ANALYSIS AND DESIGN OF THREE
DIMENSIONAL SUPERSONIC NOZZLES

ATL TR 166 - VOLUME II
NUMERICAL PROGRAM FOR ANALYSIS OF
NOZZLE-EXHAUST FLOW FIELDS

By
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<tr>
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<td>3</td>
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ABSTRACT

This manual describes the FORTRAN IV Program developed to analyze the flow field associated with scramjet exhaust systems. The instructions for preparing input and interpreting output are described. The program analyzes steady three dimensional supersonic flow by the reference plane characteristic technique. The governing equations and numerical techniques employed are presented in Volume I of this report.
I. INTRODUCTION

The FORTRAN IV program described herein analyzes inviscid three-dimensional supersonic flow in scramjet exhaust systems by use of a reference plane characteristic procedure. The governing equations and numerical techniques employed are described in detail in Volume I of this report.

The numerical grid employed in Figures (1a) and (1b) follows streamline projections in each reference plane (R,Z) or (X,Z) or (X,θ). The grid is described by a matrix of points (I,J) where "I" denotes the streamline projection being traced in a reference plane and "J" denotes the reference plane considered. The number of streamline points (I) may not vary from reference plane to reference plane, and the addition or deletion of streamline points in accordance with step-size considerations is provided for in subroutine "SPACE".

For internal flow calculations the program may use either Cartesian (X, Y, Z), line source (R, θ, Z) or cylindrical (X, θ, R) coordinates depending upon the internal geometry considered. For the external flow calculation the Cartesian system or cylindrical system is used and the switch-over is performed automatically in subroutine INTER. The marching direction is either R or X and the direction normal to the reference plane is either
FIGURE 1a. NUMERICAL GRID-CARTESIAN OR LINE SOURCE
FIGURE 1b. NUMERICAL GRID-CYLINDRICAL
0 or y. Specifying \( XJ = 0 \) or \( XJ = 1 \) with \( XJ1 = 0 \) in the input determines whether a Cartesian or line source system is used. For the cylindrical system \( XJ1 = 1 \) and \( XJ = 0 \).

For the program described herein, the following stipulations apply:

1. The internal flow is underexpanded.

2. The cowl and sidewalls end on a plane \( X = \) constant. The sidewall edges at the cowl lip plane are assumed to be straight lines for external central module configuration (Figure 2).

3. The program is dimensioned such that ten (10) reference planes may be used with forty (40) streamline points in each reference plane (40, 10). This, of course, may be changed depending on storage availability and the number of grid points needed to complete a problem.

4. The flow deflection at the sidewall exit is assumed to be zero.
PLANE - $R, X = \text{CONST.}$

FIGURE 2. INTERNAL SIDEWALL GRID
(5) For the cylindrical coordinate system only central module flows are possible.

In general, doubly curved upper, lower and sidewalls can be assumed, the only limitations being those given above. Subroutines TWALL, BWALL and SWALL describe the shape of these walls using parabolas defined in the Input Section.

Thermodynamic curve fits are contained in functions FT, FGAM and RHEQ, for temperature, equilibrium exponent and density. These are multi-variate fits obtained from data in Reference (1) and are described in Volume I.

The external flow calculation requires specifying the shape of an internal stream surface described by a two parameter parabola as in TWALL. Subroutine COWL computes the under-expansion interaction between the internal and external flows at the cowl edge station. This data, the internal flow data and external flow data provide the necessary initial data surface and boundary conditions to calculate the external flow interaction (Figure 3). The strength of the underexpansion shock is calculated in HSHOCK and the properties on the contact surface are calculated in CSURF. The crosswise shape of the discontinuities is calculated in ALSHOCK.
For end modules (Figure 4) WRAP calculates the property variations as a function of a local reference plane orientation in the wrap-around region of the flow.

The program computes derivatives for each flow field point on the initial value surface in DERIV while derivatives on the new data surface ($r + \Delta r$ or $x + \Delta x$) are computed in DERIVN. Integral correction factors for mass flow and total energy are computed in MOTHER. The flow field properties are corrected in UNOWAT based on these correction factors. The user chooses the frequency of application of these corrections by an input variable described in Section II, "Description of Input."

The main program executes the characteristic calculations and provides the control necessary to execute boundary calculations, compute thermodynamic data etc., and provides for other peripheral computations or instructions necessary to complete the overall calculation.
## II. DESCRIPTION OF INPUT

### A. Initial Input Data

<table>
<thead>
<tr>
<th>Card Number</th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>1-5</td>
<td>final marching step</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>6-10</td>
<td>print interval (in number of steps)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>11-15</td>
<td>restart indicator (0-initial run; 1-restart)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>16-20</td>
<td>indicator for second order accuracy in characteristic calculations (0-first order; 1-second order)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>21-25</td>
<td>indicator for second order accuracy in crosswise derivatives (0-first order; 1-second order) NOTE: if this input equals 1, the characteristic calculations are also second order</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>26-30</td>
<td>mass flow and energy correction interval (in number of steps)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>31-35</td>
<td>number of reference planes allowed for in dimension statement (now is 10)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>36-40</td>
<td>intermediate punched output may be obtained at a maximum of three stations (input station numbers desired, if any)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>41-45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>46-50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E10.0</td>
<td>51-60</td>
<td>stepsize factor (presently 2)</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>1-5</td>
<td>JMAX number of reference planes excluding sidewall but including planes of symmetry - maximum is 9. NOTE: if run termination is in an external end module configuration, the maximum number of initial reference planes JMAX=9-NUMEXP; where NUMEXP is input #5 on card #2.</td>
</tr>
<tr>
<td>Card Number</td>
<td>Format</td>
<td>Columns</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>--------</td>
<td>---------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>6-10</td>
<td>internal symmetry indicator (0-one plane of symmetry; 1-two planes of symmetry)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>11-15</td>
<td>external symmetry indicator (0-one plane of symmetry...)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>16-20</td>
<td>external flow indicator (0-end module, 1-central module)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>21-25</td>
<td>number of rotated reference planes for wraparound calculation (max is number of data points in z direction between vehicle undersurface and ZSAV, described on card 3) - external vehicle undersurface is a plane</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>26-30</td>
<td>sweepback indicator (0-no sweepback; 1-sweepback). If this equals one, the number of initial data points in each reference plane and sidewall must be the same.</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>31-35</td>
<td>IMAX(1) number of initial data points in first reference plane (J=1)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>36-40</td>
<td>IMAX(2) number of initial data points in second reference plane (J=2)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td></td>
<td>IMAX(JMAX) number of initial data points in last reference plane (J=JMAX)</td>
</tr>
</tbody>
</table>

*Note: Number of data points on each reference plane are equal (i.e., IMAX(1) = IMAX(2) = ... = IMAX(JMAX))
<table>
<thead>
<tr>
<th>Card Number</th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>E10.3</td>
<td>1-10</td>
<td>origin of ((r,\theta,z)) coordinate system of initial station (ft)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>11-20</td>
<td>XJ-(0-Cartesian; 1-cylindrical)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>21-30</td>
<td>XJI-(0-Vehicle I; 1-Vehicle II)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>31-40</td>
<td>(X) coordinate of cowl at end of sidewall (ft)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>41-50</td>
<td>radial distance to intersection of cowl lip with sidewall or last reference plane if no sidewall (ft)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>51-60</td>
<td>final (X) coordinate of run (ft)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>61-70</td>
<td>ZSAV-Z direction point of JMAX internal reference plane which defines origin of sweep around coordinate system</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>71-80</td>
<td>static pressure at vehicle infinity conditions ((\text{lb}_f/\text{ft}^2))</td>
</tr>
</tbody>
</table>

If input 6 on card 2 is zero, leave this card out of deck:

<table>
<thead>
<tr>
<th>Card Number</th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3a</td>
<td>E10.3</td>
<td>1-10</td>
<td>(X) coordinate of sweepback plane in first reference plane</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>11-20</td>
<td>(X) coordinate of sweepback plane in second reference plane</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td></td>
<td>(X) coordinate of sweepback plane in last reference plane or sidewall if it exists</td>
</tr>
<tr>
<td>3b</td>
<td>E10.3</td>
<td>1-10</td>
<td>initial lift</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>11-20</td>
<td>initial thrust</td>
</tr>
<tr>
<td>Card Number</td>
<td>Format</td>
<td>Columns</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>3b</td>
<td>E10.3</td>
<td>21-30</td>
<td>initial pitching moment</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>31-40</td>
<td>z moment axis</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>41-50</td>
<td>x moment axis</td>
</tr>
<tr>
<td>4a</td>
<td>E10.3</td>
<td>1-10</td>
<td>angular coordinates ((XJ=1)) (degrees) or (y) ((XJ=0)) coordinate (ft) or first reference plane</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>11-20</td>
<td>(z) coordinate of first data point ((I=1)) on first ((J=1)) reference plane (ft)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>21-30</td>
<td>(z) coordinate of second data point ((I=2)) on first ((J=1)) reference plane (ft)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td></td>
<td>(z) coordinate of last data point ((I=I\text{MAX}(1))) on first ((J=1)) reference plane (ft)</td>
</tr>
</tbody>
</table>

(If there are more than 6 data points on a reference plane continue on the next data card in Column #1 with same format)

4b-4m Same as 4a for each of the reference planes.

5 Leave this card out of input deck if input 2 on card 2 equals 1:

<table>
<thead>
<tr>
<th></th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I5</td>
<td></td>
<td>1-5</td>
<td>number of initial data points on sidewall</td>
</tr>
<tr>
<td></td>
<td>E10.0</td>
<td>6-15</td>
<td>(z) coordinate of first data point on sidewall (ft)</td>
</tr>
<tr>
<td>Card Number</td>
<td>Format</td>
<td>Columns</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>5</td>
<td>E10.0</td>
<td>16-25</td>
<td>( z ) coordinate of second data point on sidewall (ft)</td>
</tr>
<tr>
<td></td>
<td>E10.0</td>
<td></td>
<td>( z ) coordinate of last data point on sidewall (ft)</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>1-5</td>
<td>number of parabolas used to define lower wall (max is 3)</td>
</tr>
<tr>
<td>7a</td>
<td>E10.3</td>
<td>1-10</td>
<td>distance ( R ) defining starting location of first parabola (ft) (input equals input 1 on card 3)</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>11-20</td>
<td>coordinates for first parabola defining lower wall (for ( T = \theta ), ( Y ), and ( X = ) marching distance)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( Z = A_{11}X^2T^2 + A_{12}X^2T + A_{13}XT^2 + A_{14}X^2 + A_{15}T^2 + A_{16}XT + A_{17}X + A_{18}T + A_{19} ) inputs ( A_{11} - A_{17} )</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>71-80</td>
<td></td>
</tr>
<tr>
<td>8a</td>
<td>E10.3</td>
<td>1-10</td>
<td>( A_{18} )</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>11-20</td>
<td>( A_{19} )</td>
</tr>
<tr>
<td>7b, 8b, 7c, 8c</td>
<td></td>
<td></td>
<td>Give starting locations and coordinates of the second and third parabolas defining lower wall (if used).</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>Same as cards 6, 7a-7c and 8a-8c except coordinates for ( )</td>
</tr>
<tr>
<td>10a-10c, 11a-11c</td>
<td></td>
<td></td>
<td>equation of upper wall.</td>
</tr>
</tbody>
</table>
### Card Number Format Columns Description

<table>
<thead>
<tr>
<th>Card Number</th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Same format as cards 6, 7a-7c and 8a-8c except coordinates for equation of sidewall (these cards are only necessary if input 2 on card 2 is 0), where parabola is ( T = A31X^2Z^2 + A32X^2Z + A33XZ^2 + A34X^2 + A35Z^2 + A36XZ + A37X + A38Z + A39 ).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following is the input format for properties at data points in the flow field. There is a set of 6 properties for each reference plane. They are read from 1 to the number of data points for that reference plane \((IMAX(J))\) (inputs 7, 8, ... on card 2). If there are more than 7 data points on a reference plane the remaining data points are continued on the next card with the same format.

