING, ONE DERIVATIVE EVAL. PER STEP.
C       LSTC=1,  LSC.GT.0   SET WHEN STARTING TWO DERIV. EVAL. PER STEP
```

```
C        LSTC=-1  LSC.LT.0  SET WHEN HALVING THE STEPSIZE
C       IN THE LAST TWO CASES LSC IS SET EQUAL TO LSTC*(MAXIMUM KQ(I)
C       +1). AT THE END OF EACH STEP IF LSC.NE.0 IT IS REPLACED BY
C       LSC-LSTC UNTIL LSC=0, AT WHICH TIME LSTC IS SET EQUAL TO 0.
C        WHEN DOUBLING H, LSTC IS SET EQUAL TO -1 AND LSC TO -3.
C       UNDER CERTAIN CONDITIONS WHEN KQ(I)=1, LSTC IS SET =-1 AND LSC=-5
C
      KSOUT=MXSTEP
      TOUT=T
      IFL=13
      IFLAG=1
      NGA=0
      NEVAL=0
      IF(NG.NE.0) GO TO 1420
      GO TO 315
C     END OF INITIALIZATION
C
C
C     ENTRY WITH IFLAG.GT.0
C
C     CHECK FOR GSTOPS
C
   60 IF(NG.EQ.NGA) GO TO 65
      IF(NG.LT.0) GO TO 1190
      NGA=NG
      LGSS=-NGA
      LGSD=0
      LGSE=0
      IFLG=-20
C
C
   65 IF (IFL.LT.2) GO TO 320
      IF (IFL.EQ.2) GO TO 80
      IF (IFL.GT.5) GO TO 1180
C
C     SET STEP STOP
      KSOUT=KSTEP+MXSTEP
      IF (IFL.EQ.5) GO TO 210
      IF (IFL.EQ.4) GO TO 1210
C
C     SET PRINT STOP
   70 TOUT=T+TPRINT
C
   75 TPS1=ABS(AMOD((TOUT-T)/HH,TWO)-PTS1)
      LFD=-1
      IF (TPS1.GE.P5) LFD=1
C
C     LFD IS USED TO INDICATE WHETHER DOUBLING H IS PERMITTED.
C     IF LFD.LT.0 AT THE END OF A STEP THEN DOUBLING H IS
C     NOT PERMITTED. THE SIGN OF LFD IS CHANGED JUST BEFORE THE
C     END OF EACH STEP. IF TPRINT=H*(POWER OF 2) THEN
C     OUTPUT VALUES WILL BE OBTAINED WITHOUT INTERPOLATION.
C
      GO TO 200
C
C
C     ENTRY WITH IFLAG=2
C
C     UPDATE DIFFERENCE TABLE
C     AND COMPUTE KQM=MAXIMUM VALUE OF KQ(I), I=1,2,...,NEQ.
```

```
C
   80 KQM=0
      DO 90 I=1,NE
        KQQ=KQ(I)
        IF (KQQ.GT.KQM) KQM=KQQ
        D(1)=F(I)
        DO 85 K=1,KQQ
          D(K+1)=D(K)-DT(K,I)
          DT(K,I)=D(K)
   85   CONTINUE
        DT(KQQ+1,I)=D(KQQ+1)
   90 CONTINUE
C     END OF UPDATING DIFFERENCE TABLE
C
C     STORE Y(J) IN YN(J)
      DO 95 J=1,NV
        YN(J)=Y(J)
   95 CONTINUE
C
      LFD=-LFD
      TL=T
      KSTEP=KSTEP+1
C
      IF (LGSS) 1430,110,1510
  100 IFLAG=2
  110 IF (LSC.EQ.0) GO TO 140
      LSC=LSC-LSTC
      IF (LSC.EQ.0) GO TO 130
      IF (LSTC.NE.(-1)) GO TO 140
      IF (LDOUB.LT.0) RNDC=RND*P1
  120 E2HAVE=E2HMX
      TPS1=PTS1
      GO TO 190
  130 IF (ABS(HH).LT.HMIN) GO TO 1000
      LSTC=0
  140 IF (LDOUB.NE.1) GO TO 150
      IF ((LFD.GT.0).AND.(ABS(HH+HH).LE.HMAX)) GO TO 1030
      GO TO 200
  150 RQMAX=PTS1/FLOAT(KQM+3)
      IF ((LSTC.NE.0).OR.(E2HAVE.EQ.0.)) GO TO 120
      TPS1=E2HMAX/E2HAVE
      IF (TPS1-PTS1) 160,190,170
  160 E2HFAC=AMIN1(P075,E2HFAC-RQMAX,E2HFAC*TPS1)
      GO TO 180
  170 TPS1=TPS1*TPS1
      E2HFAC=AMIN1(PTS1,E2HFAC*TPS1)
  180 RNDC=(ONEP1-E2HFAC)*RND
      E2HAVE=P5*(E2HMAX+E2HAVE)
  190 ERRMX=AMAX1(P1,ERRMX-RQMAX*TPS1)
C     E2HFAC IS A FACTOR WHICH IS TAKEN TIMES AN INITIAL ESTIMATE OF
C            E2H TO GET A FINAL VALUE OF E2H. (E2H=ESTIMATE OF WHAT
C            (ESTIMATED ERROR)/(REQUESTED ERROR) WOULD BE IF H WERE
C            DOUBLED.)
