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A COMPUTER PROGRAM FOR CALCULATING INVISCID, ADIABATIC FLOW ABOUT BLUNT BODIES TRAVELING AT SUPERSONIC AND HYPERSONIC SPEEDS AT ANGLE OF ATTACK

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16. Abstract

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SUMMARY

This paper is a user's manual for a computer program which calculates inviscid plane, axisymmetric, and three-dimensional flow about blunt bodies traveling at supersonic and hypersonic speeds in a uniform free stream. An exact time-dependent finite-difference method of second-order accuracy which is described in NASA TN D-6283 is used. The bodies which can be treated include plane and axisymmetric bodies with sharp shoulders and smooth nonaxisymmetric bodies. Equilibrium-air and perfect-gas thermodynamic models can be used. A procedure for approximating equilibrium gases with the perfect-gas model is described. The results of the program include the shock-wave location and the flow properties at a number of grid points on the body surface, on the shock wave, and in the region between the body and shock. The paper contains descriptions of the input and output, a Fortran IV program listing, and an input and output for a sample case.

INTRODUCTION

This paper is a user's manual for a computer program which calculates inviscid plane, axisymmetric, and three-dimensional flow about blunt bodies traveling at supersonic and hypersonic speeds in a uniform free stream. The bodies which can be treated include plane and axisymmetric bodies with sharp shoulders and smooth nonaxisymmetric bodies. Equilibrium-air and perfect-gas thermodynamic models can be used. A curve fit is used in connection with the equilibrium-air model. A procedure for approximating equilibrium gases with the perfect-gas model is described. The results of the program include shock-wave location and the flow properties at a number of grid points on the body surface, on the shock wave, and in the region between the shock and body.

The numerical method which is employed is an exact time-dependent finite-difference method of second-order accuracy and is described in detail in references 1 and 2. Results for steady flow are obtained with time-dependent methods by applying them to the solution of initial-value problems. An approximate method is employed to determine a starting solution at the initial time. The time-dependent method is used to calculate the solution at subsequent time steps. Results for steady flow are obtained after many time steps when the difference in the solutions at consecutive time steps is sufficiently small.

A Fortran IV program listing is given in appendix A, and a sample input and output are given in appendixes B and C, respectively. The minimum number of computer storage locations required to execute the program on the CDC 6600 computer is $70\,000_8$.

SYMBOLS

a	speed of sound
B_s	bluntness of initial shock shape
C_τ	time-step coefficient
d	length characteristic of subsonic region of blunt-body flow field
e	internal energy (heat of formation chosen so that $e = 0$ at $T = 0^\circ$ K)
$f(\epsilon/\epsilon_{max})$	function plotted in figure 9
g	function which accounts for nonorthogonal nature of computational coordinate system
h	static enthalpy (heat of formation chosen so that $h = 0$ at $T = 0^\circ$ K)
I	index which indicates method of solution at points of curvature discontinuity on body
j	number: $j = 0$ for plane and axisymmetric flow fields; $j = 1$ for three-dimensional flow fields
K_i	curvature of ith segment of reference-surface generator
k_1,k_2,k_3,k_4	values of l where curvature of reference surface changes
l,m,n	grid indices for X-, Y-, and Φ-coordinates

M	Mach number
N_i	number of mesh spacings ΔX on ith reference-surface segment
p	static pressure
R	perpendicular distance from axis of initial shock shape
$R_{b,i}$	radius of curvature of ith body segment
R_s	nose radius of initial shock shape
r	perpendicular distance from axis of reference surface
S_i	arc length of ith body segment
T	absolute temperature
u,v,w	velocity components
V	magnitude of total velocity
X	distance along reference-surface generator from axis
x	distance along axis of reference surface from intersection with body surface
x_o	distance shown in figure 7
x_1,x_2,x_3	Cartesian coordinates
Y	quantity proportional to distance from body along lines perpendicular to reference surface: $Y = 0$ at body; $Y = 1$ at shock
y_b	distance from reference surface to body along normals to reference surface
y_{bo}	constant value of y_b
α	angle of attack

γ	ratio of specific heats
$\tilde{\gamma}$	ratio of static enthalpy h to internal energy e (heat of formation chosen so that $h = e = 0$ at $T = 0^{\circ}$ K)
$\Delta X, \Delta Y, \Delta \Phi$	mesh spacings for X-, Y-, and Φ-coordinates
$\Delta \tau$	mesh spacing for time given by equation (8)
δ	distances between shock and body along normal to reference surface
ϵ	damping coefficient
$\bar{\zeta}$	reference length used to normalize distance
θ	angle between normal to reference surface and axis of reference surface
λ	scale factor for X-coordinate
ρ	density
τ	time
Φ	azimuthal angle
χ	distance along axis of initial shock from intersection with shock
χ_o	distance shown in figure 7
ω	distance from origin of x_1,x_2,x_3 coordinate system

Subscripts:

f	largest value of grid indices l,m,n
max	maximum value
min	minimum value
s	quantity evaluated immediately behind normal shock

t quantity evaluated at stagnation point

∞ quantity evaluated in free stream

Barred quantities are dimensional, and unbarred quantities are nondimensional.

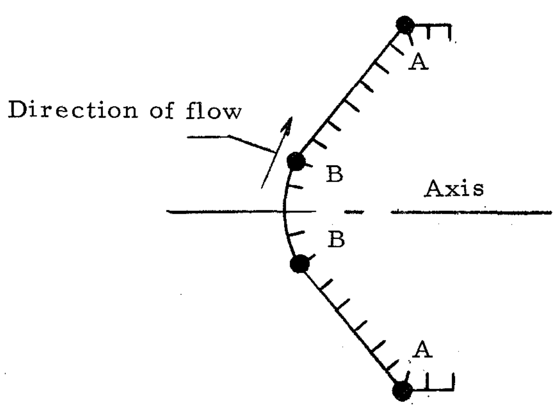
DISCUSSION

Type of Bodies Treated

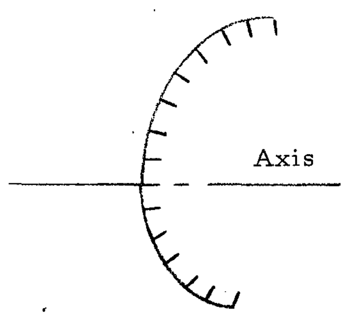
Supersonic flow fields about two classes of two- and three-dimensional bodies can be calculated with this program. Class I bodies are symmetric about an axis and can have discontinuities in both slope and curvature. Class II bodies must have continuous slope and curvature. Two-dimensional class II bodies are not required to be symmetric, but three-dimensional class II bodies must be symmetric with respect to a plane.

The generator of a class I body surface can have a maximum of four points of discontinuity in curvature or three points of discontinuity in curvature and one point of discontinuity in slope. The portion of the generator of a class I body immediately upstream of a discontinuity in slope where the flow becomes sonic (point A in fig. 1(a)) must be a segment of constant curvature (circular arc or straight-line segment). Also, the portions of the generator on either side of a discontinuity in curvature where the flow-property distributions have discontinuities in slope (point B in fig. 1(a)) must be segments of constant curvature. These requirements occur because of the way in which the program is formulated. The curvature of other portions of the surface generator of a class I body can vary continuously.

It is required that the flow fields about three-dimensional class II bodies have one plane of symmetry. Therefore, the free-stream velocity vector must be parallel to the



(a) Class I.



(b) Class II.

Figure 1. - Types of bodies treated.

plane of symmetry of the body. It should be noted that three-dimensional class I bodies are axisymmetric so that the flow fields about them always have one plane of symmetry.

Nondimensional Quantities

In this computer program, all lengths are normalized with some reference length $\bar{\xi}$ which is chosen by the user. The velocity components are made nondimensional with the magnitude of the free-stream velocity $\overline{V}_\infty$; the density, with the free-stream density $\bar{\rho}_\infty$; and the pressure, with the product $\bar{\rho}_\infty \overline{V}_\infty^{\,2}$. The speed of sound is made nondimensional with $\overline{V}_\infty$, the enthalpy and internal energy are normalized with $\overline{V}_\infty^{\,2}$, and the time is nondimensionalized with the quantity $\bar{\xi}/\overline{V}_\infty$. It should be noted that the nondimensional free-stream pressure is

$$p_\infty = \frac{\bar{p}_\infty}{\bar{\rho}_\infty \overline{V}_\infty^{\,2}} = \frac{1}{\gamma_\infty M_\infty^{\,2}} \tag{1}$$

where γ_∞ is the free-stream ratio of specific heats, and M_∞ is the free-stream Mach number.

Basic Geometry

Coordinate system.- A nonorthogonal computational coordinate system is used. This coordinate system is oriented with respect to a reference surface which is symmetric about an axis and which has a generator composed of segments of constant curvature (circular arcs and straight-line segments). The computer program is set up to use a maximum of five segments. An example of the computational grid for a three-dimensional flow field is shown in figure 2.

The region on one side of the symmetry plane is divided with a number of evenly spaced half-planes which pass through the axis. The angle Φ, which is used to identify the various half-planes, is measured from the leeward side of the symmetry plane. Each of the half-planes is subdivided with lines of constant X and Y. The coordinate X is the distance from the axis along the reference-surface generator. The grid lines of constant X are straight lines which are perpendicular to the reference surface and which are spaced so that the distance along the reference-surface generator between adjacent lines is the constant ΔX. The line $X = X_{max}$ must be located so that it is downstream of the sonic line in each half-plane of constant Φ. The quantity Y is a normalized variable which is measured along the lines normal to the reference surface and has the value 0 at the body surface and 1 at the shock wave.

As shown in figure 3, the distance from the body to the shock wave along the lines of constant X in each plane of constant Φ is designated as δ, and the distance from the

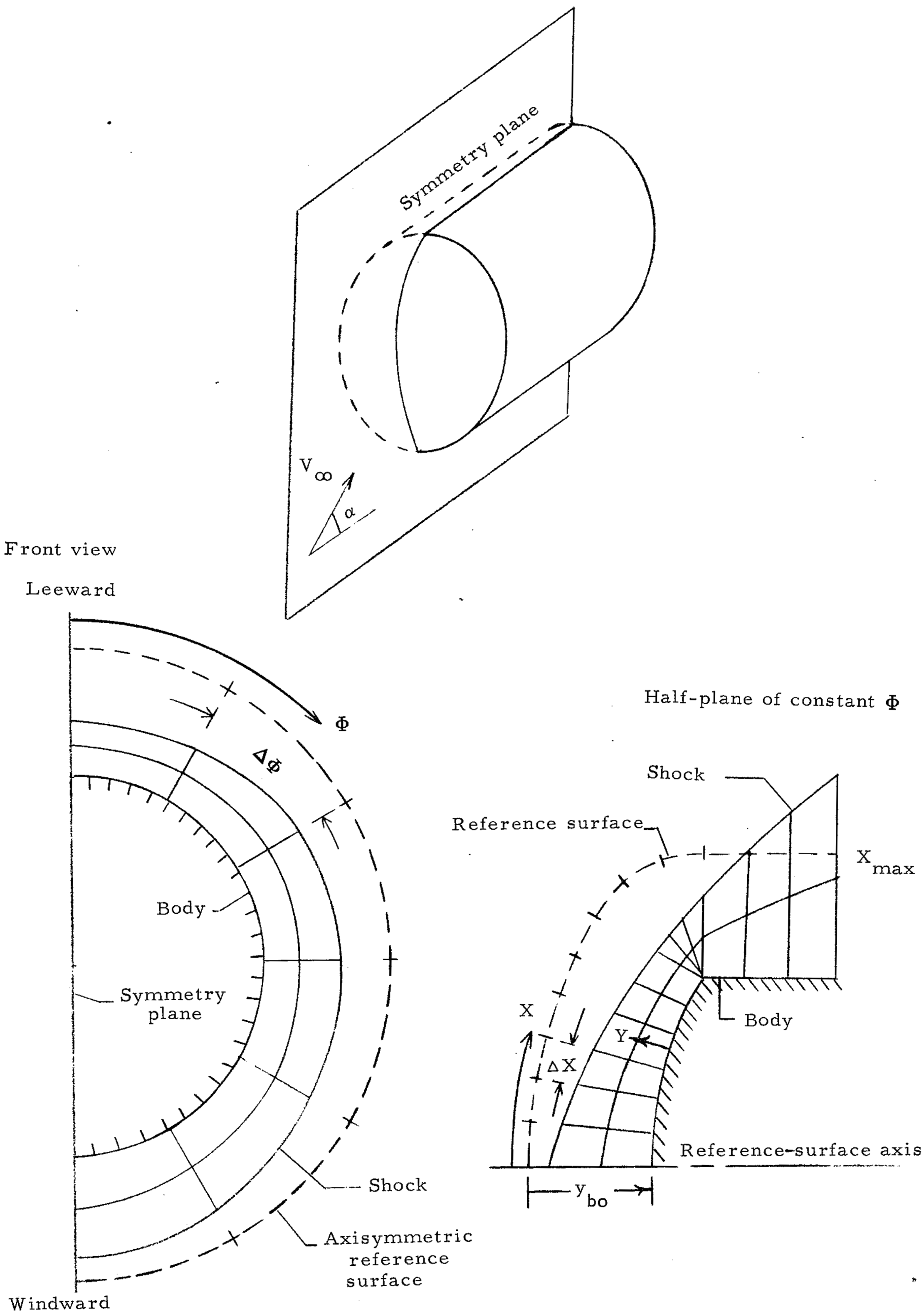


Figure 2. - Computational grid for sharp-shouldered axisymmetric body.

reference surface to the body surface along these lines is called y_b. The shock-layer thickness δ is a function of time τ as well as of X and Φ because the position of the shock wave adjusts with time during the course of the computation. In general, the distance y_b is a function of X and Φ. The velocity components which are used are oriented with respect to the reference surface rather than the body surface. The component u lies in the plane of constant Φ and is perpendicular to the normal to the reference surface; the component v is in the direction of the normal to the reference surface; and the component w is perpendicular to the plane of constant Φ.

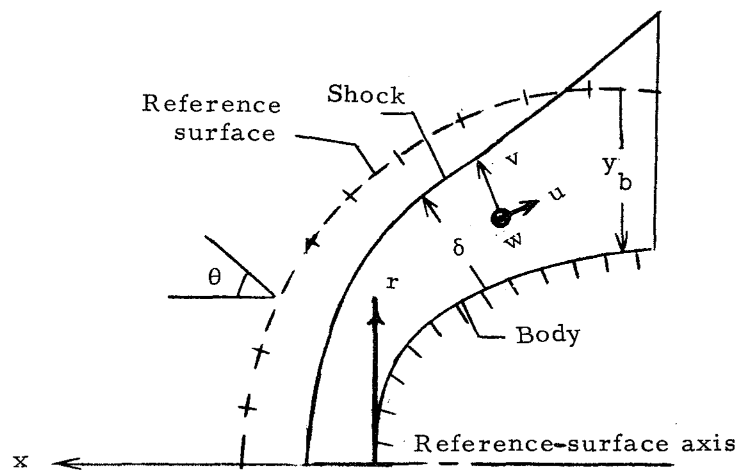


Figure 3.- Velocity components, auxiliary coordinates, and geometric parameters.

An auxiliary coordinate system x,r is used to locate points in the planes of constant Φ. In this system, which is shown in figure 3, the coordinate r is the perpendicular distance from the axis of the reference surface, and the coordinate x is the distance from the body along the axis in the upstream direction. The angle between the normal to the reference surface and the direction of the axis is denoted by θ.

The points of discontinuity in curvature and slope on the body-surface generator of class I bodies must lie on normals to the reference surface which pass through the points of discontinuity on the reference-surface generator. Because of the way in which the computer program is set up, the distance $y_b(X,\Phi)$ from the reference surface to the body surface along normals to the reference surface must have a constant value y_{bo} for the segment of the body surface located immediately upstream of a sharp sonic corner (point A in fig. 1(a)) and for the segments on either side of a point of discontinuity in curvature on the body-surface generator where the flow-property distributions have discontinuities in slope (point B in fig. 1(a)). It should be noted that when $y_b(X,\Phi) = y_{bo}$, straight-line segments on the reference-surface generator are paired with parallel straight-line segments on the body-surface generator, circular arcs on the reference-surface generator are paired with concentric circular arcs on the body-surface generator, and a circular arc on the reference-surface generator with a radius of y_{bo} subtends a sharp corner on the body-surface generator. Also, when $y_b(X,\Phi) = y_{bo}$, the velocity components are oriented with respect to the body surface as well as the reference surface.

Grid indices.- The grid indices which are used for the X-, Y-, and Φ-coordinates are l, m, and n, respectively. The following grid indices are used for the boundary locations:

Axis (X = 0) . . . . $l = 1$
Line $X = X_{max}$ . . . . $l = l_f$
Body . . . . $m = 1$
Shock . . . . $m = m_f$
Leeward side of symmetry plane ($\Phi = 0$) . . . . $n = 1$
Windward side of symmetry plane ($\Phi = 180^o$) . . . . $n = n_f$

The curvature of the reference-surface generator can be discontinuous at four points. The indices of these points are $l = k_1, k_2, k_3$, and k_4 where $k_1 < k_2 < k_3 < k_4$. The grid indices for the body shown in figure 2 are given in figure 4.

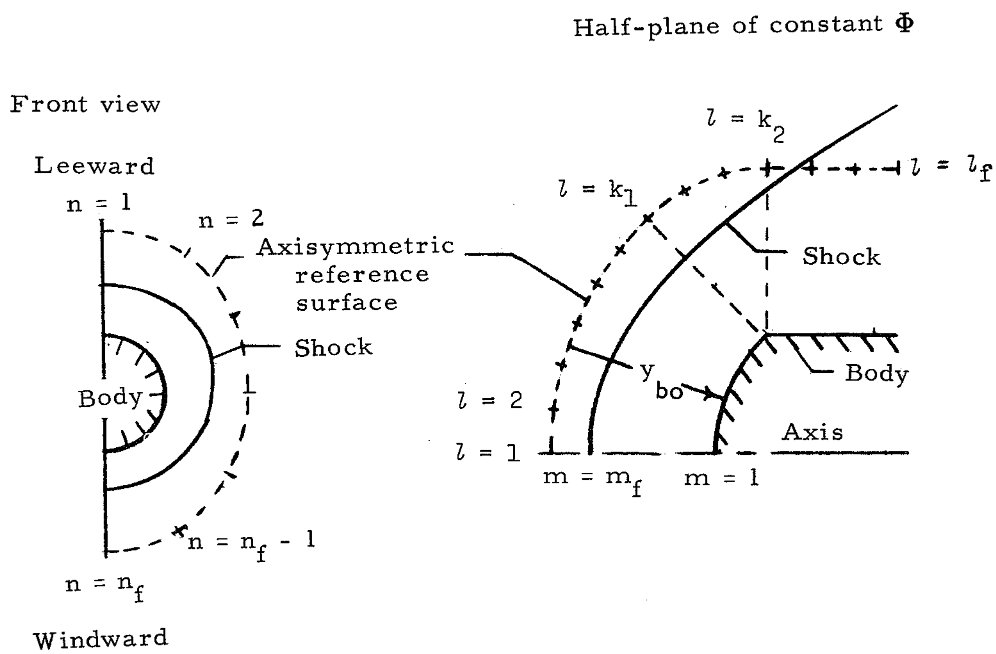


Figure 4.- Grid indices for sharp-shouldered axisymmetric body.

The values of the indices l_f, m_f, n_f, k_1, k_2, k_3, and k_4 must be supplied by the user. Because of the way in which the program is set up, the value of m_f cannot be less than 3. For axisymmetric flow or symmetric two-dimensional flow, only one plane of constant Φ is needed; therefore, n_f can be set equal to 1. For nonsymmetric two-dimensional flow n_f must have a value of 2. The program is written so that each segment of the reference-surface generator except the first must have a length of not less than $3\ \Delta X$. The first segment must have a length of at least $2\ \Delta X$. Therefore, the indices of the points of discontinuity must satisfy the relations

$$\left.\begin{aligned} & k_1 \geqq 3 \\ & k_i \geqq k_{i-1} + 3 \qquad\qquad (i = 2,3,4) \end{aligned}\right\} \tag{2}$$

The unused indices k_i should be set equal to some number greater than l_f.

Geometry Input for Class I Bodies

Consider class I bodies for which $y_b(X,\Phi) = y_{bo}$. Let S_i and $R_{b,i}$ $(i = 1,. . .,5)$ be the arc lengths and radii of curvature of the segments of the body-surface generator. The curvature of each of the corresponding segments of the reference surface is determined with the equation

$$K_i = \frac{1}{R_{b,i} + y_{bo}} \qquad (i = 1,. . .,5) \tag{3}$$

The body shown in figure 4 is a class I body with a generator which, for the purposes of this program, is considered to be composed of three segments. The second segment is associated with the corner and has an arc length S_2 and a radius of curvature $R_{b,2}$ of zero. However, the ratio $S_2/R_{b,2}$ is a finite number equal to the angle between the lines normal to the upstream and downstream surfaces at the corner. In this program, the curvatures of convex and concave arcs are positive and negative, respectively. The radius of curvature of an arc has the same sign as the curvature of that arc. For example, the arcs on the generators of the reference surface and body surface shown in figure 4 are convex and hence have positive curvatures and radii of curvature. All arc lengths are considered to be positive.

All arcs of the reference-surface generator must be integral multiples of ΔX. If the body surface is located a constant distance y_{bo} from the reference surface, the mesh spacing ΔX is related to the quantities S_i, $R_{b,i}$, and y_{bo} by the equation

$$\Delta X = \frac{S_i}{N_i}\left(\frac{R_{b,i} + y_{bo}}{R_{b,i}}\right) \tag{4}$$

where N_i is the number of mesh spacings associated with the ith segment of the body surface. If the body-surface generator has only one segment with a radius of curvature $R_{b,1}$, the values for the quantities S_1, N_1, and y_{bo} can be chosen independently. If the body-surface generator has two segments with radii of curvature $R_{b,1}$ and $R_{b,2}$, the values of the quantities S_1, S_2, N_1, and N_2 can be chosen independently, but the value of y_{bo} must satisfy the equation

$$\frac{S_1}{N_1}\left(\frac{R_{b,1} + y_{bo}}{R_{b,1}}\right) = \frac{S_2}{N_2}\left(\frac{R_{b,2} + y_{bo}}{R_{b,2}}\right) \tag{5}$$

If the body-surface generator has more than two segments of constant curvature, all of the quantities $R_{b,i}$, S_i, and N_i $(i = 1,2,\text{etc.})$ cannot be chosen independently if $y_b(X,\Phi) = y_{bo}$ for all the segments. The index k_i is related to the number N_i of mesh spacings ΔX on the ith arc by the equations

$$k_1 = 1 + N_1$$

$$k_i = k_{i-1} + N_i \qquad (i = 2,3,4)$$

Spherical cap-cylinder.- Consider the spherical cap-cylinder shown in figure 4. Let the scaling length be the radius of the cylinder $\bar{r}_b$ so that the nondimensional radius of the cylinder is 1, and assume that $y_b(X,\Phi) = y_{bo}$ as shown. Let the nose radius have the value $\sqrt{2}$. It follows that the arc length S_1 has the value $(\pi/4)\sqrt{2}$. The radius $R_{b,2}$ and arc length S_2 of the corner are both zero, but the ratio $S_2/R_{b,2}$ is $\pi/4$. The radius of the segment of the body-surface generator for the cylinder $R_{b,3}$ is ∞, and the arc length S_3 is unspecified. From figure 4 it is seen that $k_1 = 7$ and $k_2 = 10$. It follows from equations (5) and (4), respectively, that $y_{bo} = \sqrt{2}$ and $\Delta X = \sqrt{2}\pi/12$. From equation (3) it is found that the curvature for the segments of the reference-surface generator are $K_1 = \sqrt{2}/4$, $K_2 = \sqrt{2}/2$, and $K_3 = 0$.

Spherically blunted cone-cylinder.- Consider a spherically blunted cone-cylinder with a sharp corner at the junction of the cone and cylinder, a cone semiapex angle of 60°, and a ratio of nose radius to base radius equal to 0.5 as shown in figure 5. The scaling length is chosen to be the cylinder radius $\bar{r}_b$. The indices k_1, k_2, and k_3 are chosen to have values of 4, 10, and 13, respectively. Also, $S_1 = \pi/12$; $R_{b,2} = \infty$; $S_2 = \sqrt{3}/2$; $R_{b,3} = 0$; $S_3 = 0$; and $R_{b,4} = \infty$. From equations (5) and (4), the values of the quantities y_{bo} and ΔX are found to be

$$y_{bo} = \frac{1}{2}\left(\frac{3\sqrt{3}}{\pi} - 1\right) \approx 0.32699334$$

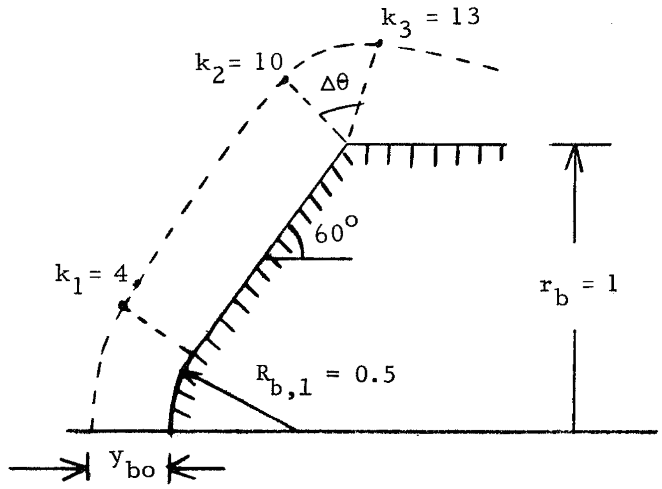


Figure 5.- Reference surface for spherically blunted cone-cylinder with cone semiapex angle of 60° and ratio of nose radius to base radius equal to 0.5.

and

$$\Delta X = \frac{\pi}{36}\left(1 + 2y_{bo}\right) = \sqrt{3}/12 \approx 0.14433757$$

From equation (3) it is found that

$$K_1 = \frac{2\pi}{3\sqrt{3}} \approx 1.2091996$$

$$K_2 = 0$$

$$K_3 = \frac{2\pi}{3\sqrt{3} - \pi} \approx 3.0581662$$

$$K_4 = 0$$

It should be noted that the product $K_3 y_{bo}$ must not differ from 1 by more than 1×10^{-6} if the sharp-corner option is to be activated. The angle subtended by the third segment is

$$\Delta\theta = \frac{3\ \Delta X}{y_{bo}} = \frac{\sqrt{3}/2}{3\sqrt{3} - \pi}\ \pi \approx 1.3242248 \text{ rad} \approx 75.872493^\circ$$

The function $y_b(X,\Phi)$ is equal to the constant y_{bo} for values of X not greater than $12\ \Delta X$ (in other words, $l \leqq k_3 = 13$). For values of X greater than $12\ \Delta X$, the equation for $y_b(X,\Phi)$ is

$$y_b(X,\Phi) = y_{bo} - (X - 12\ \Delta X)\tan\left(\Delta\theta - \frac{\pi}{3}\right) = y_b(X)$$

Geometry Input for Class II Bodies

For class II bodies it is recommended that a one-segment reference-surface generator be used so that curvature discontinuities do not occur on the reference surface. However, it should be noted that this is a recommendation and not a requirement. The expression for $y_b(X,\Phi)$ must be derived for each body and reference surface. It should be noted that y_b is defined as the distance from the reference surface to the body surface along normals to the reference surface and is positive when the reference surface lies outside the body as it does in figures 2, 3, 4, and 5.

A prolate spheroid is an example of a class II body. This shape is generated by rotating an ellipse about its major axis. The body which is considered here has semimajor and semiminor axes of 1 and 2/3, respectively, and is alined so that the major axis is normal to the free-stream direction. This body is shown in figure 6.

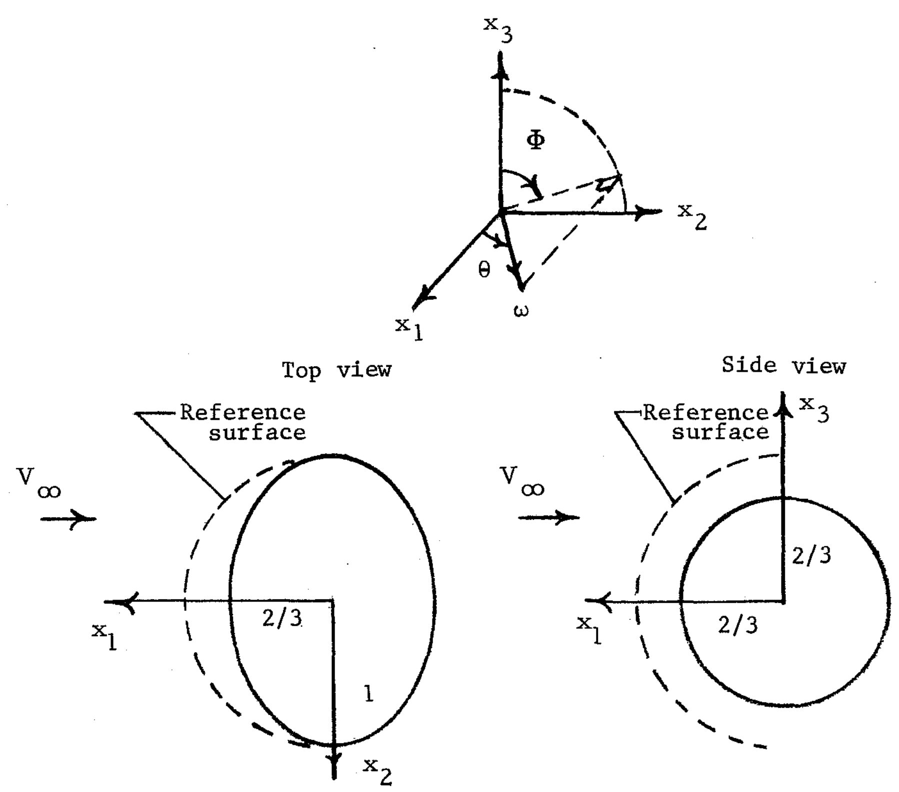


Figure 6.- Prolate spheroid with axis ratio of 2/3.