<table>
<thead>
<tr>
<th>Card</th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15a</td>
<td>E10.3</td>
<td>1-10</td>
<td>pressure at first data point in first reference plane ((lb/ft^2))</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>11-20</td>
<td>pressure at second data point in first reference plane ((lb/ft^2))</td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td></td>
<td>pressure at last data point in first reference plane ((lb/ft^2))</td>
</tr>
<tr>
<td>Card Number</td>
<td>Format</td>
<td>Columns</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>--------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>16a</td>
<td>Same as 15a except values of PHE* (degrees)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17a</td>
<td>Same as 15a except values of Q* (ft/sec)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18a</td>
<td>Same as 15a except values of SI* (degrees)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19a</td>
<td>Same as 15a except values of H, static enthalpy (ft²/sec²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20a</td>
<td>Same as 15a except values of ( \phi ), fuel to air equivalence ratio</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( \phi > 0 \): equilibrium hydrogen-air

\( \phi = -1 \): methane

\( \phi = -2 \): ethylene

*PHE is the angle associated with the direction cosine of the projection of the velocity vector in the reference plane and the Marching direction R or X.

Q is the projection of the velocity vector in the reference plane.

SI is the angle associated with the direction cosine of the velocity vector and its projection in the reference plane.

<table>
<thead>
<tr>
<th>Card Number</th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16b-20b</td>
<td>Same as 15b-20a except properties are in the second reference plane</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( N \) number of points in X-y plane

\( L \) number of points in X-

\( Z \) number of points in X-z plane
### Card Number | Format | Columns | Description
--- | --- | --- | ---
15n-20n | Same as 15a-20a except properties are in the last reference plane.

If input 2 on card 2 equals 1, there are no more input cards for initial input.

If input 2 on card 2 equals 1, there are no more input cards for initial input.

Input data for the last reference plane. They are verified by this program.

If input 2 on card 2 equals 1, there are no more input cards for initial input.

### Card Number | Format | Columns | Description
--- | --- | --- | ---
21 | Same as 15a except at sidewall.

22 | Same as 19a except at sidewall.

23 | Same as 20a except at sidewall.

24 | Same as 15a except velocity component in Cartesian X direction at sidewall (ft/sec).

25 | Same as 15a except velocity component in Z direction at sidewall (ft/sec). (Input equals z coordinate of the cowl)

### B:0 Cowl Input Data

Z location of second data point in first reference plane (ft)

### Card Number | Format | Columns | Description
--- | --- | --- | ---
1 | E10.3 | 1-10 | Z location of first data point.

2 | Same as 15a except velocity component in Z direction at sidewall (ft/sec). (Input equals Z coordinate of the cowl)

3 | E10.3 | 1-5 | number of external flow points.

4 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

5 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

6 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

7 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

8 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

9 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

10 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

11 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

12 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

13 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

14 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

15 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

16 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

17 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

18 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

19 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

20 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

21 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

22 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

23 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

24 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.

25 | [minimum is 3, cowl lip point, limiting external stream surface point, and one dummy point] | 1-5 | number of external flow points.
<table>
<thead>
<tr>
<th>Card Number</th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>E10.3</td>
<td>1-10</td>
<td>Z location of first data point in first reference plane (ft) (input equals Z coordinate of the cowl)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td>11-20</td>
<td>Z location of second data point in first reference plane (ft)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E10.3</td>
<td></td>
<td>Z location of last data point in first reference plane (ft)</td>
</tr>
</tbody>
</table>

The following is the input format for properties at data points in the free stream. There is a set of the Z locations and 6 properties for each reference plane. They are read from 1 to the number of data points in the free stream (input 1, card 1). This is done the same as cards 15a-20a to 15n-20n in the initial Input Data Section except the Z locations are added. If an end module configuration is being computed the number of external reference planes is the original JMAX (input 1 on card 2) planes plus the number of external planes (input 5 on card 2). Subtract one if external vehicle undersurface is a wall rather than a plane of symmetry.

For uniform external flow allow sufficient Z direction space between cowl lip and limiting external stream surface point for shock propagation.
<table>
<thead>
<tr>
<th>Card Number</th>
<th>Format</th>
<th>Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td></td>
<td></td>
<td>Same as 2a except values of pressure ((\text{lb/ft}^2)).</td>
</tr>
<tr>
<td>2a</td>
<td></td>
<td></td>
<td>Same as 2a except values of PHE (degrees).</td>
</tr>
<tr>
<td>3a</td>
<td></td>
<td></td>
<td>Same as 2a except values of Q (ft/sec).</td>
</tr>
<tr>
<td>4a</td>
<td></td>
<td></td>
<td>Same as 2a except values of Q (ft/sec).</td>
</tr>
<tr>
<td>5a</td>
<td></td>
<td></td>
<td>Same as 2a except values of (S_1) (degrees).</td>
</tr>
<tr>
<td>6a</td>
<td></td>
<td></td>
<td>Same as 2a except values of (H) static enthalpy ((\text{ft}^2/\text{sec}^2)).</td>
</tr>
<tr>
<td>7a</td>
<td></td>
<td></td>
<td>Same as 2a except values of fuel to air equivalence ratio.</td>
</tr>
<tr>
<td>8a</td>
<td></td>
<td></td>
<td>Same as 2a except values of fuel to air equivalence ratio.</td>
</tr>
<tr>
<td>2b-8b</td>
<td></td>
<td></td>
<td>Same as 2a-8a except properties are in the second reference plane.</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>Number of parabolae for equation of limiting internal stress surface (maximum of 3).</td>
</tr>
<tr>
<td>2n-8n</td>
<td></td>
<td></td>
<td>Same as 2a-8a except properties are in the last reference plane.</td>
</tr>
<tr>
<td>17 &amp; 18</td>
<td></td>
<td></td>
<td>Same as cards 12, 13c-13c and 14a-14a of Initial Input Data Section except coordinates for equation of limiting external stress surface (only use 10 coordinates).</td>
</tr>
<tr>
<td>19-21</td>
<td></td>
<td></td>
<td>Same as cards 12, 13c-13c and 14a-14a of Initial Input Data Section except coordinates for equation of external vehicle undersurface (only use 10 coordinates).</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>Same as 2a except along vehicle undersurface.</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>Same as 3a except along vehicle undersurface.</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>Same as 7a except along vehicle undersurface.</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>Same as 8a except along vehicle undersurface.</td>
</tr>
</tbody>
</table>
Card
Number Format Columns Description

Card
Number Format Columns Description

C. Restarting Program

The program may be restarted using the final punch deck or any
intermediate punch deck at any point outside of the initial

Whenever a punch deck is received, printed output at that station is also given. This deck replaces the Initial Input Data deck with the exception that it may be desirable to change input variables #1 [final marching step] and #2 [print interval (in number of steps)] on punched card #1. If the cowl has been passed all inputs are completed. If the cowl has not been passed, the Cowl Input Data deck is appended and the data deck is complete.

The force system or in this direction (Cartesian and Cylindrical systems) until the intersection of the cowl edge and the last plane of symmetry or forward is reached. At this time the shock is the extrapolated onto the plane \( x = x_{cowl} \); then the shock and contact surface, the Prandtl-Meyer fan and the free stream points are printed. The program then continues marching in the Cartesian system with the same print scheme as before with the addition of \( x, y, z, \beta, \alpha, \beta, \Gamma \), and flow variables in the external surrounding region at \( x = x_{cowl} \) measured from the "ZSAM" point. The program prints a statement when an un-leaded shock is encountered. This statement includes input type \( (2 = \text{downrunning shock}; 7 = \text{uprunning shock}) \), and \( x, y, z, \beta, \alpha, \beta, \Gamma \), \( \beta, \Gamma \) in each reference plane. The program terminates on the input values of \( x, y, z, \beta, \alpha, \beta, \Gamma \) if not reached.
III. DESCRIPTION OF OUTPUT

A. Output Format: The program prints a narrative describing the input data that has been read and steps taken since initial input accepted.

At every "KOUNT" which is a multiple of the print interval starting with KOUNT=0 the properties are printed at each grid point in the flow field. This includes sidewall output if applicable. Marching steps are taken in successive radii (line source system) or in the # direction (Cartesian and Cylindrical systems) until the intersection of the cowl edge and the last plane of symmetry or sidewall is reached. At this time the properties are interpolated onto the plane X = X_COWL then the shock and contact surfaces, the Prandtl-Meyer fan and the free stream points are printed. The program then continues marching in the Cartesian system with the same print scheme as before with the addition of ALP, ALPHA, BETA, IS and flow variables in the external wraparound region at radii measured from the "ZSAV" point. The program prints a statement when an embedded shock is encountered. This statement includes its type (2 - downrunning shock; 7 - uprunning shock) IS, ALP, ALPHA, BETA in each reference plane. The program terminates when either the input values of final X coordinate or final "KOUNT" is reached.
B. Identification of Variables.