C     E2HMAX IS THE MAXIMUM VALUE OF THE INITIAL ESTIMATE OF E2H OVER
C            ALL COMPONENTS WITH KQ(I).GT.1.
C     E2HAVE IS A WEIGHTED AVERAGE OF PAST VALUES OF E2HMAX.
C     THE VALUE OF E2HFAC TENDS TO BE SMALLER WHEN E2HMAX IS
C     CONSISTANTLY SMALLER THAN E2HAVE.
C
C
```

```
C       CHECK FOR PRINT STOP AND FOR T REACHING TFINAL
  200 TPD=(TOUT-TL)/HH
      TPD1=(TFINAL-TL)/HH
C
      IF (LGSE.LT.0) GO TO 1780
      IF (TPD1.LT.FAC(1)) GO TO 1220
      IF (TPD.LE.0.) GO TO 1280
C
C     CHECK FOR STEP STOP
      IF (KSOUT.GT.KSTEP) GO TO 210
C
      IFL=5
      GO TO 310
C
C     CHECK TO SEE IF ROUND-OFF ERROR IS PROMINENT
  210 IF (EMAX.EQ.ERND) GO TO 220
C     IT IS
      IFL=6
      IF (EMAX.GE.P1) GO TO 310
      IF ((LSTC.GE.0).OR.(LDOUB.EQ.1)) ERRMX=PTS1
C
  220 IFL=1
  230 T=TL+HH
C
C     START A NEW STEP
C
C     PREDICT
  240 J=0
      DO 290 I=1,NE
        KDD=KD(I)
        KDC=KDD
  250   KQQ=KQ(I)
        TPD=0.
        K=KDC
  260   TPD=TPD+DT(KQQ,I)*GAM(KQQ,KDC)
        KQQ=KQQ-1
        IF (KQQ.GT.0) GO TO 260
  270   K=K-1
        IF (K.LE.0) GO TO 280
        L=J+K
        TPD=YN(L+1)*FAC(K)+HH*TPD
        GO TO 270
  280   J=J+1
        Y(J)=YN(J)+HH*TPD
        KDC=KDC-1
        IF (KDC.GT.0) GO TO 250
  290 CONTINUE
C     END OF PREDICT
C
      IF (IFL) 1240,320,300
  300 IF (LGSD.NE.0) GO TO 1520
C
  310 IFLAG=IFL
  315 IF (IFLAG.LE.2) NEVAL=NEVAL+1
C
      RETURN
C
C
C     ENTRY WITH IFLAG=1
  320 ERND=0.
```

```
      EMAX=0.
      E2HMAX=0.
      J=0
      IF (LDOUB.GE.0) LDOUB=1
C
C     LDOUB IS SET IN THE LOOP BELOW AS FOLLOWS
C     LDOUB=0   HALVE
C     LDOUB=1   DOUBLE
C     LDOUB=2   DO NOT DOUBLE
C
C     LDOUB.LT.0 AT THE BEGINNING OF THE LOOP INDICATES THE FOLLOWING
C       =-3  STEPSIZE HAS JUST BEEN HALVED. IF A DISCONTINUITY IS
C            NOT INDICATED MODIFY THE DIFFERENCE TABLE AND REPEAT
C            THE STEP.
C       =-2  STEP AFTER LDOUB=-3. PROCEED AS USUAL (ORDER IS NOT
C            CHANGED)
C       =-1  STEP AFTER LDOUB=-2. MODIFY THE DIFFERENCE TABLE ONCE
C            AGAIN AND REPEAT THE STEP.
C     IF LDOUB IS SET EQUAL TO -4 THE ORDER IN AT LEAST ONE COMPONENT
C     HAS BEEN GREATLY REDUCED AND THE STEP IS REPEATED.
C
C
C     BEGINNING OF LOOP FOR CORRECTING, ESTIMATING THE ERROR,
C     AND ADJUSTING THE NUMBER OF DIFFERENCES USED
C
      DO 790 I=1,NE
        KDD=KD(I)
        KQQ=KQ(I)
C       KQQ GIVES THE ORDER OF THE PREDICTOR FORMULA AND KQQ+1 THE
C       ORDER OF THE CORRECTOR FORMULA.
C
        KQ1=KQQ+1
        D(1)=F(I)
C       FORM THE DIFFERENCE TABLE FROM PREDICTED DERIVATIVE VALUES.
        DO 330 K=1,KQ1
          D(K+1)=D(K)-DT(K,I)
  330   CONTINUE
C       D(K) GIVES THE (K-1)-ST DIFFERENCE FORMED FROM PREDICTED
C       DERIVATIVE VALUES
        TPS3=ABS(D(KQQ+1))
        IF (LDOUB.LT.0) GO TO 720
C
  340   IF (KQQ.NE.1) GO TO 520
C
C       KQ(I)=1  IS TREATED AS A SPECIAL CASE
        E2H=PTS2
        TPS5=DT(3,I)
        IF (LSTC.LT.2) GO TO 370
C       FIRST STEP OF INTEGRATION
        IF (LSTC.NE.4) GO TO 350
        TPS4=0.