The coordinates x_1, x_2, and x_3 are related to the angles θ and Φ and the distance from the origin ω by the equations

$$x_1 = \omega \cos \theta$$

$$x_2 = \omega \sin \theta \sin \Phi$$

$$x_3 = \omega \sin \theta \cos \Phi$$

The equation for the prolate spheroid is

$$\left(\frac{x_1}{2/3}\right)^2 + x_2^2 + \left(\frac{x_3}{2/3}\right)^2 = 1$$

It follows that the distance from the origin to a point on the surface is $\dfrac{2}{\sqrt{9 - 5 \sin^2\theta \sin^2\Phi}}$.

The reference surface is chosen to be a sphere with the curvature $K_1 = 1$. Therefore, the distance y_b from the reference surface to the body along lines normal to the reference surface is

$$y_b(X,\Phi) = 1 - \frac{2}{\sqrt{9 - 5 \sin^2\theta \sin^2\Phi}}$$

Initial Values

The shape of the initial shock wave which is used in this computer program is a conic section of revolution with the axis of symmetry alined with the free-stream direction. The plane of symmetry of a typical flow field is shown in figure 7.

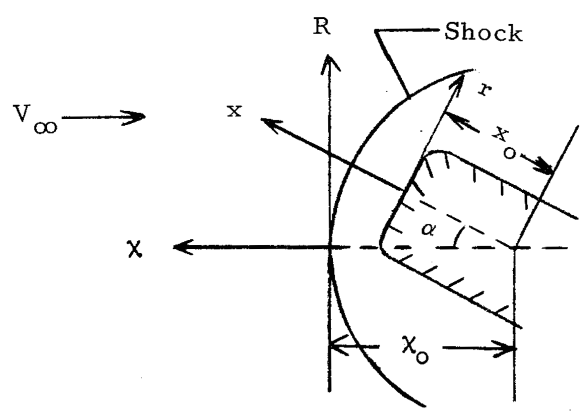


Figure 7.- Coordinate system for initial shock shape.

The quantity α is the angle of attack. The x,r coordinate system has already been introduced. The χ,R coordinate system is oriented with respect to the initial shock as shown in the figure. The initial shock shape is specified by the equation

$$R^2 = -2R_s\chi - B_s\chi^2 \tag{6}$$

where R_s is the nose radius of curvature and B_s is the bluntness. The bluntness values are -1 for a hyperbola, 0 for a parabola, 1/2 for a prolate ellipse, 1 for a circle, and 2 for an oblate ellipse. It should be noted that the major axis of a prolate ellipse and the minor axis of an oblate ellipse are alined with the χ-axis. The initial shock shape for a given angle of attack α is specified by the parameters x_o, χ_o, R_s, and B_s. These quantities must be supplied by the user. An approximate location for the shock wave can be determined from experimental or theoretical results for similar bodies and flight conditions or from empirical formulas such as those of Kaattari (refs. 3 and 4).

It is assumed that the shock is not moving initially. Therefore, the flow properties at the initial shock wave can be determined from the assumed shape and the Rankine-Hugoniot equations. The initial surface-pressure distribution is assumed to be Newtonian. There are several exceptions. At sharp shoulders where the flow would otherwise be subsonic the pressure is adjusted to a sonic value. If stagnation pressure is not achieved anywhere on the surface, the pressures are scaled up so that the largest pressure is the stagnation pressure. This situation arises for a flat-face cylinder at angle of attack. In shielded or wind-shadow regions the surface pressure is assumed to be equal to that at the last unshielded point in the same plane of constant Φ. There is a provision for specifying a minimum surface pressure p_{min} for the initial solution. The density at the surface is determined with the normal-shock entropy, and the surface velocity components are determined from the total enthalpy and the Newtonian streamlines. The flow properties at points between the shock and surface are determined by interpolation.

It is the opinion of the authors that the most important part of establishing the initial solution is positioning the shock wave as accurately as possible. In many cases, a considerable amount of computer time is required to move the shock wave a long distance. It is not of particular importance to determine the flow properties at the grid points with great accuracy. If the shock wave is accurately positioned, it will require about the same amount of computer time to obtain a converged solution from very good initial data for the flow properties as from fair data. As an illustration of this feature, consider a converged solution. Now, let this solution be altered at one grid point in the subsonic region. If the time-dependent calculation is continued, this disturbance will travel outward from the grid point, in the form of acoustic waves as shown in figure 8. If d is a characteristic length for the subsonic portion of the flow field and a_t is the speed of sound at the

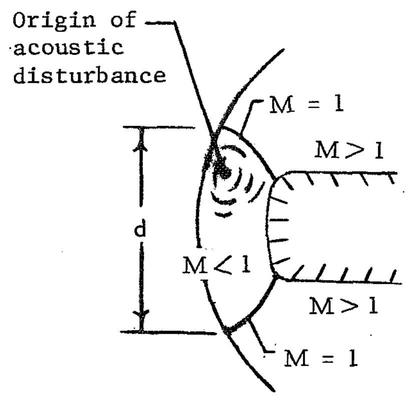


Figure 8.- Acoustic waves propagating from point of disturbance.

stagnation point, the time required to reestablish steady flow is of the order of 1 to 10 times the characteristic time d/a_f.

Thermodynamic Models

The flow of perfect gases and equilibrium air can be calculated with this computer program. The task of the thermodynamic routine, which is contained in a subroutine of the program, is to determine the speed of sound a and $\tilde{\gamma}$, the ratio of static enthalpy per unit mass h to internal energy per unit mass e, for given values of e and the density ρ. It should be noted that the heat of formation of the gas must be chosen so that $h = e = 0$ for $T = 0^{\circ}$ K.

Perfect gas.- For a perfect gas, $\tilde{\gamma}$ is a constant which is supplied by the user, and the speed of sound is simply

$$a = \sqrt{\tilde{\gamma}(\tilde{\gamma} - 1)e}$$

The program is formulated so that $\tilde{\gamma}$ can be given one value in the free stream and another value in the shock layer between the shock wave and the body surface. This provision permits the approximation of real-gas phenomena with a perfect-gas model. It should be noted that if the free stream is cold, the free-stream value of $\tilde{\gamma}$ is the same as the free-stream ratio of specific heats γ_∞. A value of $\tilde{\gamma}$ which is suggested for use in the shock layer is the normal-shock value $\tilde{\gamma}_s$. This quantity is related to the normal-shock density ratio $\bar{\rho}_s/\bar{\rho}_\infty$, the free-stream Mach number M_∞, and γ_∞ by the equation

$$\tilde{\gamma}_s = \frac{\dfrac{\bar{\rho}_s}{\bar{\rho}_\infty} + \dfrac{1}{\gamma_\infty - 1}\left[\dfrac{2\bar{\rho}_s/\bar{\rho}_\infty}{M_\infty^2\left(\dfrac{\bar{\rho}_s}{\bar{\rho}_\infty} - 1\right)}\right] + 1}{\dfrac{\bar{\rho}_s}{\bar{\rho}_\infty} - \dfrac{1}{\gamma_\infty}\left[\dfrac{2\bar{\rho}_s/\bar{\rho}_\infty}{M_\infty^2\left(\dfrac{\bar{\rho}_s}{\bar{\rho}_\infty} - 1\right)}\right]\left(1 - \dfrac{\gamma_\infty}{\gamma_\infty - 1}\dfrac{\bar{\rho}_s}{\bar{\rho}_\infty}\right) - 1} \tag{7}$$

This equation is obtained by solving equations (23) in reference 5.

Equilibrium air.- The ratio $\tilde{\gamma} = h/e$ and the speed of sound for equilibrium air are determined with a curve fit which is discussed in references 2 and 5. This curve fit is valid for the following ranges of the density ρ and internal energy per unit mass e:

$$10^{-4} \leqq \bar{\rho}/\bar{\rho}_o \leqq 10 \qquad \text{and} \qquad \bar{e}/\overline{RT}_o \leqq 1500$$

where the reference quantities have the values

$$\bar{\rho}_o = 1.292 \text{ kg/m}^3 \ (2.507 \times 10^{-3} \text{ slugs/ft}^3)$$

$$\overline{RT}_o = 78.40 \text{ kJ/kg} \ (8.439 \times 10^5 \text{ ft}^2/\text{sec}^2)$$

The user must supply values of the free-stream density in kilograms per cubic meter and the free-stream velocity in meters per second. The user must also supply the value (1.405) for the free-stream ratio of specific heats γ_∞ and an approximate value for $\tilde{\gamma}$ in the shock layer. This value of $\tilde{\gamma}$, which is used to calculate the initial solution, can be obtained from equation (7). The density ratio $\bar{\rho}_s/\bar{\rho}_\infty$ in equation (7) can be obtained from tables of the equilibrium normal-shock properties of air for various velocities and altitudes, such as those in references 6 and 7.

It should be noted that the gas-model subroutine is written so that other equilibrium-gas models can be added to the program.

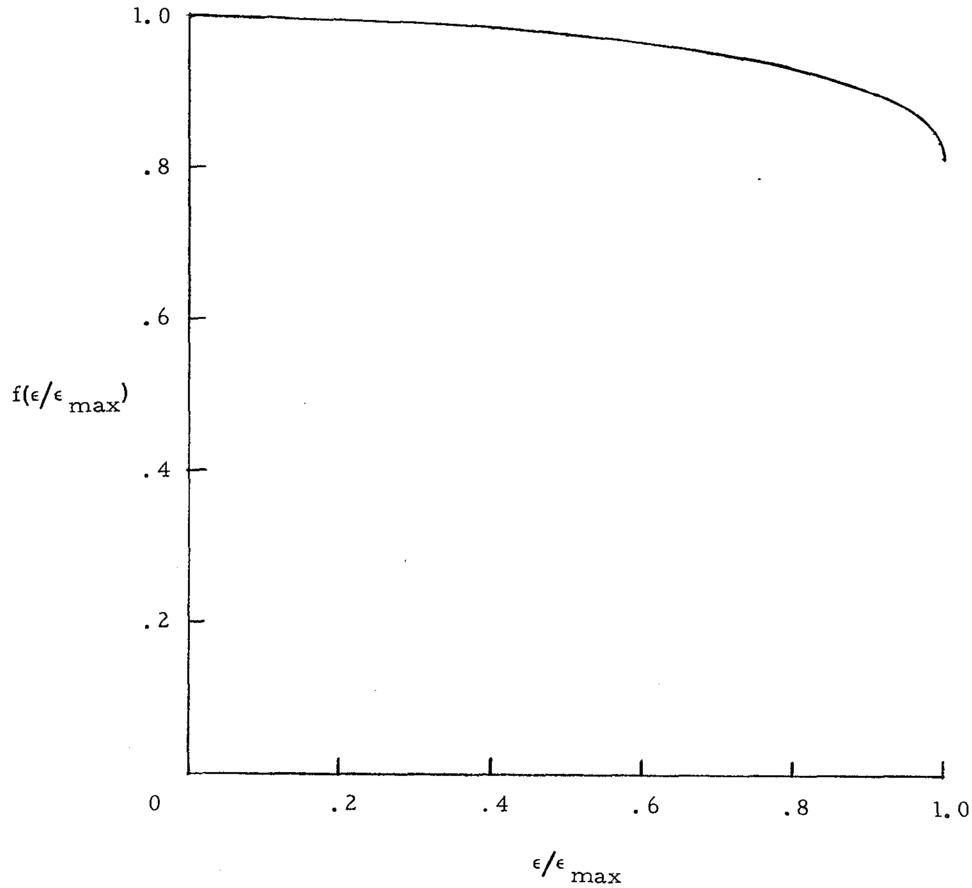


Figure 9.- Function which gives influence of damping coefficient on time-step coefficient.

Computational Parameters

The stability of the numerical calculation is governed by the time-step coefficient C_τ and the damping coefficient ϵ, which are specified by the user. The equation for the time step is

$$\Delta\tau = \frac{C_\tau g}{V + a} \min(\lambda\ \Delta X, \delta\ \Delta Y, r\ \Delta\Phi) \tag{8}$$

where V is the magnitude of the velocity, a is the speed of sound, g is a function of the independent variables and the shock-layer thickness which accounts for the nonorthogonal nature of the coordinate system, and λ is the scale factor for the X-coordinate. The function g, which is determined within the program, is obtained in appendix B of reference 2. The time step is calculated in subroutine DELTAT for each cycle.

Let the parameter j have values of 0 for plane or axisymmetric flow and 1 for three-dimensional flow. The damping coefficient must satisfy the inequalities

$$0 < \epsilon < \epsilon_{max} = \frac{1}{8(j + 2)} \tag{9}$$

The time-step coefficient C_τ must satisfy the inequality

$$C_\tau \leqq \frac{1}{\sqrt{j + 2}} f\left(\epsilon/\epsilon_{max}\right) \tag{10}$$

The function $f\left(\epsilon/\epsilon_{max}\right)$, which is derived in reference 2, is plotted in figure 9. As a general rule, the coefficient C_τ should be as large as possible. It has been found that a practical value of the damping coefficient is $\epsilon/\epsilon_{max} = 0.75$.

There are two options for calculating the flow at points on the body surface where the curvature changes discontinuously and where the flow is subsonic. These options involve the manner in which the scale factor in the governing equations is treated. In general, the first option (I = 1) should be used. However, if the flow-property distributions have severe discontinuities in slope at surface points where the flow is subsonic and where the curvature changes discontinuously, the second option (I = 0) must be chosen.

PROGRAM INPUT

The computer program has 16 fixed-point and 24 floating-point input parameters. The symbolic program name, the symbol used in the discussion section, and a brief description for each parameter are as follows:

Program name	Symbol	Description
IYREF1		Geometry index: 0, two dimensions; 1, three dimensions
LF, MF, NF	l_f, m_f, n_f	Largest values of grid indices for X-, Y-, and Φ-coordinates (see fig. 4)
DX	ΔX	Mesh spacing for X-coordinate
KURVE1, KURVE2, KURVE3, KURVE4	k_1, k_2, k_3, k_4	Values of X index where reference-surface generator changes curvature discontinuously (see inequalities (2))
CURVE1, CURVE2, CURVE3, CURVE4, CURVE5	K_1, K_2, K_3, K_4, K_5	Curvature of segments of reference-surface generator (see eq. (3))

Program name	Symbol	Description
YREFØ	y_{bo}	Perpendicular distance from reference surface to body surface (see figs. 2 and 4)
YREF1, YREF2, YREF3, YREF4		Unused floating-point parameters
IYREF2, IYREF3, IYREF4		Unused fixed-point parameters
RS	R_s	Nose radius of initial shock-wave shape
BS	B_s	Bluntness of initial shock-wave shape
XØ	x_o	Distance along axis of reference surface from body surface to intersection with axis of initial shock-wave shape (see fig. 7)
CXØ	χ_o	Distance along axis of initial shock-wave shape from shock surface to intersection with axis of reference surface (see fig. 7)
IGAS		Gas-model index: 0, perfect gas; 1, equilibrium air
DENSØ, VELØ	$\bar{\rho}_\infty,\bar{V}_\infty$	Free-stream density and magnitude of velocity in kg/m^3 and m/sec, respectively, which are used in equilibrium-air thermodynamic model
GAMMA	γ_∞	Free-stream ratio of specific heats
GAMM	$\tilde{\gamma}$	Ratio of static enthalpy h to internal energy e in region between shock and body (see section entitled "Thermodynamic Models")
PINF	p_∞	Nondimensional free-stream pressure (see eq. (1))
ALPHAD	α	Angle of attack in deg
KPØ		First time cycle at which output is printed

Program name	Symbol	Description
KPP		Number of time steps between successive printing cycles
KF		Index for final time step
IYREFØ	I	Index governing computation of body points where curvature is discontinuous (see section entitled "Computational Parameters")
CT	C_T	Time-step coefficient (see inequality (10))
EPSI	ϵ	Damping coefficient (see inequality (9))
PMIN	p_{min}	Minimum nondimensional surface pressure for initial solution

The program is set up to use reference-surface generators with a maximum of five segments of constant curvature and four points of curvature discontinuity. If it is desired to use fewer than the maximum number of segments, the unused indices KURVE4, KURVE3, and so forth should be set equal to some number greater than LF. Some value should be given to all unused parameters such as the curvature CURVE5, CURVE4, and so forth of the unused segments of the reference-surface generator and the quantities VELØ and DENSØ when a perfect gas is being treated.

The distance $y_b(X,\Phi)$ from the reference surface to the body surface along lines normal to the reference surface is specified in subroutine START. The equation for y_b which is used in this program is

$$y_b(X,\Phi) = y_{bo} \tag{11}$$

Thus, class I bodies which are located a constant distance from the reference surface along lines normal to the reference surface can be treated without any changes to the computer program. The symbolic program statement for equation (11) is YREF(L,N) = YREFØ. This statement immediately precedes statement number 4 in subroutine START.

In order to treat class II bodies and class I bodies which are not located a constant distance from the reference surface, it is necessary to replace the statement for YREF(L,N) in the program. It should be noted that the angles $\theta(X)$ and Φ are known at this point in the program and have the program names THETA(L) and PHI. Several unused fixed-point and floating-point parameters have been provided for use as the need arises. It is suggested that these parameters can be used in the new program statement for YREF(L,N). It is emphasized that the parameter YREFØ should not be used in any statement other than the one discussed above.

The program treats class I bodies with corners. The curvature of the arc of the reference-surface generator subtending the corner is $1/y_{bo}$ (1./YREFØ). In order to actuate the sharp-corner option of the program, the product of the value of the curvature of the arc subtending the corner and the value of YREFØ can differ from 1 by no more than 1×10^{-6}.

PROGRAM OUTPUT

The first quantities to be output are the geometry parameters for the reference and body surfaces. These are

Program name	Notation	Description
THETA(L)	$\theta(X)$	Angle between normal to reference surface and free-stream direction (see fig. 3)
CURV2(L)	K	Curvature of reference surface
XREF(L), RREF(L)		Coordinates x and r of points on reference surface
YREF(L,N)	$y_b(X,\Phi)$	Distance from reference surface to body surface along normals to reference surface
PYBPX(L,N)	$\partial y_b/\partial X$	Partial derivative
PYBPPH(L,N)	$\partial y_b/\partial \Phi$	Partial derivative

The complete solution at each grid point is output for the initial cycle (K = 0) and the regular printing cycles (K = KPØ, KPØ + KPP, KP0 + 2KPP, . . .). The output for each grid point is composed of four fixed-point numbers and 12 floating-point numbers. Four additional floating-point numbers are output for points on the shock wave. For each printing cycle the nondimensional time which has elapsed since the calculation started is printed. The unit time is $\bar{l}/\bar{V}_\infty$. The program name for this quantity is TIME.

Program name	Notation	Description
K		Time index
L	l	Index for X-coordinate ($L = 1$ at $X = 0$ and $L = LF$ at $X = X_{max}$)

Program name	Notation	Description
M	m	Index for Y-coordinate ($M = 1$ at body and $M = MF$ at shock)
N	n	Index for Φ-coordinate ($N = 1$ at $\Phi = 0^{\circ}$ and $N = NF$ at $\Phi = 180^{\circ}$)
UN, VN, WN	u,v,w	X-, Y-, and Φ-components of velocity made nondimensional with $\overline{V}_{\infty}$
RHØ	ρ	Density made nondimensional with $\bar{\rho}_{\infty}$
P(L,M,N)	p	Pressure made nondimensional with $\bar{\rho}_{\infty}\overline{V}_{\infty}{}^{2}$
H(L,M,N)		Total enthalpy made nondimensional with $\overline{V}_{\infty}{}^{2}$
PHI	Φ	Azimuthal angle
RAD, XAD	r,x	Perpendicular distance from axis of reference surface and distance along axis from body surface in upstream direction (see fig. 7)
GAMM	$\tilde{\gamma}$	Ratio of static enthalpy h to internal energy e
ENTRØP	$p/\rho^{\tilde{\gamma}}$	Function of entropy for perfect gas
AMACH	M	Mach number
DELTA(1,L,N)	$\delta(X,\Phi,\tau)$	Distance between shock and body along normal to reference surface
PDPT(1,L,N)	$\partial\delta/\partial\tau$	Component of shock velocity in direction normal to reference surface
PDPX(1,L,N)	$\partial\delta/\partial X$	Partial derivative
PDPPH(1,L,N)	$\partial\delta/\partial\Phi$	Partial derivative

PROGRAM DETAILS

Arrays Used in Program

A number of arrays are used in the program. Many of these arrays are functions of L,M, and N, the indices for the X-, Y-, and Φ-coordinates. The arrays which depend on L,M, and N are

A1(L,M,N), A2(L,M,N), A3(L,M,N), A4(L,M,N), A5(L,M,N), H(L,M,N), P(L,M,N), R(L,M,N), U(L,M,N), V(L,M,N), W(L,M,N), C1A(L,I1,N), C2A(L,I1,N), C3A(L,I1,N), C4A(L,I1,N), C5A(L,I1,N), C1AØ(I2,I1,N), C2AØ(I2,I1,N), C3AØ(I2,I1,N), C4AØ(I2,I1,N), C5AØ(I2,I1,N), DELTA(I3,L,N), PDPT(I3,L,N), PDPX(I3,L,N), PDPPH(I3,L,N), D1A(L,I1), D2A(L,I1), D3A(L,I1), D4A(L,I1), D5A(L,I1), YREF(L,N), PYBPX(L,N), PYBPPH(L,N), THETA(L), CURV2(L), RREF(L), XREF(L)

The arrays are dimensioned for maximum values of L,M, and N of 17, 6, and 9, respectively. These maximum values can be changed by the user if necessary. The maximum values of the indices I1, I2, and I3 are 3, 4, and 2, respectively, and should not be changed.

Error Statements

The program contains five error statements which are located in three of the subroutines. The triggering of any of these statements results in the termination of the calculation.

Subroutine DELTAT.- The error statement in this subroutine is triggered when the nondimensional quantity $V + a$ in equation (8) is less than 1×10^{-12}. When this occurs, the calculation is clearly unstable. The quantities which are printed in the error statement are the time index, the position indices of the point where the instability occurs, and

$$Y\delta - y_b, \lambda, \delta, r, \Delta X, \Delta Y, \Delta\Phi, \lambda\ \Delta X, r\ \Delta\Phi, \min(\lambda\ \Delta X, \delta\ \Delta Y, r\ \Delta\Phi)$$

The error statement is followed by the complete output at the previous time step. The suggested remedy for avoiding the instability is to decrease the coefficient C_T. If the instability occurs repeatedly for smaller and smaller values of C_T, a more fundamental problem which is peculiar to the particular case may be present.

Subroutine SHOCK.- There are two error statements in this subroutine, both of which indicate a breakdown in the solution of a cubic equation at the shock wave. Let CSSHK be the cosine of the angle between the outward normal to the shock and the free-stream direction, and let CSBX, CSBY, and CSBP be the direction cosines of the shock normal. The breakdown of the solution generally occurs because the shock wave develops a kink, the magnitude of CSSHK becomes so small that the discontinuity can no longer be interpreted as a shock wave, or the flow at the downstream boundary has become subsonic. The suggested remedy is to change the location of the initial shock wave.

BLK(1): The quantities which are printed are the time index K, the position indices L,M, and N of the point of instability, and the quantities F4, F5, CSSHK, CSBX, CSBY, CSBP, F9, and F10, where F4, F5, F9, and F10 are functions of the flow properties. The error statement is followed by the full output for the time cycle at which the error occurs.

The quantity F9 should always be positive. The error statement is triggered when the value of F9 becomes less than 1×10^{-6}.

BLK(2): The quantities which are printed are those listed for the previous error statement and the quantity F11, which should never be greater than 1 in magnitude. The error statement is triggered when the magnitude of F11 exceeds 1.

Subroutine START.- There are two error statements in this subroutine, both of which indicate that the shape which was input for the initial shock wave cannot, in fact, be interpreted as a shock wave. If one of these errors occurs, the user should change the shape of the initial shock wave.

ER(1): The quantities which are printed are the time index $K = 0$, the position indices L,M, and N of the point where the error occurs, and CSSHK, the cosine of the angle between the normal to the initial shock shape and the free-stream direction. It should be noted that CSSHK should always be negative. The error statement is triggered when CSSHK becomes greater than -1.0×10^{-6}.

ER(2): The quantities which are printed are the time index $K = 0$, the position indices L,M, and N of the point where the error occurs, and the shock density ratio. The error statement is triggered when the density ratio becomes less than 1.

Conservation of Total Enthalpy

One application of the present method is the generation of an initial data line for a method-of-characteristics calculation of the supersonic flow on the afterbody. For such a calculation, it is necessary that the total enthalpy be conserved, and even small excursions can jeopardize the characteristics calculation. In the present program the total enthalpy is a computed rather than a constrained quantity. The ability of the method to conserve this quantity is considered to be an indication of the accuracy and proximity to convergence of the solution. In general, the total enthalpy is conserved to within a percent or so for a converged solution. However, at points on the body surface downstream of a sharp shoulder, the error in the total enthalpy is much larger. This is probably due to the fact that the flow there is highly expanded, and the entropy layer lies between the surface ($m = 1$) and the first line of grid points in the shock layer ($m = 2$) and hence is not resolved. This discrepancy in the results for the total enthalpy is of concern from the point of view of establishing an initial data line for a characteristics calculation, but it is not so important from a purely physical point of view since the flow at the surface downstream of a sharp corner is viscous dominated and probably separated so that the inviscid solution in this region does not represent reality.

The total enthalpy at grid points on the surface and in the region between the shock and surface can be constrained to a constant value with relatively simple changes to subroutine PDE. These changes are given in terms of Fortran IV statements:

(1) At the beginning of the subroutine define the total enthalpy as

```
HTØT=GAMMA*PINF/(GAMMA-1.)+.5
```

(2) If the equilibrium-air gas model is being used, place the following statements immediately after statement 26 in order to estimate the value of the ratio $\tilde{\gamma} = h/e$ at the grid location

```
HXX=(HTØT*R(L,M,N)-.5*(U(L,M,N)**2+V(L,M,N)**2+W(L,M,N)**2)/R(L,M,N))/P(L,M,N)
GAMM=HXX/(HXX-1.)
```

Omit these statements if the perfect-gas model is being used.

(3) Replace the statement following statement 30 with the statement

```
ENERS=(HTØT-.5*(U(L,M,N)**2+V(L,M,N)**2+W(L,M,N)**2)/R(L,M,N)**2)/GAMM
```

(4) Replace the statement following statement 31 with the statement

```
H(L,M,N)=HTØT
```

It is not recommended that the total enthalpy be constrained in this manner unless it is absolutely necessary since the effect is to ignore the corrective influence of the differential-energy equation and hence retard convergence. No attempt should be made to constrain the total enthalpy at the shock since this could interfere with the solution of a cubic equation for the shock speed.

It has been found that in highly expanded regions of flow the pressure can assume small negative values. In particular, this has been found to be true at grid points on the surface downstream of a sharp corner, starting several mesh spacings from the corner. Requiring that the total enthalpy be constant does not prevent the negative pressures. Constraining the surface entropy to be constant does not help since the effect is to decrease the value of the density and hence cause instabilities rather than increase the value of the pressure. It is recommended that characteristic initial data lines for bodies with sharp corners be located just downstream of the corner in order to avoid the negative pressure values.

Alternate Expressions for Shock Slopes

Under certain conditions the converged results of many time-dependent, blunt-body methods for the shock-layer thickness (distance between the shock and body) do not vary smoothly with distance along the body but contain oscillations. The wavelength of these oscillations is usually two mesh spacings. Although no oscillations of this type are exhibited by the results computed by the present method and reported in references 1 and 2, it is possible that they may occur in other cases.

In some instances the oscillations are due to the type of finite-difference expressions which are used to represent the derivatives of the shock-layer thickness with respect to the coordinates. Under such circumstances, improved results can sometimes be obtained by substituting other finite-difference expressions for these derivatives. Unfortunately, the expressions which are less likely to produce oscillations are also generally of a lower order of formal accuracy.

In the present program three-point central-difference formulas are used to evaluate the derivatives $\partial\delta/\partial X$ and $\partial\delta/\partial\Phi$ if the velocity components tangent to the shock and in the X- and Φ-directions, respectively, are less than the local speed of sound. These formulas are of second-order accuracy. Two-point upwind-difference formulas are used if the velocity components are greater than or equal to the local sonic speed. Although these formulas are only of first-order accuracy, they correctly prevent the influence of downstream points on the shock-layer-thickness derivatives in supersonic regions.

In the event that central-difference formulas permit the development of oscillations in the shock-layer-thickness distribution with respect to the X- or Φ-coordinate, it is suggested that upwind-difference procedures be employed for that coordinate in the subsonic as well as the supersonic regions to calculate the shock-layer-thickness derivatives. These changes in the differencing procedure can be effected by modifying subroutine SLØPE. In order to obtain windward difference expressions for the derivative $\partial\delta/\partial X$ at all points, remove the second statement after statement 6 in subroutine SLØPE and replace the next statement with the statement

```
IF(PDPX(KKK,L,N).LT.0.)GØ TØ 7
```

Statement 8 should also be removed. In order to obtain upwind-difference expressions for the derivative $\partial\delta/\partial\Phi$ at all points, remove the third "IF" statement following statement 9 and replace the next statement with the statement

```
IF(PDPPH(KKK,L,N).LT.0.)GØ TØ 10
```

Langley Research Center,

National Aeronautics and Space Administration,

Hampton, Va., July 2, 1971.