(1) Reference plane output

KOUNT - number of marching steps taken since initial input accepted

R - radius (cylindrical system) (degrees) or X coordinate (Cartesian system) (ft)

J - reference plane number

THETA - angular coordinate in degrees (cylindrical system) or Y coordinate in ft. (Cartesian system) of reference planes

I - data point index within a reference plane

Z - Z coordinate (ft)

P - pressure (lb/ft²)

Q - projection of velocity vector in reference plane (ft/sec)

PHE - angle associated with the direction cosine of Q and the marching direction R or X (degrees)
(3) **Discontinuities**

\( SI \) - angle associated with the direction cosine of \( Q \) and the velocity continuity and plane \( X \) or \( R \) equals a constant

\( M \) - Mach number

\( ALPHA \) - angle associated with the direction cosine of \( Q \)

\( H \) - static enthalpy (\( \text{ft}^2/\text{sec}^2 \))

\( PHI \) - fuel to air equivalence ratio

\( RHO \) - density (\( \text{slugs/ft}^3 \))

\( GAM \) - isentropic exponent

\( T \) - temperature (\( ^\circ \text{R} \))

(2) **Sidewall output (extra variables printed)**

\( X \) - Cartesian \( X \) coordinate of data point

\( Y \) - Cartesian \( Y \) coordinate of data point

\( U \) - component of velocity vector in \( X \) direction

\( V \) - component of velocity vector in \( Y \) direction

\( W \) - component of velocity vector in \( Z \) direction
(3) Discontinuities

Column 1 - second contact discontinuity
ALP - angle of intersection between discontinuity and plane X or R equals a constant

Column 2 - third downrunning shock wave

ALPHA - angle associated with the direction cosine between the normal to the reference plane and the tangent to the discontinuity

Column 3 - first downrunning shock wave
BETA - angle associated with the direction cosine between the intersection of discontinuity and marching direction

Column 4 - second downrunning shock wave
IS - matrix whose non-zero elements indicate the data points in each reference plane where a discontinuity exists

Column 1 - first uprunning shock wave

Column 2 - first downrunning shock wave

Column 3 - first contact discontinuity

Column 4 - second downrunning shock wave
### IV. SUPPORTS AND FORMULAS

#### A. Supports

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>INTER interpolates internal flow properties onto cline x equals x coordinate of core</td>
</tr>
<tr>
<td>2.</td>
<td>ID: single table, linear interpolation and extrapolation of flow properties to be used for derivatives normal to reference planes</td>
</tr>
<tr>
<td>3.</td>
<td>STEP computer marching step based on characteristic criteria</td>
</tr>
<tr>
<td>4.</td>
<td>INDATA accepts initial input data and program restart data</td>
</tr>
<tr>
<td>5.</td>
<td>INDA12 accepts interior interpolated data in plane x equal to x coordinate of core and free stream data at start x</td>
</tr>
<tr>
<td>6.</td>
<td>CSURF computes properties upstream and downstream of all contact surfaces</td>
</tr>
<tr>
<td>7.</td>
<td>USURF computes properties downstream of all shock discontinuities in marching direction</td>
</tr>
</tbody>
</table>
### IV. **SUBROUTINES AND FUNCTIONS**

#### 9. INT/HAA. **Subroutines**

**Description**: Integral correction factors for mass flow and total energy

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. <strong>TBL</strong></td>
<td>Computes shock surface strength, contact surface strength, and shock pressure. Expects initial input data and program restart data.</td>
</tr>
<tr>
<td>1. <strong>INTER</strong></td>
<td>Interpolates internal flow properties onto plane X equals X coordinate of cowl.</td>
</tr>
<tr>
<td>2. <strong>TBL</strong></td>
<td>Single table linear interpolation and extrapolation of flow properties to be used for derivatives normal to reference planes.</td>
</tr>
<tr>
<td>3. <strong>STEP</strong></td>
<td>Computes marching step based on characteristic criteria.</td>
</tr>
<tr>
<td>4. <strong>INDATA</strong></td>
<td>Accepts initial input data and program restart data.</td>
</tr>
<tr>
<td>5. <strong>INDAT2</strong></td>
<td>Accepts interior interpolated data in plane X equal to X coordinate of cowl and free stream data at same X.</td>
</tr>
<tr>
<td>6. <strong>CSURF</strong></td>
<td>Computes properties upstream and downstream of all contact surfaces.</td>
</tr>
<tr>
<td>7. <strong>HSHOCK</strong></td>
<td>Computes properties downstream of all shock discontinuities in marching direction.</td>
</tr>
<tr>
<td>8a. <strong>SWALL</strong></td>
<td>Computes properties upstream and downstream of all contact surfaces.</td>
</tr>
<tr>
<td>14a. <strong>SWALL</strong></td>
<td>Computes properties downstream of all shock discontinuities in marching direction.</td>
</tr>
<tr>
<td>14b. <strong>SWALL</strong></td>
<td>Computes properties downstream of all shock discontinuities in marching direction.</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CURREN</td>
<td>Computes flow properties in corners of flow.</td>
</tr>
<tr>
<td>MOTHER</td>
<td>Computes integral correction factors for mass flow and total energy.</td>
</tr>
</tbody>
</table>
| SWALL   | Locates lower wall at new marching step and computes shock surface strength, contact surf-
<p>|         | face strength and extent of Prandtl-Meyer expansion normal to cowl edge for under-expanded internal flow. |
| COWL    | Computes angles associated with the direction cosine of a tangent to each discontinuity in the crosswise direction for each reference plane. |
| LEXIC   | Prints error statement and program line number and error message.           |
| ALSHOC  | Computes properties across discontinuity at external wall.                  |
| ALLOW   | Computes equilibrium density.                                               |
| SHOCK   | Computes flow properties upstream of shock at new marching station.          |
| WALL    | Computes flow properties associated with sidewall at new marching step.      |
| PJOLY   | Is a four point 'each second routine.                                       |
| MSNK    | Locates sidewall at new marching step and computes direction cosines of sidewall for cylindrical system. |
| SWALL1  | Locates sidewall at new marching step and computes direction cosines of sidewall for cylindrical system. |</p>
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. CORNER</td>
<td>computes flow properties in corners of flow field</td>
</tr>
<tr>
<td>16. BWALL</td>
<td>locates lower wall at new marching step and computes direction cosines of lower wall</td>
</tr>
<tr>
<td>17. TWALL</td>
<td>locates upper wall at new marching step and computes direction cosines of upper wall</td>
</tr>
<tr>
<td>18. ERROR</td>
<td>prints error statement and program line number nearest iteration error</td>
</tr>
<tr>
<td>19. ADDSUB</td>
<td>add or subtracts reference planes</td>
</tr>
<tr>
<td>20. WDISC</td>
<td>computes properties across discontinuity at external vehicle undersurface</td>
</tr>
<tr>
<td>21. PLANES-</td>
<td>inserts a pseudo reference plane in flow to facilitate derivative calculations for end module calculation</td>
</tr>
<tr>
<td>22. PSOLV</td>
<td>is a four point least squares routine</td>
</tr>
<tr>
<td>23. WSHK</td>
<td>computes line of intersection between discontinuity and vehicle undersurface</td>
</tr>
<tr>
<td>24. PNCH</td>
<td>gives intermediate and final printed and punched output used to restart the program</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>25. SPACE</td>
<td>adds or subtracts data points to facilitate maximum allowable marching step</td>
</tr>
<tr>
<td>26. SWEEP</td>
<td>interpolates data points along throat sweep-back plane</td>
</tr>
<tr>
<td>27. EMBED</td>
<td>locates embedded shocks</td>
</tr>
<tr>
<td>28. WRAP</td>
<td>computes derivatives at all data points except discontinuities on two reference planes bounding 90° wraparound area</td>
</tr>
<tr>
<td>29. SOLVE</td>
<td>solves the determinant of 3x3 matrix</td>
</tr>
<tr>
<td>30. TBLDUM</td>
<td>single table linear interpolation used for derivatives on reference planes bounding wrap-around area</td>
</tr>
<tr>
<td>31. ALWRAP</td>
<td>computes angles associated with the direction cosines of a tangent to each discontinuity in crosswise direction for planes bounding wrap-around region</td>
</tr>
<tr>
<td>32. LTHM</td>
<td>computes lift, thrust and moment</td>
</tr>
<tr>
<td>33. SETN</td>
<td>sets flow variables and crosswise derivatives at the new station equal to these quantities at old station prior to the new station being calculated</td>
</tr>
</tbody>
</table>
### 34. UNOWAT
- **Name**: UNOWAT
- **Description**: Corrects flow field properties based on correction factors computed in MOTHER.

### 35. DERIV
- **Name**: DERIV
- **Description**: Computes crosswise derivatives on initial value surface (old station).

### 36. DERIVN
- **Name**: DERIVN
- **Description**: Computes crosswise derivatives on new data surface (new station).

### B. Functions

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. XLAM</td>
<td>Computes bi-characteristic directions in each reference plane.</td>
</tr>
<tr>
<td>2. F</td>
<td>Computes the terms associated with derivatives normal to reference plane used by bi-characteristic calculation.</td>
</tr>
<tr>
<td>3. FGAM</td>
<td>Computes isentropic exponent and associated thermodynamic data at each point in flow field.</td>
</tr>
<tr>
<td>4. FT</td>
<td>Computes temperature at any point in flow field.</td>
</tr>
<tr>
<td>5. FH</td>
<td>Computes static enthalpy at any point in flow field.</td>
</tr>
</tbody>
</table>
V. MACHINE CONTROL CONSIDERATIONS

1. Computer program is written in FORTRAN IV for CDC 6600.

2. Time and core estimates.
   (a) Field length
      (1) compile  - 60,000 octal
      (2) execution  - 177,000 octal
   (b) CP time variable depending on mesh size and number of steps to be run.
   (c) I/O: less than 100 octal seconds.
   (d) Tape or disk storage necessary.
      (1) tape 5  - card input
      (2) tape 6  - printed output
      (3) tape 7  - punched output
      (4) tape 55 - used temporarily during run to store primary flow properties interpolated along cowl edge
   (e) Printed output: variable depending on print interval and length of run.
VI. FLOW CHART

The following is a flow chart of program CHAR3D.
START

CALL INDATA

1

STEP = FINAL STEP

2

STEP ≥ MULTIPLE OF PRINT INTERVAL

3

WRITE OUTPUT

4

STEP = FINAL STEP

5

STEP = COWL LOCATION

6

CALL COWL
CALL STEP

COMPUTE 0 DERIVATIVES

DO J=1, JMAX
  Do IS1, IMAX(J)

DATA POINTS IN P-M FAN

SHOCK OR CONTACT SURFACE ENCOUNTERED

I=1

COMPUTE A POINT PROPERTIES

ISIMAX(J)
COMPUTE SHOCK, CONTACT & P-M FAN LOCATIONS AND PROPERTIES

IS THERE A SIDEWALL

CALL WALL

OLD AND NEW STATIONS BRACKET COWL LOCATION

CALL INTER

UPDATE LOCATIONS & PROPERTIES TO NEW STATION
VII. PROGRAM LISTING

The following is a listing of the program.
DATA TWOL/0/
ILOCAL=15
KOUNT=10000
WCOWLT=0
FRZZZ=1.E-04
ISTOP=0
ZLIFT=0.
XTHR=0.
YMOM=0.
ISL1=0.
IFS=0
MM=0
KC1=0
KC2=0
JD1=100
JD2=100
JINT=100
AAV=1.
RAV=0.