        IF (KDD.GT.1) TPS3=AMAX1(TPS3,ABS(HH*D(1)))
        TPS3=TPS3*P1
        GO TO 510
  350   DT(2,I)=D(2)
        D(2)=D(1)-DT(5,I)
        TPS2=-D(2)
        TPS3=PTS5*ABS(TPS2)
C       FIRST STEP THAT KQ(I)=1
  360   DT(7,I)=PT(4)
```

```
      IF (LSTC-2) 420,380,380
  370 IF (TPS5.EQ.0.) GO TO 360
      IF (DT(6,I).EQ.0.) GO TO 400
      TPS2=DT(5,I)-DT(1,I)
  380 TPS4=DT(4,I)
      TPS1=ABS(TPS4)
      TPS4=TPS2*SIGN(PTS2,TPS4)-TPS5*TPS1
      IF (TPS4.GT.(-TPS1)) GO TO 410
  390 TPS6=-PTS1
      GO TO 450
C     FIRST STEP AFTER THE STEPSIZE HAS BEEN CHANGED
  400 DT(6,I)=PT(1)
      TPS6=0.
      GO TO 450
  410 IF (TPS4.LT.TPS1) GO TO 440
      IF (TPS1.EQ.0.) GO TO 390
  420 TPS6=PTS1
      GO TO 450
  430 KQ(I)=2
      IF (2-LSTC) 510,510,520
  440 TPS6=TPS4/TPS1
  450 TPS4=TPS5+TPS6
      IF (TPS4.LT.P25) GO TO 430
C     INCREASE E2H IF (-S).GT..25
      E2H=PTS4*TPS4
      IF (2-LSTC) 460,470,480
  460 LSC=0
      GO TO 510
  470 IF (TPS5-P25) 430,460,460
  480 IF (TPS4.GT.PTS2) GO TO 490
      IF (TPS4.GT.P5) D(2)=D(2)*GAM(2,1)
      GO TO 510
  490 IF (TPS4.LT.PTS4) GO TO 500
      TPS4=PTS4
      D(2)=D(2)/PT(3)
C     THE ESTIMATE OF E (AND HENCE OF E2H) IS INCREASED IF (-S).GE.8.
      TPS3=TPS3*DT(7,I)
      GO TO 510
  500 D(2)=D(2)*(PTS2*(TPS4-PTS1)/(TPS4*TPS4))
      IF (TPS4.GE.3.) E2H=E2H*DT(7,I)
C     STORE D(1)=PREDICTED DERIVATIVE  AND  D(2)=2*(CORRECTED Y -
C     PREDICTED Y)/H    D(1) AND D(2) ARE USED TO COMPUTE (-S) ON
C     THE NEXT STEP.
  510 DT(5,I)=D(1)
      DT(4,I)=D(2)
      D(4)=TPS4
C    STORE D(4)= CURRENT ESTIMATE OF (-S).  (-S).GT.3 IS AN INDICATION
C    THAT THE STEPSIZE SHOULD BE LIMITED BECAUSE OF STABILITY PROBLEMS.
C    S=H*(ESTIMATE OF EIGENVALUE OF F)=H*(DIFFERENCE BETWEEN PREDICTED
C    AND CORRECTED DERIVATIVE VALUES)/(DIFFERENCE BETWEEN PREDICTED
C    AND CORRECTED INTEGRALS OF THE DERIVATIVE VALUES)
C    THE TREATMENT OF THE CASE KQ(I)=1 COULD BE IMPROVED BY USING A
C    SPECIAL METHOD FOR STIFF EQUATIONS WHEN (-S).GT.3  (MAYBE).
C    (THE ENTIRE TREATMENT OF THE CASE KQ(I)=1 IS FAR FROM IDEAL.)
      DT(3,I)=D(4)
C
C     CORRECT
  520 KDC=0
      TPD=D(KQ1)
      J=J+KDD
```

```
      K=J
  530 TPD=HH*TPD
      KDC=KDC+1
      Y(K)=Y(K)+GAM(KQQ+1,KDC)*TPD
      K=K-1
      IF (KDC.LT.KDD) GO TO 530
C     END OF CORRECT
C
      IF (EPS(I).NE.0.) GO TO 560
  550 IF (HMAX) 1190,780,1190
  560 TPS4=ABS(D(KQQ+2))
      TPS2=ABS(D(KQQ))
      TPS6=HH/EPS(I)
C
      E=ABS(GAS(KQQ+1)*TPS3*TPS6)
C     E GIVES  ABS((ESTIMATED ERROR)/EPS(I))
C
      LRND=1
C
C     LRND= 1  MEANS NO ROUND-OFF ERROR
C         = 0  MEANS SOME ROUND-OFF ERROR
C         =-1  MEANS EXTREME ROUND-OFF ERROR
C
      FRND=RNDC*ABS(PT(KQQ+2)*D(1))
C     CHECK TO SEE IF ROUND OFF ERROR IS DOMINANT
      IF ((TPS3+TPS4).GT.FRND) GO TO 570
      LRND=0
      IF ((PTS4*TPS2).LT.FRND) LRND=-1
C
  570 IF (E.LE.ERND) GO TO 590
      IF (E.LE.EMAX) GO TO 580
      EMAX=E
      KEMAX=I
  580 IF (LRND.LE.0) GO TO 590
      ERND=E
      IF (ERND.GT.ERRMX) LDOUB=0
  590 IF (LDOUB.LE.0) GO TO 780
      TPS1=ABS(DD(KQQ))
      TPS5=TPS1
      IF (KQQ-2) 600,610,620
  600 E2H=E*E2H
      IF (E2H.LT.P01) GO TO 780
      IF (D(4).LT.3.) GO TO 770
      LSTC=-1
      LSC=-5
      GO TO 770
  610 TPS1=TPS2
      IF (LSTC.NE.2) GO TO 620
      KQ(I)=3
      TPS2=0.