APPENDIX A

PROGRAM LISTING

The computational program is listed in this appendix in the Fortran IV computer language. This program consists of the main executive program and 11 subroutines.

```
      PRCGRAM EXEC(INPUT=201,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
C**** CAVIS-DLD-A2636-APPLIED MECHANICS
C**** CICK BARNWELL
C**** TIME DEPENDENT METHOD FOR COMPUTING FLOW ABCUT BLUNT BODIES
C****    TRAVELING AT SUPERSONIC SPEEDS AT ANGLE OF ATTACK
      CCMMCN IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCORN
      CCMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      CCMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1A0(4,3,9),C2A0
     3(4,3,9),C3A0(4,3,9),C4A0(4,3,9),C5A0(4,3,9)
      CCMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PCPT(2,17,9),PDPX(2,17,9),PCPPH(2,17,9)
      CCMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      CCMMON/ERROR/ER(12),BLK(12)
      CCMMCN/BLCCK1/KPO
      DATA(ER(I),I=1,12)/3HER1,3HER2,3HER3,3HER4,3HER5,3HER6,3HER7,3HER8
     1,3HER9,4HER10,4HER11,4HER12/
      CATA (BLK(I),I=1,12)/4HBLK1,4HBLK2,4HBLK3,4HBLK4,4HBLK5,4HBLK6,4HB
     1LK7,4HBLK8,4HBLK9,5HBLK10,5HBLK11,5HBLK12/
      NAMELIST/NAME/IYREF1,LF,MF,NF,DX,KURVE1,KURVE2,KURVE3,KURVE4,CURVE
     11,CURVE2,CURVE3,CURVE4,CURVE5,IYREF2,IYREF3,IYREF4,YREFO,YREF1,YRE
     2F2,YREF3,YREF4,RS,BS,XO,CXO,IGAS,DENSO,VELO,GAMMA,GAMM,PINF,ALPHAD
     3,KPO,KPP,KF,IYREFO,CT,EPSI,PMIN
  80C FORMAT(//* DAVIS-DLD-A2636-APPLIED MECHANICS-9-22-69*)
  801 FORMAT(* DICK BARNWELL *)
  802 FORMAT(* TIME DEPENDENT METHCD FOR CCMPUTING FLOW ABOUT BLUNT BODI
     1ES TRAVELING AT SUPERSONIC SPEEDS AT ANGLE OF ATTACK*//)
  803 FCRMAT(1H1//)
  804 FCRMAT(2A10)
  805 FCRMAT(* A2636 COMPLETED AT CENTER AT *,2A10)
      CIMENSICN IDATE(2)
      CALL CAYTIM(ICATE)
      PRINT 8C4,IDATE$ PRINT 803$ PRINT 804,IDATE
      PRINT 800$ PRINT 801$ PRINT 802
    1 FEAC(5,NAME)
      IF(EOF,5)9999,9990


 9990 CCNTINUE
      KP=KPC
      ALPHA=ALPHAD/57.29577951
      WRITE(6,NAME)
      CALL START
      CALL RESULT
    2 KK=1
      K=K+1
      IF(K.GT.KF)GO TC 1
      CALL DELTAT
      CALL A
    3 M=MF
      CO 4 J=1,3
      MM=M+J-3
      CALL C
    4 CCNTINUE
      CALL SHCCK
      MMZHI=MF-1
      CC 7 MMZ=1,MMZHI
      M=MF-MMZ
      IF(M.EC.1.OR.MMZ.EQ.1)GO TC 6
      DO 5 IIZ=1,2
      J=4-IIZ
      CALL TRANSC
    5 CONTINUE
      J=1
      MM=M-1
      CALL C
    6 CALL PDE
    7 CONTINUE
      IF(KK.EQ.2)GO TO 8
      KK=2
      GC TO 3
    8 IF(K.NE.KP)GO TO 2
      CALL RESULT
      KP=KP+KPP
      GO TO 2
 9999 CALL CAYTIM(ICATE)$ PRINT 805,IDATE
      STCP C1C1
      END
```

```
      SUBROUTINE A
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCORN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1AO(4,3,9),C2AO
     3(4,3,9),C3AO(4,3,9),C4AO(4,3,9),C5AO(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
      MFM1=MF-1
      ISND=1
      DO 11 M=1,MFM1
      LLO=1
      DO 10 N=1,NF
      IKZ=0
      DO 9 L=LLO,LF
      IF(M.EQ.1.AND.L.GT.LCORN.AND.L.LT.LHI)GO TO 9
      IF(M.EQ.1)C1A(L,M,N)=1.
      DO 7 II=1,5
      LL=L+II-3
      IF(LL.LE.LF)GO TO 2
      DO 1 JJ=1,5
      IIM1=II-1
      IIM2=II-2
      AAA(JJ,II)=2.*AAA(JJ,IIM1)-AAA(JJ,IIM2)
    1 CONTINUE
      GO TO 7
    2 IF(L.EQ.LLO.OR.II.EQ.5)GO TO 4
      IF(M.EQ.1.AND.L.EQ.LHI)GO TO 4
      DO 3 JJ=1,5
      IIP1=II+1
      AAA(JJ,II)=AAA(JJ,IIP1)
    3 CONTINUE
      GO TO 7
    4 IF(LL.LT.1)GO TO 5


      LLL=LL
      NN=N
      F1=1.
      GO TO 6
    5 LLL=2-LL
      NN=NF+1-N
      F1=-1.
    6 AAA(1,II)=R(LLL,M,NN)
      AAA(2,II)=F1*U(LLL,M,NN)
      AAA(3,II)=V(LLL,M,NN)
      AAA(4,II)=W(LLL,M,NN)
      AAA(5,II)=R(LLL,M,NN)*H(LLL,M,NN)-P(LLL,M,NN)
    7 CONTINUE
      IF(M.NE.1)GO TO 70
      LP1=L+1
      IF(KURVE1.NE.LP1.AND.KURVE2.NE.LP1.AND.KURVE3.NE.LP1.AND.KURVE4.NE
     1.LP1.AND.IKZ.EQ.0)GO TO 70
      IF(IKZ.EQ.1)GO TO 74
      IF(IKZ.EQ.2)GO TO 75
      IF(IKZ.EQ.3)GO TO 72
      L=L+1
      RHO=R(L,M,N)
      ENERS=H(L,M,N)-(P(L,M,N)+.5*(U(L,M,N)**2+V(L,M,N)**2+W(L,M,N)**2)/
     1R(L,M,N))/R(L,M,N)
      CALL GAS
      CHECK9=U(L,M,N)/(R(L,M,N)*SND)
      L=L-1
      IF(LP1.NE.LCORN)GO TO 69
      IKZ=1
      GO TO 73
   69 IF(CHECK9.LT.1..AND.CHECK9.GT.-1..AND.IYREFO.NE.0)GO TO 70
      CHECK8=CURV2(L)-CURV2(LP1)
      IF(CHECK9.GE.1..AND.CHECK8.GT.0.)IKZ=1
      IF(CHECK9.LE.-1..AND.CHECK8.LT.0.)IKZ=2
      IF(IKZ.EQ.0)IKZ=1
      GO TO 73
   70 DO 80 JJ=1,5
      AAB(JJ)=AAA(JJ,3)-EPSI*(6.*AAA(JJ,3)-4.*(AAA(JJ,2)+AAA(JJ,4))+AAA(
     1JJ,1)+AAA(JJ,5))
   80 CONTINUE
      GO TO 8
   72 IKZ=0
   73 DO 83 JJ=1,5
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      AAB(JJ)=AAA(JJ,3)+EPSI*(AAA(JJ,2)-2.*AAA(JJ,3)+AAA(JJ,4))
 83   CCNTINUE
      GC TO 8
 74   IJ1=2
      IJ2=1
      IF(L.NE.LCCRN)GO TO 76
      IF(CHECK9.LT.1.)C1A(L,M,N)=0.
      GO TO 76
 75   IJ1=4
      IJ2=5
 76   DC 86 JJ=1,5
      IF(L.EQ.LCORN.AND.CHECK9.LT.1.)GO TO 860
      AAB(JJ)=AAA(JJ,3)-EPSI*(AAA(JJ,3)-2.*AAA(JJ,IJ1)+AAA(JJ,IJ2))
      GO TO 86
860   AAB(JJ)=AAA(JJ,3)
 86   CCNTINUE
      IKZ=3
  8   A1(L,M,N)=AAB(1)
      A2(L,M,N)=AAB(2)
      A3(L,M,N)=AAB(3)
      A4(L,M,N)=AAB(4)
      A5(L,M,N)=AAB(5)
  9   CONTINUE
      LLO=2
 10   CCNTINUE
 11   CCNTINUE
      IF(NF.LE.2)GC TO 220
      DO 22 M=1,MFM1
      NUP=1
      DC 21 L=1,LF
      IF(M.EC.1.AND.L.GT.LCORN.AND.L.LT.LHI)GO TC 21
      DO 20 N=1,NUP
      DO 18 II=1,5
      NN=N+II-3
      IF(NN.GT.NF.AND.II.EQ.5)GC TC 12
      IF(N.EQ.1.OR.II.EQ.5)GO TC 15
      IIP1=II+1
      F2=1.
      GO TO 13
 12   F2=-1.
      IF(N.LT.NF)IIP1=3
      IF(N.EQ.NF)IIP1=1
 13   DO 14 JJ=1,5
      IF(JJ.NE.4)F3=1.
      IF(JJ.EQ.4)F3=F2
      AAA(JJ,II)=F3*AAA(JJ,IIP1)
 14   CCNTINUE
      GO TO 18
 15   IF(NN.LT.1)GC TO 16
      F4=1.
      NNN=NN
      GO TO 17
 16   F4=-1.
      NNN=2-NN
 17   AAA(1,II)=R(L,M,NNN)
      AAA(2,II)=U(L,M,NNN)
      AAA(3,II)=V(L,M,NNN)
      AAA(4,II)=F4*W(L,M,NNN)
      AAA(5,II)=R(L,M,NNN)*H(L,M,NNN)-P(L,M,NNN)
 18   CCNTINUE
      DC 19 JJ=1,5
      AAB(JJ)=-EPSI*(6.*AAA(JJ,3)-4.*(AAA(JJ,2)+AAA(JJ,4))+AAA(JJ,1)+AAA
     1(JJ,5))
 19   CCNTINUE
      F5=1.
      IF(M.EQ.1)F5=C1A(L,M,N)
      A1(L,M,N)=A1(L,M,N)+F5*AAB(1)
      A2(L,M,N)=A2(L,M,N)+F5*AAB(2)
      A3(L,M,N)=A3(L,M,N)+AAB(3)
      A4(L,M,N)=A4(L,M,N)+AAB(4)
      A5(L,M,N)=A5(L,M,N)+F5*AAB(5)
 20   CCNTINUE
      NUP=NF
 21   CCNTINUE
 22   CCNTINUE
220   IF(MF.LE.3)GO TO 39
      NUP=1
      DO 38 L=1,LF
      MLC=1
      IF(L.GT.LCORN.AND.L.LT.LHI)MLC=2
      LM1=L-1
      IF(L.EQ.1)LM1=1
      DO 37 N=1,NUP
      DO 36 M=MLO,MFM1
      AM=M
      IILO=1
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      IF(M.EQ.1)IILO=3
      IF(M.EQ.2)IILO=2
      IIUP=5
      IF(M.EQ.MFM1)IIUP=4
      DO 25 II=IILO,IIUP
      IF(M.EQ.MLO.OR.II.EQ.5)GO TO 24
      IIP1=II+1
      DO 23 JJ=1,5
      AAA(JJ,II)=AAA(JJ,IIP1)
   23 CONTINUE
      GO TO 25
   24 MM=M+II-3
      AMM=MM
      ALAMB=1.+CURV2(LM1)*((AMM-1.)*DY*DELTA(1,L,N)-YREF(L,N))
      AAA(1,II)=R(L,MM,N)*ALAMB
      AAA(2,II)=U(L,MM,N)*ALAMB
      AAA(3,II)=V(L,MM,N)*ALAMB
      AAA(4,II)=W(L,MM,N)*ALAMB
      AAA(5,II)=(R(L,MM,N)*H(L,MM,N)-P(L,MM,N))*ALAMB
   25 CONTINUE
      ALAMB=1.+CURV2(LM1)*((AM-1.)*DY*DELTA(1,L,N)-YREF(L,N))
      IF(M.EQ.1)GO TO 27
      IF(M.EQ.2)GO TO 31
      IF(M.EQ.MFM1)GO TO 32
      DO 26 JJ=1,5
      AAB(JJ)=-EPSI*(6.*AAA(JJ,3)-4.*(AAA(JJ,2)+AAA(JJ,4))+AAA(JJ,1)+AAA
     1(JJ,5))/ALAMB
   26 CONTINUE
      GO TO 35
   27 I2=4
      I3=5
   29 DO 30 JJ=1,5
      AAB(JJ)=-EPSI*(AAA(JJ,3)-2.*AAA(JJ,I2)+AAA(JJ,I3))
   30 CONTINUE
      GO TO 35
   31 I1=2
      I2=3
      I3=4
      I4=5
      GO TO 33
   32 I1=4
      I2=3
      I3=2
      I4=1
   33 DO 34 JJ=1,5
      AAB(JJ)=-EPSI*(AAA(JJ,I4)-AAA(JJ,I1)-3.*(AAA(JJ,I3)-AAA(JJ,I2)))/A
     1LAMB
   34 CONTINUE
   35 F5=1.
      IF(M.EQ.1)F5=C1A(L,M,N)
      A1(L,M,N)=A1(L,M,N)+F5*AAB(1)
      A2(L,M,N)=A2(L,M,N)+F5*AAB(2)
      A3(L,M,N)=A3(L,M,N)+AAB(3)
      A4(L,M,N)=A4(L,M,N)+AAB(4)
      A5(L,M,N)=A5(L,M,N)+F5*AAB(5)
   36 CONTINUE
   37 CONTINUE
      NUP=NF
   38 CONTINUE
   39 RETURN
      END
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      SUBROUTINE C
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCCRN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1AO(4,3,9),C2AO
     3(4,3,9),C3AO(4,3,9),C4AO(4,3,9),C5AO(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
      AMM=MM
      LLO=1
      F3=0.
      DO 4 N=1,NF
      DO 3 L=LLO,LF
      Y=(AMM-1.)*DY
      RAD=RREF(L)+(Y*DELTA(KK,L,N)-YREF(L,N))*SIN(THETA(L))
      F4=PDPX(KK,L,N)
      LJ=L
    1 ALAMB=1.+CURV2(LJ)*(Y*DELTA(KK,L,N)-YREF(L,N))
      IF(L.EQ.1)GO TO 10
      F3=(PYBPPH(L,N)+Y*PDPPH(KK,L,N))*ALAMB/RAD
   10 F1=Y*PDPT(KK,L,N)*ALAMB
      F2=PYBPX(L,N)+Y*F4
      C10=ALAMB*V(L,MM,N)-F1*R(L,MM,N)-F2*U(L,MM,N)-F3*W(L,MM,N)
      C20=C10*U(L,MM,N)/R(L,MM,N)-F2*P(L,MM,N)
      C30=C10*V(L,MM,N)/R(L,MM,N)+ALAMB*P(L,MM,N)
      C40=C10*W(L,MM,N)/R(L,MM,N)-F3*P(L,MM,N)
      C50=C10*H(L,MM,N)+F1*P(L,MM,N)
      IF(L.GT.LJ)GO TO 2
      C1A(L,J,N)=C10
      C2A(L,J,N)=C20
      C3A(L,J,N)=C30
      C4A(L,J,N)=C40
      C5A(L,J,N)=C50
      IF(L.NE.KURVE1.AND.L.NE.KURVE2.AND.L.NE.KURVE3.AND.L.NE.KURVE4)GO


     1TO 3
      LJ=L-1
      F4=F4*(1.+CURV2(LJ)*(DELTA(KK,L,N)-YREF(L,N)))/(1.+CURV2(L)*(DELTA
     1(KK,L,N)-YREF(L,N)))
      GO TO 1
    2 IF(L.EQ.KURVE1)JJJ=1
      IF(L.EQ.KURVE2)JJJ=2
      IF(L.EQ.KURVE3)JJJ=3
      IF(L.EQ.KURVE4)JJJ=4
      C1AO(JJJ,J,N)=C10
      C2AO(JJJ,J,N)=C20
      C3AO(JJJ,J,N)=C30
      C4AO(JJJ,J,N)=C40
      C5AO(JJJ,J,N)=C50
      IF(MM.EQ.1.AND.IYREFO.EQ.0)C3A(L,2,N)=V(L,2,N)/R(L,2,N)
    3 CONTINUE
      LLO=2
    4 CONTINUE
      RETURN
      END
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      SUBROUTINE D
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCORN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1AO(4,3,9),C2AO
     3(4,3,9),C3AO(4,3,9),C4AO(4,3,9),C5AO(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
      AM=M
      DO 10 IJ=1,3
      IF(N.EQ.NF.AND.IJ.EQ.3)GO TO 6
      IF(N.GT.1.AND.IJ.LT.3)GO TO 7
      IF(N.EQ.1.AND.IJ.EQ.3)GO TO 6
      IF(N.EQ.1.AND.IJ.EQ.1)GO TO 1
      NN=N+IJ-2
      G1=1.
      GO TO 2
    1 NN=2
      G1=-1.
    2 DO 5 L=LLO,LF
      IF(M.EQ.1.AND.L.GT.LCORN.AND.L.LT.LHI)GO TO 5
      IF(NF.LE.2)GO TO 40
      IF(L.EQ.1)GO TO 3
      Y=(AM-1.)*DY
      ALAMB=1.+CURV2(L)*(Y*DELTA(KK,L,NN)-YREF(L,NN))
      LM1=L-1
      IF(M.EQ.1.AND.L.EQ.LCORN)ALAMB=1.-CURV2(LM1)*YREF(L,NN)
      RAD=RREF(L)+(Y*DELTA(KK,L,NN)-YREF(L,NN))*SIN(THETA(L))
      G2=ALAMB/RAD
      GO TO 4
    3 G2=0.
    4 C1A(L,IJ)=G1*G2*W(L,M,NN)
      C2A(L,IJ)=D1A(L,IJ)*U(L,M,NN)/R(L,M,NN)
      C3A(L,IJ)=D1A(L,IJ)*V(L,M,NN)/R(L,M,NN)


      C4A(L,IJ)=G2*(P(L,M,NN)+W(L,M,NN)**2/R(L,M,NN))
      C5A(L,IJ)=D1A(L,IJ)*H(L,M,NN)
      GO TO 5
   40 C1A(L,IJ)=0.
      C2A(L,IJ)=0.
      C3A(L,IJ)=0.
      C4A(L,IJ)=0.
      D5A(L,IJ)=0.
    5 CONTINUE
      GO TO 10
    6 IJJ=1
      G1=-1.
      GO TO 8
    7 IJJ=IJ+1
      G1=1.
    8 DO 9 L=LLO,LF
      C1A(L,IJ)=G1*D1A(L,IJJ)
      C2A(L,IJ)=G1*C2A(L,IJJ)
      C3A(L,IJ)=G1*C3A(L,IJJ)
      C4A(L,IJ)=D4A(L,IJJ)
      C5A(L,IJ)=G1*D5A(L,IJJ)
    9 CONTINUE
   10 CONTINUE
      RETURN
      END
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      SUBROUTINE DELTAT
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCORN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1A0(4,3,9),C2A0
     3(4,3,9),C3A0(4,3,9),C4A0(4,3,9),C5A0(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
  900 FORMAT(* SUBROUTINE DELTAT  *,1A6,4I5/(8E16.8))
      ISND=1
      DT=100.
      DO 7 M=1,MF
      AM=M
      Y=(AM-1.)*DY
      LLO=1
      DO 6 N=1,NF
      DO 5 L=LLO,LF
      FO=Y*DELTA(1,L,N)-YREF(L,N)
      IF(M.EQ.1.AND.L.GT.LCORN.AND.L.LT.LHI)GO TO 5
      LP=L
      IF(M.EQ.1.AND.L.EQ.LCORN)LP=L-1
      ALAMB=1.+CURV2(LP)*FO
      F1=(Y*PDPX(1,L,N)+PYBPX(L,N))/ALAMB
      DS1=ALAMB*DX
      IF(L.EQ.1)GO TO 3
      RAD=RREF(L)+FO*SIN(THETA(L))
      F2=(Y*PDPPH(1,L,N)+PYBPPH(L,N))/RAD
      DS2=RAD*DPHI
      GO TO 4
    3 F2=0.
      DS2=100.
    4 CC=SQRT(F1**2+F2**2)
      F3=SQRT(4.+CC**2)
      CT1=1./SQRT(1.+.5*CC*(CC+F3))


      DS=DELTA(1,L,N)*DY
      IF(DS1.LT.DS)DS=DS1
      IF(DS2.LT.DS)DS=DS2
      ENERS=H(L,M,N)-(P(L,M,N)+.5*(U(L,M,N)**2+V(L,M,N)**2+W(L,M,N)**2)/
     1R(L,M,N))/R(L,M,N)
      RHO=R(L,M,N)
      CALL GAS
      DENOM=SQRT(U(L,M,N)**2+V(L,M,N)**2+W(L,M,N)**2)/R(L,M,N)+SND
      IF(DENOM.GT.1.E-12)GO TO 40
      PRINT 900,BLK(1),K,L,M,N,FO,ALAMB,DELTA(1,L,N),RAD,DX,DY,DPHI,DS1,
     1DS2,DS,CC,ENERS,RHO,SND
      K=K-1
      CALL RESULT
      STOP C5C1
   40 CT2=1./DENOM
      DT1=CT*CT1*CT2*DS
      IF(DT1.LT.DT)DT=DT1
    5 CONTINUE
      LLO=2
    6 CONTINUE
    7 CONTINUE
      TIME=TIME+DT
      RETURN
      END
```

```
      SUBROUTINE GAS
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCORN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1AO(4,3,9),C2AO
     3(4,3,9),C3AO(4,3,9),C4AO(4,3,9),C5AO(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
      IF(IGAS.GT.0)GO TO 2
      IF(ISND.EQ.0)GO TO 101
      GAME=0.
      GAMR=0.
      GO TO 100
    2 IF(IGAS.GT.1)GO TO 7
      RHO=ABS(RHO)
      Y2=ALOG10(RHO*DENSO/1.292)
      Z3=ABS(ENERS)
      Z2=ALOG10(Z3*VELO**2/78400.)
      IF(Z2.GT..801)GO TO 3
      GAMM=1.405
      IF(ISND.EQ.0)GO TO 101
      GAME=0.
      GAMR=0.
      GO TO 100
    3 IF(Z2.GT.2.3)GO TO 5
      TESTY2=(3.255-2.278*Z2)/(1.-.822*Z2)
      IF(Y2.GT.TESTY2)GO TO 4
      GAS1=1.637-.0404*Y2
      GAS2=.2175-.0332*Y2
      GAS3=.1366-.0366*Y2
      GAS4=.0833-.0248*Y2
      GAS5=.0404-.0332*Z2
      GAS6=.0366-.0248*Z2
      GAS7=EXP(-18.3*Z2+.586*Y2+35.57)


      GAS8=-18.3
      GAS9=.503
      GO TO 6
    4 GAMM=1.5055-.1255*Z2
      IF(ISND.EQ.0)GO TO 101
      GAME=-.2892
      GAMR=0.
      GO TO 100
    5 GAS1=1.5004-.0038*Y2
      GAS2=.1342-.0084*Y2
      GAS3=.3274+.0091*Y2
      GAS4=.1342+.0016*Y2
      GAS5=.0038-.0084*Z2
      GAS6=-(.0091-.0016*Z2)
      GAS7=EXP(-15.85*Z2+.507*Y2+42.91)
      GAS8=-15.85
      GAS9=.507
    6 GAS10=1./(1.+GAS7)
      GAMM=GAS1-GAS2*Z2-(GAS3-GAS4*Z2)*GAS10
      IF(ISND.EQ.0)GO TO 101
      GAS11=(GAS3-GAS4*Z2)*GAS7*GAS10**2
      GAME=2.304*(-GAS2+GAS4*GAS10+GAS11*GAS8)
      GAMR=2.304*(-GAS5+GAS6*GAS10+GAS11*GAS9)
      GO TO 100
    7 GO TO 101
  100 SNDSQ=ENERS*((GAMM-1.)*(GAMM+GAME)+GAMR)
      SND=SQRT(ABS(SNDSQ))
  101 RETURN
      END
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      SUBROUTINE PDE
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELC,KP,KPP,KF,LHI,LCORN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1A0(4,3,9),C2A0
     3(4,3,9),C3A0(4,3,9),C4A0(4,3,9),C5A0(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
      AM=M
      PHI=0.
      ISND=0
      KKK=3-KK
      LLO=1
      L1=2
      N1=NF
      F1=-1.
      DO 33 N=1,NF
      CALL D
      IKURV=0
      DO 32 L=LLO,LF
      IF(M.EQ.1.AND.L.GT.LCORN.AND.L.LT.LHI)GO TO 32
      F17=1.
      IKURVL=IKURV
      IF(L.NE.KURVE1.AND.L.NE.KURVE2.AND.L.NE.KURVE3.AND.L.NE.KURVE4)GO
     1TO 2
      IKURV=1
      IF(M.NE.1)GO TO 102
      ISND=1
      RHO=R(L,M,N)
      ENERS=H(L,M,N)-(P(L,M,N)+.5*(U(L,M,N)**2+V(L,M,N)**2+W(L,M,N)**2)/
     1R(L,M,N))/R(L,M,N)
      CALL GAS
      ISND=0
      CHECK9=U(L,M,N)/(R(L,M,N)*SND)


      IF(L.EQ.LCORN)GO TO 99
      CHECK8=CURV2(L-1)-CURV2(L)
      IF(CHECK9.GT.1..AND.CHECK8.GT.0.)GO TO 100
      IF(CHECK9.LT.-1..AND.CHECK8.LT.0.)GO TO 101
      IF(IYREFO.NE.0)GO TO 102
      IKURV=-1
      GO TO 3
   99 IF(CHECK9.LT.1.)F17=0.
  100 IKURV=3
      GO TO 3
  101 IKURV=4
      GO TO 3
  102 CHECK=(CURV2(L-1)-CURV2(L))*((AM-1.)*DY*DELTA(KK,L,N)-YREF(L,N))
      IF(CHECK.LT.0.)GO TO 3
      IKURV=2
      GO TO 3
    2 IKURV=0
    3 DO 12 I=1,3
      IF(M.EQ.1.AND.L.EQ.LHI)GO TO 40
      IF(L.NE.LLO.AND.I.EQ.2.AND.IKURVL.NE.1)GO TO 10
      IF(I.EQ.3.AND.L.EQ.LF)GO TO 11
      IF(L.EQ.1.AND.I.EQ.1)GO TO 4
      IF(L.NE.LLO.AND.I.EQ.1.AND.IKURV.NE.2)GO TO 10
   40 N1=N
      F1=1.
      L1=L+I-2
      IF(M.EQ.1.AND.L.EQ.LCORN.AND.I.EQ.3)GO TO 12
    4 IF((IKURV.EQ.1.AND.I.EQ.3).OR.(IKURV.EQ.2.AND.I.EQ.1))GO TO 5
      B1A(I)=F1*U(L1,M,N1)
      B2A(I)=P(L1,M,N1)+U(L1,M,N1)**2/R(L1,M,N1)
      B3A(I)=B1A(I)*V(L1,M,N1)/R(L1,M,N1)
      B4A(I)=B1A(I)*W(L1,M,N1)/R(L1,M,N1)
      B5A(I)=B1A(I)*H(L1,M,N1)
      GO TO 12
    5 F201=(AM-1.)*DY*DELTA(KK,L,N1)-YREF(L,N1)
      ALAMP=1.+CURV2(L)*F201
      LQ=L-1
      ALAMM=1.+CURV2(LQ)*F201
      LG=L+2-I
      IF(I.EQ.1)GO TO 6
      F4=ALAMM/ALAMP
      GO TO 7
    6 F4=ALAMP/ALAMM
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 7 IF(F4.GT.1.)F4=1.
   F4=2.*F4/(1.+F4)
   F5=1.-F4
   THETAA=2.*THETA(L)-THETA(L1)-THETA(LG)
   THETAB=2.*(THETA(L)-THETA(LG))
   IF(I.EQ.1)GO TO 8
   RNEW=R(L1,M,N1)
   UNEW=U(L1,M,N1)*COS(THETAA)-V(L1,M,N1)*SIN(THETAA)
   VNEW=U(L1,M,N1)*SIN(THETAA)+V(L1,M,N1)*COS(THETAA)
   WNEW=W(L1,M,N1)
   PNEW=P(L1,M,N1)
   HNEW=H(L1,M,N1)
   UOLD=UOLD1*COS(THETAB)-VOLD1*SIN(THETAB)
   VOLD=UOLD1*SIN(THETAB)+VOLD1*COS(THETAB)
   GO TO 9
 8 RNEW=ROLD
   UNEW=UOLD1*COS(THETAA)-VOLD1*SIN(THETAA)
   VNEW=UOLD1*SIN(THETAA)+VOLD1*COS(THETAA)
   WNEW=WOLD
   PNEW=POLD
   HNEW=HOLD
   ROLD=R(LG,M,N1)
   UOLD=U(LG,M,N1)*COS(THETAB)-V(LG,M,N1)*SIN(THETAB)
   VOLD=U(LG,M,N1)*SIN(THETAB)+V(LG,M,N1)*COS(THETAB)
   WOLD=W(LG,M,N1)
   POLD=P(LG,M,N1)
   HOLD=H(LG,M,N1)
 9 B1A(I)=F4*UNEW+F5*UOLD
   B2A(I)=F4*(PNEW+UNEW**2/RNEW)+F5*(POLD+UOLD**2/ROLD)
   B3A(I)=F4*UNEW*VNEW/RNEW+F5*UOLD*VOLD/ROLD
   B4A(I)=F4*UNEW*WNEW/RNEW+F5*UOLD*WOLD/ROLD
   B5A(I)=F4*UNEW*HNEW+F5*UOLD*HOLD
   GO TO 12
10 IG=I+1
   B1A(I)=B1A(IG)
   B2A(I)=B2A(IG)
   B3A(I)=B3A(IG)
   B4A(I)=B4A(IG)
   B5A(I)=B5A(IG)
   GO TO 12
11 B1A(3)=2.*B1A(2)-B1A(1)
   B2A(3)=2.*B2A(2)-B2A(1)
   B3A(3)=2.*B3A(2)-B3A(1)


   B4A(3)=2.*B4A(2)-B4A(1)
   B5A(3)=2.*B5A(2)-B5A(1)
12 CONTINUE
   IF(L1.NE.KURVE1.AND.L1.NE.KURVE2.AND.L1.NE.KURVE3.AND.L1.NE.KURVE4
  1)GO TO 13
   ROLD=R(L,M,N)
   UOLD1=U(L,M,N)
   VOLD1=V(L,M,N)
   WOLD=W(L,M,N)
   POLD=P(L,M,N)
   HOLD=H(L,M,N)
13 F6=.5/DX
   IF(IKURV.GE.3)F6=2.*F6
   IF(IKURV.EQ.-1)GO TO 240
   F7=F6
   IF(L.EQ.1.AND.IYREF1.NE.0)F6=1./DX
   IH=3
   IF(IKURV.EQ.3)IH=2
   IL=1
   IF(IKURV.EQ.4)IL=2
16 DIFB1=F6*(B1A(IH)-B1A(IL))
   DIFB2=F7*(B2A(IH)-B2A(IL))
   DIFB3=F6*(B3A(IH)-B3A(IL))
   DIFB4=F7*(B4A(IH)-B4A(IL))
   DIFB5=F6*(B5A(IH)-B5A(IL))
   IF(L.NE.1.OR.NF.LE.2)GO TO 17
   N11=NF-1
   DIFB1=DIFB1+F7*(W(2,M,2)-W(2,M,N11))/DPHI
   DIFB2=DIFB2+F7*(U(2,M,1)**2/R(2,M,1)-U(2,M,NF)**2/R(2,M,NF)+(U(2,M
  1,2)*W(2,M,2)/R(2,M,2)+U(2,M,N11)*W(2,M,N11)/R(2,M,N11))/DPHI)
   DIFB3=DIFB3+F7*(V(2,M,2)*W(2,M,2)/R(2,M,2)-V(2,M,N11)*W(2,M,N11)/R
  1(2,M,N11))/DPHI
   DIFB5=DIFB5+F7*(W(2,M,2)*H(2,M,2)-W(2,M,N11)*H(2,M,N11))/DPHI
   IF(F17.GT..1.OR.NF.LE.2)GO TO 17
   LAX=L-1
   ALAX=1.-CURV2(LAX)*YREF(L,N)
   RLAX=RREF(L)-YREF(L,N)*SIN(THETA(L))
   WLAX=W(L,M,N)/R(L,M,N)
   ULAX=U(L,M,N)/R(L,M,N)
   DIFW=WLAX*((WLAX*(D1A(L,3)-D1A(L,1))-D4A(L,3)+D4A(L,1))/(2.*DPHI*A
  1LAX*ULAX)-WLAX*COS(THETA(L))/RLAX)
   DIFB1=DIFB1+DIFW/ULAX
   DIFB2=DIFB2+2.*DIFW
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      DIFB5=DIFB5+DIFW*H(L,M,N)/ULAX
   17 F8=.5/(DY*DELTA(KK,L,N))
      IF(M.EQ.1)F8=2.*F8
      IH=3
      IF(M.EQ.1)IH=2
      IL=1
   20 IF(IKURV.EQ.1.OR.IKURV.EQ.3)GO TO 21
      DIFC1=F8*(C1A(L,IH,N)-C1A(L,IL,N))
      DIFC2=F8*(C2A(L,IH,N)-C2A(L,IL,N))
      DIFC3=F8*(C3A(L,IH,N)-C3A(L,IL,N))
      DIFC4=F8*(C4A(L,IH,N)-C4A(L,IL,N))
      DIFC5=F8*(C5A(L,IH,N)-C5A(L,IL,N))
      F9=.5/DPHI
      F10=F9
      GO TO 22
   21 IF(L.EQ.KURVE1)JJJ=1
      IF(L.EQ.KURVE2)JJJ=2
      IF(L.EQ.KURVE3)JJJ=3
      IF(L.EQ.KURVE4)JJJ=4
      DIFC1=F8*(C1AO(JJJ,IH,N)-C1AO(JJJ,IL,N))
      DIFC2=F8*(C2AO(JJJ,IH,N)-C2AO(JJJ,IL,N))
      DIFC3=F8*(C3AO(JJJ,IH,N)-C3AO(JJJ,IL,N))
      DIFC4=F8*(C4AO(JJJ,IH,N)-C4AO(JJJ,IL,N))
      DIFC5=F8*(C5AO(JJJ,IH,N)-C5AO(JJJ,IL,N))
      IF(M.EQ.1.AND.L.EQ.LCORN)GO TO 22
      IF(NF.LE.2)GO TO 22
      LM1=L-1
      NM1=N-1
      NP1=N+1
      IF(N.EQ.1)NM1=2
      IF(N.EQ.NF)NP1=NF-1
      Y=(AM-1.)*DY
      F9=.5*(1.+CURV2(LM1)*(Y*DELTA(KK,L,NP1)-YREF(L,NP1)))/((1.+CURV2(L
     1)*(Y*DELTA(KK,L,NP1)-YREF(L,NP1)))*DPHI)
      F10=.5*(1.+CURV2(LM1)*(Y*DELTA(KK,L,NM1)-YREF(L,NM1)))/((1.+CURV2(
     1L)*(Y*DELTA(KK,L,NM1)-YREF(L,NM1)))*DPHI)
   22 DIFD1=F9*D1A(L,3)-F10*D1A(L,1)
      DIFD2=F9*D2A(L,3)-F10*D2A(L,1)
      DIFD3=F9*D3A(L,3)-F10*D3A(L,1)
      DIFD4=F9*D4A(L,3)-F10*D4A(L,1)
      DIFD5=F9*D5A(L,3)-F10*D5A(L,1)
      IF(IKURV.EQ.-1)GO TO 241
      Y=(AM-1.)*DY


      LQ=L
      IF(IKURV.EQ.1.OR.IKURV.EQ.3)LQ=L-1
      F14=CURV2(LQ)
      ALAMB=1.+F14*(Y*DELTA(KK,L,N)-YREF(L,N))
      RAD=RREF(L)+(Y*DELTA(KK,L,N)-YREF(L,N))*SIN(THETA(L))
      IF(L.EQ.1.OR.IYREF1.EQ.0)GO TO 23
      F11=ALAMB*PDPPH(KK,L,N)/RAD
      F12=ALAMB*COS(THETA(L))/RAD
      F13=ALAMB*SIN(THETA(L))/RAD
      GO TO 24
   23 F11=0.
      F12=0.
      F13=F14
      IF(IYREF1.EQ.0)F13=0.
   24 E1=(PDPT(KK,L,N)*ALAMB*R(L,M,N)+PDPX(KK,L,N)*U(L,M,N)+F11*W(L,M,N)
     1)/DELTA(KK,L,N)+F12*U(L,M,N)+F13*V(L,M,N)
      E2=((E1+F14*V(L,M,N))*U(L,M,N)-F12*W(L,M,N)**2)/R(L,M,N)+PDPX(KK,L
     1,N)*P(L,M,N)/DELTA(KK,L,N)
      E3=(E1*V(L,M,N)-F13*W(L,M,N)**2-F14*U(L,M,N)**2)/R(L,M,N)-F14*P(L,
     1M,N)
      E4=(E1+F12*U(L,M,N)+F13*V(L,M,N))*W(L,M,N)/R(L,M,N)+F11*P(L,M,N)/D
     1ELTA(KK,L,N)
      E5=E1*H(L,M,N)-PDPT(KK,L,N)*ALAMB*P(L,M,N)/DELTA(KK,L,N)
      GO TO 242
  240 ALAMB=1.
      LJ=L-1
      ALAMM=1.-CURV2(LJ)*YREF(L,N)
      ALAMP=1.-CURV2(L)*YREF(L,N)
      DIFB1=F6*((B1A(3)-B1A(2))/ALAMP+(B1A(2)-B1A(1))/ALAMM)
      DIFB2=F6*((B2A(3)-B2A(2))/ALAMP+(B2A(2)-B2A(1))/ALAMM)
      DIFB4=F6*((B4A(3)-B4A(2))/ALAMP+(B4A(2)-B4A(1))/ALAMM)
      DIFB5=F6*((B5A(3)-B5A(2))/ALAMP+(B5A(2)-B5A(1))/ALAMM)
      F8=C3A(L,2,N)/(DY*DELTA(KK,L,N))
      DIFC1=R(L,M,N)*F8
      DIFC2=U(L,M,N)*F8
      DIFC4=W(L,M,N)*F8
      DIFC5=DIFC1*H(L,M,N)
      F9=.5/(DPHI*ALAMP)
      F10=F9
      GO TO 22
  241 RAD=RREF(L)-YREF(L,N)*SIN(THETA(L))
      F30=COS(THETA(L))/RAD
      IF(IYREF1.EQ.0)F30=0.
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      E1=F30*U(L,M,N)
      E2=F30*(U(L,M,N)**2-W(L,M,N)**2)/R(L,M,N)
      E4=2.*F30*U(L,M,N)*W(L,M,N)/R(L,M,N)
      E5=E1*H(L,M,N)
  242 IF(KK.EQ.2)GO TO 25
      A10=ALAMB*R(L,M,N)
      A20=ALAMB*U(L,M,N)
      A30=ALAMB*V(L,M,N)
      A40=ALAMB*W(L,M,N)
      A50=A10*H(L,M,N)-ALAMB*P(L,M,N)
      GO TO 26
   25 A10=ALAMB*A1(L,M,N)
      A20=ALAMB*A2(L,M,N)
      A30=ALAMB*A3(L,M,N)
      A40=ALAMB*A4(L,M,N)
      A50=ALAMB*A5(L,M,N)
   26 ALAMB=1.+CURV2(LQ)*(Y*DELTA(KKK,L,N)-YREF(L,N))
      IF(IKURV.EQ.-1)ALAMB=1.
      R(L,M,N)=(A10-DT*(DIFB1+F17*(DIFC1+DIFD1+E1)))/ALAMB
      U(L,M,N)=(A20-DT*(DIFB2+F17*(DIFC2+DIFD2+E2)))/ALAMB
      W(L,M,N)=(A40-DT*(DIFB4+DIFC4+DIFD4+E4))/ALAMB
      IF(M.EQ.1)GO TO 27
      V(L,M,N)=(A30-DT*(DIFB3+DIFC3+DIFD3+E3))/ALAMB
      GO TO 30
   27 F15=PYBPX(L,N)/ALAMB
      IF(L.EQ.1)GO TO 28
      F16=PYBPPH(L,N)/RAD
      GO TO 29
   28 F16=0.
   29 V(L,M,N)=F15*U(L,M,N)+F16*W(L,M,N)
   30 ENERT=(A50-DT*(DIFB5+F17*(DIFC5+DIFD5+E5)))/(R(L,M,N)*ALAMB)
      ENERS=ENERT-.5*(U(L,M,N)**2+V(L,M,N)**2+W(L,M,N)**2)/R(L,M,N)**2
      IF(IGAS.EQ.0.AND.(M.NE.1.OR.L.NE.LCORN))GO TO 31
      ISND=1
      RHO=R(L,M,N)
      CALL GAS
      ISND=0
      IF(M.NE.1.OR.L.NE.LCORN)GO TO 31
      GAMOO=GAMM
      BETASQ=(U(L,M,N)/(R(L,M,N)*SND))**2-1.
   31 P(L,M,N)=(GAMM-1.)*ENERS*R(L,M,N)
      H(L,M,N)=ENERT+P(L,M,N)/R(L,M,N)
      IF(M.NE.1.OR.L.NE.LHI)GO TO 32


      LHIM1=LHI-1
      ALAMB1=1.-CURV2(LHIM1)*YREF(LHIM1,N)
      F17=PYBPX(LHIM1,N)/ALAMB1
      F18=1./SQRT(1.+F17**2)
      THETA8=ATAN(F17)
      F19=SQRT((GAMOO+1.)/(GAMOO-1.))
      IF(BETASQ.LT.1.E-09)GO TO 310
      F20=SQRT(BETASQ)
      F21=F20/F19
      ANU=F19*ATAN(F21)-ATAN(F20)
      GO TO 311
  310 ANU=0.
  311 AMLHI=2./((GAMOO-1.)*(THETA(LCORN)-THETA(LHIM1)+THETA8+(F19-1.)*1.
     15707964-ANU))
      EXPF=1./(GAMOO-1.)
      F22=2.*(GAMOO-1.)*H(LCORN,M,N)/(2.+(GAMOO-1.)*AMLHI**2)
      F23=(F22*R(LCORN,M,N)/(GAMOO*P(LCORN,M,N)))**EXPF
      R(LHIM1,M,N)=R(LCORN,M,N)*F23
      P(LHIM1,M,N)=P(LCORN,M,N)*F23**GAMOO
      H(LHIM1,M,N)=H(LCORN,M,N)
      U(LHIM1,M,N)=F18*SQRT(F22)*AMLHI*R(LHIM1,M,N)
      V(LHIM1,M,N)=F17*U(LHIM1,M,N)
      W(LHIM1,M,N)=W(LCORN,M,N)*F23
   32 CONTINUE
      LLO=2
      IF(N.EQ.1)GO TO 33
      PHI=PHI+DPHI
      R(1,M,N)=R(1,M,1)
      U(1,M,N)=U(1,M,1)*COS(PHI)
      V(1,M,N)=V(1,M,1)
      W(1,M,N)=-U(1,M,1)*SIN(PHI)
      P(1,M,N)=P(1,M,1)
      H(1,M,N)=H(1,M,1)
   33 CONTINUE
      RETURN
      END
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```
      SUBROUTINE RESULT