101 FORMAT(7E10.3)
INT=0
CALL TNDATA
CALL SETN(0)
XJ1=45
XJ2=45
YW=VMAX
JW=0
IF(ISIM.EQ.1) JW=VMAX
CONTINUE
IF(KOUNT.EQ.0) CALL MOTHER
IF(KOUNT.EQ.0)
WRITE(6,1066) XMAST,XENT,FSX,FSZ
1066 FORMAT(10X,*INITIAL MASS FLOW IS*E13.5//10X,*INITIAL ENERGY IS
1*E13.5//10X,*INITIAL STREAM THRUST IS *E13.5//10X,*X DIRECTION = *
1E13.5//20X,*Z DIRECTION = *E13.5//10X,GE.XFIN) KOUNT=KOUNT
IF(XJ.EQ.XFIN) KOUNT=KOUNT
IF(KOUNT.EQ.KOUNT) GO TO 73
IF(KOUNT.EQ.KOUNT) CALL PNCH
IF(KOUNT.EQ.KOUNT) CALL EXIT
CALL PNCH
IF(KOUNT.EQ.KOUNT) CALL EXIT
IF((KOUNT/KOUNTP)*KOUNTP).NE.KOUNT) GO TO 3002
IF(IHOWL.EQ.1.AND.IHOWL.EQ.1) GO TO 3002
73 CONTINUE
IF(XJ.EQ.0) GO TO 513
WRITE(6,700) KOUNT,X1
70 FORMAT(1H1,10X,*KOUNT = *i4,1AX,*R = *E13.5//) GO TO 503
513 WRITE(6,504) KOUNT,X1
504 FORMAT(1H1,10X,*KOUNT = *i4,1AX,*X = *E13.5//)
503 CONTINUE
WRITE(6,610) ZSHIFT,XSHIFT,XTHR,ZLIFT,YMOM
610 FORMAT(10X,*Z MOMENT AXIS = *E11.35X,*X MOMENT AXIS = *E11.3/1
10X,*THRUST = *E11.35X,*LIFT = *E11.35X
1.*PITCHING MOMENT = *E11.3)
TF(IS(3),NE.0. AND.KOUNT.NE.0. AND.ISIM.EQ.0) WRITE(6,621) XTHRCZL1

IF(TIMYONMC

621 FORMAT(* CONTACT * THUST = *E11.3*5X LIFT = *E11.3*5X
1 *PITCHING MOMENT = *E11.3*5X

TF(IS(1),NE.0. AND.KOUNT.NE.0. AND.ISIM.EQ.0) WRITE(6,622) XTHRSZL1

LIFTS_YMOMS

622 FORMAT(* SHOCK * THUST = *E11.3*5X LIFT = *E11.3*5X
1 *PITCHING MOMENT = *E11.3*5X

WRITE(6,623)

623 FORMAT(/)

DO 71 J=1,JMAX
IF(J.GT.JCALC) GO TO 71
IF(J.GT.JINT) GO TO 2260
IF(XJJ.NE.0.* OR.XJ1.NE.0.) GO TO 505
WRITE(6,506) J,HE(1),HE(4),TH(1),HE(5)

505 FORMAT(*10X*J = *12*24X*A5*3*E13.5*4X*A*6*A1*10X*
1*P*10X*Q*9*X*PHE**8X*SI*.10X*HI.10X*HE*9X*PHI*
1*8X*RHO*8X*GAM*9X*TE*)
GO TO 510

WRITE(6,506) J,HE(2),HE(4),TH(1),HE(6)
GO TO 510

507 CONTINUE
WRITE(6,506) J,HE(3),HE(4),Z15,HE(7)
GO TO 510

2260 Z15=SAV=TH(J)
WRITE(6,506) J,HE(3),HE(4),Z15,HE(7)

510 CONTINUE

IMAXJ=IMAX(J)
TF(R.GT.(XJOWL-1.E-06). AND.ICOWL.EQ.0) IMAXJ=IMAXJ+1
DO 71 J=1,IMAXJ

EM=Q(I,J)/COS(SI(I,J))/A(I,J)
Z15=Z(I,J)
WRITE(6,79) I,Z15, P(I,J),Q(T,J),PHI(I,J),SI(I,J),EM*H(I,J)*

1PHI(I,J),RHO(I,J),GAM(I,J),T(I,J)

79 FORMAT(I5*1'E11.3*)

71 CONTINUE

IF(ISIM.EQ.1) GO TO 211

J,JW

IF(J.GT.JCALC) GO TO 211
IF(J.LT.JINT.OR.ICOWL.EQ.0) GO TO 2270
WRITE(6,2300) JW,HE(10),HE(7)

2300 FORMAT(* // 40X SIDEWALL*/ 10X**J = *12*11X*X*X,9X,A3
1*9X **U*10X**W*10X**V*1*
14X,**6X*A1*10X*

1*10X**Q*9X*PHE**8X*SI*.10X**HI.10X*HE*9X*PHI*
1*8X*RHO**8X*GAM*9X**T*)
GO TO 6885

2270 CONTINUE
IF(XJ1.EQ.1) GO TO 6884
WRITE(6,2300) JW,HE(9),HE(5)
GO TO 6885

6884 WRITE(6,2300) JW,HE(8),HE(6)

6885 CONTINUE

IMAXJ=IMAX(J)
IF(R.GT.(XCOWL-1.E-06).AND.ICOWL.EQ.1) IMAXJ=IMAXJ+1

DO 3001 I=1,IMAXJ
FM=SORT(UW(I)**2+VW(I)**2+WW(I)**2)/A(I*J)
THW=THW(I)*XJ
XW(I)=R*COS(THW)
YW(I)=R*SIN(THW)+(1.-XJ)*THW(I)
Z15=YW(I)

IF(J.GT.JINT.AND.ICOWL.EQ.1) Z15=ZSAV-THW(I)
WRITE(6,302) XW(I),Z15,UW(I),WW(I),VW(I)
302 FORMAT(5X,SE11.3)
Z15=Z(I,J)

301 WRITE(6,79) I,Z15,PHF(I,J),SI(I,J),EMH(I,J),1PHI(I,J),RHO(I,J),GAM(I,J),T(I,J)

211 CONTINUE
DO 3000 M=1,7
IF(IS(M).NE.0) GO TO 3001
3000 CONTINUE
DO 3001 CONTINUE
WRITE(6,4005)
DO 4006 J=1,JW
IF(J.GT.JCALC) GO TO 4006
WRITE(6,79) J,(ALPHA(M,J)*M=1,7)
4006 CONTINUE
4005 FORMAT(/10X,*ALPHA*/4X,*J*)
WRITE(6,4000)
DO 3003 J=1,JW
IF(J.GT.JCALC) GO TO 3003
WRITE(6,79) J,(BETA(M,J),M=1,7)
3003 CONTINUE
WRITE(6,4004) J,(IS(M,J),M=1,7)
3004 CONTINUE
WRITE(6,4001)
DO 3008 J=1,JW
IF(J.GT.JCALC) GO TO 3008
WRITE(6,79) J,(T(S),S=1,7)
3008 CONTINUE
WRITE(6,4002)
DO 3009 J=1,JW
IF(J.GT.JCALC) GO TO 3009
WRITE(6,4004) J,(IS(M,J),M=1,7)
3009 CONTINUE
4000 FORMAT(/10X,*ALPHA*/4X,*J*)
4001 FORMAT(/10X,*BETA*/4X,*J*)
4002 FORMAT(/10X,*IS*/4X,*J*)
4004 FORMAT(15+7(I4,T7X))
3002 CONTINUE
IF(ICOWL.EQ.1) CALL COWL(MM,IFS,OPT)
IF(ICOWL.NE.1) GO TO 5023
ICOWL=1
IF(IWRAP.EQ.1) GO TO 5622
IMAXJ=IMAX(JINT)
DO 5621 L=1,IMAXJ
IF(Z(L,JINT).LT.ZSAV) GO TO 5621
IF(Z(L+1,JINT)=Z(L+1,JINT).LT.1.E-06) GO TO 5622
5621 CONTINUE
DO 5624 L=1,JINT
DO 5624 J=1,JINT
Z(I,J)=Z(I+1,J)
\[ f(I,J) = P(I+1,J) \]

\[ d^2 f(J) = Q(n^t \Delta J) \]

\[ (I,J) = H(I,J) \]

\[ (I,J) = A(I,J) \]

\[ (I,J) = S(I,J) \]

\[ (I,J) = \Phi(I,J) \]

\[ (I,J) = PHE(I,J) \]

\[ (I,J) = \Gamma(I,J) \]

\[ (I,J) = \rho(I,J) \]

\[ (I,J) = XPLAM(I,J) \]

\[ X\text{XMLAM}(I,J) = X\text{XMLAM}(I+1,J) \]

\[ T\text{MAX}(J) = T\text{MAX}(J) - 1 \]

\[ \text{IF}(T\text{.LT.}0) \text{GO TO 509} \]

\[ \text{WRITE}(6,511) J \]

\[ \text{FORMAT}(/10x,J=1,12) \]

\[ /4x,I,6x,R,10x, \]

\[ 1*P*I*X,-,9*PHE*, 8X,SI*,10X,*H*, 9X,*PHI* \]

\[ 1*PHI*,8X,*H*,9X,*T* \]

\[ \text{GO TO 512} \]

\[ \text{WRITE}(6,5021) J \]

\[ \text{FORMAT}(/10x,J=1,12) \]

\[ /4x,I,6x,Z,10x, \]

\[ 1*P*I*X,-,9*PHE*, 8X,SI*,10X,*H*, 9X,*PHI* \]

\[ 1*PHI*,8X,*H*,9X,*T* \]

\[ \text{GO TO 5022} \]

\[ \text{DO 5022 M=1,7} \]

\[ \text{IF}(I*S(I,J).NE.0) \text{GO TO 5001} \]

\[ \text{WRITE}(6,4000) \]

\[ \text{DO 5003 J=1,JW} \]

\[ \text{DO 5004 M=1,7} \]

\[ \text{ALPHA}(M,J) = \text{ALPHAN}(M,J) \]