      TPS4=0.
      LRND=0
  620 E2H=TPS2+TPS3+TPS4
      E2H=ABS(GAS(KQQ-1)*PT(KQQ+1)*E2H*TPS6)
C     E2H IS USED AS AN ESTIMATE OF WHAT THE VALUE OF E WOULD BE
C     IF H WERE DOUBLED. THE ESTIMATE IS CONSERVATIVELY LARGE.
      IF (E2H.GT.E2HMAX) E2HMAX=E2H
C
      IF (LRND) 630,640,660
C     EXTREME ROUND-OFF ERROR--REDUCE E2H
```

```
  630   K=(KBIT2/KQQ)-4
        IF (K.LE.3) GO TO 640
        IF (K.GT.KQMAX) K=KQMAX
        E2H=E2H/PT(K+1)
        GO TO 650
  640   E2H=AMIN1(E2H,E2H*3.*E2HFAC)
  650   E2H=E2H*P1
        TPS6=PTS4
        GO TO 670
C
  660   E2H=E2H*E2HFAC
        TPS6=KQQ+2
C       TEST TO SEE IF DIFFERENCES DECREASE MORE RAPIDLY THAN NECESSARY
C
  670   IF (TPS5.LT.(TPS3*TPS6)) GO TO 680
        IF (TPS2.LE.(TPS4*TPS6)) GO TO 760
C       THEY DO   INCREASE KQ(I)
        IF (KQQ.NE.KQMAX) KQ(I)=KQ1
        GO TO 760
C
C       TEST TO SEE IF DIFFERENCES DECREASE TOO SLOWLY
  680   TPS6=TPS6*P25
        IF ((TPS1.GT.(TPS3*TPS6)).OR.(TPS2.GT.(TPS4*TPS6))) GO TO 760
C       THEY DO
        IF (LSTC.LE.0) GO TO 750
        IF (E2H.LT.P01) GO TO 750
        IF (LSC-LSTC) 690,750,770
  690   IF (KSTEP-4) 750,700,710
  700   KQ1=LSTC
  710   LSC=KQ1
C       END OF ONE DERIVATIVE EVALUATION PER STEP
        GO TO 770
C
C       AFTER HALVING H, REDUCE KQ(I) IF A DISCONTINUITY HAS OCCURRED.
  720   IF (LDOUB.EQ.(-2)) GO TO 340
        DT(KQQ+1,I)=D(KQQ+1)
        IF (LDOUB.EQ.(-1)) DT(KQQ+1,I)=D(KQQ+2)
        K=KQQ
  730   IF (K.EQ.1) GO TO 740
        IF ((ABS(D(K-1)).GT.(PT(2)*ABS(D(K+1)))).OR.
     1    (ABS(D(K)).GT.(PT(2)*ABS(D(K+2))))) GO TO 740
        K=K-1
        GO TO 730
  740   IF ((K+K).GE.KQQ) GO TO 780
        LDOUB=-4
        E2H=0.
        KQQ=K+1
C
C
C       DIFFERENCES DECREASE TOO SLOWLY REDUCE KQ(I).
  750   KQ(I)=KQQ-1
        IF (KQQ.EQ.2) DT(3,I)=0.
  760   IF (E2H.LT.P01) GO TO 780
  770   LDOUB=2
  780   CONTINUE
C
C
  790 CONTINUE
C
C     END OF LOOP FOR CORRECTING, ESTIMATING THE ERROR, ETC.