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCCFN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1CT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHC,RS,SNALP,SND,XO,
     2YREF0,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1A0(4,3,9),C2A0
     3(4,3,9),C3A0(4,3,9),C4A0(4,3,9),C5A0(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREF0,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
      COMMON/BLOCK1/KPO
  900 FORMAT(* GRID*//4H LF=I3,2X3HMF=I3,2X3HNF=I3//
     14H DX=E16.8,2X3HDY=E16.8,2X5HDPHI=E16.8///
     2* REFFRENCE-SURFACE PROFILE*//
     38H KURVE1=I3,2X7HKURVE2=I3,2X7HKURVE3=I3,2X7HKURVE4=I3//
     48H CURVE1=E16.8,2X7HCURVE2=E16.8,2X7HCURVE3=E16.8,2X7HCURVE4=E16.8
     5,2X7HCURVE5=E16.8/)
  901 FORMAT(3H L=I3,2X9HTHETA(L)=E16.8,2X9HCURV2(L)=E16.8,2X8HXREF(L)=E
     116.8,2X8HRREF(L)=E16.8)
  902 FORMAT(//* BODY SURFACE*//7H YREF0=E16.8,2X6HYREF1=E16.8,2X6HYREF2
     1=E16.8,2X6HYREF3=E16.8,2X6HYREF4=E16.8/)
  903 FORMAT(3H L=I3,2X2HN=I3,2X10HYREF(L,N)=E16.8,2X11HPYBPX(L,N)=E16.8
     1,2X12HPYBPPH(L,N)=E16.8)
  904 FORMAT(//* INITIAL SHOCK*//
     14H RS=E16.8,2X3HBS=E16.8,2X3HXC=E16.8,2X4HCXO=E16.8///
     2* GAS MODEL PARAMETERS*//6H IGAS=I5//
     37H DENSC=E16.8,2X5HVELO=E16.8///
     4* NONDIMENSIONAL FLIGHT CONDITIONS*//
     57H GAMMA=E16.8,2X5HGAMM=E16.8,2X5HPINF=E16.8,2X6HALPHA=E16.8///
     6* PRINTING AND CUTOFF PARAMETERS*//
     75H KPO=I5,2X4HKPP=I5,2X3HKF=I5///
     8* COMPUTATIONAL PARAMETERS*//* IYREF0=*,I3//
     94H CT=E16.8,2X5HEPSI=E16.8,2X5HPMIN=E16.8////)
  905 FORMAT(4I5,6E16.8/(20X6E16.8))
  906 FORMAT(20X6E16.8)
  907 FORMAT(/)


  908 FORMAT(4X1HK,4X1HL,4X1HM,4X1HN,7X2HUN,14X2HVN,14X2HWN,13X3HRHO,11X
     18HP(L,M,N),8X8HH(L,M,N)/26X3HPHI,13X3HRAD,13X3HXAD,12X4HGAMM,11X6H
     2ENTROP,11X5HAMACH/22X12HDELTA(1,L,N),4X11HPDPT(1,L,N),5X11HPDPX(1,
     3L,N),5X12HPDPPH(1,L,N)////)
  909 FORMAT(* TIME=*,E16.8///)
  910 FORMAT(8H IYREF2=I3,2X7HIYREF3=I3,2X7HIYREF4=I3//)
  911 FORMAT(//* TYPE OF FLOW*//* IYREF1=*,I3//)
  912 FORMAT(//)
  913 FORMAT(1H1//)
  914 FORMAT(3H L=I5,2X2HN=I5,2X13HDELTA(1,L,N)=E16.8,2X4HRAD=E16.8,2X4H
     1XAD=E16.8)
      PRINT 913
      ALPHAD=ALPHA*57.29577951
      IF(K.GT.0)GO TO 3                                                 00000968
      PRINT 911,IYREF1
      PRINT 900,LF,MF,NF,DX,DY,DPHI,KURVE1,KURVE2,KURVE3,KURVE4,CURVE1,C
     1URVE2,CURVE3,CURVE4,CURVE5
      LHIM1=LHI-1
      DO 1 L=1,LF
      THETAD=THETA(L)*57.29577951
    1 PRINT 901,L,THETAD,CURV2(L),XREF(L),RREF(L)
      PRINT 902,YREF0,YREF1,YREF2,YREF3,YREF4
      PRINT 910,IYREF2,IYREF3,IYREF4
      DO 20 N=1,NF
      DO 2 L=1,LF
    2 PRINT 903,L,N,YREF(L,N),PYBPX(L,N),PYBPPH(L,N)
      PRINT 907
   20 CONTINUE
      PRINT 904,RS,BS,XO,CXO,IGAS,DENSC,VELO,GAMMA,GAMM,PINF,ALPHAD,KPO,
     1KPP,KF,IYREF0,CT,EPSI,PMIN
      PRINT 913
      IF(K.EQ.0)GO TO 3
      DO 30 N=1,NF
      DO 30 L=1,LF
      F1=DELTA(1,L,N)-YREF(L,N)
      RAD=RREF(L)+F1*SIN(THETA(L))
      XAD=XREF(L)+F1*COS(THETA(L))
   30 PRINT 914,L,N,DELTA(1,L,N),RAD,XAD
      RETURN
    3 PRINT 909,TIME
      PRINT 908
      DO 6 N=1,NF
      AN=N
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      PHI=57.29577951*(AN-1.)*DPHI
      DO 5 M=1,MF
      AM=M
      DO 4 L=1,LF
      IF(M.EQ.1.AND.L.GT.LCORN.AND.L.LT.LHIM1)GO TO 4
      F1=(AM-1.)*DY*DELTA(1,L,N)-YREF(L,N)
      RAD=RREF(L)+F1*SIN(THETA(L))
      XAD=XREF(L)+F1*COS(THETA(L))
      UN=U(L,M,N)/R(L,M,N)
      VN=V(L,M,N)/R(L,M,N)
      WN=W(L,M,N)/R(L,M,N)
      ISND=1
      RHO=R(L,M,N)
      F2=UN**2+VN**2+WN**2
      ENERS=H(L,M,N)-P(L,M,N)/R(L,M,N)-.5*F2
      CALL GAS
      AMACH=SQRT(F2)/SND
      ENTROP=P(L,M,N)/ABS(R(L,M,N))**GAMM
      PRINT 905,K,L,M,N,UN,VN,WN,RHO,P(L,M,N),H(L,M,N),PHI,RAD,XAD,GAMM,
     1ENTROP,AMACH
      IF(M.EQ.MF)PRINT 906,DELTA(1,L,N),PDPT(1,L,N),PDPX(1,L,N),PDPPH(1,
     1L,N)
    4 CONTINUE
      IF(M.NE.MF)PRINT 907
    5 CONTINUE
      PRINT 912
    6 CONTINUE
      RETURN
      END
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      SUBROUTINE SHOCK
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCCFN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1CT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1AO(4,3,9),C2AO
     3(4,3,9),C3AO(4,3,9),C4AO(4,3,9),C5AO(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
  900 FORMAT(* SUBROUTINE SHOCK *,1A6,4I5/(8E16.8))
      KKK=3-KK
      ISND=1
      M=MF
      MM1=M-1
      MM2=M-2
      LLO=1
      DO 66 N=1,NF
      DO 65 L=LLO,LF
      IF(L.NE.KURVE1.AND.L.NE.KURVE2.AND.L.NE.KURVE3.AND.L.NE.KURVE4)GO
     1TO 41
      IKURV=1
      CHECK=(CURV2(L-1)-CURV2(L))*(DELTA(KK,L,N)-YREF(L,N))
      IF(CHECK.LT.0.)GO TO 42
      IKURV=2
      GO TO 42
   41 IKURV=0
   42 ALAMB=1.+CURV2(L)*(DELTA(KK,L,N)-YREF(L,N))
      SNTHE=SIN(THETA(L))
      CSTHE=COS(THETA(L))
      RAD=RREF(L)+(DELTA(KK,L,N)-YREF(L,N))*SNTHE
      IF(L.EQ.1)GO TO 43
      F1=(PDPPH(KK,L,N)+PYBPPH(L,N))/RAD
      GO TO 44
   43 F1=0.
   44 F2=(PDPX(KK,L,N)+PYBPX(L,N))/ALAMB
      F3=SQRT(1.+F1**2+F2**2)
      CSBX=-F2/F3
      CSBY=1./F3
      CSBP=-F1/F3
      IF(IKURV.NE.1)GO TO 45
      ALAMB=1.+CURV2(L-1)*(DELTA(KK,L,N)-YREF(L,N))
      F2=(PDPX(KK,L,N)+PYBPX(L,N))/ALAMB
      F3=SQRT(1.+F1**2+F2**2)
   45 RHO=R(L,M,N)
      ENERS=H(L,M,N)-(P(L,M,N)+(U(L,M,N)**2+V(L,M,N)**2+W(L,M,N)**2)/R(L
     1,M,N))/R(L,M,N)
      CALL GAS
      VN1=(CSBX*U(L,M,N)+CSBY*V(L,M,N)+CSBP*W(L,M,N))/R(L,M,N)
      VN2=(CSBX*U(L,MM1,N)+CSBY*V(L,MM1,N)+CSBP*W(L,MM1,N))/R(L,MM1,N)
      VN3=(CSBX*U(L,MM2,N)+CSBY*V(L,MM2,N)+CSBP*W(L,MM2,N))/R(L,MM2,N)
      LG=L
      IF(IKURV.EQ.1)LG=L-1
      IF(KK.EQ.1)A4(L,M,N)=P(L,M,N)
      IF(KK.EQ.1)A5(L,M,N)=VN1
      A1(L,M,N)=R(L,M,N)*SND
      A2(L,M,N)=A4(L,M,N)+A1(L,M,N)*A5(L,M,N)-DT/(DELTA(KK,L,N)*DY)*(F3*
     1(VN1+SND)-PDPT(KK,L,N))*.5*(3.*P(L,M,N)-4.*P(L,MM1,N)+P(L,MM2,N)+A
     21(L,M,N)*(3.*VN1-4.*VN2+VN3))
      A3(L,M,N)=-DT*SND*CURV2(LG)/ALAMB*(SND*V(L,M,N)-U(L,M,N)/R(L,M,N)*
     1(CSBY*U(L,M,N)-CSBX*V(L,M,N)))
      IF(L.EQ.LF)GO TO 46
      IF(IKURV.EQ.1)GO TO 49
      LP1=L+1
      VN5=(CSBX*U(LP1,M,N)+CSBY*V(LP1,M,N)+CSBP*W(LP1,M,N))/R(LP1,M,N)
      UTX5=(U(LP1,M,N)-CSBX*(CSBX*U(LP1,M,N)+CSBY*V(LP1,M,N)+CSBP*W(LP1,
     1M,N)))/R(LP1,M,N)
   46 IF(IKURV.EQ.2)GO TO 49
      IF(L.EQ.1)GO TO 47
      LM1=L-1
      N1=N
      F4=1.
      GO TO 48
   47 LM1=2
      N1=NF
      F4=-1.
   48 VN4=(F4*CSBX*U(LM1,M,N1)+CSBY*V(LM1,M,N1)+CSBP*W(LM1,M,N1))/R(LM1,
     1M,N1)
      UTX4=(F4*U(LM1,M,N1)-CSBX*(F4*CSBX*U(LM1,M,N1)+CSBY*V(LM1,M,N1)+CS
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     1BP*W(LM1,M,N1)))/R(LM1,M,N1)
      GO TO 54
   49 L1=L+3-2*IKURV
      LQ=L+1-IKURV
      CHECK=ABS(CURV2(LQ))
      IF(CHECK.LT.1.E-09)GO TO 50
      RR1=RREF(L)+(DELTA(KK,L,N)-YREF(L,N))*SIN(THETA(L))
      XX1=XREF(L)+(DELTA(KK,L,N)-YREF(L,N))*COS(THETA(L))
      RR3=RREF(L1)+(DELTA(KK,L1,N)-YREF(L1,N))*SIN(THETA(L1))
      XX3=XREF(L1)+(DELTA(KK,L1,N)-YREF(L1,N))*COS(THETA(L1))
      RADA=SQRT((RR1-RR3)**2+(XX1-XX3)**2)
      IF(IKURV.EQ.1)F5=1.
      IF(IKURV.EQ.2)F5=-1.
      RADB=1./CURV2(LQ)+DELTA(KK,L,N)-YREF(L,N)
      RR2=RR1-RADB*SIN(THETA(L))
      XX2=XX1-RADB*COS(THETA(L))
      RADC=SQRT((RR2-RR3)**2+(XX2-XX3)**2)
      IF(CURV2(LQ).GT.0.)F6=1.
      IF(CURV2(LQ).LT.0.)F6=-1.
      DTHETA=F5*F6*ACOS(F6*(RADB**2+RADC**2-RADA**2)/(2.*RADB*RADC))
      THETAA=THETA(L)+DTHETA-THETA(L1)
      IF(IKURV.EQ.1)L2=L-1
      IF(IKURV.EQ.2)L2=L+1
      F7=(THETA(L)-THETA(L2))/DTHETA
      GO TO 51
   50 THETAA=THETA(L)-THETA(L1)
      RADB=1./CURV2(LQ)+DELTA(KK,L1,N)-YREF(L1,N)
      RADC=RADB*ABS(SIN(THETAA))
      F7=DX/RADC
   51 IF(F7.GT.1.)F7=1.
      UNEW=U(L1,M,N)*COS(THETAA)-V(L1,M,N)*SIN(THETAA)
      VNEW=U(L1,M,N)*SIN(THETAA)+V(L1,M,N)*COS(THETAA)
      VNN=(CSBX*UNEW+CSBY*VNEW+CSBP*W(L1,M,N))/R(L1,M,N)
      UTXX=(UNEW-CSBX*(CSBX*UNEW+CSBY*VNEW+CSBP*W(L1,M,N)))/R(L1,M,N)
      IF(IKURV.EQ.2)GO TO 52
      VN5=VNN
      UTX5=UTXX
      GO TO 46
   52 VN4=VNN
      UTX4=UTXX
   54 LP1=L+1
      LM1=L-1
      IF(L.LT.LF)GO TO 55
      DIF2=P(L,M,N)-P(LM1,M,N)+A1(L,M,N)*(VN1-VN4)
      UTX1=U(L,M,N)/R(L,M,N)-CSBX*VN1
      DIF3=UTX1-UTX4
      GO TO 59
   55 F8=.5
      IF(IKURV.EQ.1.OR.IKURV.EQ.2)F8=F7/(1.+F7)
      N1=N
      IF(L.NE.1)GO TO 56
      N1=NF
      LM1=2
   56 DIF2=F8*(P(LP1,M,N)-P(LM1,M,N1)+A1(L,M,N)*(VN5-VN4))
      DIF3=F8*(UTX5-UTX4)
   59 A2(L,M,N)=A2(L,M,N)-DT*DIF2/(ALAMB*DX)*(U(L,M,N)/R(L,M,N)+CSBX*SND
     1)
      A3(L,M,N)=A3(L,M,N)-DT*DIF3/(ALAMB*DX)*R(L,M,N)*SND**2
      IF(IYREF1.EQ.0)GO TO 65
      IF(N.NE.1.AND.N.NE.NF)GO TO 63
      DA2=0.
      IF(L.EQ.1)GO TO 62
      IF(N.EQ.NF)GO TO 60
      N1=2
      F8=1.
      GO TO 61
   60 N1=NF-1
      IF(NF.EQ.1)N1=N
      F8=-1.
   61 DIF3=F8*(1.-CSBP**2)*W(L,M,N1)/R(L,M,N1)
      DA3=-DT*SND**2/RAD*(R(L,M,N)*DIF3/DPHI+V(L,M,N)*SIN(THETA(L))+U(L,
     1M,N)*COS(THETA(L)))
      GO TO 64
   62 N1=NF-1
      IF(NF.EQ.1)N1=N
      DA3=-DT*SND**2/ALAMB*(R(L,M,N)*(U(2,M,1)/R(2,M,1)+U(2,M,NF)/R(2,M,
     1NF))*.5/DX+V(L,M,N)*CURV2(LQ))
      IF(NF.LE.2)GO TO 64
      DA3=DA3-DT*SND**2/ALAMB*(1.-CSBP**2)*(W(2,M,2)/R(2,M,2)-W(2,M,N1)/
     1R(2,M,N1))/DPHI *.5/DX*R(L,M,N)
      GO TO 64
   63 NP1=N+1
      NM1=N-1
      VN7=(CSBX*U(L,M,NP1)+CSBY*V(L,M,NP1)+CSBP*W(L,M,NP1))/R(L,M,NP1)
      VN6=(CSBX*U(L,M,NM1)+CSBY*V(L,M,NM1)+CSBP*W(L,M,NM1))/R(L,M,NM1)
      UTP7=(W(L,M,NP1)-CSBP*(CSBX*U(L,M,NP1)+CSBY*V(L,M,NP1)+CSBP*W(L,M,
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     1NP1)))/R(L,M,NP1)*R(L,M,N)
      UTP6=(W(L,M,NM1)-CSBP*(CSBX*U(L,M,NM1)+CSBY*V(L,M,NM1)+CSBP*W(L,M,
     1NM1)))/R(L,M,NM1)*R(L,M,N)
      DA2=-.5*DT/RAD*(W(L,M,N)/R(L,M,N)+CSBP*SND)/DPHI*(P(L,M,NP1)-P(L,M
     1,NM1)+A1(L,M,N)*(VN7-VN6))
      DA3=-DT*SND/RAD*(SND*(UTP7-UTP6)*.5/DPHI+(SND*V(L,M,N)-W(L,M,N)/R(
     1L,M,N)*(CSBY*W(L,M,N)-CSBP*V(L,M,N)))*SIN(THETA(L))+(SND*U(L,M,N)-
     2W(L,M,N)/R(L,M,N)*(CSBX*W(L,M,N)-CSBP*U(L,M,N)))*COS(THETA(L)))
   64 A2(L,M,N)=A2(L,M,N)+DA2
      A3(L,M,N)=A3(L,M,N)+DA3
   65 CONTINUE
      LLO=2
   66 CONTINUE
      LLO=1
      DO 4 N=1,NF
      AN=N
      PHI=(AN-1.)*DPHI
      SNPHI=SIN(PHI)
      CSPHI=COS(PHI)
      DO 3 L=LLO,LF
      SNTHE=SIN(THETA(L))
      CSTHE=COS(THETA(L))
      CSAX=SNTHE*CSALP+CSTHE*CSPHI*SNALP
      CSAY=-CSTHE*CSALP+SNTHE*CSPHI*SNALP
      CSAP=-SNPHI*SNALP
      ALAMB=1.+CURV2(L)*(DELTA(KK,L,N)-YREF(L,N))
      RAD=RREF(L)+(DELTA(KK,L,N)-YREF(L,N))*SNTHE
      IF(L.EQ.1)GO TO 1
      F1=(PDPPH(KK,L,N)+PYBPPH(L,N))/RAD
      GO TO 2
    1 F1=0.
    2 F2=(PDPX(KK,L,N)+PYBPX(L,N))/ALAMB
      F3=SQRT(1.+F1**2+F2**2)
      CSBX=-F2/F3
      CSBY=1./F3
      CSBP=-F1/F3
      CSSHK=CSAX*CSBX+CSAY*CSBY+CSAP*CSBP
      ES=H(L,MF,N)-(P(L,MF,N)+.5*(U(L,MF,N)**2+V(L,MF,N)**2+W(L,MF,N)**2
     1)/R(L,MF,N))/R(L,MF,N)
      ITERU=4
      IF(IGAS.EQ.0)ITERU=1
      DO 32 ITER=1,ITERU
      RHO=R(L,MF,N)

      ENERS=ES
      CALL GAS
      IF(ITER.GT.1)GO TO 30
      F4=A1(L,M,N)
      F5=A2(L,M,N)+A3(L,M,N)
      GO TO 31
   30 IF(ITER.EQ.ITERU)GO TO 32
   31 F6=(GAMMA-GAMM)/(GAMMA-1.)*PINF/(F5-(GAMM-1.)/(GAMMA-1.)*PINF-F4*C
     1SSHK)
      F9=(1.-F6+F6**2)*F4**2+1.5*(1.-F6)*((GAMM+1.)*(F5-F4*CSSHK)+(GAMM-
     11.)*PINF)
      F10=(2.*(1.+F6**3)-3.*F6*(1.+F6))*F4**2+4.5*(1.-F6**2)*(GAMM+1.)*(
     1F5-F4*CSSHK)-4.5*((5.*GAMM+1.)-6.*GAMM*F6+(GAMM-1.)*F6**2)*PINF
      IF(F9.GE.1.E-06)GO TO 311
      PRINT 900,BLK(1),K,L,M,N,F4,F5,CSSHK,CSBX,CSBY,CSBP,F9,F10
      CALL RESULT
      STOP 1101
  311 F11=.5*F4*F10/F9**1.5
      IF(ABS(F11).LE.1.)GO TO 310
      PRINT 900,BLK(2),K,L,M,N,F4,F5,CSSHK,CSBX,CSBY,CSBP,F9,F10,F11
      CALL RESULT
      STOP 1102
  310 PSA=ACOS(F11)/3.
      F7=(SQRT(F9)*(COS(PSA)+1.7320508*SIN(PSA))-F4*(1.+F6))/3.
      F12=PINF/F7**2
      F8=F7*(GAMM*(F12+1.)-SQRT((GAMM*F12-1.)**2+2.*(GAMM+1.)*(GAMMA-GAM
     1M)*F12/(GAMMA-1.)))/(GAMM+1.)
      R(L,MF,N)=F7/F8
      ES=(F8/F7*PINF+F8*(F7-F8))/(GAMM-1.)
   32 CONTINUE
      RHO=R(L,MF,N)
      P(L,MF,N)=(GAMM-1.)*RHO*ES
      U(L,MF,N)=(CSAX+(F7-F8)*CSBX)*RHO
      V(L,MF,N)=(CSAY+(F7-F8)*CSBY)*RHO
      W(L,MF,N)=(CSAP+(F7-F8)*CSBP)*RHO
      F9=1.+(F7-F8)*(2.*CSSHK+F7-F8)
      H(L,MF,N)=ES+.5*F9+P(L,MF,N)/RHO
      WS=(CSSHK+F7)*CSBY
      DELTA(KKK,L,N)=DELTA(1,L,N)+.5*DT*(WS+PDPT(1,L,N))
      PDPT(KKK,L,N)=WS
      IF(KK.EQ.1)GO TO 300
      F10=SQRT(F9)
      F11=CSAX*CSBY-CSAY*CSBX
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```
      F12=CSAP-CSSHK*CSBP
      F13=1.
      F14=1.
      IF(F11.LT.0.)F13=-1.
      IF(F12.LT.0.)F14=-1.
      PDPX(KKK,L,N)=F13*F10/SND
      PDPPH(KKK,L,N)=F14*F10/SND
      GO TO 3
  300 PDPX(KKK,L,N)=PDPX(KK,L,N)
      PDPPH(KKK,L,N)=PDPPH(KK,L,N)
    3 CONTINUE
      LLC=2
      IF(N.EQ.1)GO TO 4
      R(1,MF,N)=R(1,MF,1)
      U(1,MF,N)=U(1,MF,1)*CSPHI
      V(1,MF,N)=V(1,MF,1)
      W(1,MF,N)=-U(1,MF,1)*SNPHI
      P(1,MF,N)=P(1,MF,1)
      H(1,MF,N)=H(1,MF,1)
      DELTA(KKK,1,N)=DELTA(KKK,1,1)
      PDPT(KKK,1,N)=PDPT(KKK,1,1)
      IF(KK.EQ.1)GO TO 400
      PDPX(KKK,1,N)=PDPX(KKK,1,1)
      PDPPH(KKK,1,N)=PDPPH(KKK,1,1)
      GO TO 4
  400 PDPX(KKK,1,N)=PDPX(KK,1,N)
      PDPPH(KKK,1,N)=PDPPH(KK,1,N)
    4 CONTINUE
      IF(KK.EQ.2)CALL SLOPE
      RETURN
      END
```

```
      SUBROUTINE SLOPE
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELC,KP,KPP,KF,LHI,LCORN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1AO(4,3,9),C2AO
     3(4,3,9),C3AO(4,3,9),C4AO(4,3,9),C5AO(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
      IF(K.EQ.0)GO TO 1
      KKK=3-KK
      GO TO 2
    1 KKK=1
    2 DO 13 N=1,NF
      DO 12 L=1,LF
      DO 6 ILQ=1,5
      LLQ=L-3+ILQ
      IF(L.EQ.1.OR.ILQ.EQ.5)GO TO 3
      ILQP1=ILQ+1
      RRXF(ILQ)=RRXF(ILQP1)
      XRXF(ILQ)=XRXF(ILQP1)
      GO TO 6
    3 IF(LLQ.GT.LF)GO TO 5
      IF(LLQ.LT.1)GO TO 4
      N1=N
      F100=1.
      GO TO 40
    4 N1=NF-N+1
      LLQ=2-LLQ
      F100=-1.
   40 RRXF(ILQ)=RREF(LLQ)+(DELTA(KKK,LLQ,N1)-YREF(LLQ,N1))*SIN(THETA(LLQ
     1))
      RRXF(ILQ)=F100*RRXF(ILQ)
      XRXF(ILQ)=XREF(LLQ)+(DELTA(KKK,LLQ,N1)-YREF(LLQ,N1))*COS(THETA(LLQ
     1))


      GO TO 6
    5 ILQM2=ILQ-2
      RRXF(ILQ)=2.*RRXF(ILQ)-RRXF(ILQM2)
      XRXF(ILQ)=2.*XRXF(ILQ)-XRXF(ILQM2)
    6 CONTINUE
      IF(K.EQ.0)GO TO 8
      IF(PDPX(KKK,L,N).GE.-1..AND.PDPX(KKK,L,N).LE.1.)GO TO 8
      IF(PDPX(KKK,L,N).LT.-1.)GO TO 7
      TGTME=-(XRXF(3)-XRXF(2))/(RRXF(3)-RRXF(2))
      GO TO 9
    7 TGTME=-(XRXF(4)-XRXF(3))/(RRXF(4)-RRXF(3))
      GO TO 9
    8 TGTME=(XRXF(4)-XRXF(2))/(RRXF(4)-RRXF(2))-(XRXF(4)-XRXF(3))/(RRXF(
     14)-RRXF(3))-(XRXF(2)-XRXF(3))/(RRXF(2)-RRXF(3))
    9 TGE=(SIN(THETA(L))-COS(THETA(L))*TGTME)/(COS(THETA(L))+SIN(THETA(L
     1))*TGTME)
      PDPX(KKK,L,N)=TGE*(1.+CURV2(L)*(DELTA(KKK,L,N)-YREF(L,N)))-PYBPX(L
     1,N)
      IF(K.EQ.0)GO TO 11
      IF(N.EQ.1.OR.N.EQ.NF)GO TO 11
      IF(PDPPH(KKK,L,N).GE.-1..AND.PDPPH(KKK,L,N).LE.1.)GO TO 11
      IF(PDPPH(KKK,L,N).LT.-1.)GO TO 10
      NM1=N-1
      IF(NM1.LT.1)NM1=2
      PDPPH(KKK,L,N)=(DELTA(KKK,L,N)-DELTA(KKK,L,NM1))/DPHI
      GO TO 12
   10 NP1=N+1
      IF(NP1.GT.NF)NP1=NF-1
      PDPPH(KKK,L,N)=(DELTA(KKK,L,NP1)-DELTA(KKK,L,N))/DPHI
      GO TO 12
   11 NP1=N+1
      IF(NP1.GT.NF)NP1=NF-1
      IF(NF.LE.2)NP1=N
      NM1=N-1
      IF(NM1.LT.1)NM1=2
      IF(NF.LE.2)NM1=N
      PDPPH(KKK,L,N)=.5*(DELTA(KKK,L,NP1)-DELTA(KKK,L,NM1))/DPHI
   12 CONTINUE
   13 CONTINUE
      RETURN
      END
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```
      SUBROUTINE START
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCORN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1AO(4,3,9),C2AO
     3(4,3,9),C3AO(4,3,9),C4AO(4,3,9),C5AO(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFC,IYREF1,IYREF2,IYREF3,IYREF4
      COMMCN/ERROR/ER(12),BLK(12)
  900 FORMAT(* SUBROUTINE START*,1A6,4I5/(8E16.8))
      AMF=MF
      ANF=NF
      IF(NF.EQ.1)ANF=2.
      DY=1./(AMF-1.)
      DPHI=3.141592654/(ANF-1.)
      EINF=PINF/(GAMMA-1.)
      LCORN=0
      LHI=0
      TIME=0.
      DO 1 L=1,LF
      IF(L.LT.KURVE1)CURV2(L)=CURVE1
      IF(L.GE.KURVE1.AND.L.LT.KURVE2)CURV2(L)=CURVE2
      IF(L.GE.KURVE2.AND.L.LT.KURVE3)CURV2(L)=CURVE3
      IF(L.GE.KURVE3.AND.L.LT.KURVE4)CURV2(L)=CURVE4
      IF(L.GE.KURVE4)CURV2(L)=CURVE5
    1 CONTINUE
      THETA(1)=0.0
      RREF(1)=0.
      XREF(1)=YREFO
      DO 3 L=2,LF
      LM1=L-1
      THETA(L)=THETA(LM1)+CURV2(LM1)*DX
      IF(ABS(CURV2(LM1)).GT.1.E-09)GO TO 2
      RREF(L)=RREF(LM1)+COS(THETA(L))*DX
      XREF(L)=XREF(LM1)-SIN(THETA(L))*DX


      GO TO 31
    2 RREF(L)=RREF(LM1)+(SIN(THETA(L))-SIN(THETA(LM1)))/CURV2(LM1)
      XREF(L)=XREF(LM1)+(COS(THETA(L))-COS(THETA(LM1)))/CURV2(LM1)
   31 F99=ABS(1.-YREFO*CURV2(LM1))
      IF(LCORN.NE.0)GO TO 30
      IF(F99.LT.1.E-06)LCORN=LM1
      GO TO 3
   30 IF(LHI.NE.0)GO TO 3
      IF(F99.GE.1.E-06)LHI=L
      IF(L.EQ.LF)LHI=99
    3 CONTINUE
      DO 5 N=1,NF
      AN=N
      PHI=(AN-1.)*DPHI
      DO 4 L=1,LF
      YREF(L,N)=YREFO
    4 CONTINUE
    5 CONTINUE
      DO 12 N=1,NF
      DO 11 L=1,LF
      IF(N.NE.1.AND.N.NE.NF)GO TO 6
      PYBPPH(L,N)=0.
      GO TO 7
    6 NP1=N+1
      NM1=N-1
      PYBPPH(L,N)=-.5*(YREF(L,NP1)-YREF(L,NM1))/DPHI
    7 IF(L.NE.1)GO TO 8
      YREFP1=YREF(2,N)
      NXY=NF-N+1
      LP1=2
      LM1=2
      GO TO 10
    8 LM1=L-1
      LP1=L+1
      NXY=N
      IF(LP1.LE.LF)GO TO 9
      YREFP1=2.*YREF(L,N)-YREF(LM1,N)
      GO TO 10
    9 YREFP1=YREF(LP1,N)
   10 PYBPX(L,N)=-.5*(YREFP1-YREF(LM1,NXY))/DX
      IF(LP1.EQ.LHI)PYBPX(L,N)=2.*PYBPX(L,N)
   11 CONTINUE
   12 CONTINUE
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      SNALP=SIN(ALPHA)
      CSALP=COS(ALPHA)
      DO 18 N=1,NF
      AN=N
      PHI=(AN-1.)*DPHI
      SNPHI=SIN(PHI)
      CSPHI=-COS(PHI)
      DO 17 L=1,LF
      SNTHE=SIN(THETA(L))
      CSTHE=COS(THETA(L))
      R1=RREF(L)-YREF(L,N)*SNTHE
      X1=XREF(L)-YREF(L,N)*CSTHE-YREFO+YREF(1,1)
      F1=CSTHE*SNALP-SNTHE*CSPHI*CSALP
      F2=CSTHE*CSALP+SNTHE*CSPHI*SNALP
      F3=R1*CSTHE-(X1+XO)*SNTHE
      F4=(RS-BS*CXO)*CSTHE
      F5=SNPHI**2+CSPHI**2*(CSALP**2+BS*SNALP**2)
      F6=F1**2+(SNTHE*SNPHI)**2+BS*F2**2
      F7=F2*F4-((F1*CSALP-F2*BS*SNALP)*CSPHI-SNTHE*SNPHI**2)*F3
      F8=F3**2*F5+2.*F3*F4*CSPHI*SNALP-(RS*CSTHE+F4)*CXO*CSTHE
      IF(ABS(F6).LT.1.E-09)GO TO 13
      F9=SQRT(ABS(F7**2-F6*F8))
      IF(CSTHE.LT.0.)F9=-F9
      X2=(F9-F7)/F6-XO
      GO TO 130
   13 X2=-.5*F8/F7-XO
  130 IF(ABS(CSTHE).LT..01)GO TO 14
      R2=R1+SNTHE*(X2-X1)/CSTHE
      GO TO 16
   14 F10=SNPHI**2+(CSPHI*CSALP)**2+BS*(CSPHI*SNALP)**2
      F11=(BS-1.)*(X2+XO)*CSPHI*SNALP*CSALP+(RS-BS*CXO)*CSPHI*SNALP
      F12=(X2+XO)**2*(SNALP**2+BS*CSALP**2)+2.*(RS-BS*CXO)*(X2+XO)*CSALP
     1-2.*RS*CXO+BS*CXO**2
      IF(ABS(F10).LT.1.E-09)GO TO 15
      F13=SQRT(ABS(F11**2-F10*F12))
      R2=(F13-F11)/F10
      GO TO 16
   15 R2=-.5*F12/F11
   16 DELTA(1,L,N)=SQRT((X2-X1)**2+(R2-R1)**2)
      DELTA(2,L,N)=DELTA(1,L,N)
      PDPT(1,L,N)=0.
   17 CONTINUE
   18 CONTINUE


      K=0
      CALL SLOPE
      CSBDMX=0.
      LLO=1
      DO 22 N=1,NF
      AN=N
      PHI=(AN-1.)*DPHI
      SNPHI=SIN(PHI)
      CSPHI=COS(PHI)
      DO 21 L=LLO,LF
      SNTHE=SIN(THETA(L))
      CSTHE=COS(THETA(L))
      CSAX=SNTHE*CSALP+CSTHE*CSPHI*SNALP
      CSAY=-CSTHE*CSALP+SNTHE*CSPHI*SNALP
      CSAP=-SNPHI*SNALP
      ALAMB=1.+CURV2(L)*(DELTA(1,L,N)-YREF(L,N))
      RAD=RREF(L)+(DELTA(1,L,N)-YREF(L,N))*SNTHE
      IF(L.EQ.1)GO TO 19
      F14=(PDPPH(1,L,N)+PYBPPH(L,N))/RAD
      GO TO 20
   19 F14=0.
   20 F15=(PDPX(1,L,N)+PYBPX(L,N))/ALAMB
      F16=SQRT(1.+F14**2+F15**2)
      CSBX=-F15/F16
      CSBY=1./F16
      CSBP=-F14/F16
      CSSHK=CSAX*CSBX+CSAY*CSBY+CSAP*CSBP
      IF(CSSHK.LE.-1.E-06)GO TO 201
      PRINT 900,ER(1),K,L,MF,N,CSSHK
      K=-1
      CALL RESULT
      STOP 1301
  201 IF(L.GE.LCORN)GO TO 200
      F98=-PYBPX(L,N)/(1.-YREF(L,N)*CURV2(L))
      F97=1./SQRT(1.+F98**2)
      CSBD=(CSAX*F98+CSAY)*F97
      IF(CSBD.GT.CSBDMX)GO TO 200
      CSBDMX=CSBD
  200 F17=1.+PINF/CSSHK**2
      F18=1.+2.*GAMMA/(GAMMA-1.)*PINF/CSSHK**2
      F19=SQRT(F17**2-(1.-1./GAMM**2)*F18)
      R(L,MF,N)=(GAMM+1.)/(GAMM*(F17-F19))
      IF(R(L,MF,N).GE.1.)GO TO 202
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      PRINT 900,ER(2),K,L,MF,N,R(L,MF,N)
      K=-1
      CALL RESULT
      STOP 1302
  202 U(L,MF,N)=R(L,MF,N)*(CSAX-CSSHK*CSBX)+CSSHK*CSBX
      V(L,MF,N)=R(L,MF,N)*(CSAY-CSSHK*CSBY)+CSSHK*CSBY
      W(L,MF,N)=R(L,MF,N)*(CSAP-CSSHK*CSBP)+CSSHK*CSBP
      P(L,MF,N)=PINF+CSSHK**2*(1.-1./R(L,MF,N))
      H(L,MF,N)=.5+GAMMA/(GAMMA-1.)*PINF
   21 CONTINUE
      LLC=2
      IF(N.EQ.1)GO TO 22
      R(1,MF,N)=R(1,MF,1)
      U(1,MF,N)=U(1,MF,1)*CSPHI
      V(1,MF,N)=V(1,MF,1)
      W(1,MF,N)=-U(1,MF,1)*SNPHI
      P(1,MF,N)=P(1,MF,1)
      H(1,MF,N)=H(1,MF,1)
   22 CONTINUE
      F17=1.+PINF
      F18=1.+2.*GAMMA/(GAMMA-1.)*PINF
      F19=SQRT(F17**2-(1.-1./GAMM**2)*F18)
      RNS=(GAMM+1.)/(GAMM*(F17-F19))
      PNS=PINF+1.-1./RNS
      AMSQ=1./(GAMM*RNS*PNS)
      EXPO=GAMM/(GAMM-1.)
      F20=1.+.5*(GAMM-1.)*AMSQ
      PNST=PNS*F20**EXPO
      EXPC=EXPO/GAMM
      RNST=RNS*F20**EXPO
      HNST=GAMM/(GAMM-1.)*PNST/RNST
      EXPO=1./GAMM
      DO 27 N=1,NF
      AN=N
      PHI=(AN-1.)*DPHI
      SNPHI=SIN(PHI)
      CSPHI=COS(PHI)
      DO 26 L=1,LF
      SNTHE=SIN(THETA(L))
      CSTHE=COS(THETA(L))
      CSAX=SNTHE*CSALP+CSTHE*CSPHI*SNALP
      CSAY=-CSTHE*CSALP+SNTHE*CSPHI*SNALP
      CSAP=-SNPHI*SNALP


      LAL=L
      IF(L.GE.LCORN.AND.LCORN.NE.0)LAL=LCORN-1
      ALAMB=1.-CURV2(LAL)*YREF(L,N)
      RAD=RREF(L)-YREF(L,N)*SNTHE
      IF(L.EQ.1)GO TO 23
      F21=PYBPPH(L,N)/RAD
      GO TO 24
   23 F21=0.
   24 F22=PYBPX(L,N)/ALAMB
      F23=SQRT(1.+F21**2+F22**2)
      CSBX=-F22/F23
      CSBY=1./F23
      CSBP=-F21/F23
      CSBD=CSAX*CSBX+CSAY*CSBY+CSAP*CSBP
      IF(L.GT.LCORN)GO TO 240
      P(L,1,N)=PNST*(CSBD/CSBDMX)**2
      GO TO 241
  240 P(L,1,N)=PNST*CSBD**2+PINF*(1.-CSBD**2)
      IF(LCORN.EQ.0)GO TO 241
      IF(P(L,1,N).GT.P(LCORN,1,N))P(L,1,N)=P(LCORN,1,N)
  241 LM1=L-1
      IF(CSBD.GT.0.0)P(L,1,N)=P(LM1,1,N)
      IF(P(L,1,N).LT.PMIN)P(L,1,N)=PMIN
      R(L,1,N)=(P(L,1,N)/PNST)**EXPO*RNST
      UT=SQRT(ABS(2.*(HNST-GAMM/(GAMM-1.)*P(L,1,N)/R(L,1,N))))
      F24=SQRT(ABS(1.-CSBD**2))
      IF(F24.LT.1.E-09)F24=1.
      UT=UT/F24
      U(L,1,N)=R(L,1,N)*UT*(CSAX-CSBD*CSBX)
      V(L,1,N)=R(L,1,N)*UT*(CSAY-CSBD*CSBY)
      W(L,1,N)=R(L,1,N)*UT*(CSAP-CSBD*CSBP)
      IF(L.NE.LCORN)GO TO 242
      WCHK=W(L,1,N)/R(L,1,N)
      HCHK=HNST-.5*WCHK**2
      EXPCK=GAMM/(GAMM-1.)
      PCHK=PNST*(2.*HCHK*(GAMM-1.)*RNST/(GAMM*(GAMM+1.)*PNST))**EXPCK
      IF(P(L,1,N).LE.PCHK)GO TO 242
      P(L,1,N)=PCHK
      R(L,1,N)=RNST*(PCHK/PNST)**EXPC
      UT=SQRT(GAMM*PCHK/R(L,1,N))
      U(L,1,N)=R(L,1,N)*UT*CSBY
      V(L,1,N)=-R(L,1,N)*UT*CSBX
      W(L,1,N)=WCHK*R(L,1,N)
```

```
242 H(L,1,N)=HNST
    MUP=MF-1
    DO 25 M=2,MUP
    AM=M
    Y=(AM-1.)*DY
    R(L,M,N)=Y*R(L,MF,N)+(1.-Y)*R(L,1,N)
    U(L,M,N)=Y*U(L,MF,N)+(1.-Y)*U(L,1,N)
    V(L,M,N)=Y*V(L,MF,N)+(1.-Y)*V(L,1,N)
    W(L,M,N)=Y*W(L,MF,N)+(1.-Y)*W(L,1,N)
    P(L,M,N)=Y*P(L,MF,N)+(1.-Y)*P(L,1,N)
    H(L,M,N)=(GAMM/(GAMM-1.)*P(L,M,N)+.5*(U(L,M,N)**2+V(L,M,N)**2+W(L,
   1M,N)**2)/R(L,M,N))/R(L,M,N)
 25 CONTINUE
 26 CONTINUE
 27 CONTINUE
    RETURN
    END
```

```
      SUBROUTINE TRANSC
      COMMON IGAS,ISND,J,K,KK,KURVE1,KURVE2,KURVE3,KURVE4,LF,M,MF,MM,N,N
     1F,LLO,DENSO,VELO,KP,KPP,KF,LHI,LCORN
      COMMON ALPHA,BS,CSALP,CURVE1,CURVE2,CURVE3,CURVE4,CURVE5,CXO,DPHI,
     1DT,DX,DY,EINF,ENERS,EPSI,GAMM,GAMMA,PINF,PMIN,RHO,RS,SNALP,SND,XO,
     2YREFO,YREF1,YREF2,YREF3,YREF4
      COMMON A1(17,6,9),A2(17,6,9),A3(17,6,9),A4(17,6,9),A5(17,6,9),H(17
     1,6,9),P(17,6,9),R(17,6,9),U(17,6,9),V(17,6,9),W(17,6,9),C1A(17,3,9
     2),C2A(17,3,9),C3A(17,3,9),C4A(17,3,9),C5A(17,3,9),C1AO(4,3,9),C2AO
     3(4,3,9),C3AO(4,3,9),C4AO(4,3,9),C5AO(4,3,9)
      COMMON D1A(17,3),D2A(17,3),D3A(17,3),D4A(17,3),D5A(17,3),CURV2(17)
     1,THETA(17),RREF(17),XREF(17),YREF(17,9),PYBPX(17,9),PYBPPH(17,9),D
     2ELTA(2,17,9),PDPT(2,17,9),PDPX(2,17,9),PDPPH(2,17,9)
      COMMON AAA(5,5),AAB(5),B1A(3),B2A(3),B3A(3),B4A(3),B5A(3),RRXF(5),
     1XRXF(5),CT,TIME,IYREFO,IYREF1,IYREF2,IYREF3,IYREF4
      COMMON/ERROR/ER(12),BLK(12)
      IJ=J-1
      LLC=1
      DO 3 N=1,NF
      DO 1 L=LLC,LF
      C1A(L,J,N)=C1A(L,IJ,N)
      C2A(L,J,N)=C2A(L,IJ,N)
      C3A(L,J,N)=C3A(L,IJ,N)
      C4A(L,J,N)=C4A(L,IJ,N)
      C5A(L,J,N)=C5A(L,IJ,N)
    1 CONTINUE
      LLC=2
      IF(KURVE1.GE.LF)GO TO 3
      IF(KURVE1.LT.LF)JJJH=1
      IF(KURVE2.LT.LF)JJJH=2
      IF(KURVE3.LT.LF)JJJH=3
      IF(KURVE4.LT.LF)JJJH=4
      DO 2 JJJ=1,JJJH
      C1AO(JJJ,J,N)=C1AO(JJJ,IJ,N)
      C2AO(JJJ,J,N)=C2AO(JJJ,IJ,N)
      C3AO(JJJ,J,N)=C3AO(JJJ,IJ,N)
      C4AO(JJJ,J,N)=C4AO(JJJ,IJ,N)
      C5AO(JJJ,J,N)=C5AO(JJJ,IJ,N)
    2 CONTINUE
    3 CONTINUE
    4 RETURN
      END
```