\[ \text{WRITE}(6,79) J,(ALPHA(M,J), M=1,7) \]
WRITE(6,4001)
DO 5008 J=1,JWS
WRITE(6,79) J,(BETA(M,J),M=1,7)
5008 CONTINUE
WRITE(6,4002)
DO 5009 J=1,JWS
WRITE(6,4004) J,(IS(M,J),M=1,7)
5009 CONTINUE
5002 CONTINUE
5023 CONTINUE
74 CONTINUE
IF(KOUNT.GE.KOUNT+20) CALL SPACE
IF(KOUNT.EQ.KOUNT+20 .AND. ICWLT.EQ.1 .AND. IWRAP.EQ.0) CALL WRAP(0)
IF(KOUNT.EQ.KOUNT+20) CALL MOTHER
KOUNT=KOUNT+1
IF(ICWLT.EQ.1 .AND. IWRAP.EQ.0) CALL PLANES(6)
CALL STEP(IFSM,MM, DFLX,X2,KOUNT)
IF(ISTLP.EQ.1) KOUNT=KOUNT+1
IF(ISTLP.EQ.1) WRITE(6,1000)
1000 FORMAT(1 INDEX GREATER THAN MAXIMUM DIMENSION, CONTACT AT LOWER WALL* OR SHOCK DOES NOT HAVE * FREE STREAM POINTS*)
IF(ISTLP.EQ.1) CALL PNCH
IF(KOUNT.NE.1 .OR. ISWEEP.EQ.0) GO TO 1313
CALL SWEPT(1)
GO TO 620
1313 CONTINUE
CALL DERTV(MM)
620 IF(((KOUNT-1)/KOUNTP)*KOUNTP.NE.(KOUNT-1)) GO TO 7744
IF(ICWLT.EQ.1) GO TO 7744
IF(ICWLT.EQ.1 .AND. IWRAP.EQ.0) CALL WRAP(1)
7744 CONTINUE
CALL SETN(1)
KS=0
961 CONTINUE
7678 CONTINUE
DO 707 J=1,JMAX
IF(J.GT.JCALC) GO TO 707
IF(J.GT.JINT) XJ=0.
II=IMAX(J)-IFS+2
II=II-IMM+2
DELR=DELX
IMAXJ=IMAX(J)
IF(R.GE.(XCOWL-1.E-06).AND.INT.EQ.2) IMAXJ=IMAXJ+1
DO 8 I=1,IMAXJ
CALL F(RHO(I,J),Q(I,J),RZ(I,J),PHE(I,J),XPLAM(I,J),XMLAM(I,J),
SIG(I,J),A(I,J),PQ(I,J),PHEQ(I,J),P(I),FM(I))
8 CONTINUE
IMAXJ=IMAXJ
DO 7 I=1,IMAXJ
IF(I.NE.1 .OR. J.LT.(JINT+1)) GO TO 735
IF(J.GT.(JINT+1)) GO TO 7
IMP=IDUMMY+1
7DUMMY(1)=ZN(1,JINT)
DO 736 I=1,IMP
7 R(I10,1)=Z (I10,JFINAL)
P R(I10,1)=P (I10,JFINAL)
736 CONTINUE
DO 736 I9=1,NUMExp
   J9=JW(I9)
   CALL TBL(ZDUMMY(I9),PN(I,J9),STNN(I,J9),HN(I,J9),PHIN(I,J9),
           1ON(I,J9),PHEN(I,J9),RHON(I,J9),GAMN(I,J9),THX,JFINAL,IMP,I9)
   U1=ON(I,J9)*COS(PHEN(I,J9))
   V1=ON(I,J9)*TAN(STNN(I,J9))
   W1=ON(I,J9)*SIN(PHEN(I,J9))
   V&=W1
   WT=V1
   IF(I9.NE.1) GO TO 8697
   UWN(1)=U1
   VWN(1)=V1
   WWN(1)=WT
   XWN(1)=RN
   THWN(1)=VWU-ZSAV-ZN(I,JINT)
   YWN(1)=THWN(1)
8697 CONTINUE
   QN(I,J9)=SORT(U1*U1*WT*WT)
   PHEN(I,J9)=ATAN(WT/U1)
   SNN(I,J9)=ATAN(VT/QN(I,J9))
737 ZN(I,J9)=0.
   TH(JFINAL)=THSVR
   DO 1743 I10=1,IMP
      Z(I10,JFINAL)=R(I10,1)
      P(I10,JFINAL)=P(I10,1)
      O(I10,JFINAL)=O(I10,1)
      H(I10,JFINAL)=H(I10,1)
      SI(I10,JFINAL)=SI(I10,1)
      PHII(I10,JFINAL)=PHII(I10,1)
      PHE(I10,JFINAL)=PHE(I10,1)
      RHII(I10,JFINAL)=RHII(I10,1)
1743 GAMII(I10,JFINAL)=GAMII(I10)
   GO TO 7
735 CONTINUE
   IF(ISCMWL.EQ.1.AND.I.GT.IMT+1) GO TO 7
   IF(ISCMWL.EQ.1.AND.IS(1,J).EQ.IMAX(J)-1.AND.I.EQ.IMAX(J)) GO TO 7
   DO 89 M=1,7
   IF(ISM(M,1).EQ.1) GO TO 89
TEST = IS (M, J) -1
IF (M/2 EQ. EQ. M) TEST = IS (M, J)
IF (I . GE. TEST AND, I . LE. (TEST + 1)) GO TO 7
CONTINUE

PT = PN (I, J)
PHET = PHEN (I, J)
SIT = SIN (I, J)

KALL = 1
ALL = 1.
BALL = 0.

IF (BALL EQ. 0) GO TO 1482
ALL = 5
BALL = 5.

CONTINUE

DUM = DELR + (TAN (PHET (I, J)) * ALL * BALL * TAN (PHEN (I, J)))
ZN (I, J) = Z (I, J) - DUM

IF (I . EQ. I + 1) GO TO 13
ZA = 5 * (Z (I = 1, J) + 7 (I, J))
ITE = 1

RATA = (ZB = Z (I = 1, J)) / (Z (I, J) - Z (I - 1, J))
ITE = IT + 1
ALAM = XMLAM (I, J) * RATA * (XMLAM (I + 1, J) - XMLAM (I, J))
DUMP = ALL * ALAM + BALL * TAN (PHET (I, J))
ZBT = ZN (I, J) - DUMP * DELR
ER = ABS ((ZBT - ZA) / (Z (I + 1, J) - Z (I, J)))
IF (ER . LT. ERZZZ) GO TO 9
ZB = ZAT
IF (IT . LT. 20) GO TO 10
WRITE (6, 200)

FORMAT (* ERROR IN A POINT ITERATION *)
CALL PNC

IF (I . EQ. IMA (J)) GO TO 11
ZB = (ZB - Z (I, J)) + Z (I + 1, J)

IF (I . LT. 1) GO TO 12
RATA = (ZB - Z (I, J)) / (Z (I + 1, J) - Z (I, J))
ITE = IT + 1
ALAM = XMLAM (I, J) * RATA * (XMLAM (I + 1, J) - XMLAM (I, J))
DUMP = ALL * ALAM + BALL * TAN (PHET (I, J))
ZBT = ZN (I, J) - DUMP * DELR
ER = ABS ((ZBT - ZB) / (Z (I + 1, J) - Z (I, J)))
IF (ER . LT. ERZZZ) GO TO 11
ZB = ZAT
IF (IT . LT. 20) GO TO 12
WRITE (6, 201)

FORMAT (* ERROR IN B POINT ITERATION *)
CALL PNC

CONTINUE

R0 = GN (I, J) * QN (I, J) * RHON (I, J)
IF (I . EQ. I + 1) GO TO 14

ITE = 1
FP A = FP (II) + RATA * (FP (I) - FP (II))
RHO = RHO (I, J) + RATA * (RHO (I, J) - RHO (II, J))
O = A = O (I, J) + RATA * (O (I, J) - O (II, J))
A = A = A (II, J) + RATA * (A (I, J) - A (II, J))
PHE = PHE (I, J) + RATA * (PHE (I, J) - PHE (II, J))
P = P = P (I, J) - RATA * (P (II, J) - P (I, J))
QA2=QA*QA
A1=FP/((RHOA*QA2)
A1=AV*A1*AV*FPN(I,J)/RQ2
AC=BALL*SORT((ON(I,J)/AN(I,J))**2-1.0)/RQ2
A2=SQR(T((QA/AA)**2-1.0)/(RHOA*QA2)*ALL+AC
14 IF(I*EQ.*IMAX(J)) GO TO 15
I=I+1
FP=R*FM(I)+**RHB*(RHO(I,J)-**RHO(I,J))
B=G(I,J)+**RATB*(Q(I,J)-Q(I,J))
A=**RATB*(A(I,J)-A(I,J))
P=B**RATB*(P(I,J)+P(I,J))
PHEB=PHE(I,J)+**RATB*(PHE(I,J)-PHE(I,J))
OB2=QR*QR
R1=FP(RHOA*QR2)
R1=A1*AV*R1*AV*FPN(I,J)/RQ2
AC=BALL*SQRT((ON(I,J)/AN(I,J))**2-1.0)/RQ2
R2=SORT((GB/AB)**2-1.0)/(RHOA*QR2)*ALL+AC
15 IF(I*EQ.*JN(I,J)) GO TO 16
IT=1
VOU=TAN(SI(I,J))/COS(PHE(I,J))
119 CALL TWALL(RN*TH(I,J),ZN(I,J),FRT*FTB)
PHEN(I,J)=ATAN(VOU*FTB)*FRT
PN(I,J)=PA*(PHEN(I,J)-PHEB)+B1*DELR/B2
GO TO 17
16 IF(I*EQ.*IMAX(J)) GO TO 18
PN(I,J)=(A2*PA,B2*PB+BAI,1)*DFLR*PHEA+PHEB)/(A2*B2)
PHEN(I,J)=PHEA-A2*(PA=PN(I,J)),1-DEL)
GO TO 17
18 CONTINUE
IT=1
VOU=TAN(SI(1*MAXJ,J))/COS(PHE(IMAXJ,J))
118 CALL TWALL(RN*TH(I,J),ZN(IMAXJ,J),FRT,FRT)
PHEN(I,J)=ATAN(VOU*FTT)*FRT
PN(I,J)=PA*(PHEA-PHATJ+AJ*DELR)/A2
17 CONTINUE
SPHE=COS(PHE(I,J))
TSI=TAN(SI(I,J))
CSI=COS(SI(I,J))
CPHE=COS(PHE(I,J))
VD=G(I,J)*TSI
T1=DFLR/CPHE
IF(XJ.EQ.1.0) T1=T1/Z(I,J)
IF(XJ.EQ.1.0) T1=T1/Z(I,J)
T2=PQ(I,J)*RHO(I,J)/Q(I,J)
T3=TSI
T4=G(I,J)+SIG(I,J)/CS1
T5=G(I,J)*CPHE*XJ
T1=DFLR/CPHE
IF(XJ.GT.0.0) T1=T1/ZN(I,J)

*Q(I,J)+SPHE*XJ
VCE=VD*(TTSI*(T3+T4+T5)*AAV
SPHE=SIN(PHE(I,J))
T3=TAN(SINN(I,J))
CSN=COS(PHEN(I,J))
CPHE=COS(PHEN(I,J))
T1=DFLR/CPHE
IF(XJ.GT.0.0) T1=T1/ZN(I,J)
IF (XJ .GT. 0.0) T11 = T11/RN
T2 = PON(I,J)/RHO(I,J)/QN(I,J)
T3 = T3*QN(I,J)/SDN(I,J)
T4 = QN(I,J)/SIGN(I,J)/CSN
T5 = QN(I,J)*(CPHEN*XJ*SPHEN/XJ)
T6 = T2 + T3*SIGN(T3 + T4 + T5) * BA
VC = VC - DVC
T11 = DELR*TAN(STT)/COS(PHET)
IF (XJ .GT. 0.0) T11 = T11/RN
IF (XJ .GT. 0.0) T11 = T11/RN
T1 = T1 + TSI
T1 = T1 + T11 * TALL
RHO = RHO(I,J) - RHOQ(I,J) * T1
PZ = P(I,J) * P0(I,J) + T1
GAMZ = GAM(M(I,J) = GAMQ(I,J) * T1
PHON(I,J) = RHOZ*(PN(I,J)/PZ) ** (T1/2)
T2 = Q0(I,J)/CSI + Q(I,J) * TSI
SVZ = Q0(I,J)/CSI - T2 * T1
SVZ = SVZ - VVZ
VVC = SORT(VVZ + 2 * GAMZ/(GAMZ + 1) * (PZ/RHOZ - PN(I,J)/RHON(I,J))
VVC = VVC * VVC
QN(I,J) = SORT(VVC2 * VVC)
SINN(I,J) = ATAN(VC/QN(I,J))
HN(I,J) = H(I,J) + 5 * (VVZ - VCC) = H0(I,J) * T1
PHIN(I,J) = PHI(I,J) = PHIQ(I,J) * T1
TN(I,J) = PN(I,J) * PHIN(I,J) * HN(I,J)
GAMN(I,J) = GAM(TN(I,J) + PN(I,J) * PHIN(I,J))
AN(I,J) = SORT(GAMN(I,J) * PN(I,J) / RHON(I,J))
CALL XLAM(QN(I,J), AN(I,J), PHEN(I,J), XPLAMN(I,J), XMN(I,J))
IF (I, NE.1 AND I .NE. IMAXJ) GO TO 1642
IT = IT + 1
VOUT = TAN(SINN(I,J)) / COS(PHEN(I,J))
ERR = (VOUT - VOUT)
IF (ABS(ERR) .LT. 1.E-10) GO TO 1642
IF (IT .GT. 2) GO TO 21
ERR = ERR
VOUT = VOUT
VOUT = VOUT
GO TO 171
21 VOUT = VOUT - ER1 * (VOUT - VOUT) / (ERR - ER1)
ERR = ERR
VOUT = VOUT
VOUT = VOUT
171 IF (IT .GT. 10) CALL ERROR(171)
IF (I .EQ. 1) GO TO 115
GO TO 118
1642 CONTINUE
EC = ABS(1.0 - PT/PN(I,J))
IF (EC .LT. 1.0E-04 OR IVX .EQ. 0) GO TO 7
SIT = SINN(I,J)
PHET = PHEN(I,J)
PT = PN(I,J)
KALL = KALL + 1
IF (KALL .GT. ILOCAL) GO TO 1493
ALL = 5
BALL = 5
GO TO 1482