```

```
C
C
      IF (IFL.LT.0) GO TO 1250
C     TEST FOR HALVING H
      IF (LDOUB) 800,950,870
  800 LDOUB=LDOUB+1
      IF (LDOUB+1) 810,870,820
  810 IF (LDOUB.EQ.(-2)) GO TO 820
C     ORDER IN AT LEAST ONE COMPONENT HAS BEEN GREATLY REDUCED
      LDOUB=0
      GO TO 220
  820 DO 860 I=1,NE
        KQQ=KQ(I)
        TP=DT(KQQ+1,I)
        IF (KQQ.LE.3) GO TO 860
        IF (LDOUB.NE.0) GO TO 840
        DO 830 K=3,KQQ
C       SECOND MODIFICATION OF DIFFERENCE TABLE AFTER HALVING H
          DT(K,I)=DT(K,I)+ETA(KQQ-1,K-2)*TP
  830   CONTINUE
        GO TO 860
  840   DO 850 K=2,KQQ
C       FIRST MODIFICATION OF DIFFERENCE TABLE AFTER HALVING H
          DT(K,I)=DT(K,I)+ETA(K-1,KQQ-1)*TP
  850   CONTINUE
  860 CONTINUE
      IFL=0
      GO TO 240
C
  870 IFL=2
      IF (LSTC.LE.0) GO TO 300
      IF (2-LSTC) 880,900,940
  880 LSTC=LSTC-1
      IF (LSTC.EQ.3) GO TO 890
      IF (LSC) 920,960,920
  890 IFL=1
      GO TO 300
  900 IF (LSC-2) 910,930,920
  910 LSTC=0
  920 LDOUB=2
      GO TO 80
  930 LSTC=1
      LSC=0
      GO TO 80
  940 IF (LSC) 300,80,300
C
C     HALVE H
  950 HH=FAC(2)*HH
      IF (LSTC.LT.2) GO TO 990
      ERND=P25*ERND
C     IN LOOP TO FIND A NEW INITIAL STEPSIZE
      IF (ERND.GE.P1) GO TO 950
      LSTC=4
  960 LSC=4
      DO 970 I=1,NE
        KQ(I)=1
  970 CONTINUE
      IF (LSTC-3) 890,890,1170
C
C     ENTRY AFTER IFLAG=7
```

```
  980 IF (LDOUB.EQ.0) GO TO 990
      LSC=1
      LSTC=1
      GO TO 140
C     TEST TO SEE IF H IS TOO SMALL FOR HALVING
  990 IF (ABS(HH).GE.HMIN) GO TO 1040
      IF (IFL.EQ.7) GO TO 1010
 1000 IFL=7
      GO TO 1020
C
 1010 HH=HH+HH
      IFL=2
 1020 H=HH
      GO TO 310
C
C
C     ERROR CRITERIA PERMIT DOUBLING
 1030 HH=HH+HH
      IF (LSTC.EQ.1) GO TO 1050
      LSC=-3
 1040 LSTC=-1
C
C     CHANGE THE STEPSIZE
 1050 DO 1160 I=1,NE
        KQQ=KQ(I)
        IF (KQQ.NE.1) GO TO 1070
        DT(6,I)=0.
        D(3)=DT(3,I)*PT(2)
        IF (D(3).GT.PT(3)) LSC=-6
        IF (LDOUB.NE.0) GO TO 1060
        KQM=8
        IF (D(3).GE.PT(5)) DT(7,I)=DT(7,I)*PT(2)
        D(3)=D(3)/PT(3)
 1060   DT(3,I)=D(3)
        GO TO 1160
C
C       BEGINNING OF LOOP FOR CHANGING DIFFERENCE TABLE TO
C       CORRESPOND TO NEW VALUE OF H
 1070   DO 1080 K=1,KQQ
          D(K)=DT(K,I)/PT(K)
          IF (LDOUB.EQ.0) D(K)=D(K)/PT(K)
 1080   CONTINUE
        KQQ2=KQQ-2
        IF (KQQ2) 1160,1140,1090
 1090   DO 1130 J=1,KQQ2
          IF (LDOUB.NE.0) GO TO 1110
C
C         HALVE
          K=KQQ
 1100     D(K-1)=D(K-1)+D(K)
          K=K-1
          IF (K+J-KQQ) 1130,1130,1100
C
C         DOUBLE
 1110     DO 1120 K=J,KQQ2
            D(K+1)=D(K+1)-D(K+2)
 1120     CONTINUE
 1130   CONTINUE
C
 1140   DO 1150 K=2,KQQ
```

```
            IF (LDOUB.NE.0) D(K)=D(K)*F[illegible](K)                        DVDQ1004
            DT(K,I)=D(K)*PT(K)                                               DVDQ1005
 1150     CONTINUE                                                           DVDQ1006
C         DIFFERENCE TABLE NOW CORRESPONDS TO NEW VALUE OF H                 DVDQ1007
C                                                                            DVDQ1008
 1160 CONTINUE                                                               DVDQ1009
 1170 H=HH                                                                   DVDQ1010
      IF (LDOUB.NE.0) GO TO 75                                               DVDQ1011
      LFD=1                                                                  DVDQ1012
      IF (LSTC.GE.0) GO TO 220                                               DVDQ1013
      LDOUB=-3                                                               DVDQ1014
      LSC=LSTC-KQM                                                           DVDQ1015
      GO TO 220                                                              DVDQ1016
C     END OF CHANGING STEPSIZE                                               DVDQ1017
C                                                                            DVDQ1018
C                                                                            DVDQ1019
 1180 K=IFL-5                                                                DVDQ1020
      GO TO (220,980,1200,1570,1570,1720,1720,80,1480,1450,1630,1570), KDVDQ1021
C                                                                            DVDQ1022
C     ILLEGAL VALUE OF PARAMETER   INTEGRATION CAN NOT PROCEED               DVDQ1023
 1190 IFL=8                                                                  DVDQ1024
      GO TO 310                                                              DVDQ1025
 1200 WRITE (6,4000)                                                         DVDQ1026
 4000 FORMAT (26HOIFLAG=8  IN CALL TO DVDQ1.)                                DVDQ1027
      STOP                                                                   DVDQ1028
C                                                                            DVDQ1029
C                                                                            DVDQ1030
 1210 IF (T-TFINAL) 200,1190,200                                             DVDQ1031
C                                                                            DVDQ1032
C                                                                            DVDQ1033
 1220 IFL=4                                                                  DVDQ1034
      IF (KSTEP.NE.0) GO TO 1270                                             DVDQ1035
      TPD2=TPD                                                               DVDQ1036
C     ESTIMATE ERROR WHEN EXTRAPOLATION FROM INITIAL POINT IS REQUESTED DVDQ1037
 1230 HH=HH*TPD1*P75                                                         DVDQ1038
C                                                                            DVDQ1039
      IFLS=IFL                                                               DVDQ1040
      IFL=-1                                                                 DVDQ1041