APPENDIX B

SAMPLE INPUT

The input for a sample case is presented in this appendix. The case involves the Apollo configuration traveling at 6935 m/s (22 750 ft/sec) and an angle of attack of 22° at an altitude of 45.87 km (150 500 ft) in the atmosphere of the earth.

```
$NAME
IYREF1  =  1,
LF      =  10,
MF      =  4,
NF      =  7,
DX      =  0.14096201E+00,
KURVE1  =  6,
KURVE2  =  99,
KURVE3  =  99,
KURVE4  =  99,
CURVE1  =  0.57043531E+00,
CURVE2  =  0.16582451E+01,
CURVE3  =  0.0,
CURVE4  =  0.1E+01,
CURVE5  =  0.1E+01,
IYREF2  =  99,
IYREF3  =  99,
IYREF4  =  99,
YREF0   =  0.55304716E+00,
YREF1   =  0.1E+01,
YREF2   =  0.1E+01,
YREF3   =  0.1E+01,
YREF4   =  0.1E+01,
RS      =  0.1253E+01,
BS      =  0.1E+01,
X0      =  0.1015E+01,
CX0     =  0.107E+01,
IGAS    =  1,
DENS0   =  0.1668E-02,
VEL0    =  0.6935E+04,
GAMMA   =  0.1405E+01,
GAMM    =  0.1142E+01,
PINF    =  0.1583E-02,
ALPHAD  =  0.22E+02,
KP0     =  100,
KPP     =  100,
KF      =  300,
IYREF0  =  1,
CT      =  0.54E+00,
EPSI    =  0.3125E-01,
PMIN    =  0.1E+00,
$END
```

APPENDIX C

SAMPLE OUTPUT

In this appendix, the output for the calculation described in appendix B is given. This solution was calculated in 10 minutes on the CDC 6600 digital computer.