WRITE(6,1393)
FORMAT(* AVERAGING PROCESS DOES NOT CONVERGE IN CHAR38*)
STOP

7 CONTINUE
707 CONTINUE
7070 CONTINUE

XJ1=XJ1S
IF(ICO*EQ.1) GO TO 430
DO 97 M=1,7
IF(IST(M+1)*EQ.0) GO TO 97
JWW=JW
IF(KS*EQ.1) JWW=JMAX
DO 96 J=1,JWW
IF(J*GT*JINT) XJ1=0.
I=IS(M,J)
IF((M/2)*EQ.0) I=I+1
IF(BAVEG.0.) RETAN(M,J)=BETA(M,J)
ZN(I,J)=.5*(TAN(BETA(M,J))+TAN(RETAN(M,J)))*DELR+Z(I,J)
96 CONTINUE
97 CONTINUE
430 CONTINUE

IF(JW*GT*JCALC) GO TO 7500
IF(ICO*EQ.1) GO TO 1875
DO 431 M=1,3
IF(IS(M+1)*EQ.0) GO TO 431
SHC=0.
IF(BAVEG.0.) SHC=1.
CALL ALSHOC(M)
JWW=JW
IF(KS*EQ.1) JWW=JMAX
IF(M*NE.KC1.AND.M*NE.KC2) CALL FSHOCK(M,1,JWW)
IF(M*NE.KC1.AND.M*NE.KC2) CALL HSHOCK(M,1,JWW,0)
IF(M*EQ.KC1.OR.M*EQ.KC2) CALL PSURF(M,JWW)
IF(ISTM*EQ.1) GO TO 431
431 CONTINUE
1875 CONTINUE

IF(ISTM*EQ.1) GO TO 2241
ISOP=0
IF(ICO*EQ.1.AND.ZIT.EQ.1MAX) ISOP=1.
CALL WALL(RN,ICO*WLT,ZIT,ZIT)
IF(ICO*EQ.1) GO TO 4483
IF(ICO*EQ.0) GO TO 8892
DO 5631 J=1,JW
IMAX=I3AX(J)
IMAXP=IMAX(J)+1
ZN(IMAXP,J)=ZN(1MAX,J)
P N(IMAXP,J)=P N(IMAXJQ,J)
Q N(IMAXP,J)=Q N(IMAXJQ,J)
H N(IMAXP,J)=H N(IMAXJQ,J)
SINN(IMAXP,J)=SINN(IMAXJQ,J)
PHEN(IMAXP,J)=PHEN(IMAXJQ,J)
PHIN(IMAXP,J)=PHIN(IMAXJQ,J)
5631 CONTINUE
RHON(IMAXJP,J) = RHON(IMAXJQ,J)

IF(J .NE. JMAX+1) GO TO 5631
U W(N(IMAXJP)) = U W(N(IMAXJQ))
V W(N(IMAXJP)) = V W(N(IMAXJQ))
W W(N(IMAXJP)) = W W(N(IMAXJQ))
X W(N(IMAXJP)) = X W(N(IMAXJQ))
Y W(N(IMAXJP)) = Y W(N(IMAXJQ))
THWN(IMAXJP) = THWN(IMAXJQ)

5631 CONTINUE
IF(KS .GT. 0) GO TO 2241
DO 2346 M = 1, 3
IF(IS(M,1) .EQ. 0) GO TO 2346
CALL WDISC(M)
2346 CONTINUE
2241 CONTINUE

IF(ICNOW .EQ. 0) GO TO 8892

4483 DO 788 J = 1, JW
IF(J .GT. JINT) xJ1 = 0.
ISAVE = 0
II = IMAX(J) - IFS + 1
IIT = II - MM
IMAXJO = IMAX(J) + 1
DO 8890 II = IIT, IMAXJO
IF(I .EQ. ISAVE) GO TO 8891
DO 8893 M = 1, 7
IF(IS(M,1) .EQ. 0) GO TO 8893
I TEST = IS(M,J)
IF((M/2) .EQ. M) ITEST = ITEST .AND. ISOP .NE. 0
IF(I .NE. ITEST) GO TO 8893
ZN(I,J) = Z(I,J) + TAN(BETA(M,J)) * (RN-R)
ZN(I,J) = ZN(I,J)
ISAVE = ITEST + 1
GO TO 8891

8893 CONTINUE

ZNAM = XPLAM(I+J)
IF(OPT = LT .EQ. 0.) ZLAM = XNLAM(I+J)
IF(I .EQ. IIT .AND. ISOP .NE. 0) ZLAM = PHE(IIT,JW)
ZN(I,J) = Z(I,J) + ZLAM * (RN-R)

8891 P N(I,J) = P (I,J)
O N(I,J) = O (I,J)
W N(I,J) = W (I,J)
RHON(I,J) = RHON(I,J)
PHIN(I,J) = PHIN(I,J)
PHEN(I,J) = PHE(I,J)
SINN(I,J) = SIN (I,J)
TF(J .NE. JMAX+1) GO TO 8890
ZN(I,J) = ZN(I,JMAX)
U W(N(I,J)) = U W(I)
W W(N(I,J)) = W W(I)
X W(N(I,J)) = RN
IF(XJ1 .EQ. 1.) GO TO 8696
CALL SWALL(RN, ZN(I,J), XW(N(I), YW(N(I), FX, FZ)
THWN(I) = YWN(I)
IF(XJ1 .EQ. 1.) THWN(I) = ATAN(YWN(I) / XWN(I))
8696 IF(XJ1 .EQ. 1.) CALL SWALL1(THWN(I), RN, ZN(I,J), FX, FZ)
VWN(I) = (UWN(I)) * FX * WWN(I) * FZ)
IF(XJ1.GT.0.) VWN(I)=VWN(I)+ZN(J)

8890 CONTINUE
778 CONTINUE
XJ1=XJ1S

8892 CONTINUE
KS=KS-1
DO 9999 J=1,JW
IMAI1=IMAX(J)
DO 9999 I=1,IMAX1
TN(I,J)=FT(PN(I,J)*PHI(I,J),M)(I,J))
GAMN(I,J)=-FAM(TN(I,J),PN(I,J)*PHI(I,J))
AN(I,J)=-SRT(GAMN(I,J)*PN(I,J)/RHON(I,J))

9999 CALL XLAM(QN(I,J),AN(I,J)*PHEN(I,J)*XPLAMN(I,J)*XMLAMN(I,J))
IF(IAV.EQ.0.OR.BAV.GT.0.) GO TO 8898
AAV=.S
BAV=.S
IF(ICOMLT.EQ.1.AND.1WRAP.EQ.0) CALL PLANES(I)
CALL DERIVN(MM)
DO 9998 J=1,JW
IMAXJ=IMAX(J)
DO 9998 I=1,IMAXJ
CALL F(RHON(I,J),QN(I,J),RN,ZN(I,J),PHEN(I,J)*XPLAMN(I,J),XMLAMN(I,J))
IF(SINN(I,J),AN(I,J)*SIGN(I,J)*PN(I,J)*PHEN(I,J)*FPN(I,J))
FMN(I,J))

9998 CONTINUE
IF(KS.EQ.1) GO TO 961

8898 CONTINUE
ICOML=0
AAV=.1
BAV=.S
DO 1645 M=1,3
IF(M.EQ.2) GO TO 1645
IF(IS(M,1).EQ.0) GO TO 1645
CALL ALSHOC(M)

1645 CONTINUE
212 CONTINUE
IF(RN.LT.XXI) GO TO 7500
IF(INT.EQ.2) GO TO 7500
INT=1
J=J(JJ+1)

7501 THJ=TH(J)*XJ
XCN=RN*COS(THJ)
XCN=COS(THJ)
IF(XCN.LT.(XXI-5.E-04).AND.XCN.LT.(XXI-5.E-04)) CALL INTER
IF(XCN.LT.(XXI-5.E-04)) GO TO 7500
J(J)=J

J=J+1
IF(J.GT.JW) GO TO 7500
IF(ISWEEP.EQ.0.AND.J.EQ.JW) TH(J)=THWN(IMAXJ)

7500 CONTINUE
CALL L TH M
IF(ISWEEP.EQ.0) CALL EMBED
DO 1941 J=1,JW
IF(J.GT.JCALC) GO TO 1941
IMAXJ=IMAX(J)-1
IF (IC<0).EQ.0) IMAX=IMAX(J)
DO 20 I=1,IMAX(J)
  T(I,J)=ZN(I,J)
P(I,J)=PN(I,J)
  PHE(I,J)=PHEN(I,J)
  Q(I,J)=QN(I,J)
  SI(I,J)=SINN(I,J)
  H(I,J)=HN(I,J)
  PHI(I,J)=PHIN(I,J)
  RH0(I,J)=RHON(I,J)
  T(I,J)=FP(P(I,J),PHI(I,J),H(I,J))
  GAM(I,J)=FGAM(T(I,J)*P(I,J)*PHI(I,J))
  A(I,J)=SORT(GAM(I,J)*P(I,J)/RH0(I,J))
  CALL XLAM(Q(I,J)*A(I,J)*PHE(I,J)*XPLAM(I,J)*XMLAM(I,J))
20 CONTINUE
DO 300 M=1,7
  ALPHA(M,J)=ALPHAN(M,J)
  ALP(M,J)=ALPN(M,J)
3004 BETA(M,J)=BETAN(M,J)
1941 CONTINUE
IF(JW.GT.JCALC) GO TO 214
IF(ISIM.EQ.1) GO TO 214
IMAX=IMAX(J)+1
IF(ICO<0).EQ.0) IMAX=IMAX(J)
DO 401 I=1,IMAX
  W(I)=U W(I)
  V(I)=V W(I)
  W(I)=W W(I)
  THW(I)=THWN(I)
  R=RN
  THWX=THW(I)*XJ
  THW(I)=R*COS(THWX)
401 YW(I)=R*SIN(THWX)*(1-*XJ)*THW(I)
TH(JW)=THW(I)
214 XI=XJ
  IFR=0
  IF(JW.GT.JCALC) CALL SWEEP(I)
  R=RN
  IF(JW.GT.JCALC) GO TO 8759
  IF(ISIM.EQ.0) CALL ADDSUR
8759 IF((KOUNT.KCORR).EQ.1) CALL WRAP(I)
  IF(ICO<0).AND.IWRAP.EQ.0) CALL MOTHER
GO TO 1
END
SUBROUTINE SPACE
COMMON /C/ LMAX,ISTART,KOUNT,KOUNTP
COMMON /D/ W(40),XW(40),YW(40),THW(40)
COMMON /H/ ISIM
COMMON /J/ QN(40,10),PHEN(40,10),SINN(40,10),XPLAM(40,10)
COMMON /M/ IS(7,10)
COMMON /S/ RI,KOUNT,KOUNTS,ICOUNT
COMMON /W/ XIMEX,ITDUMMY,JINT,THW(40),XW(40),YW(40),THW(40)
COMMON /T/ NUMEXP,IZAV
COMMON /W/ IMMEXTIDUMMY
COMMON /Q/ NUMEXP,IZAV
COMMON /WR/ IWRAP
COMMON /TEM/ T(40,10)
COMMON /PL/ DE TH
DIMENSION LDROP(100),LDROR(100)
DIMENSION LDROR(100),LADD(100)
DATA IX420/
IF(IX42=EQ.0.AND.LDROR.EQ.0)E=TH(T(JINT)=TH(JINT-1)
IX42=] ICON=IS(3,1)=1
IS3=IS(3,1)
NZ=(Z(IS3-1)-Z(1,1))/FLOAT(IS3-2)
IJL=1
IJU=JMAX
1300 KSNo=1
MSA=1
KSAS=1
MSA=1
IREDO=0
DO 400 I=1,100
LDROP(I)=0
LDROR(I)=0
400 LADD(I)=0
402 CONTINUE
DO 2 L=IJL,IJU
J=L
JS=J
ICON=IS(3,J)=1
IH=1
IL=2
IU=ICON
IF(LDROP(I)=EQ.0.AND.IRED=EQ.1.AND.LDROR(I)=EQ.0) GO TO 7
KP=0
4 CONTINUE
KP=KP+1
4121 CONTINUE
DO 3 K=1,IU
KP=KP+1
I=K
NZ=(K-1)*Z(K-1,J)
IF(IRED=EQ.0) GO TO 2600
DO 440 K=1,KSAS
IF(J.GT.JINT.AND.KP.EQ.LDROR(KP)) GO TO 441
IF(J.EQ.JINT.AND.KP.EQ.LDROP(KP)) GO TO 441