      GO TO 230                                                              DVDQ1042
C                                                                            DVDQ1043
 1240 IF ((LGSD.EQ.0).OR.(IFLS.NE.4)) GO TO 60                               DVDQ1044
      LGSE=-1                                                                DVDQ1045
      TPD=FAC(1)                                                             DVDQ1046
      GO TO 1820                                                             DVDQ1047
 1250 HH=H                                                                   DVDQ1048
      IF (EMAX.LT.P01) GO TO 1260                                            DVDQ1049
C     ERROR IS TOO LARGE, REDUCE H AND REPEAT THE FIRST STEP                 DVDQ1050
      IF (TPD1.LT.0.) GO TO 1190                                             DVDQ1051
      LDOUB=1                                                                DVDQ1052
      ERND=FAC(1)/TPD1                                                       DVDQ1053
      ERND=ERND*ERND*P25                                                     DVDQ1054
      GO TC 950                                                              DVDQ1055
C                                                                            DVDQ1056
 1260 IFL=IFLS                                                               DVDQ1057
      IF (IFL.NE.4) GO TO 1790                                               DVDQ1058
      TPD=TPD2                                                               DVDQ1059
      IFLAG=3                                                                DVDQ1060
 1270 IF (TPD1.GT.TPD) GC TO 1280                                            DVDQ1061
      T=TFINAL                                                               DVDQ1062
      TPD=TPD1                                                               DVDQ1063
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      GO TO 1290                                                        DVDQ1064
 1280 T=TOUT                                                            DVDQ1065
      IFL=3                                                             DVDQ1066
 1290 IF ((TPD.EQ.0.).AND.(IFLAG.LE.2)) GO TO 310                       DVDQ1067
C                                                                       DVDQ1068
C     INTERPOLATE FOR OUTPUT                                            DVDQ1069
 1300 TP=TPD                                                            DVDQ1070
      D(2)=TP                                                           DVDQ1071
      KQQ2=0                                                            DVDQ1072
      KDC=0                                                             DVDQ1073
      D(1)=PT(1)                                                        DVDQ1074
      DD(1)=PT(1)                                                       DVDQ1075
      DO 1310 K=2,KQM                                                   DVDQ1076
        DD(1)=DD(1)+PT(1)                                               DVDQ1077
        TP=TP+PT(1)                                                     DVDQ1078
        D(K+1)=(D(K)*TP)/DD(1)                                          DVDQ1079
 1310 CONTINUE                                                          DVDQ1080
      GO TO 1350                                                        DVDQ1081
C                                                                       DVDQ1082
C     COMPUTE THE INTERPOLATING INTEGRATION COEFFICIENTS                DVDQ1083
 1320 KQQ2=1                                                            DVDQ1084
      L=KQM-KDC                                                         DVDQ1085
      KDC=KDC+1                                                         DVDQ1086
 1330 IF (L.LE.0) GO TO 1350                                            DVDQ1087
      TP=0.                                                             DVDQ1088
      K=L                                                               DVDQ1089
      J=L+KDC                                                           DVDQ1090
 1340 JS=J-K                                                            DVDQ1091
      TP=TP+GAS(K)*D(JS+1)                                              DVDQ1092
      K=K-1                                                             DVDQ1093
      IF (K.GT.0) GO TO 1340                                            DVDQ1094
      D(J)=TP                                                           DVDQ1095
C                                                                       DVDQ1096
C     D(J) IS THE INTEGRATION COEFFICIENT FOR THE INTERPOLATION WHICH   DVDQ1097
C     CORRESPONDS TO GAM(J-KDC,KDC).                                    DVDQ1098
C                                                                       DVDQ1099
      L=L-1                                                             DVDQ1100
      GO TO 1330                                                        DVDQ1101
C     END OF COMPUTING INTEGRATION COEFFICIENTS                         DVDQ1102
C                                                                       DVDQ1103
C     PERFORM THE PARTIAL STEP INTEGRATION                              DVDQ1104
 1350 J=0                                                               DVDQ1105
      DO 1415 I=1,NE                                                    DVDQ1106
      KDD=KD(I)                                                         DVDQ1107
      IF (KDC.GT.KDD) GO TO 1410                                        DVDQ1108
      TP=0.                                                             DVDQ1109
      KQQ=KQ(I)+KQQ2                                                    DVDQ1110
 1360 L=KQQ-KDC                                                         DVDQ1111
      IF (L.LE.0) GO TO 1370                                            DVDQ1112
      TP=TP+D(KQQ)*DT(L,I)                                              DVDQ1113