TYPE OF FLOW

IYREF1= 1

GRID

LF= 10 MF= 4 NF= 7

DX= 1.40962010E-01 DY= 3.33333333E-01 DPHI= 5.23598776E-01

REFERENCE-SURFACE PROFILE

KURVE1= 6 KURVE2= 99 KURVE3= 99 KURVE4= 99

CURVE1= 5.70435310E-01 CURVE2= 1.65824510E+00 CURVE3= 0. CURVE4= 1.00000000E+00 CURVE5= 1.00000000E+00

L	THETA(L)	CURV2(L)	XREF(L)	RREF(L)
L= 1	THETA(L)= 0.	CURV2(L)= 5.70435310E-01	XREF(L)= 5.53047160E-01	RREF(L)= 0.
L= 2	THETA(L)= 4.60713689E+00	CURV2(L)= 5.70435310E-01	XREF(L)= 5.47382856E-01	RREF(L)= 1.40810156E-01
L= 3	THETA(L)= 9.21427379E+00	CURV2(L)= 5.70435310E-01	XREF(L)= 5.30426548E-01	RREF(L)= 2.80710362E-01
L= 4	THETA(L)= 1.38214107E+01	CURV2(L)= 5.70435310E-01	XREF(L)= 5.02287811E-01	RREF(L)= 4.18796552E-01
L= 5	THETA(L)= 1.84285476E+01	CURV2(L)= 5.70435310E-01	XREF(L)= 4.63148486E-01	RREF(L)= 5.54176379E-01
L= 6	THETA(L)= 2.30356845E+01	CURV2(L)= 1.65824510E+00	XREF(L)= 4.13261499E-01	RREF(L)= 6.85974986E-01
L= 7	THETA(L)= 3.64285478E+01	CURV2(L)= 1.65824510E+00	XREF(L)= 3.43511075E-01	RREF(L)= 8.08101384E-01
L= 8	THETA(L)= 4.98214112E+01	CURV2(L)= 1.65824510E+00	XREF(L)= 2.47369793E-01	RREF(L)= 9.10750459E-01
L= 9	THETA(L)= 6.32142746E+01	CURV2(L)= 1.65824510E+00	XREF(L)= 1.30066829E-01	RREF(L)= 9.88339074E-01
L= 10	THETA(L)= 7.66071380E+01	CURV2(L)= 1.65824510E+00	XREF(L)= -2.01764858E-03	RREF(L)= 1.03664714E+00

BODY SURFACE

YREF0= 5.53047160E-01 YREF1= 1.00000000E+00 YREF2= 1.00000000E+00 YREF3= 1.00000000E+00 YREF4= 1.00000000E+00

IYREF2= 99 IYREF3= 99 IYREF4= 99

```
L=  1   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  2   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  3   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  4   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  5   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  6   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  7   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  8   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  9   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L= 10   N=  1   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.

L=  1   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  2   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  3   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  4   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  5   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  6   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  7   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  8   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  9   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L= 10   N=  2   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.

L=  1   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  2   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  3   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  4   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  5   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  6   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  7   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  8   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L=  9   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
L= 10   N=  3   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.              PYBPPH(L,N)=   0.
```

```
L=  1   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  2   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  3   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  4   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  5   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  6   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  7   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  8   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  9   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L= 10   N=  4   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.

L=  1   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  2   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  3   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  4   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  5   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  6   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  7   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  8   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  9   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L= 10   N=  5   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.

L=  1   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  2   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  3   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  4   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  5   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  6   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  7   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  8   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L=  9   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
L= 10   N=  6   YREF(L,N)=   5.53047160E-01   PYBPX(L,N)=   0.            PYBPPH(L,N)=   0.
```

```
L=  1  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L=  2  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L=  3  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L=  4  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L=  5  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L=  6  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L=  7  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L=  8  N=  7  YREF(L,N)=  5.53047150E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L=  9  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.
L= 10  N=  7  YREF(L,N)=  5.53047160E-01  PYBPX(L,N)=  0.            PYBPPH(L,N)=  0.


INITIAL SHOCK

RS=  1.25300000E+00  BS=  1.00000000E+00  XO=  1.01500000E+00  CXO=  1.07000000E+00

GAS MODEL PARAMETERS

IGAS=    1

DENSO=  1.66800000E-03  VELO=  6.93500000E+03

NONDIMENSIONAL FLIGHT CONDITIONS

GAMMA=  1.40500000E+00  GAMM=  1.14200000E+00  PINF=  1.58300000E-03  ALPHA=  2.20000000E+01

PRINTING AND CUTOFF PARAMETERS

KPO=  100  KPP=  100  KF=  300

COMPUTATICNAL PARAMETERS

IYREFC=  1

CT=  5.40000000E-01  EPSI=  3.12500000E-02  PMIN=  1.00000000E-01
```

TIME= 2.07263396E+00

K	L	M	N	UN PHI DELTA(1,L,N)	VN RAD PDPT(1,L,N)	WN XAD PDPX(1,L,N)	RHO GAMM PDPPH(1,L,N)	P(L,M,N) ENTROP	H(L,M,N) AMACH
300	1	1	1	8.98355684E-02	0.	3.95391614E-12	1.29678747E+01	8.24937531E-01	5.06218276E-01
				0.	0.	3.55271368E-15	1.14504882E+00	4.38663956E-02	3.43016968E-01
300	2	1	1	1.28655837E-01	0.	6.12473820E-13	1.22780700E+01	7.74346887E-01	5.05392870E-01
				0.	9.63877017E-02	-3.87734284E-03	1.14530028E+00	4.38081123E-02	4.93901867E-01
300	3	1	1	1.63678001E-01	0.	-1.78137211E-13	1.15518717E+01	7.22050969E-01	5.05441028E-01
				0.	1.92152523E-01	-1.54843151E-02	1.14551615E+00	4.37806713E-02	6.31836570E-01
300	4	1	1	1.95007449E-01	0.	-1.51068438E-13	1.05207478E+01	6.50646190E-01	5.05847797E-01
				0.	2.86675609E-01	-3.47459096E-02	1.14551904E+00	4.39107684E-02	7.57571933E-01
300	5	1	1	2.22413795E-01	0.	-3.59217734E-14	8.80338647E+00	5.35515469E-01	5.04711700E-01
				0.	3.79346129E-01	-6.15376536E-02	1.14512952E+00	4.43634882E-02	8.72344400E-01
300	6	1	1	2.51330998E-01	0.	1.43607998E-14	6.42701840E+00	3.79568658E-01	4.99276998E-01
				0.	4.69565224E-01	-9.56864122E-02	1.14452572E+00	4.51338766E-02	1.00278939E+00
300	7	1	1	3.23037988E-01	0.	6.66006112E-15	4.62810039E+00	2.61977733E-01	4.98333326E-01
				0.	4.79690999E-01	-1.01469577E-01	1.14531072E+00	4.53076413E-02	1.32200519E+00
300	8	1	1	3.97762628E-01	0.	3.43889315E-15	3.30694317E+00	1.77735949E-01	4.97834466E-01
				0.	4.88201866E-01	-1.09440868E-01	1.14725795E+00	4.50670189E-02	1.67895888E+00
300	9	1	1	4.55612542E-01	0.	2.12030507E-15	2.51926588E+00	1.29450343E-01	4.99318999E-01
				0.	4.94634913E-01	-1.19166721E-01	1.14931027E+00	4.47625553E-02	1.97477918E+00
300	10	1	1	5.06550282E-01	0.	1.33189849E-15	1.98071323E+00	9.76166154E-02	5.02997762E-01
				0.	4.98640244E-01	-1.30118144E-01	1.15144715E+00	4.44374734E-02	2.24970543E+00
300	1	2	1	1.63291730E-01	-1.68684079E-02	8.88681512E-12	1.30359501E+01	8.19450798E-01	5.05733052E-01
				0.	0.	2.13209011E-02	1.14639301E+00	4.31649360E-02	6.31955587E-01
300	2	2	1	2.08745398E-01	-1.61573847E-02	1.47718268E-12	1.23236163E+01	7.63779361E-01	5.04821625E-01
				0.	9.81940048E-02	1.85379660E-02	1.14723908E+00	4.28184036E-02	8.13260991E-01
300	3	2	1	2.52080056E-01	-1.49552171E-02	-5.08548331E-13	1.16317757E+01	7.09485669E-01	5.04234143E-01
				0.	1.95938980E-01	7.85713160E-03	1.14827952E+00	4.23920213E-02	9.90748490E-01
300	4	2	1	2.93489189E-01	-1.48313182E-02	-3.75893845E-13	1.08494739E+01	6.49661407E-01	5.03671277E-01
				0.	2.92733201E-01	-1.01235375E-02	1.14946946E+00	4.19291839E-02	1.16613352E+00
300	5	2	1	3.28256928E-01	-8.46801014E-03	-9.35505276E-14	9.84159600E+00	5.77750563E-01	5.02712566E-01
				0.	3.88200491E-01	-3.49646716E-02	1.15048873E+00	4.16130622E-02	1.31866998E+00
300	6	2	1	3.53006400E-01	2.17906278E-02	3.96000456E-15	8.62554061E+00	4.96924195E-01	5.01687351E-01
				0.	4.82671237E-01	-6.48639670E-02	1.15099842E+00	4.16103683E-02	1.43609897E+00
300	7	2	1	3.66601987E-01	7.48911851E-02	1.33562120E-14	7.48716929E+00	4.24751453E-01	5.02377668E-01
				0.	5.01818957E-01	-7.14872332E-02	1.15102210E+00	4.18577554E-02	1.53286847E+00
300	8	2	1	3.80698641E-01	1.23667917E-01	7.33668589E-15	6.05542377E+00	3.36142378E-01	5.03421935E-01
				0.	5.22427035E-01	-8.05402740E-02	1.15092769E+00	4.22991322E-02	1.66040691E+00
300	9	2	1	4.11212016E-01	1.55791440E-01	2.83848387E-15	4.37354151E+00	2.34187371E-01	5.04476481E-01
				0.	5.46992331E-01	-9.27354575E-02	1.15115555E+00	4.28415045E-02	1.86228793E+00
300	10	2	1	4.98841891E-01	1.67157102E-01	4.70573406E-15	2.58232957E+00	1.26819499E-01	5.04287259E-01
				0.	5.80979650E-01	-1.10512970E-01	1.15502816E+00	4.23936640E-02	2.34073966E+00

300	1	3	1	2.42881190E-01	-3.46192830E-02	1.40788620E-11	1.33845359E+01	8.24488422E-01	5.05345155E-01
				0.	0.	4.26418022E-02	1.14891828E+00	4.18609824E-02	9.57318564E-01
300	2	3	1	2.96377721E-01	-3.17647460E-02	6.57362581E-13	1.27807897E+01	7.70451920E-01	5.04649774E-01
				0.	1.00000308E-01	4.09532749E-02	1.15072641E+00	4.10582455E-02	1.17887938E+00
300	3	3	1	3.52635529E-01	-2.80092901E-02	-9.44353936E-13	1.21832780E+01	7.14418134E-01	5.03984266E-01
				0.	1.99725437E-01	3.11985783E-02	1.15319431E+00	3.99811630E-02	1.42277015E+00
300	4	3	1	4.04362561E-01	-2.29185177E-02	-3.91116129E-13	1.16105282E+01	6.60078245E-01	5.03215118E-01
				0.	2.98790793E-01	1.44988346E-02	1.15603755E+00	3.87781014E-02	1.65914819E+00
300	5	3	1	4.41964565E-01	-7.30919040E-03	-6.16739097E-14	1.11166064E+01	6.15847132E-01	5.02882148E-01
				0.	3.97054853E-01	-8.39168966E-03	1.15837732E+00	3.78305292E-02	1.83822820E+00
300	6	3	1	4.56907608E-01	3.98904015E-02	9.30672944E-15	1.06552150E+01	5.83006266E-01	5.03477506E-01
				0.	4.95777250E-01	-3.40415218E-02	1.15924949E+00	3.75380968E-02	1.92097605E+00
300	7	3	1	4.60430446E-01	1.26002738E-01	9.30325496E-15	9.96700818E+00	5.36919801E-01	5.04087173E-01
				0.	5.23946915E-01	-4.15048891E-02	1.16019252E+00	3.72719391E-02	2.01721574E+00
300	8	3	1	4.56056670E-01	2.18869655E-01	3.57257339E-15	8.94380287E+00	4.68805883E-01	5.04043635E-01
				0.	5.56652205E-01	-5.16396801E-02	1.16193982E+00	3.67605078E-02	2.16927766E+00
300	9	3	1	4.45282968E-01	3.14613541E-01	8.99417431E-16	7.71674880E+00	3.87676124E-01	5.03544202E-01
				0.	5.99349748E-01	-6.63041935E-02	1.16489047E+00	3.58678401E-02	2.39338679E+00
300	10	3	1	4.26718473E-01	4.25865829E-01	-2.70165735E-18	6.46088017E+00	3.02574015E-01	5.03321922E-01
				0.	6.63319057E-01	-9.09077963E-02	1.17044272E+00	3.40746669E-02	2.74823650E+00
300	1	4	1	3.22915611E-01	-4.98713933E-02	0.	1.39433576E+01	8.33603585E-01	5.04718488E-01
				0.	0.	6.39627034E-02	1.15268699E+00	3.99817873E-02	1.29940414E+00
				6.39627034E-02	-8.78227822E-04	4.24657514E-02	0.		
300	2	4	1	3.84058445E-01	-4.02636100E-02	0.	1.36733031E+01	7.92535403E-01	5.04452101E-01
				0.	1.01806611E-01	6.33685837E-02	1.15584231E+00	3.85592063E-02	1.56450351E+00
				6.74639105E-02	-1.21073483E-03	5.40176403E-02	0.		
300	3	4	1	4.57200924E-01	-3.46233671E-02	0.	1.32788132E+01	7.33858700E-01	5.04318307E-01
				0.	2.03511895E-01	5.45400249E-02	1.16068452E+00	3.64736206E-02	1.90971239E+00
				7.09397174E-02	-1.42196186E-03	5.39158290E-02	0.		
300	4	4	1	5.13863636E-01	-2.18616584E-02	0.	1.29219890E+01	6.81817127E-01	5.04196386E-01
				0.	3.04848384E-01	3.91212067E-02	1.16531899E+00	3.45632597E-02	2.19670400E+00
				7.60697091E-02	-1.62834304E-03	6.58605292E-02	0.		
300	5	4	1	5.59035780E-01	-2.32421368E-03	0.	1.26011923E+01	6.35835088E-01	5.04047237E-01
				0.	4.05909215E-01	1.81812923E-02	1.16970725E+00	3.28235099E-02	2.44588250E+00
				8.40280184E-02	-1.87722221E-03	8.63346063E-02	0.		
300	6	4	1	5.57939571E-01	4.22860303E-02	0.	1.25966857E+01	6.35194793E-01	5.03989816E-01
				0.	5.08883264E-01	-3.21907660E-03	1.16977046E+00	3.27989259E-02	2.44891317E+00
				1.00479433E-01	-1.92829294E-03	4.98406533E-02	0.		
300	7	4	1	5.46606067E-01	1.67392237E-01	0.	1.25026563E+01	6.21870539E-01	5.03840822E-01
				0.	5.46074873E-01	-1.15225450E-02	1.17109953E+00	3.22850241E-02	2.52021647E+00
				1.11791267E-01	-1.99875467E-03	1.18570333E-01	0.		
300	8	4	1	5.17334470E-01	2.88754003E-01	0.	1.23337573E+01	5.98105469E-01	5.03442302E-01
				0.	5.90877374E-01	-2.27390862E-02	1.17353643E+00	3.13572214E-02	2.64681242E+00
				1.34385486E-01	-2.24590178E-03	2.20242822E-01	0.		
300	9	4	1	4.63788848E-01	4.05014714E-01	0.	1.21382518E+01	5.70855633E-01	5.03145994E-01
				0.	6.51707165E-01	-3.98729296E-02	1.17643905E+00	3.02748969E-02	2.79429513E+00
				1.75952260E-01	-2.19329304E-03	4.08658497E-01	0.		
300	10	4	1	3.98869770E-01	5.16729123E-01	0.	1.18332569E+01	5.28823916E-01	5.04443066E-01
				0.	7.45658463E-01	-7.13026227E-02	1.18114942E+00	2.85637071E-02	3.03742088E+00
				2.53923740E-01	-7.97417623E-04	8.10005915E-01	0.		

300	1	1	2	7.77998844E-02	0.	-4.49177842E-02	1.29678747E+01	8.24937531E-01	5.06218276E-01
				3.00000000E+01	0.	3.55271368E-15	1.14504882E+00	4.38663956E-02	3.43016968E-01
300	2	1	2	1.17679417E-01	0.	-4.15779783E-02	1.23551229E+01	7.79954617E-01	5.05460802E-01
				3.00000000E+01	9.63877017E-02	-3.87734284E-03	1.14527414E+00	4.38132142E-02	4.78846299E-01
300	3	1	2	1.53165229E-01	0.	-3.96747878E-02	1.17091759E+01	7.33286243E-01	5.05626140E-01
				3.00000000E+01	1.92152523E-01	-1.54843151E-02	1.14547548E+00	4.37827285E-02	6.10050592E-01
300	4	1	2	1.84530709E-01	0.	-4.10135007E-02	1.07568286E+01	6.67165121E-01	5.06223431E-01
				3.00000000E+01	2.86675609E-01	-3.47459096E-02	1.14547856E+00	4.38996586E-02	7.33082704E-01
300	5	1	2	2.12560557E-01	0.	-4.46546353E-02	9.09195404E+00	5.55098421E-01	5.05342236E-01
				3.00000000E+01	3.79346129E-01	-6.15376536E-02	1.14512419E+00	4.43188418E-02	8.50040494E-01
300	6	1	2	2.45724661E-01	0.	-4.95465570E-02	6.78507511E+00	4.02854419E-01	5.01397638E-01
				3.00000000E+01	4.69565224E-01	-9.56864122E-02	1.14459986E+00	4.50143294E-02	9.97054856E-01
300	7	1	2	3.14637729E-01	0.	-5.26956090E-02	4.87622807E+00	2.77720013E-01	4.99950805E-01
				3.00000000E+01	4.79690999E-01	-1.01469577E-01	1.14524967E+00	4.52458957E-02	1.30085133E+00
300	8	1	2	3.87911897E-01	0.	-5.52466977E-02	3.49537161E+00	1.89328469E-01	4.99354387E-01
				3.00000000E+01	4.88201866E-01	-1.09440868E-01	1.14701901E+00	4.50628562E-02	1.64634730E+00
300	9	1	2	4.44308669E-01	0.	-5.87262835E-02	2.65573964E+00	1.37637987E-01	5.00268355E-01
				3.00000000E+01	4.94634913E-01	-1.19166721E-01	1.14892180E+00	4.48107640E-02	1.93279598E+00
300	10	1	2	4.92084133E-01	0.	-6.35623518E-02	2.09340263E+00	1.04299182E-01	5.03320833E-01
				3.00000000E+01	4.98640244E-01	-1.30118144E-01	1.15079333E+00	4.45703129E-02	2.18967414E+00
300	1	2	2	1.41414786E-01	-1.68684079E-02	-8.16458648E-02	1.30359501E+01	8.19450798E-01	5.05733052E-01
				3.00000000E+01	0.	2.13209011E-02	1.14639301E+00	4.31649360E-02	6.31955587E-01
300	2	2	2	1.88913748E-01	-1.59187856E-02	-7.71887767E-02	1.24150862E+01	7.70723844E-01	5.04911113E-01
				3.00000000E+01	9.82038006E-02	1.86595269E-02	1.14714942E+00	4.28523844E-02	7.94277493E-01
300	3	2	2	2.31834223E-01	-1.47431197E-02	-7.86479940E-02	1.18067609E+01	7.22529717E-01	5.04477126E-01
				3.00000000E+01	1.95938714E-01	7.85549043E-03	1.14810116E+00	4.24562013E-02	9.60283256E-01
300	4	2	2	2.72566694E-01	-1.48755745E-02	-8.24528730E-02	1.10851746E+01	6.66991834E-01	5.04119084E-01
				3.00000000E+01	2.92693738E-01	-1.02839447E-02	1.14919597E+00	4.20248914E-02	1.12824318E+00
300	5	2	2	3.07772628E-01	-9.85245599E-03	-8.65983328E-02	1.00979477E+01	5.96174304E-01	5.03355199E-01
				3.00000000E+01	3.88054969E-01	-3.54014012E-02	1.15016730E+00	4.17193145E-02	1.28019760E+00
300	6	2	2	3.34856800E-01	1.68886951E-02	-8.97682456E-02	8.84578801E+00	5.12246910E-01	5.02348633E-01
				3.00000000E+01	4.82254905E-01	-6.58430892E-02	1.15072359E+00	4.16914781E-02	1.40503733E+00
300	7	2	2	3.52096303E-01	6.64301950E-02	-8.91600945E-02	7.63188068E+00	4.34681310E-01	5.02805966E-01
				3.00000000E+01	5.00939721E-01	-7.26785577E-02	1.15080376E+00	4.19213480E-02	1.50908188E+00
300	8	2	2	3.68518319E-01	1.12848061E-01	-8.76974529E-02	6.15215651E+00	3.42747266E-01	5.03502309E-01
				3.00000000E+01	5.20664989E-01	-8.20281899E-02	1.15070464E+00	4.23678613E-02	1.63607568E+00
300	9	2	2	3.99268258E-01	1.43464930E-01	-8.70746049E-02	4.45227560E+00	2.39525122E-01	5.04289090E-01
				3.00000000E+01	5.43414433E-01	-9.45416647E-02	1.15082197E+00	4.29485601E-02	1.82912579E+00
300	10	2	2	4.86059497E-01	1.53063041E-01	-8.89036448E-02	2.65191315E+00	1.31167459E-01	5.03390587E-01
				3.00000000E+01	5.73562880E-01	-1.12278917E-01	1.15450128E+00	4.25428277E-02	2.29228273E+00

300	1	3	2	2.10341281E-01	-3.46192830E-02	-1.21440595E-01	1.33845359E+01	8.24488422E-01	5.05345155E-01
				3.00000000E+01	0.	4.26418022E-02	1.14891828E+00	4.18609824E-02	9.57318564E-01
300	2	3	2	2.63360404E-01	-3.21392476E-02	-1.24840360E-01	1.28598237E+01	7.77001413E-01	5.04747555E-01
				3.00000000E+01	1.00019900E-01	4.11963966E-02	1.15054840E+00	4.11332699E-02	1.15803523E+00
300	3	3	2	3.19136537E-01	-2.86158406E-02	-1.27526664E-01	1.23331155E+01	7.26913561E-01	5.04197111E-01
				3.00000000E+01	1.99724905E-01	3.11952959E-02	1.15277653E+00	4.01531535E-02	1.38279417E+00
300	4	3	2	3.70730110E-01	-2.41779364E-02	-1.29260561E-01	1.18020476E+01	6.76320408E-01	5.03540150E-01
				3.00000000E+01	2.98711866E-01	1.41780202E-02	1.15535463E+00	3.90536468E-02	1.60392913E+00
300	5	3	2	4.10351186E-01	-1.07571468E-02	-1.28603258E-01	1.13029337E+01	6.31901087E-01	5.03228990E-01
				3.00000000E+01	3.96763809E-01	-9.26514883E-03	1.15756950E+00	3.81511039E-02	1.77951063E+00
300	6	3	2	4.30131659E-01	3.15564847E-02	-1.26107311E-01	1.07848934E+01	5.94458536E-01	5.03654342E-01
				3.00000000E+01	4.94944585E-01	-3.59997662E-02	1.15858150E+00	3.78024741E-02	1.87408355E+00
300	7	3	2	4.39793922E-01	1.12052261E-01	-1.24767489E-01	1.00363860E+01	5.43598925E-01	5.04137481E-01
				3.00000000E+01	5.22188442E-01	-4.38875382E-02	1.15967623E+00	3.74777179E-02	1.98283155E+00
300	8	3	2	4.42421353E-01	2.00906954E-01	-1.23658772E-01	8.97909422E+00	4.72555637E-01	5.04070592E-01
				3.00000000E+01	5.53128113E-01	-5.46155119E-02	1.16156264E+00	3.69159164E-02	2.14700531E+00
300	9	3	2	4.38257882E-01	2.93624624E-01	-1.23467858E-01	7.74076430E+00	3.90248874E-01	5.03564424E-01
				3.00000000E+01	5.92193954E-01	-6.99166079E-02	1.16454724E+00	3.60006952E-02	2.37379670E+00
300	10	3	2	4.25675157E-01	4.01780661E-01	-1.24237095E-01	6.47398850E+00	3.04950103E-01	5.03450322E-01
				3.00000000E+01	6.48485516E-01	-9.44396913E-02	1.16985673E+00	3.42983993E-02	2.71955282E+00

300	1	4	2	2.79653122E-01	-4.98713933E-02	-1.61457805E-01	1.39433576E+01	8.33603585E-01	5.04718488E-01
				3.00000000E+01	0.	6.39627034E-02	1.15268699E+00	3.99817873E-02	1.29940414E+00
				6.39627034E-02	-8.78227822E-04	3.33025500E-02	0.		
300	2	4	2	3.30957509E-01	-4.42804417E-02	-1.92888732E-01	1.36764845E+01	7.93014732E-01	5.04491385E-01
				3.00000000E+01	1.01835998E-01	6.37332663E-02	1.15580441E+00	3.85759782E-02	1.56194286E+00
				6.78297752E-02	-1.16427393E-03	5.66394659E-02	6.67350525E-04		
300	3	4	2	4.10350250E-01	-3.82705891E-02	-1.81459499E-01	1.33282779E+01	7.41136021E-01	5.04401668E-01
				3.00000000E+01	2.03511096E-01	5.45351014E-02	1.16006156E+00	3.67359097E-02	1.86896813E+00
				7.09347296E-02	-1.31453782E-03	5.12683184E-02	-1.43863428E-03		
300	4	4	2	4.68237309E-01	-2.58550432E-02	-1.76592592E-01	1.30108231E+01	6.94819409E-01	5.04300406E-01
				3.00000000E+01	3.04729994E-01	3.86399851E-02	1.16414203E+00	3.50479741E-02	2.12802556E+00
				7.55741382E-02	-1.48352827E-03	6.23383745E-02	-4.09135564E-03		
300	5	4	2	5.16825268E-01	-7.79702987E-03	-1.69607766E-01	1.27139730E+01	6.51910217E-01	5.04198514E-01
				3.00000000E+01	4.05472649E-01	1.68711035E-02	1.16813964E+00	3.34374420E-02	2.35971937E+00
				8.26470096E-02	-1.66024976E-03	7.99407867E-02	-9.32048044E-03		
300	6	4	2	5.22977739E-01	3.26208798E-02	-1.57917001E-01	1.26904221E+01	6.48545295E-01	5.04216777E-01
				3.00000000E+01	5.07634266E-01	-6.15644320E-03	1.16846473E+00	3.33094493E-02	2.37815290E+00
				9.72875495E-02	-1.62341788E-03	4.45324610E-02	-1.96488501E-02		
300	7	4	2	5.21840989E-01	1.49333945E-01	-1.53583398E-01	1.25638119E+01	6.30528773E-01	5.04097838E-01
				3.00000000E+01	5.43437163E-01	-1.50965186E-02	1.17023290E+00	3.26194662E-02	2.47511721E+00
				1.07349330E-01	-1.69190988E-03	1.07589471E-01	-2.60694056E-02		
300	8	4	2	5.04894546E-01	2.66404187E-01	-1.47454385E-01	1.23654020E+01	6.02541852E-01	5.04087324E-01
				3.00000000E+01	5.85591236E-01	-2.72028339E-02	1.17307494E+00	3.15315341E-02	2.62743758E+00
				1.27466794E-01	-1.56797421E-03	1.96988977E-01	-3.78299106E-02		
300	9	4	2	4.62347723E-01	3.81011778E-01	-1.39974793E-01	1.21449430E+01	5.71783923E-01	5.03331098E-01
				3.00000000E+01	6.40973474E-01	-4.52915511E-02	1.17633822E+00	3.03121044E-02	2.79053764E+00
				1.63928384E-01	-2.10270637E-03	3.56314560E-01	-5.95549109E-02		
300	10	4	2	3.99133470E-01	4.93619071E-01	-1.31738579E-01	1.19008088E+01	5.38091175E-01	5.06447739E-01
				3.00000000E+01	7.23408152E-01	-7.66004652E-02	1.18008656E+00	2.89455975E-02	2.99992277E+00
				2.31051410E-01	7.64181017E-04	6.86038206E-01	-1.02355222E-01		