440 CONTINUE
GO TO 3

2600 CONTINUE
IF(DZ/DZT.GE.333) GO TO 3
IF(IT.NE.IU) GO TO 1500
IT=IT-1

IF(KOINT.LT.KOINTC+40) GO TO 3

1500 CONTINUE
LDROP(KSA)=IT
IF(J.GT.JINT) LDROP(KSA)=IT+IS(J,JINT)-IS(3,J)
IF(J.GT.JINT.AND.IU.EQ.IS(3,J)-1.AND.KOINT.GT.KOINTC+2) LDROP(KSA)
I=0
IF(J.GT.JINT) LDROP(KSA)=IT
KSA=KSA+1
GO TO 3

442 IT=IT+1

441 CONTINUE
IM=IMAX(J)
IOV=0
IF(J.EQ.JINT.AND.Z(IT,J).LT.ZSAV) IDUMMY=IDUMMY+1

32 DO 21 I=IT,IM
I

7(I,J)=Z(I+1,J)
P(I,J)=P(I+1,J)
Q(I,J)=Q(I+1,J)
H(I,J)=H(I+1,J)
SI(I,J)=SI(I+1,J)
PHE(I,J)=PHE(I+1,J)
PHI(I,J)=PHI(I+1,J)
PHO(I,J)=PHO(I+1,J)
GAM(I,J)=GAM(I+1,J)

T(I,J)=T(I+1,J)
A(I,J)=A(I+1,J)
XPLAM(I,J)=XPLAM(I+1,J)
XMLAM(I,J)=XMLAM(I+1,J)
IF(IOV.EQ.0) GO TO 21
W(I)=W(I+1)
V(I)=V(I+1)
W(I)=W(I+1)
X(I)=X(I+1)
Y(I)=Y(I+1)
THW(I)=THW(I+1)

21 CONTINUE
IF(ISIM.EQ.1.OR.LNE.JMAX) GO TO 30
IF(IOV.EQ.1) GO TO 31
IOV=1
J=J+1 GO TO 32

31 J=JS

30 CONTINUE
IMAX(J)=IMAX(J)-1
IF(IT.LT.IS(3,J)) IS(3,J)=IS(3,J)-1
IF(IT.LT.IS(1,J)) IS(1,J)=IS(1,J)-1
IF(K.GE.IU) GO TO 3
TL=IT
TU=IU-1
GO TO 4121

3 CONTINUE
GO TO (6,5,7), IJ

6 IF(IS(3,J)+2.E0.IS(1,J)) GO TO 530
IL=IS(3,J)+1
IJ=IS(1,J)+1
IH=2
IF(J.GE.JMAX.OR.ISIMEX.EQ.1) GO TO 4
DZIQ=Z(IL+J+1)-Z(IL-1+J+1)
DZQQ=Z(IL+1+J+1)-Z(IL-1+J+1)
IF(DZIQ/DZQQ.GE.2) GO TO 4
LDRP(KSA)=IL
IF(J.GT.JINT) LDRP(KSA)=IL+IS(3,JINT)-IS(3,J)
KSA=KSA+1
GO TO 4

530 KP=KP+2
5 IL=IS(1,J)+1
IJ=MAX(J)
IH=3
GO TO 4

7 IL=2
IF(LAND(1).EQ.0.AND.MSAS.EQ.7).AND.IRED.EQ.1) GO TO 2
IJ=IS(3,J)-1
KP=0

8 CONTINUE
KP=KP+1

8484 CONTINUE
DO 9 K=IL,IU
KP=KP+1
IT=K
DZ=Z(K+J)-Z(K-1+J)
IF(IRED.EQ.0) GO TO 601
DO 444 KR=1,MSAS
IF(IMAX(J).GE.37) GO TO 9
IF(J.GT.JINT.AND.KP.EQ.LADD(KR)) GO TO 445
IF(J.LE.JINT.AND.KP.EQ.LADD(KR).AND.(IJ.NE.IS(3,J)+1.OR.IWRAP.EQ.11)) GO TO 445
444 CONTINUE

GO TO 9

601 CONTINUE
IF(DZ.DZLT.1,5) GO TO 9

1501 CONTINUE
IF(J.GE.JMAX.OR.ISIMEX.EQ.1) GO TO 5021
Z00=Z(K-1+J)-Z(K-1+J)
DZIQ=Z00-Z(K-1+J+1)
DZQQ=Z(K+J)-Z(K-1+J+1)
IF(DZIQ/DZQQ.LT.4) GO TO 9

5021 CONTINUE
LADD(MSA)=IT
IF(J.GT.JINT) LADD(MSA)=IT+IS(3,JINT)-IS(3,J)
IF(J.GT.JINT) LADR(MSA)=IT
MSA=MSA+1
GO TO 9

445 CONTINUE
IMAXX=IMAX(J) + 1

10V=0

33 DO 18 I=IT+IMAXX

11=IMAXX+1+IT=1

12=I1=1

7(II+J)=7(I2+J)

P(I1,J)=P(I2,J)

O(I1,J)=O(I2,J)

H(I1,J)=H(I2,J)

PHI(I1+J)=PHI(I2+J)

PHE(I1,J)=PHE(I2+J)

PHO(I1,J)=PHO(I2,J)

SI(I1+J)=SI(I2+J)

GAM(I1,J)=GAM(I2+J)

T(I1,J)=T(I2,J)

A(I1,J)=A(I2,J)

XPLAM(I1,J)=XPLAM(I2,J)

XMLAM(I1,J)=XMLAM(I2,J)

IF(IOV.EQ.0) GO TO 18

U W(I1)=U W(I2)

V W(I1)=V W(I2)

W W(I1)=W W(I2)

X W(I1)=X W(I2)

Y W(I1)=Y W(I2)

THW(I1)=THW(I2)

18 CONTINUE

IF(ISIM.EQ.1.OR.L.NE.JMAX) GO TO 36

IF(IOV.EQ.1) GO TO 35

10V=1

J=J+1

GO TO 33

35 J=JS

34 CONTINUE

IMAX(J)=IMAX(J)+1

IP=IT+1

IM=IT-1

10V=0

RAT 5

Z(IT+J)=.5*(Z(IP+J)+Z(IM+J))

38 P(IT+J)=P(IM+J)*RAT*(P(IP+J)=P(IM+J))

O(IP+J)=O(IM+J)*RAT*(O(IP+J)=O(IM+J))


SI(IP+J)=SI(IM+J)*RAT*(SI(IP+J)=SI(IM+J))

PHE(IP+J)=PHE(IM+J)*RAT*(PHE(IP+J)=PHE(IM+J))

PHI(IP+J)=PHI(IM+J)*RAT*(PHI(IP+J)=PHI(IM+J))

PHO(IP+J)=PHO(IM+J)*RAT*(PHO(IP+J)=PHO(IM+J))

1=IT

T(I1,J)=T(P(IP+J)*PHI(IP+J)+H(I1,J))

GAM(I1,J)=GAM(T(I1,J)+P(IP+J)*PHI(I1,J))

A(I1,J)=SQRT(GAM(I1,J)*P(IP+J)+PHO(IP+J))

CALL XLAM(Q(I1,J)*A(I1,J)*PHE(IP+J)*XPLAM(I1,J)+XMLAM(I1,J))

IF(ISIM.EQ.1.OR.L.NE.JMAX) GO TO 36

IF(IOV.EQ.1) GO TO 37

10V=1

J=J+1

7(IT+J)=Z(IT+J=1)
```plaintext
RAT = (Z(IT+J) - Z(IM+J)) / (Z(IP+J) - Z(IM+J))
GO TO 30

37 J = JS
U W(IT) = U W(IM) * RAT * (U W(IP) - U W(IM))
W W(IT) = W W(IM) * RAT * (W W(IP) - W W(IM))
X W(IT) = R
CALL SWALL (R, Z(IT+J), XW(IT), YW(IT), FX, FZ)
THW(IT) = YW(IT)
V W(IT) = U W(IT) * FX + W W(IT) * FZ

36 CONTINUE
IF (IT.LT.IS(3, J))
IS(1+J) = IS(1, J) + 1
IF (IT.LT.IS(3+J))
IS(3+J) = IS(3, J) + 1
IL = IT + 2
IU = IU + 1
IF (IL.GT.IU) GO TO 10
GO TO 8484

9 CONTINUE
10 CONTINUE
IF (IH.EQ.2) GO TO 2
IH = 2
IL = IS(3+J) + 1
IU = IS(1+J) + 1
GO TO 8

2 CONTINUE
IF (IREDO.EQ.1) GO TO 600
IF (KSAS.EQ.1 .AND. MSA.EQ.1) GO TO 400
KSAS = KSAS - 1
IF (KSAS.EQ.0) KSAS = 1
MSA = MSA - 1
IF (MSA.EQ.0) MSA = 1
DO 500 K = 1, KSAS
DO 500 M = 1, MSA
IF (LDROP(K).EQ.LADD(M)) LADD(M) = 0
DO 321 J = JL, IU
IF (J.LE.JINT) GO TO 321
IF (Z(2+J).GT.2 .AND. DEWW) GO TO 322
DO 322 M = 1, MSA
IF (LADD(M).EQ.0) LADD(M) = 0
DO 320 M = 1, MSA
320 CONTINUE
IF (MSA.GE.JMAX) GO TO 3000
DO 3001 M = 1, MSA
LADD(M) = 0
DO 3005
3000 DO 3002 M = 1, MSA
IF (LADD(M).EQ.0) GO TO 3005
IN = 0
DO 3004 M = 1, MSA
3004 IF (LADD(M).EQ.0) LADD(M) = 0
IF (IN.LT.JMAX) LADD(M) = 0
3002 CONTINUE
3005 IF (IWRAP.EQ.1) GO TO 402
DO 3006 M = 1, MSA
IN = 0
```