      KQQ=KQQ-1                                                         DVDQ1114
      IF (KQQ) 1390,1390,1360                                           DVDQ1115
 1370 K=J+KDD                                                           DVDQ1116
      L=KDC                                                             DVDQ1117
 1380 L=L-1                                                             DVDQ1118
      IF (L.EQ.0) GO TO 1400                                            DVDQ1119
      TP=TP*HH+YN(K)*FAC(L)*TPD                                         DVDQ1120
      K=K-1                                                             DVDQ1121
      GO TO 1380                                                        DVDQ1122
 1390 F(I)=TP                                                           DVDQ1123
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      GO TO 1415                                                        DVDQ1124
 1400 Y(K)=YN(K)+HH*TP                                                  DVDQ1125
 1410 J=J+KDD                                                           DVDQ1126
 1415 CONTINUE                                                          DVDQ1127
      IF (KDC.NE.KDMAX) GO TO 1320                                      DVDQ1128
C     END OF PARTIAL STEP INTEGRATION                                   DVDQ1129
      IF (LGSE) 1800,310,1810                                           DVDQ1130
C                                                                       DVDQ1131
C     INITIALIZE FOR GSTOPS                                             DVDQ1132
 1420 NGA=IABS(NG)                                                      DVDQ1133
      LGSS=-NGA                                                         DVDQ1134
      LGSD=0                                                            DVDQ1135
      LGSE=0                                                            DVDQ1136
      IFLG=-20                                                          DVDQ1137
      IF (NG) 1425,315,315                                              DVDQ1138
 1425 IFLG=-IFL                                                         DVDQ1139
      IFLG=-IFL                                                         DVDQ1140
 1430 LGSD=NGE                                                          DVDQ1141
      IF (LGSD) 1190,1450,1440                                          DVDQ1142
 1440 IFL=15                                                            DVDQ1143
      GO TO 1470                                                        DVDQ1144
C     ENTRY WITH IFL=15                                                 DVDQ1145
 1450 LGSS=0                                                            DVDQ1146
      IF (LGSD-NGA) 1460,1480,1190                                      DVDQ1147
 1460 LGSS=LGSD+1                                                       DVDQ1148
      IFL=14                                                            DVDQ1149
 1470 IFLAG=IFL-5                                                       DVDQ1150
      GO TO 315                                                         DVDQ1151
C     ENTRY WITH IFL=14                                                 DVDQ1152
 1480 DO 1490 I=1,NGA                                                   DVDQ1153
      GT(I)=G(I)                                                        DVDQ1154
 1490 CONTINUE                                                          DVDQ1155
      GO TO 1730                                                        DVDQ1156
C     END OF INITIALIZATION FOR GSTOPS                                  DVDQ1157
C                                                                       DVDQ1158
C     ENTRY TO EVALUATE G AT THE END OF THE STEP                        DVDQ1159
 1500 LGSE=1                                                            DVDQ1160
 1510 IGK=LGSS                                                          DVDQ1161
      IFLG=0                                                            DVDQ1162
      IFL=9                                                             DVDQ1163
      GO TO 310                                                         DVDQ1164
C     ENTRY TO EVALUATE G BEFORE EVALUATING THE DERIVATIVES             DVDQ1165
 1520 IFLG=IFL                                                          DVDQ1166
      IFL=10                                                            DVDQ1167
 1530 IFLAG=10                                                          DVDQ1168
      IGKM=LGSD                                                         DVDQ1169
 1540 IGK=1                                                             DVDQ1170
 1550 GO TO 315                                                         DVDQ1171
 1560 IGK=IGK+1                                                         DVDQ1172
      IF (IGK.GT.IGKM) GO TO 1650                                       DVDQ1173
C     ENTRY WITH IFL=9,10, AND 17                                       DVDQ1174
C     TEST FOR G CHANGING SIGN                                          DVDQ1175
 1570 IF (G(IGK)*GT(IGK)) 1600,1580,1590                                DVDQ1176
 1580 IF (GT(IGK).NE.0.) GO TO 1600                                     DVDQ1177
      IF (TL.EQ.TG) GO TO 1560                                          DVDQ1178
 1590 IF (LGSE.GT.0) GT(IGK)=G(IGK)                                     DVDQ1179
      GO TO 1560                                                        DVDQ1180
C     G CHANGES SIGN -- PREPARE FOR ITERATION TO FIND ZERO              DVDQ1181
 1600 NSTOP=IGK                                                         DVDQ1182
      IFLGS=IFL                                                         DVDQ1183
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C     COMPUTE INITIAL VALUE FOR RG (=RATIO OF PARTIAL STEPSIZE WHERE
C     G IS KNOWN/THE INTEGRATION STEPSIZE)
      IF (IFLG.EQ.0) GO TO 1610
      RG(3)=FAC(1)
      RG(2)=0.