300	1	1	3	4.49177842E-02	0.	-7.77998844E-02	1.29678747E+01	8.24937531E-01	5.06218276E-01
				6.00000000E+01	0.	3.55271368E-15	1.14504882E+00	4.38663956E-02	3.43016968E-01
300	2	1	3	8.71421525E-02	0.	-7.27423886E-02	1.25776311E+01	7.96200878E-01	5.05725226E-01
				6.00000000E+01	9.63877017E-02	-3.87734284E-03	1.14519696E+00	4.38293856E-02	4.34758667E-01
300	3	1	3	1.24050465E-01	0.	-6.87574918E-02	1.21623542E+01	7.65887197E-01	5.06283087E-01
				6.00000000E+01	1.92152523E-01	-1.54843151E-02	1.14534681E+00	4.37968936E-02	5.44997133E-01
300	4	1	3	1.56435566E-01	0.	-6.95844360E-02	1.14669815E+01	7.17342828E-01	5.07651288E-01
				6.00000000E+01	2.86675609E-01	-3.47459096E-02	1.14533428E+00	4.38837141E-02	6.60506098E-01
300	5	1	3	1.86369830E-01	0.	-7.42872982E-02	1.00358214E+01	6.20204560E-01	5.08087695E-01
				6.00000000E+01	3.79346129E-01	-6.15376536E-02	1.14501297E+00	4.42327426E-02	7.79468072E-01
300	6	1	3	2.22588283E-01	0.	-8.08323083E-02	7.79592194E+00	4.70396068E-01	5.05894082E-01
				6.00000000E+01	4.69565224E-01	-9.56864122E-02	1.14451850E+00	4.48440522E-02	9.32913199E-01
300	7	1	3	2.91273731E-01	0.	-8.50512607E-02	5.67977219E+00	3.29698245E-01	5.04536534E-01
				6.00000000E+01	4.79690999E-01	-1.01469577E-01	1.14495580E+00	4.51274797E-02	1.22338594E+00
300	8	1	3	3.62133744E-01	0.	-8.79587845E-02	4.09484815E+00	2.26888989E-01	5.03583956E-01
				6.00000000E+01	4.88201866E-01	-1.09440868E-01	1.14629792E+00	4.50823450E-02	1.54492416E+00
300	9	1	3	4.15937877E-01	0.	-9.20010171E-02	3.10474889E+00	1.65010491E-01	5.03429615E-01
				6.00000000E+01	4.94634913E-01	-1.19166721E-01	1.14781847E+00	4.49525648E-02	1.81011798E+00
300	10	1	3	4.58018190E-01	0.	-9.75542129E-02	2.45470724E+00	1.26046905E-01	5.05455475E-01
				6.00000000E+01	4.98640244E-01	-1.30118144E-01	1.14907219E+00	4.49153072E-02	2.03040734E+00

300	1	2	3	8.16458648E-02	-1.68684079E-02	-1.41414786E-01	1.30359501E+01	8.19450798E-01	5.05733052E-01
				6.00000000E+01	0.	2.13209011E-02	1.14639301E+00	4.31649360E-02	6.31955587E-01
300	2	2	3	1.33853917E-01	-1.56691772E-02	-1.36130429E-01	1.26647349E+01	7.89782234E-01	5.05211393E-01
				6.00000000E+01	9.82131562E-02	1.87756252E-02	1.14690270E+00	4.29474038E-02	7.41190552E-01
300	3	2	3	1.76770687E-01	-1.44843403E-02	-1.36680952E-01	1.22885467E+01	7.58847722E-01	5.05197720E-01
				6.00000000E+01	1.95898508E-01	7.60764133E-03	1.14760048E+00	4.26425644E-02	8.71830733E-01
300	4	2	3	2.17172114E-01	-1.50038623E-02	-1.40243868E-01	1.17555616E+01	7.16966583E-01	5.05443047E-01
				6.00000000E+01	2.92523147E-01	-1.09773450E-02	1.14842023E+00	4.23067602E-02	1.01611243E+00
300	5	2	3	2.54090395E-01	-1.30655916E-02	-1.45356835E-01	1.08669249E+01	6.52401035E-01	5.05348169E-01
				6.00000000E+01	3.87540724E-01	-3.69447109E-02	1.14920018E+00	4.20552937E-02	1.16088613E+00
300	6	2	3	2.86623885E-01	4.73240415E-03	-1.50102361E-01	9.54143930E+00	5.61918834E-01	5.04509978E-01
				6.00000000E+01	4.80912977E-01	-6.89990070E-02	1.14975286E+00	4.20106800E-02	1.29669302E+00
300	7	2	3	3.13173042E-01	4.48786187E-02	-1.49344612E-01	8.12229199E+00	4.69342040E-01	5.04407395E-01
				6.00000000E+01	4.98237858E-01	-7.63394543E-02	1.14992381E+00	4.22112663E-02	1.41755601E+00
300	8	2	3	3.36429092E-01	8.49074065E-02	-1.46610057E-01	6.50848345E+00	3.67571861E-01	5.04365641E-01
				6.00000000E+01	5.15620384E-01	-8.62879814E-02	1.14982479E+00	4.26562830E-02	1.54654656E+00
300	9	2	3	3.68938414E-01	1.11913095E-01	-1.43867516E-01	4.75898044E+00	2.60162136E-01	5.04377159E-01
				6.00000000E+01	5.34135468E-01	-9.92259063E-02	1.14975766E+00	4.32780088E-02	1.72147114E+00
300	10	2	3	4.47373683E-01	1.22595321E-01	-1.41233069E-01	2.94391018E+00	1.50278012E-01	5.04421271E-01
				6.00000000E+01	5.56184350E-01	-1.16416780E-01	1.15200980E+00	4.33201308E-02	2.11086941E+00

300	1	3	3	1.21440595E-01	-3.46192830E-02	-2.10341281E-01	1.33845359E+01	8.24488422E-01	5.05345155E-01
				6.00000000E+01	0.	4.26418022E-02	1.14891828E+00	4.18609824E-02	9.57318564E-01
300	2	3	3	1.73662832E-01	-3.29512571E-02	-2.14433342E-01	1.30748878E+01	7.95402914E-01	5.05006759E-01
				6.00000000E+01	1.00038611E-01	4.14285932E-02	1.15000126E+00	4.13696749E-02	1.09291209E+00
300	3	3	3	2.29137896E-01	-3.01063106E-02	-2.17977874E-01	1.27432682E+01	7.62034982E-01	5.04776333E-01
				6.00000000E+01	1.99644493E-01	3.06995977E-02	1.15157610E+00	4.06593029E-02	1.26273044E+00
300	4	3	3	2.81441198E-01	-2.74025862E-02	-2.19987772E-01	1.23379540E+01	7.22701780E-01	5.04437999E-01
				6.00000000E+01	2.98370685E-01	1.27912197E-02	1.15346548E+00	3.98334412E-02	1.44195943E+00
300	5	3	3	3.27133969E-01	-1.96201717E-02	-2.18833366E-01	1.18515133E+01	6.79727611E-01	5.04280578E-01
				6.00000000E+01	3.95735319E-01	-1.23517683E-02	1.15531122E+00	3.90653735E-02	1.60602067E+00
300	6	3	3	3.59919968E-01	9.82834762E-03	-2.15594120E-01	1.12059652E+01	6.31589706E-01	5.04391003E-01
				6.00000000E+01	4.92260729E-01	-4.23116017E-02	1.15657429E+00	3.86072617E-02	1.72783298E+00
300	7	3	3	3.86098929E-01	7.51963064E-02	-2.14298035E-01	1.02914188E+01	5.67494509E-01	5.04487484E-01
				6.00000000E+01	5.16784717E-01	-5.12093313E-02	1.15799249E+00	3.81524937E-02	1.86767307E+00
300	8	3	3	4.07067225E-01	1.52446789E-01	-2.13767249E-01	9.14315664E+00	4.88369905E-01	5.04276916E-01
				6.00000000E+01	5.43038903E-01	-6.31350948E-02	1.16014034E+00	3.74750710E-02	2.05683500E+00
300	9	3	3	4.20182191E-01	2.36110549E-01	-2.15157894E-01	7.86611216E+00	4.02292092E-01	5.03857590E-01
				6.00000000E+01	5.73636022E-01	-7.92850910E-02	1.16317639E+00	3.65270376E-02	2.29457506E+00
300	10	3	3	4.24841313E-01	3.35125750E-01	-2.18914605E-01	6.56013934E+00	3.14404891E-01	5.03277573E-01
				6.00000000E+01	6.13728455E-01	-1.02715416E-01	1.16816955E+00	3.49298186E-02	2.62876685E+00
300	1	4	3	1.61457805E-01	-4.98713933E-02	-2.79653122E-01	1.39433576E+01	8.33603585E-01	5.04718488E-01
				6.00000000E+01	0.	6.39627034E-02	1.15268699E+00	3.99817873E-02	1.29940414E+00
				6.39627034E-02	-8.78227822E-04	2.31789729E-02	0.		
300	2	4	3	1.90956524E-01	-5.04629116E-02	-3.16619075E-01	1.37372240E+01	8.02185811E-01	5.04562220E-01
				6.00000000E+01	1.01864065E-01	6.40815612E-02	1.15508411E+00	3.88960903E-02	1.50522144E+00
				6.81791991E-02	-1.07510657E-03	5.91448793E-02	-9.23463549E-04		
300	3	4	3	2.83039359E-01	-4.50361198E-02	-3.06358838E-01	1.35031831E+01	7.67050178E-01	5.04566819E-01
				6.00000000E+01	2.03390477E-01	5.37915541E-02	1.15739554E+00	3.76614289E-02	1.71984880E+00
				7.01814624E-02	-1.09629037E-03	4.33884335E-02	-4.36761622E-03		
300	4	4	3	3.44248347E-01	-3.53570640E-02	-3.02070228E-01	1.32763177E+01	7.33492142E-01	5.04512410E-01
				6.00000000E+01	3.04218224E-01	3.65597844E-02	1.16071607E+00	3.64603809E-02	1.91355642E+00
				7.34319094E-02	-1.18679572E-03	5.23639442E-02	-8.28308901E-03		
300	5	4	3	4.04892297E-01	-2.25543907E-02	-2.91287666E-01	1.30259903E+01	6.97011420E-01	5.04547216E-01
				6.00000000E+01	4.03929914E-01	1.22411744E-02	1.16394256E+00	3.51288729E-02	2.11799949E+00
				7.77668175E-02	-1.17365000E-03	6.02107230E-02	-1.67623976E-02		
300	6	4	3	4.32849694E-01	6.08573183E-03	-2.72373470E-01	1.29470953E+01	6.85449149E-01	5.04526334E-01
				6.00000000E+01	5.03608482E-01	-1.56241965E-02	1.16498461E+00	3.46985699E-02	2.18040346E+00
				8.69994356E-02	-1.07784664E-03	2.95748205E-02	-3.33327075E-02		
300	7	4	3	4.59592543E-01	1.00840565E-01	-2.67017610E-01	1.27410545E+01	6.55784925E-01	5.04611860E-01
				6.00000000E+01	5.35331576E-01	-2.60792083E-02	1.16776728E+00	3.35844903E-02	2.34196267E+00
				9.36994210E-02	-1.07354071E-03	7.82892946E-02	-4.17595932E-02		
300	8	4	3	4.75297790E-01	2.04272600E-01	-2.60798183E-01	1.24533775E+01	6.14914542E-01	5.04608007E-01
				6.00000000E+01	5.70457421E-01	-3.99822083E-02	1.17180390E+00	3.20149635E-02	2.56395811E+00
				1.07659100E-01	-1.03288827E-03	1.40343021E-01	-5.50295407E-02		
300	9	4	3	4.57512119E-01	3.14546167E-01	-2.53329940E-01	1.22049520E+01	5.80122492E-01	5.04678744E-01
				6.00000000E+01	6.13136577E-01	-5.93442758E-02	1.17543872E+00	3.06452470E-02	2.75459430E+00
				1.32745506E-01	-8.65002027E-04	2.43753353E-01	-7.71075699E-02		
300	10	4	3	4.10654870E-01	4.23020418E-01	-2.45149404E-01	1.19648035E+01	5.46890336E-01	5.04774248E-01
				6.00000000E+01	6.71272560E-01	-8.90140515E-02	1.17909003E+00	2.93057291E-02	2.93892543E+00
				1.77458341E-01	-6.54000494E-04	4.42710611E-01	-1.16784685E-01		

300	1	1	4	-1.84246256E-11	0.	-8.98355684E-02	1.29678747E+01	8.24937531E-01	5.06218276E-01
				9.00000000E+01	0.	3.55271368E-15	1.14504882E+00	4.38663956E-02	3.43016968E-01
300	2	1	4	4.37300957E-02	0.	-8.47405574E-02	1.29057919E+01	8.20320471E-01	5.06237240E-01
				9.00000000E+01	9.63877017E-02	-3.87734284E-03	1.14507664E+00	4.38581176E-02	3.64292998E-01
300	3	1	4	8.30721984E-02	0.	-7.88015434E-02	1.28285098E+01	8.14397565E-01	5.07447229E-01
				9.00000000E+01	1.92152523E-01	-1.54843151E-02	1.14513530E+00	4.38353792E-02	4.37772624E-01
300	4	1	4	1.18463001E-01	0.	-7.75804327E-02	1.25524591E+01	7.95314976E-01	5.10115015E-01
				9.00000000E+01	2.86675609E-01	-3.47459096E-02	1.14507671E+00	4.38945279E-02	5.42011806E-01
300	5	1	4	1.51473700E-01	0.	-8.04791942E-02	1.15479727E+01	7.26940993E-01	5.12563515E-01
				9.00000000E+01	3.79346129E-01	-6.15376536E-02	1.14474406E+00	4.41775896E-02	6.58927497E-01
300	6	1	4	1.90402504E-01	0.	-8.54921075E-02	9.45948848E+00	5.84952946E-01	5.12427863E-01
				9.00000000E+01	4.69565224E-01	-9.56864122E-02	1.14420796E+00	4.47224307E-02	8.10082270E-01
300	7	1	4	2.60166112E-01	0.	-8.85281646E-02	7.03144192E+00	4.19852572E-01	5.10968824E-01
				9.00000000E+01	4.79690999E-01	-1.01469577E-01	1.14440453E+00	4.50542093E-02	1.08929474E+00
300	8	1	4	3.29711382E-01	0.	-9.01452486E-02	5.15000641E+00	2.94859243E-01	5.09650315E-01
				9.00000000E+01	4.88201866E-01	-1.09440868E-01	1.14532311E+00	4.51195600E-02	1.38956270E+00
300	9	1	4	3.82662140E-01	0.	-9.24392411E-02	3.92652613E+00	2.16373133E-01	5.08939298E-01
				9.00000000E+01	4.94634913E-01	-1.19166721E-01	1.14642235E+00	4.51043806E-02	1.63729711E+00
300	10	1	4	4.24150766E-01	0.	-9.61704581E-02	3.08665329E+00	1.64666252E-01	5.10116104E-01
				9.00000000E+01	4.98640244E-01	-1.30118144E-01	1.14729159E+00	4.51876035E-02	1.84371235E+00

300	1	2	4	-3.34899532E-11	-1.68684079E-02	-1.63291730E-01	1.30359501E+01	8.19450798E-01	5.05733052E-01
				9.00000000E+01	0.	2.13209011E-02	1.14639301E+00	4.31649360E-02	6.31955587E-01
300	2	2	4	5.56283501E-02	-1.57561481E-02	-1.60784116E-01	1.30092793E+01	8.16557577E-01	5.05726452E-01
				9.00000000E+01	9.82002102E-02	1.86149711E-02	1.14652869E+00	4.30986347E-02	6.58405372E-01
300	3	2	4	1.01121172E-01	-1.42747164E-02	-1.57834413E-01	1.29576826E+01	8.10634582E-01	5.06280352E-01
				9.00000000E+01	1.95776444E-01	6.85518481E-03	1.14683768E+00	4.29473982E-02	7.25988393E-01
300	4	2	4	1.45523363E-01	-1.50291275E-02	-1.57601364E-01	1.27376032E+01	7.92014436E-01	5.07454010E-01
				9.00000000E+01	2.92177782E-01	-1.23811574E-02	1.14729033E+00	4.27441457E-02	8.33692597E-01
300	5	2	4	1.86731390E-01	-1.62566185E-02	-1.59643654E-01	1.20962954E+01	7.44712678E-01	5.08592479E-01
				9.00000000E+01	3.86615881E-01	-3.97202729E-02	1.14773877E+00	4.25977469E-02	9.60416953E-01
300	6	2	4	2.25862857E-01	-8.67465144E-03	-1.63192273E-01	1.07691177E+01	6.52330209E-01	5.08449037E-01
				9.00000000E+01	4.78636503E-01	-7.43527698E-02	1.14809786E+00	4.26013829E-02	1.09813400E+00
300	7	2	4	2.63644115E-01	1.96880309E-02	-1.62140587E-01	9.06751166E+00	5.38081042E-01	5.07652390E-01
				9.00000000E+01	4.93909847E-01	-8.22037058E-02	1.14827328E+00	4.27946679E-02	1.23652125E+00
300	8	2	4	2.97917736E-01	5.07505296E-02	-1.58937606E-01	7.26225088E+00	4.20663005E-01	5.06889807E-01
				9.00000000E+01	5.08282215E-01	-9.24845164E-02	1.14827016E+00	4.31709792E-02	1.38068071E+00
300	9	2	4	3.34063327E-01	7.41654816E-02	-1.54789192E-01	5.43987639E+00	3.05952788E-01	5.06559627E-01
				9.00000000E+01	5.22121706E-01	-1.05290738E-01	1.14808955E+00	4.37655444E-02	1.54472415E+00
300	10	2	4	4.00516776E-01	8.81503393E-02	-1.48290696E-01	3.57248283E+00	1.90725531E-01	5.06723689E-01
				9.00000000E+01	5.36355892E-01	-1.21137974E-01	1.14902307E+00	4.41604379E-02	1.84893936E+00

300	1	3	4	-4.98131762E-11	-3.46192830E-02	-2.42881190E-01	1.33845359E+01	8.24488422E-01	5.05345155E-01
				9.00000000E+01	0.	4.26418022E-02	1.14891828E+00	4.18609824E-02	9.57318564E-01
300	2	3	4	5.35315950E-02	-3.37949003E-02	-2.45841471E-01	1.33708256E+01	8.21383584E-01	5.05373885E-01
				9.00000000E+01	1.00012719E-01	4.11072851E-02	1.14920585E+00	4.17213543E-02	9.92331410E-01
300	3	3	4	1.10725829E-01	-3.19808419E-02	-2.48764505E-01	1.33130688E+01	8.12268982E-01	5.05620034E-01
				9.00000000E+01	1.99400365E-01	2.91946847E-02	1.14990011E+00	4.13896995E-02	1.07634952E+00
300	4	3	4	1.65823005E-01	-3.12791329E-02	-2.48370586E-01	1.31089844E+01	7.91581267E-01	5.05769400E-01
				9.00000000E+01	2.97679954E-01	9.98359483E-03	1.15084734E+00	4.09585093E-02	1.18645656E+00
300	5	3	4	2.21611498E-01	-3.00918396E-02	-2.46462231E-01	1.27235442E+01	7.57109782E-01	5.06103366E-01
				9.00000000E+01	3.93885633E-01	-1.79028923E-02	1.15210082E+00	4.04146624E-02	1.32685472E+00
300	6	3	4	2.72167337E-01	-1.66115932E-02	-2.43612519E-01	1.19856653E+01	7.00263247E-01	5.06135580E-01
				9.00000000E+01	4.87707782E-01	-5.30191274E-02	1.15340239E+00	3.99144210E-02	1.47381800E+00
300	7	3	4	3.20630441E-01	2.88428703E-02	-2.43202772E-01	1.08525778E+01	6.18126168E-01	5.05725491E-01
				9.00000000E+01	5.08128695E-01	-6.29378343E-02	1.15503582E+00	3.93549650E-02	1.65076562E+00
300	8	3	4	3.64191640E-01	8.91426251E-02	-2.43991167E-01	9.58103129E+00	5.27693037E-01	5.05292469E-01
				9.00000000E+01	5.28362563E-01	-7.55281649E-02	1.15729107E+00	3.86012813E-02	1.86629399E+00
300	9	3	4	3.99377211E-01	1.59126101E-01	-2.46917856E-01	8.23283288E+00	4.34506085E-01	5.04985004E-01
				9.00000000E+01	5.49608499E-01	-9.14147535E-02	1.16026515E+00	3.76457466E-02	2.11951046E+00
300	10	3	4	4.27656652E-01	2.45705389E-01	-2.53128058E-01	6.82011188E+00	3.38458834E-01	5.04318485E-01
				9.00000000E+01	5.74071539E-01	-1.12157805E-01	1.16485904E+00	3.61623203E-02	2.45031650E+00

300	1	4	4	-6.62276572E-11	-4.98713933E-02	-3.22915611E-01	1.39433576E+01	8.33603585E-01	5.04718488E-01
				9.00000000E+01	0.	6.39627034E-02	1.15268699E+00	3.99817873E-02	1.29940414E+00
				6.39627034E-02	-8.78227822E-04	2.57108601E-03	0.		
300	2	4	4	7.21629490E-03	-5.07057001E-02	-3.26871272E-01	1.39258056E+01	8.30909899E-01	5.04665695E-01
				9.00000000E+01	1.01825227E-01	6.35995991E-02	1.15288829E+00	3.98893414E-02	1.31735651E+00
				6.76956747E-02	-9.37224323E-04	5.56783130E-02	-5.56200622E-03		
300	3	4	4	1.12022728E-01	-5.09659044E-02	-3.41992318E-01	1.37855960E+01	8.09516891E-01	5.04814816E-01
				9.00000000E+01	2.03024286E-01	5.15341846E-02	1.15451507E+00	3.91509185E-02	1.46117779E+00
				6.78945839E-02	-7.80633926E-04	3.05067394E-02	-7.65693410E-03		
300	4	4	4	1.77117353E-01	-4.69865755E-02	-3.44290207E-01	1.36593279E+01	7.90431065E-01	5.04848496E-01
				9.00000000E+01	3.03182127E-01	3.23483471E-02	1.15600904E+00	3.84855266E-02	1.58164857E+00
				6.90948942E-02	-7.50693349E-04	3.76538413E-02	-1.07654196E-02		
300	5	4	4	2.60310525E-01	-4.25064279E-02	-3.37172624E-01	1.34643284E+01	7.61268658E-01	5.05172390E-01
				9.00000000E+01	4.01155385E-01	3.91448839E-03	1.15837182E+00	3.74560703E-02	1.75973649E+00
				6.89900466E-02	-3.80022812E-04	2.83745089E-02	-1.79272947E-02		
300	6	4	4	3.25224377E-01	-3.02648787E-02	-3.16468081E-01	1.33142761E+01	7.39073731E-01	5.05351933E-01
				9.00000000E+01	4.96779061E-01	-3.16854849E-02	1.16023743E+00	3.66616874E-02	1.88946164E+00
				6.95464708E-02	-1.68568368E-04	9.05656448E-03	-3.50829114E-02		
300	7	4	4	3.94261830E-01	3.55147845E-02	-3.12274645E-01	1.30055162E+01	6.93919202E-01	5.05386333E-01
				9.00000000E+01	5.22347543E-01	-4.36719629E-02	1.16421149E+00	3.50129550E-02	2.14036483E+00
				7.18341491E-02	-1.28777355E-04	4.04116068E-02	-4.16496839E-02		
300	8	4	4	4.45367951E-01	1.20782043E-01	-3.08414051E-01	1.26498895E+01	6.42764048E-01	5.05455576E-01
				9.00000000E+01	5.48442912E-01	-5.85718134E-02	1.16902701E+00	3.30889069E-02	2.41931339E+00
				7.98456994E-02	-4.39143028E-05	7.81709142E-02	-5.04812980E-02		
300	9	4	4	4.62384847E-01	2.22385074E-01	-3.02847674E-01	1.23362602E+01	5.98456078E-01	5.05605781E-01
				9.00000000E+01	5.77095292E-01	-7.75387696E-02	1.17349985E+00	3.13710157E-02	2.66116365E+00
				9.23720766E-02	1.33228100E-04	1.34722151E-01	-6.46718203E-02		
300	10	4	4	4.41884518E-01	3.30888783E-01	-2.96409056E-01	1.20859609E+01	5.63611218E-01	5.06060851E-01
				9.00000000E+01	6.11787186E-01	-1.03177635E-01	1.17723065E+00	2.99836876E-02	2.85561111E+00
				1.16310023E-01	6.02468608E-04	2.32568767E-01	-8.76663075E-02		

300	1	1	5	-4.49177842E-02	0.	-7.77998844E-02	1.29678747E+01	8.24937531E-01	5.06218276E-01
				1.20000000E+02	0.	3.55271368E-15	1.14504882E+00	4.38663956E-02	3.43016968E-01
300	2	1	5	-1.88978427E-03	0.	-7.33303585E-02	1.32535697E+01	8.45968011E-01	5.06854844E-01
				1.20000000E+02	9.63877017E-02	-3.87734284E-03	1.14495658E+00	4.38865604E-02	2.79495273E-01
300	3	1	5	4.06434146E-02	0.	-6.69335775E-02	1.35465388E+01	8.67229629E-01	5.08862050E-01
				1.20000000E+02	1.92152523E-01	-1.54843151E-02	1.14491127E+00	4.38824719E-02	2.97819480E-01
300	4	1	5	8.06248560E-02	0.	-6.45489690E-02	1.37758094E+01	8.84618714E-01	5.13048355E-01
				1.20000000E+02	2.86675609E-01	-3.47459096E-02	1.14479243E+00	4.39241599E-02	3.92030004E-01
300	5	1	5	1.17683821E-01	0.	-6.50207332E-02	1.33360211E+01	8.56007372E-01	5.17618542E-01
				1.20000000E+02	3.79346129E-01	-6.15376536E-02	1.14443906E+00	4.41523158E-02	5.10320070E-01
300	6	1	5	1.59949992E-01	0.	-6.73901355E-02	1.15621252E+01	7.33833258E-01	5.19665666E-01
				1.20000000E+02	4.69565224E-01	-9.56864122E-02	1.14387620E+00	4.46286657E-02	6.62974790E-01
300	7	1	5	2.31361437E-01	0.	-6.87256861E-02	8.81317065E+00	5.42050491E-01	5.17983046E-01
				1.20000000E+02	4.79690999E-01	-1.01469577E-01	1.14391996E+00	4.49659920E-02	9.39588120E-01
300	8	1	5	3.00783172E-01	0.	-6.91953148E-02	6.62076763E+00	3.92118153E-01	5.16503038E-01
				1.20000000E+02	4.88201866E-01	-1.09440868E-01	1.14457641E+00	4.50634689E-02	1.22942972E+00
300	9	1	5	3.55512403E-01	0.	-6.97089898E-02	5.09532621E+00	2.91216932E-01	5.15874195E-01
				1.20000000E+02	4.94634913E-01	-1.19166721E-01	1.14539375E+00	4.51051618E-02	1.47434697E+00
300	10	1	5	4.03366171E-01	0.	-7.13973761E-02	3.91696663E+00	2.16178274E-01	5.16567348E-01
				1.20000000E+02	4.98640244E-01	-1.30118144E-01	1.14620849E+00	4.52030631E-02	1.70203069E+00
300	1	2	5	-8.16458648E-02	-1.68684079E-02	-1.41414786E-01	1.30359501E+01	8.19450798E-01	5.05733052E-01
				1.20000000E+02	0.	2.13209011E-02	1.14639301E+00	4.31649360E-02	6.31955587E-01
300	2	2	5	-2.99990455E-02	-1.55053490E-02	-1.39803578E-01	1.33661724E+01	8.44977539E-01	5.06287286E-01
				1.20000000E+02	9.81222363E-02	1.76473545E-02	1.14609123E+00	4.32850928E-02	5.51677495E-01
300	3	2	5	2.45723375E-02	-1.35330175E-02	-1.34598470E-01	1.36414471E+01	8.65255821E-01	5.07366950E-01
				1.20000000E+02	1.95562452E-01	5.53604191E-03	1.14598480E+00	4.33123463E-02	5.26290348E-01
300	4	2	5	7.75520573E-02	-1.48015788E-02	-1.32798089E-01	1.38070711E+01	8.76129867E-01	5.09751718E-01
				1.20000000E+02	2.91728914E-01	-1.42056736E-02	1.14608812E+00	4.32425829E-02	5.91277216E-01
300	5	2	5	1.26485472E-01	-1.81107166E-02	-1.30444824E-01	1.35743633E+01	8.58606322E-01	5.12496093E-01
				1.20000000E+02	3.85626767E-01	-4.26887216E-02	1.14622290E+00	4.31961555E-02	7.00249112E-01
300	6	2	5	1.72655195E-01	-1.81714609E-02	-1.31287189E-01	1.24204720E+01	7.76797860E-01	5.13579352E-01
				1.20000000E+02	4.76240498E-01	-7.99876432E-02	1.14634799E+00	4.32558652E-02	8.40431667E-01
300	7	2	5	2.22480371E-01	-3.54283423E-04	-1.29492577E-01	1.04387115E+01	6.39193337E-01	5.12293649E-01
				1.20000000E+02	4.89593223E-01	-8.80525229E-02	1.14651571E+00	4.34247744E-02	1.00662627E+00
300	8	2	5	2.69773033E-01	2.14875006E-02	-1.26688859E-01	8.43749424E+00	5.03647052E-01	5.11176548E-01
				1.20000000E+02	5.01550551E-01	-9.81689021E-02	1.14671981E+00	4.36534866E-02	1.18632286E+00
300	9	2	5	3.11554706E-01	4.23374473E-02	-1.22630327E-01	6.51576097E+00	3.78353608E-01	5.11003316E-01
				1.20000000E+02	5.12045499E-01	-1.10377445E-01	1.14663964E+00	4.41136687E-02	1.36163301E+00
300	10	2	5	3.70911608E-01	6.22648732E-02	-1.15972969E-01	4.52056864E+00	2.51511181E-01	5.11439540E-01
				1.20000000E+02	5.21471340E-01	-1.24682015E-01	1.14705129E+00	4.45673943E-02	1.62825120E+00

300	1	3	5	-1.21440595E-01	-3.46192830E-02	-2.10341281E-01	1.33845359E+01	8.24488422E-01	5.05345155E-01
				1.20000000E+02	0.	4.26418022E-02	1.14891828E+00	4.18609824E-02	9.57318564E-01
300	2	3	5	-5.91910319E-02	-3.46758448E-02	-2.15380906E-01	1.36666353E+01	8.48082232E-01	5.05841127E-01
				1.20000000E+02	9.98567708E-02	3.91720519E-02	1.14837206E+00	4.20994004E-02	8.77961110E-01
300	3	3	5	-1.53566382E-03	-3.39495729E-02	-2.16284428E-01	1.38896255E+01	8.65105302E-01	5.06608995E-01
				1.20000000E+02	1.98972382E-01	2.65563989E-02	1.14816968E+00	4.21760927E-02	8.48422257E-01
300	4	3	5	5.91891497E-02	-3.43564288E-02	-2.09968743E-01	1.39306071E+01	8.67999206E-01	5.07239912E-01
				1.20000000E+02	2.96782220E-01	6.33456247E-03	1.14816311E+00	4.21750033E-02	8.55593001E-01
300	5	3	5	1.28154835E-01	-3.81082787E-02	-2.07610152E-01	1.37827643E+01	8.53101856E-01	5.08483351E-01
				1.20000000E+02	3.91907404E-01	-2.38397897E-02	1.14875405E+00	4.18970714E-02	9.60769869E-01
300	6	3	5	1.97354327E-01	-3.78742709E-02	-2.05164623E-01	1.31190835E+01	7.99755123E-01	5.09111458E-01
				1.20000000E+02	4.82915773E-01	-6.42888742E-02	1.14981407E+00	4.14548987E-02	1.12797874E+00
300	7	3	5	2.65877916E-01	-1.10551448E-02	-2.05538382E-01	1.17923156E+01	7.00333632E-01	5.08192509E-01
				1.20000000E+02	4.99495456E-01	-7.46354685E-02	1.15139673E+00	4.08760842E-02	1.34172941E+00
300	8	3	5	3.28103103E-01	3.16494867E-01	-2.07048237E-01	1.03850384E+01	5.96736407E-01	5.07486391E-01
				1.20000000E+02	5.14899237E-01	-8.68969363E-02	1.15353108E+00	4.01166076E-02	1.58409238E+00
300	9	3	5	3.83172344E-01	8.72775363E-02	-2.10059318E-01	8.93144558E+00	4.92646596E-01	5.07335201E-01
				1.20000000E+02	5.29456086E-01	-1.01588169E-01	1.15630338E+00	3.91725137E-02	1.85724631E+00
300	10	3	5	4.33804504E-01	1.61288867E-01	-2.16120569E-01	7.33707280E+00	3.81728056E-01	5.06598477E-01
				1.20000000E+02	5.44302435E-01	-1.19245887E-01	1.16052015E+00	3.77830833E-02	2.19982589E+00

300	1	4	5	-1.61457806E-01	-4.98713933E-02	-2.79653122E-01	1.39433576E+01	8.33603585E-01	5.04718488E-01
				1.20000000E+02	0.	6.39627034E-02	1.15268699E+00	3.99817873E-02	1.29940414E+00
				6.39627034E-02	-8.78227822E-04	-8.41293187E-04	0.		
300	2	4	5	-6.89345149E-02	-5.74571965E-02	-3.00767661E-01	1.39950953E+01	8.41564514E-01	5.04749361E-01
				1.20000000E+02	1.01591305E-01	6.06967493E-02	1.15209663E+00	4.02543193E-02	1.24378245E+00
				6.47834151E-02	-8.39198947E-04	-3.54043802E-02	-2.72297288E-03		
300	3	4	5	2.49034497E-03	-6.97355236E-02	-3.24533038E-01	1.39135263E+01	8.29027111E-01	5.04044264E-01
				1.20000000E+02	2.02382311E-01	4.75767558E-02	1.15302949E+00	3.98246447E-02	1.32281430E+00
				6.38854226E-02	-1.65001180E-03	2.26291159E-02	2.88334396E-05		
300	4	4	5	7.57278429E-03	-5.51271343E-02	-2.83524061E-01	1.40947598E+01	8.56994331E-01	5.05283586E-01
				1.20000000E+02	3.01835525E-01	2.68747985E-02	1.15097164E+00	4.07798055E-02	1.13714608E+00
				6.34581337E-02	-2.32963348E-04	2.59586330E-02	-1.38673504E-02		
300	5	4	5	1.13482348E-01	-6.00676622E-02	-3.03744349E-01	1.39456424E+01	8.33954521E-01	5.05894332E-01
				1.20000000E+02	3.98188042E-01	-4.99085776E-03	1.15266082E+00	3.99938233E-02	1.31122475E+00
				5.96033371E-02	4.57982593E-04	1.61133747E-03	-9.36359673E-03		
300	6	4	5	2.27613418E-01	-6.35243431E-02	-2.83489952E-01	1.37754801E+01	8.07981588E-01	5.06065114E-01
				1.20000000E+02	4.89591047E-01	-4.85901052E-02	1.15463375E+00	3.90976245E-02	1.48473632E+00
				5.11771014E-02	6.61769362E-04	-7.22395937E-03	-2.31747435E-02		
300	7	4	5	3.43292107E-01	-2.87043327E-02	-2.81587232E-01	1.33811064E+01	7.48933078E-01	5.06074629E-01
				1.20000000E+02	5.09397684E-01	-6.12184141E-02	1.15940134E+00	3.70157584E-02	1.83975038E+00
				5.00264256E-02	6.98512853E-04	1.13304330E-02	-2.63247565E-02		
300	8	4	5	4.15288430E-01	4.02772935E-02	-2.78871479E-01	1.30301648E+01	6.97615063E-01	5.06144170E-01
				1.20000000E+02	5.28247923E-01	-7.56249704E-02	1.16388774E+00	3.51511320E-02	2.12819803E+00
				5.24137536E-02	7.93630459E-04	3.74384754E-02	-3.07813350E-02		
300	9	4	5	4.76495609E-01	1.27662786E-01	-2.76453156E-01	1.25827244E+01	6.33212086E-01	5.06291329E-01
				1.20000000E+02	5.46866672E-01	-9.27988929E-02	1.16996658E+00	3.27227333E-02	2.47758698E+00
				5.85099906E-02	9.80239165E-04	6.73679302E-02	-3.68003026E-02		
300	10	4	5	4.85259388E-01	2.35048686E-01	-2.71996131E-01	1.22840010E+01	5.91144729E-01	5.06622859E-01
				1.20000000E+02	5.67133531E-01	-1.13809758E-01	1.17426672E+00	3.10826687E-02	2.70865021E+00
				7.04080517E-02	1.32014834E-03	1.17962400E-01	-4.70373806E-02		

300	1	1	6	-7.77998844E-02	0.	-4.49177842E-02	1.29678747E+01	8.24937531E-01	5.06218276E-01
				1.50000000E+02	0.	3.55271368E-15	1.14504882E+00	4.38663956E-02	3.43016968E-01
300	2	1	6	-3.50221853E-02	0.	-4.24317447E-02	1.35326710E+01	8.66441700E-01	5.07443595E-01
				1.50000000E+02	9.63877017E-02	-3.87734284E-03	1.14488643E+00	4.38968846E-02	2.09227828E-01
300	3	1	6	9.64488340E-03	0.	-3.82723034E-02	1.41378798E+01	9.10813069E-01	5.10210870E-01
				1.50000000E+02	1.92152523E-01	-1.54843151E-02	1.14476940E+00	4.39040437E-02	1.49517398E-01
300	4	1	6	5.26423479E-02	0.	-3.61423457E-02	1.47798811E+01	9.58731238E-01	5.15524149E-01
				1.50000000E+02	2.86675609E-01	-3.47459096E-02	1.14459363E+00	4.39439379E-02	2.40851010E-01
300	5	1	6	9.31251472E-02	0.	-3.55936305E-02	1.48528273E+01	9.67370820E-01	5.21667477E-01
				1.50000000E+02	3.79346129E-01	-6.15376536E-02	1.14423186E+00	4.41338320E-02	3.74976293E-01
300	6	1	6	1.38436214E-01	0.	-3.62030702E-02	1.34863120E+01	8.72978701E-01	5.25455825E-01
				1.50000000E+02	4.69565224E-01	-9.56864122E-02	1.14369039E+00	4.45405579E-02	5.39947688E-01
300	7	1	6	2.11780681E-01	0.	-3.65925291E-02	1.05374228E+01	6.62783643E-01	5.23705840E-01
				1.50000000E+02	4.79690999E-01	-1.01469577E-01	1.14369717E+00	4.48407988E-02	8.25305305E-01
300	8	1	6	2.81722903E-01	0.	-3.66403765E-02	8.12047899E+00	4.93409028E-01	5.22343494E-01
				1.50000000E+02	4.88201866E-01	-1.09440868E-01	1.14424772E+00	4.49179949E-02	1.11433666E+00
300	9	1	6	3.39227101E-01	0.	-3.66343875E-02	6.30038798E+00	3.69962142E-01	5.22086071E-01
				1.50000000E+02	4.94634913E-01	-1.19166721E-01	1.14493279E+00	4.49713016E-02	1.36631868E+00
300	10	1	6	3.94872520E-01	0.	-3.70694258E-02	4.70909785E+00	2.65965643E-01	5.22519215E-01
				1.50000000E+02	4.98640244E-01	-1.30118144E-01	1.14579359E+00	4.50586130E-02	1.62560532E+00
300	1	2	6	-1.41414786E-01	-1.68684079E-02	-8.16458647E-02	1.30359501E+01	8.19450798E-01	5.05733052E-01
				1.50000000E+02	0.	2.13209011E-02	1.14639301E+00	4.31649360E-02	6.31955587E-01
300	2	2	6	-8.95611926E-02	-1.57303890E-02	-8.16958245E-02	1.36029848E+01	8.64017780E-01	5.06628221E-01
				1.50000000E+02	9.80840628E-02	1.71736417E-02	1.14580107E+00	4.34113595E-02	4.67460653E-01
300	3	2	6	-3.22788031E-02	-1.39632980E-02	-7.78108174E-02	1.41258805E+01	9.04760089E-01	5.08280991E-01
				1.50000000E+02	1.95563258E-01	5.54100935E-03	1.14537434E+00	4.35848107E-02	3.24787684E-01
300	4	2	6	2.73603447E-02	-1.44872626E-02	-7.50566820E-02	1.46673072E+01	9.45352644E-01	5.11724727E-01
				1.50000000E+02	2.91150711E-01	-1.65559029E-02	1.14517247E+00	4.36436928E-02	3.07593877E-01
300	5	2	6	8.34839439E-02	-1.85025281E-02	-7.23728707E-02	1.48575790E+01	9.59463995E-01	5.15822155E-01
				1.50000000E+02	3.85110143E-01	-4.42391707E-02	1.14512760E+00	4.36514445E-02	4.23899164E-01
300	6	2	6	1.38194985E-01	-2.25096493E-02	-7.15232357E-02	1.39984415E+01	8.97695548E-01	5.18346142E-01
				1.50000000E+02	4.74657768E-01	-8.37098755E-02	1.14513322E+00	4.37235235E-02	5.97461040E-01
300	7	2	6	1.98855391E-01	-1.23395195E-02	-7.00303335E-02	1.18216110E+01	7.41744413E-01	5.16617409E-01
				1.50000000E+02	4.86864901E-01	-9.17492781E-02	1.14538638E+00	4.38152249E-02	8.13287702E-01
300	8	2	6	2.55721717E-01	2.62800852E-03	-6.83740676E-02	9.69299622E+00	5.92601369E-01	5.15583350E-01
				1.50000000E+02	4.97445871E-01	-1.01634997E-01	1.14576973E+00	4.39044845E-02	1.03562011E+00
300	9	2	6	3.04664457E-01	2.13171779E-02	-6.61895771E-02	7.65771943E+00	4.55366391E-01	5.15751467E-01
				1.50000000E+02	5.06311820E-01	-1.13271942E-01	1.14594128E+00	4.41809368E-02	1.24288374E+00
300	10	2	6	3.61289111E-01	4.55217000E-02	-6.23217945E-02	5.48016145E+00	3.13304562E-01	5.16258513E-01
				1.50000000E+02	5.13485030E-01	-1.26583571E-01	1.14627463E+00	4.45765689E-02	1.50389039E+00

300	1	3	6	-2.10341281E-01	-3.46192830E-02	-1.21440595E-01	1.33845359E+01	8.24488422E-01	5.05345155E-01
				1.50000000E+02	0.	4.26418022E-02	1.14891828E+00	4.18609824E-02	9.57318564E-01
300	2	3	6	-1.50228335E-01	-3.52475214E-02	-1.24704880E-01	1.38415313E+01	8.65951974E-01	5.05973477E-01
				1.50000000E+02	9.97804240E-02	3.82246263E-02	1.14764541E+00	4.24442698E-02	7.66567704E-01
300	3	3	6	-8.28371579E-02	-3.47589561E-02	-1.24064641E-01	1.42222166E+01	9.00650020E-01	5.06826728E-01
				1.50000000E+02	1.98973993E-01	2.65663338E-02	1.14666878E+00	4.29026847E-02	5.87180189E-01
300	4	3	6	-8.43261860E-03	-3.59056805E-02	-1.18907403E-01	1.45720719E+01	9.30171391E-01	5.08439177E-01
				1.50000000E+02	2.95625814E-01	1.63410376E-03	1.14611753E+00	4.31549695E-02	4.74784915E-01
300	5	3	6	7.47244015E-02	-4.22999318E-02	-1.16030464E-01	1.47316995E+01	9.40425732E-01	5.10764728E-01
				1.50000000E+02	3.90874157E-01	-2.69406878E-02	1.14624386E+00	4.30746584E-02	5.50520010E-01
300	6	3	6	1.57091086E-01	-4.94701362E-02	-1.14700882E-01	1.43324009E+01	9.04917549E-01	5.12541162E-01
				1.50000000E+02	4.79750311E-01	-7.17333388E-02	1.14708451E+00	4.26789237E-02	7.70971973E-01
300	7	3	6	2.33918666E-01	-3.47936710E-02	-1.15712607E-01	1.28734285E+01	7.92954785E-01	5.11188900E-01
				1.50000000E+02	4.94038802E-01	-8.20289789E-02	1.14844840E+00	4.21523580E-02	1.02712696E+00
300	8	3	6	3.07140891E-01	-4.83384521E-03	-1.17102766E-01	1.13349990E+01	6.76064887E-01	5.10139805E-01
				1.50000000E+02	5.06689877E-01	-9.38291265E-02	1.15044152E+00	4.13940690E-02	1.30807442E+00
300	9	3	6	3.74144022E-01	4.01383729E-02	-1.19012857E-01	9.74876004E+00	5.58965060E-01	5.09933853E-01
				1.50000000E+02	5.17988728E-01	-1.07377163E-01	1.15301410E+00	4.04680313E-02	1.60786733E+00
300	10	3	6	4.40592841E-01	1.05188218E-01	-1.22539657E-01	7.95537312E+00	4.30779019E-01	5.09126762E-01
				1.50000000E+02	5.28329815E-01	-1.23048999E-01	1.15701133E+00	3.91002993E-02	1.97667165E+00

300	1	4	6	-2.79653122E-01	-4.98713933E-02	-1.61457805E-01	1.39433576E+01	8.33603585E-01	5.04718488E-01
				1.50000000E+02	0.	6.39627034E-02	1.15268699E+00	3.99817873E-02	1.29940414E+00
				6.39627034E-02	-8.78227822E-04	1.62443725E-03	0.		
300	2	4	6	-2.17724671E-01	-5.71567339E-02	-1.65654895E-01	1.41238263E+01	8.61517761E-01	5.04957952E-01
				1.50000000E+02	1.01476785E-01	5.92756108E-02	1.15064667E+00	4.09331693E-02	1.09776689E+00
				6.33576698E-02	-5.96500177E-04	-2.51362711E-02	-2.45936971E-03		
300	3	4	6	-1.37444047E-01	-6.12875132E-02	-1.76508697E-01	1.42760779E+01	8.85406528E-01	5.05259276E-01
				1.50000000E+02	2.02384728E-01	4.75916582E-02	1.14896627E+00	4.17384218E-02	9.01514960E-01
				6.39005197E-02	-2.56105012E-04	-2.73049806E-02	-2.41059951E-03		
300	4	4	6	-5.18601439E-02	-6.18120498E-02	-1.61715600E-01	1.44046463E+01	9.05856999E-01	5.05347992E-01
				1.50000000E+02	3.00100916E-01	1.98241105E-02	1.14757556E+00	4.24219251E-02	6.96115404E-01
				5.61972060E-02	-1.56371728E-04	-3.25665970E-02	-8.38027495E-03		
300	5	4	6	7.23111124E-02	-7.14469624E-02	-1.67698639E-01	1.43779596E+01	9.01588689E-01	5.06020538E-01
				1.50000000E+02	3.96638170E-01	-9.64220485E-03	1.14786222E+00	4.22796621E-02	7.56764058E-01
				5.47005693E-02	5.75173320E-04	-6.82475479E-02	-8.53533475E-03		
300	6	4	6	2.69169732E-01	-1.10764142E-01	-1.57082549E-01	1.41222451E+01	8.61272868E-01	5.20472507E-01
				1.50000000E+02	4.84842855E-01	-5.97568021E-02	1.15066413E+00	4.09249139E-02	1.29926414E+00
				3.90428341E-02	1.63053041E-02	-1.70005036E-02	-1.05243487E-02		
300	7	4	6	3.04812658E-01	-6.71540340E-02	-1.68011649E-01	1.38597849E+01	8.20811605E-01	5.07485030E-01
				1.50000000E+02	5.01212703E-01	-7.23086797E-02	1.15364984E+00	3.95417877E-02	1.41777020E+00
				3.62428154E-02	2.28561419E-03	-2.62434895E-03	-1.10984082E-02		
300	8	4	6	3.99159731E-01	-1.47949067E-02	-1.67429661E-01	1.34510809E+01	7.59300639E-01	5.06306150E-01
				1.50000000E+02	5.15933882E-01	-8.60232558E-02	1.15853486E+00	3.73860188E-02	1.78204333E+00
				3.62966843E-02	9.65331234E-04	1.71873708E-02	-1.23327842E-02		
300	9	4	6	4.77534154E-01	6.33273791E-02	-1.66660833E-01	1.29839211E+01	6.90785179E-01	5.06545838E-01
				1.50000000E+02	5.29665635E-01	-1.01482384E-01	1.16449648E+00	3.48968157E-02	2.16723313E+00
				3.92413972E-02	1.27734368E-03	3.91757360E-02	-1.41850246E-02		
300	10	4	6	5.25978555E-01	1.63505982E-01	-1.65428803E-01	1.25157660E+01	6.23724046E-01	5.06793595E-01
				1.50000000E+02	5.43174600E-01	-1.19514426E-01	1.17091308E+00	3.23567746E-02	2.53284421E+00
				4.57793369E-02	1.57813006E-03	6.88826942E-02	-1.71241297E-02		

300	1	1	7	-8.98355684E-02	0.	3.68479746E-11	1.29678747E+01	8.24937531E-01	5.06218276E-01
				1.80000000E+02	0.	3.55271368E-15	1.14504882E+00	4.38663956E-02	3.43016968E-01
300	2	1	7	-4.70839953E-02	0.	9.33799115E-12	1.36423830E+01	8.74483463E-01	5.07701456E-01
				1.80000000E+02	9.63877017E-02	-3.87734284E-03	1.14486232E+00	4.38993945E-02	1.78924889E-01
300	3	1	7	-1.56504112E-03	0.	-3.54756207E-12	1.43690854E+01	9.27871147E-01	5.10766877E-01
				1.80000000E+02	1.92152523E-01	-1.54843151E-02	1.14472289E+00	4.39088492E-02	5.92008810E-03
300	4	1	7	4.25740191E-02	0.	-5.32660768E-12	1.51680872E+01	9.87511532E-01	5.16467038E-01
				1.80000000E+02	2.86675609E-01	-3.47459096E-02	1.14453026E+00	4.39471912E-02	1.60214803E-01
300	5	1	7	8.43594569E-02	0.	-4.78371127E-12	1.54686724E+01	1.01294160E+00	5.23256288E-01
				1.80000000E+02	3.79346129E-01	-6.15376536E-02	1.14416846E+00	4.41214470E-02	3.16223424E-01
300	6	1	7	1.31016685E-01	0.	-4.33108709E-12	1.43128613E+01	9.33433651E-01	5.27821404E-01
				1.80000000E+02	4.69565224E-01	-9.56864122E-02	1.14364146E+00	4.44986416E-02	4.92093320E-01
300	7	1	7	2.04918638E-01	0.	-2.69725581E-12	1.13149745E+01	7.17855566E-01	5.26081704E-01
				1.80000000E+02	4.79690999E-01	-1.01469577E-01	1.14365218E+00	4.47737898E-02	7.82764760E-01
300	8	1	7	2.75212503E-01	0.	-2.11115286E-12	8.81693237E+00	5.41040824E-01	5.24844003E-01
				1.80000000E+02	4.88201866E-01	-1.09440868E-01	1.14417884E+00	4.48350592E-02	1.07308937E+00
300	9	1	7	3.34076879E-01	0.	-2.21048554E-12	6.85699201E+00	4.06788387E-01	5.24753792E-01
				1.80000000E+02	4.94634913E-01	-1.19166721E-01	1.14482646E+00	4.48890719E-02	1.32965248E+00
300	10	1	7	3.93089420E-01	0.	-2.82432049E-12	5.05461250E+00	2.87853668E-01	5.25035728E-01
				1.80000000E+02	4.98640244E-01	-1.30118144E-01	1.14571321E+00	4.49725261E-02	1.60334917E+00

300	1	2	7	-1.63291730E-01	-1.68684079E-02	6.69775859E-11	1.30359501E+01	8.19450798E-01	5.05733052E-01
				1.80000000E+02	0.	2.13209011E-02	1.14639301E+00	4.31649360E-02	6.31955587E-01
300	2	2	7	-1.11919040E-01	-1.58774050E-02	1.54283592E-11	1.36868202E+01	8.70874461E-01	5.06762594E-01
				1.80000000E+02	9.80495849E-02	1.67457876E-02	1.14568845E+00	4.34617120E-02	4.31778807E-01
300	3	2	7	-5.21777061E-02	-1.40993922E-02	-8.74578362E-12	1.43038014E+01	9.19467729E-01	5.08615863E-01
				1.80000000E+02	1.95427712E-01	4.70544177E-03	1.14514597E+00	4.36893816E-02	2.05092874E-01
300	4	2	7	1.01257782E-02	-1.43215589E-02	-1.15550294E-11	1.49926844E+01	9.71786586E-01	5.12452562E-01
				1.80000000E+02	2.91030079E-01	-1.70462405E-02	1.14484935E+00	4.37891116E-02	6.62031052E-02
300	5	2	7	6.93485890E-02	-1.85279504E-02	-9.51693460E-12	1.53838120E+01	1.00107849E+00	5.17199075E-01
				1.80000000E+02	3.84684915E-01	-4.55153281E-02	1.14475275E+00	4.38100142E-02	2.70261869E-01
300	6	2	7	1.27267548E-01	-2.38210293E-02	-7.93182332E-12	1.46884446E+01	9.50859951E-01	5.20397331E-01
				1.80000000E+02	4.73939002E-01	-8.54002533E-02	1.14473095E+00	4.38776371E-02	4.89036937E-01
300	7	2	7	1.91961870E-01	-1.65088079E-02	-1.01961878E-11	1.24563883E+01	7.88880527E-01	5.18572873E-01
				1.80000000E+02	4.85714649E-01	-9.33078147E-02	1.14502914E+00	4.39294046E-02	7.37634555E-01
300	8	2	7	2.51977632E-01	-4.14926549E-03	-1.22428436E-11	1.02829383E+01	6.34465820E-01	5.17545208E-01
				1.80000000E+02	4.95801299E-01	-1.03023716E-01	1.14549014E+00	4.39579993E-02	9.80358700E-01
300	9	2	7	3.03793830E-01	1.35943522E-02	-1.51611435E-11	8.18740790E+00	4.91242508E-01	5.17857046E-01
				1.80000000E+02	5.04101720E-01	-1.14387653E-01	1.14576509E+00	4.41615837E-02	1.20297429E+00
300	10	2	7	3.60625008E-01	3.89381740E-02	-2.15144568E-11	5.90531786E+00	3.40738936E-01	5.18311158E-01
				1.80000000E+02	5.10577584E-01	-1.27275840E-01	1.14614066E+00	4.45111156E-02	1.46850829E+00

300	1	3	7	-2.42881190E-01	-3.46192830E-02	9.96229008E-11	1.33845359E+01	8.24488422E-01	5.05345155E-01
				1.80000000E+02	0.	4.26418022E-02	1.14891828E+00	4.18609824E-02	9.57318564E-01
300	2	3	7	-1.84093280E-01	-3.54805166E-02	4.84493848E-11	1.39024049E+01	8.72245523E-01	5.05990525E-01
				1.80000000E+02	9.97114681E-02	3.73689181E-02	1.14739080E+00	4.25664940E-02	7.23041451E-01
300	3	3	7	-1.13886685E-01	-3.50712200E-02	2.27957652E-11	1.43436201E+01	9.13975248E-01	5.06925287E-01
				1.80000000E+02	1.98702901E-01	2.48951986E-02	1.14611149E+00	4.31791930E-02	4.54931132E-01
300	4	3	7	-3.29677904E-02	-3.63326212E-02	1.92620030E-11	1.48088062E+01	9.54045830E-01	5.08901265E-01
				1.80000000E+02	2.95384548E-01	6.53428681E-04	1.14533739E+00	4.35440544E-02	1.85943606E-01
300	5	3	7	5.65363643E-02	-4.33088130E-02	2.11600490E-11	1.51286279E+01	9.77312885E-01	5.11698393E-01
				1.80000000E+02	3.90023702E-01	-2.94930026E-02	1.14531204E+00	4.35306354E-02	2.69470888E-01
300	6	3	7	1.43753096E-01	-5.24893591E-02	2.54956362E-11	1.48914166E+01	9.53280172E-01	5.13949372E-01
				1.80000000E+02	4.78312780E-01	-7.51140943E-02	1.14607923E+00	4.31462401E-02	5.82606200E-01
300	7	3	7	2.23574614E-01	-4.20816213E-02	2.95341620E-11	1.33869802E+01	8.36629432E-01	5.12505229E-01
				1.80000000E+02	4.91738299E-01	-8.51460522E-02	1.14735004E+00	4.26416292E-02	8.79394718E-01
300	8	3	7	3.00905482E-01	-1.68936884E-02	3.24307381E-11	1.17929177E+01	7.13851285E-01	5.11416259E-01
				1.80000000E+02	5.03400732E-01	-9.66065631E-02	1.14928924E+00	4.18798347E-02	1.18832322E+00
300	9	3	7	3.72126202E-01	2.41002647E-02	3.50182942E-11	1.01412857E+01	5.90269892E-01	5.11136775E-01
				1.80000000E+02	5.13568526E-01	-1.09608585E-01	1.15181069E+00	4.09469852E-02	1.50564155E+00
300	10	3	7	4.44004280E-01	8.57866349E-02	3.85675794E-11	8.24968624E+00	4.53550856E-01	5.10248947E-01
				1.80000000E+02	5.22514924E-01	-1.24433536E-01	1.15573546E+00	3.95791768E-02	1.88817424E+00

300	1	4	7	-3.22915611E-01	-4.98713933E-02	1.32455314E-10	1.39433576E+01	8.33603585E-01	5.04718488E-01
				1.80000000E+02	0.	6.39627034E-02	1.15268699E+00	3.99817873E-02	1.29940414E+00
				6.39627034E-02	-8.78227822E-04	4.20764005E-03	0.		
300	2	4	7	-2.56517331E-01	-5.67000820E-02	1.53658208E-10	1.41799769E+01	8.70289396E-01	5.04984303E-01
				1.80000000E+02	1.01373351E-01	5.79920486E-02	1.15002265E+00	4.12297552E-02	1.02787904E+00
				6.20699469E-02	-5.63973263E-04	-3.39975109E-02	0.		
300	3	4	7	-1.86175303E-01	-6.15639481E-02	1.53658208E-10	1.43685590E+01	9.00089021E-01	5.05236721E-01
				1.80000000E+02	2.01978090E-01	4.50849554E-02	1.14796334E+00	4.22296538E-02	7.57214629E-01
				6.13610487E-02	-2.78605136E-04	-2.76509727E-02	0.		
300	4	4	7	-9.27269594E-02	-6.36672157E-02	1.53658208E-10	1.45259021E+01	9.25411633E-01	5.05531220E-01
				1.80000000E+02	2.99739018E-01	1.83530978E-02	1.14628711E+00	4.30710332E-02	4.29520021E-01
				5.46823302E-02	4.26117641E-05	-3.82483011E-02	0.		
300	5	4	7	4.42075226E-02	-7.34930214E-02	1.53658208E-10	1.45639373E+01	9.31604047E-01	5.06108515E-01
				1.80000000E+02	3.95362488E-01	-1.34706771E-02	1.14588760E+00	4.32757513E-02	3.26604416E-01
				5.06651554E-02	6.58416602E-04	-8.21538937E-02	0.		
300	6	4	7	2.49014456E-01	-1.20333295E-01	1.53658208E-10	1.43086927E+01	8.90570259E-01	5.19294515E-01
				1.80000000E+02	4.82686558E-01	-6.48279353E-02	1.14861088E+00	4.19115289E-02	1.07246150E+00
				3.35322980E-02	1.46817515E-02	-1.80518371E-02	0.		
300	7	4	7	2.87306480E-01	-7.84617927E-02	1.53658208E-10	1.40868433E+01	8.55767128E-01	5.07254022E-01
				1.80000000E+02	4.97761949E-01	-7.69842896E-02	1.15106002E+00	4.07382251E-02	1.17278874E+00
				3.04317024E-02	1.97678126E-03	-5.71401835E-03	0.		
300	8	4	7	3.93857315E-01	-3.29868243E-02	1.53658208E-10	1.36532587E+01	7.89517682E-01	5.06419994E-01
				1.80000000E+02	5.11000165E-01	-9.01894106E-02	1.15608156E+00	3.84535184E-02	1.60348372E+00
				2.98392536E-02	1.08242455E-03	1.13340757E-02	0.		
300	9	4	7	4.81147578E-01	4.07150144E-02	1.53658208E-10	1.31586918E+01	7.16279160E-01	5.06576843E-01
				1.80000000E+02	5.23035332E-01	-1.04829517E-01	1.16221690E+00	3.58355759E-02	2.02859165E+00
				3.18141357E-02	1.30306619E-03	3.04169042E-02	0.		
300	10	4	7	5.41978703E-01	1.37772959E-01	1.53658208E-10	1.26363999E+01	6.40842691E-01	5.06776971E-01
				1.80000000E+02	5.34452264E-01	-1.21591232E-01	1.16921495E+00	3.30154281E-02	2.44006253E+00
				3.68131635E-02	1.56541534E-03	5.48774719E-02	0.		

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