      IF ((IFLG.EQ.2).AND.(IGK.LT.LGSS)) RG(2)=FAC(1)
      GO TO 1620
 1610 RG(3)=0.
      RG(2)=-FAC(1)
 1620 IF (LGSE.LT.0) RG(3)=TPD
      LGSE=-3
      GI(2)=GT(IGK)
      EPSGS=RND
      IFL=16
      K=1
      GO TO 1640
C     END OF PREPARATION TO BEGIN THE ITERATION
C
C     ENTRY WITH IFL=16
C     ITERATE TO FIND GSTOP
 1630 K=1
      IF ((GI(2)*G(IGK)).GT.0.) K=2
      IF (ABS(GI(K)).GT.ABS(G(IGK))) GO TO 1640
C     CONVERGENCE PROBLEMS
      LGSE=LGSE-1
      IF (LGSE.EQ.(-5)) EPSGS=PTS1
      EPSGS=EPSGS*PTS4
 1640 GI(K)=G(IGK)
      RG(K)=RG(3)
C     SECANT ITERATION (GIVES NEW PARTIAL STEPSIZE/H)
      TPD=RG(1)-(GI(1)*(RG(2)-RG(1)))/(GI(2)-GI(1))
      T=TL+TPD*HH
C     TEST FOR CONVERGENCE OF ITERATION
      IF (ABS(TPD-RG(3)).LE.EPSGS) GO TO 1560
      RG(3)=TPD
      GO TO 1300
 1650 IF (10-IFL) 1660,1700,100
 1660 IF (IGKM.NE.NGA) GO TO 1710
      IF (LGSE.GT.(-3)) GO TO 1690
      IF (LSTC.NE.4) GO TO 1670
C     ESTIMATE ERROR -- GSTOP IS THE RESULT OF EXTRAPOLATING FROM
C     THE INITIAL POINT
      TPD1=TPD
      RG(3)=TPD
      GO TO 1230
 1670 IFL=11
      IF (LGSE.LT.(-4)) IFL=12
 1680 IFLAG=IFL
C     TEST TO SEE IF GSTOP IS PRECEDED BY ANOTHER STOP
      IF ((HH*(T-TOUT).LE.0.).AND.(HH*(T-TFINAL).LE.0.)) GO TO 1300
C     IT IS
      RG(3)=TPD
      IFLS=IFL
      GO TO 200
 1690 LGSE=1
      IFL=IFLG
      IF (IFL.LT.0) GO TO 60
 1700 IGKM=NGA
      IFL=IFLG
      GO TO 310
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 1710 IFL=17                                                            DVDQ1244
      IFLAG=9                                                           DVDQ1245
      IGKM=NGA                                                          DVDQ1246
      GO TO 315                                                         DVDQ1247
C     ENTRY WITH IFL=11 AND 12                                          DVDQ1248
C     SET PARAMETERS TO INDICATE A GSTOP HAS BEEN FOUND                 DVDQ1249
 1720 GT(NSTOP)=0.                                                      DVDQ1250
 1730 LGSE=1                                                            DVDQ1251
      IGKM=NGA                                                          DVDQ1252
      TG=TL                                                             DVDQ1253
      IF (IFLG) 1740,1760,1770                                          DVDQ1254
 1740 IF (IFL.LT.13) GO TO 1750                                         DVDQ1255
      IF (IFLG.EQ.(-20)) GO TO 100                                      DVDQ1256
      IFL=-IFLG                                                         DVDQ1257
      GO TO 310                                                         DVDQ1258
 1750 HH=H                                                              DVDQ1259
      GO TO 200                                                         DVDQ1260
 1760 TPD=0.                                                            DVDQ1261
      T=TL                                                              DVDQ1262
      LGSE=-2                                                           DVDQ1263
      GO TO 1300                                                        DVDQ1264
 1770 IF (IFLG-3) 220,200,200                                           DVDQ1265
 1780 IF (LGSE.EQ.(-1)) GO TO 1790                                      DVDQ1266
      LGSE=-1                                                           DVDQ1267
      GO TO 1220                                                        DVDQ1268
 1790 TPD=RG(3)                                                         DVDQ1269
      T=TL+TPD*HH                                                       DVDQ1270
      IF (LGSE.NE.(-1)) GO TO 1670                                      DVDQ1271
      IFL=IFLS                                                          DVDQ1272
      LGSE=-3                                                           DVDQ1273
      GO TO 1680                                                        DVDQ1274
 1800 IF (LGSE+2) 1550,1500,310                                         DVDQ1275
 1810 IF (TPD.LE.0.) GO TO 310                                          DVDQ1276
      LGSE=-2                                                           DVDQ1277
 1820 IFLG=IFL                                                          DVDQ1278
      IFL=17                                                            DVDQ1279
      IFLAG=9                                                           DVDQ1280
      IF (LGSD .GT. 0) GO TO 1530                                       DVDQ1281
      GO TO 1540                                                        DVDQ1282
      END                                                               DVDQ1283
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