DO 3007 MM=1,MSAS

3007 IF(LADR(MM).EQ.LADR(M)) IN=IN+1
IF(IN.LT.JMAX-JINT) LADR(M)=0
IF(LADR(M).LT.IS(3,JINT+1)) GO TO 3006
IN=0
DO 2931 MM=1,MSAS
2931 IF(LAND(MM).EQ.LADR(M)+IS(3,JINT)-IS(3,JINT+1)) IN=IN+1
IF(IN.LT.JINT) LADR(M)=0
CONTINUE
GO TO 402

600 IF(IJU.EQ.JMAX) GO TO 1301
IJL=JINT+1
IJU=JMAX
GO TO 1300

1301 CONTINUE
IF(ISIM.EQ.1) RETURN
JMAX(JMAX+1)=JMAX(JMAX)
IS(3,JMAX+1)=IS(3,JMAX)
IS(1,JMAX+1)=IS(1,JMAX)
RETURN
END
SUBROUTINE DERIV(MM)

COMMON /IQ/ NUMEXP, ZSAV
COMMON /WR/ IWPAP
COMMON /X/ X1, THMAX, TH(10), R, Z(40, 10), P(40, 10), PH(40, 10),
1 Q(40, 10), SI(40, 10), H(40, 10), PI(40, 10), RHO(40, 10), GAM(40, 10),
COMMON /IC/ IMAX(10), JMAX, ISTART, KOUNTF, KOUTTP
COMMON /UX/ UW(40), VU(40), WU(40), XU(40), YU(40), THU(40),
COMMON /HY/ ISIM
COMMON /X/ XJ
COMMON /Y/ IS
COMMON /Z/ S(7, 10)
COMMON /A/ SIQ(40, 10), PQ(40, 10), PHEQ(40, 10), HO(40, 10), PHI(40, 10),
1 Q(40, 10), RHOQ(40, 10), GAMQ(40, 10),
COMMON /Q/ XQWL
COMMON /R/ JXCN, XCIXXI, JWINT, ICOWL, RCOWL
COMMON /W/ ISIME, IDUMMY, JINT, DUMMY(40), THWW(2), JD1, JD2
COMMON /TB/ IMAXJ, IS1, IS2, ISL, ISL2
COMMON /SW/ JCALC, ISWEEPS, XINSB(10), X2
COMMON /IH/ ISW1, IFR
COMMON /JS/ JFINA
COMMON /KS/ RI, KOUNT, KOUNT, ICOWL
COMMON /LP/ DE TH
COMMON /PS/ ZR(40), PR(40, 2), OR(40, 2), MR(40, 2), SI(40, 2), RHOR(40, 2),
1 PHIR(40, 2), PHER(40, 2), THR(2), THWR(40),
COMMON /PS/ GAMRR(40)
DO 10 J=1, JMAX
JSWOL=0
IF(J.GT.JCALC) GO TO 10
IF(J.EQ.JCALC .AND. IFR.EQ.1) GO TO 10
J=J+1
JP=J+1
IF(J.EQ.JCALC) JP=J
IF(J.EQ.1) JM=J
IF(ISIM.EQ.1 .AND. J.EQ.JMAX) J=JM
IMAX J=IMAX(J)
DO 20 I=1, IMAX(J)
THJ1=THW(1)
IF(JP.NE.JW) THJ1=TH(JP)
IF(ISIM.EQ.1 .AND. JP.EQ.JMAX) THJ1=TH(JMAX)
IF(J.EQ.JIN1 .AND. I.LE.IDUMMY) GO TO 20
DZ=Z(I, J)-Z(I, JM)
DTH=TH(J)-TH(JM)
DUMZ=0
IF(XJ1.GT.0.0) DUMZ=.5*(Z(I, J)+Z(I, JM))
DUMR=R
IF(XJ.GT.0.0) DUMR=R
DS1=DSRT(DZ=DZ(DTH.DUMZ.DUMR)**2)
IF(J.EQ.JINT .AND. IG1.IDUMMY) GO TO 901
DZ=Z(I, JP)-Z(I, J)
DTH=THJ1=TH(J)
DUMZ=0
IF(XJ1.GT.0.0) DUMZ=.5*(Z(I, J)+Z(I, JP))
DS2=DSRT(DZ=DZ(DTH.DUMZ.DUMR)**2)
IF(J.EQ.JINT+1) GO TO 900
D1=DS1/DS2
DZ=DS2/DS1
n3 = D1 - D2
GO TO 902

901 D1 = 0.
JP = J
n2 = 1.
n3 = 1.
IF (I.EQ.I.S(3, J) - 1) GO TO 909
JSHOC = 1
JP = J + 1
IA = IS(1, JP) + I - IS(1, J)
RAV = (Z(I, J) + ZSAV + Z(IA, JP))/2.
DS2 = RAV * 3.142/2.
D1 = D1/DS2
D2 = DS2/D1
D3 = D1 - D2
CONTINUE
GO TO 902

900 D1 = 1.
n2 = 0.
n3 = 1.
IF (I.EQ.I.S(3, J) - 1) GO TO 910
JSHOC = 2
IB = IS(1, JM) + I - IS(1, J)
RAV = (Z(I, J) + Z(IB, JM) - ZSAV)/2.
DS1 = RAV * 3.142/2.
D1 = D1/DS1
D2 = DS1/D1
D3 = D1 - D2
910 CONTINUE

CONTINUE
M = 1
IF (JSHOC.EQ.1) M = IA
IF (JSHOC.EQ.2) N = IB
DTHS = D1 * TH(J) + D2 * TH(JM)
IF (J.EQ.0) DTHS = TH(2)
IF (I.SM.EQ.1 AND J.EQ.JMAX) DTHS = TH(JMAX) - TH(JMAX - 1)
IF (JSHOC.EQ.1) DTHS = (Z(I, J) - ZSAV) * 3.142/2 * D1 * (TH(J) + TH(JM)) * D2
IF (JSHOC.EQ.2) DTHS = (TH(JP) - TH(J)) * D1 * Z(I, J) * 3.142/2 * D2
D2 = D1 * P (M, JP) = D3 * Z (I, J) * D2 * Z (N, JM)
IF (JSHOC.EQ.1) D2S = (Z(I, J) - Z(I, JM)) * D2 * (Z(M, JP) - Z(I, J) + ZSAV) * D1
IF (JSHOC.EQ.2) D2S = (Z(I, J) - Z(I, JM) + ZSAV) * D2 * (Z(I, JP) - Z(I, J)) * D1
DPHES = D1 * PHE (M, JP) = D3 * PHE (I, J) * D2 * PHE (N, JM)
DPHIS = D1 * PHI (M, JP) = D3 * PHI (I, J) * D2 * PHI (N, JM)
DPHS = D1 * PHI (M, JP) = D3 * PHI (I, J) * D2 * PHI (N, JM)
DPHIS = D1 * PHI (M, JP) = D3 * PHI (I, J) * D2 * PHI (N, JM)
DPM = D1 * GAM (M, JP) = D3 * GAM (I, J) * D2 * GAM (N, JM)
DSI = D1 * SI (M, JP) = D3 * SI (I, J) * D2 * SI (N, JM)
IF (J.EQ.0) DSI = SI (I, J)
IF (I.SM.EQ.1 AND J.EQ.JMAX) DSI = SI (I, JMAX - 1)
40 IF (I.EQ.1) GO TO 50
IF (I.EQ.JMAXJ) GO TO 50
IF (ICOWL.NE.1) GO TO 400
IF (I.LT.IS(1, J)) MM = OR. 1. GT. IS(1, J)) GO TO 400
DP  Z=0.
DH  Z=0.
DSI Z=0.
PHEZ  Z=0.
PHI7  Z=0.
RHOZ  Z=0.
GAMZ  Z=0.
GO TO 60

CONTINUE

400 CONTINUE
IF(I, EQ, IS(I,J)) .OR. I, EQ. IS(I,J) = 1 GO TO 50
IF(I, EQ, IS(3,J)) .OR. I.EQ.IS(3,J) = 1 GO TO 50
IF(IP=I+1)

DZ1 = Z(IP,J) - Z(I,J)
DZ2 = Z(I,J) - Z(II,J)
D1 = DZ1/DZ2
D2 = DZ2/DZ1
D3 = D1 - D2

NPDEZ = D1 + D2


GO TO 60

50 CONTINUE
L=1

IF(I, EQ, IMAXJ) GO TO 100
DO 421 M = 1,7
IF((M/2)*2*NE.N.AND.I, EQ.IS(M,J) = 1) GO TO 100
IF((M/2)*2*EQ.N.AND.I.EQ.IS(M,J)) GO TO 100

421 CONTINUE
L=1

100 JL = I + 1
I2L = I2 + 1
DZ = Z(I,J) - Z(I2L,J)

IF(ABS(DZ) .GT. 1.E-10) GO TO 5000
DEL = 0.

GO TO 5001

5000 DEL = 0
5001 DELLE = DEL + DEL

DELQ = 1 + DEL
DELE = 1 + 2*DEL

DP  Z = (DELE*P(IL,J) = DELE*P(IL,J) = DELE*P(IL,J) = DELE*H(IL,J) = DELE*H(IL,J) = DELE*H(IL,J) = DELE*Q(IL,J) = DELE*Q(IL,J) = DELE*Q(IL,J) = DELE*PHE(IL,J) = DELE*PHE(IL,J) = DELE*PHE(IL,J) = DELE*PHI(IL,J) = DELE*PHI(IL,J) = DELE*PHI(IL,J) = DELE*RHO(IL,J) = DELE*RHO(IL,J) = DELE*RHO(IL,J) = DELE*GAM(IL,J) = DELE*GAM(IL,J) = DELE*GAM(IL,J)

GO TO 5001
0 CONTINUE
P Q(I,J) = (DP S = DP Z) * DZ / DTHS
H Q(I,J) = (DH S = DH Z) * DZ / DTHS
G Q(I,J) = (DG S = DQ Z) * DZ / DTHS
SI Q(I,J) = (DSI S = SI Z) * DZ / DTHS
PHEQ(I,J) = (DPHE S = DPHE Z) * DZ / DTHS
PHIQ(I,J) = (DPHI S = DPHI Z) * DZ / DTHS
RHOG(I,J) = (DRH S = DRHO Z) * DZ / DTHS
GAMQ(I,J) = (DGAMS S = DGAMZ) * DZ / DTHS

20 CONTINUE
10 CONTINUE
IF (IWRAP, EQ.1) GO TO 955
IF (ICOWL, EQ.1 OR ICOWL, EQ.0) GO TO 955
J2 = JINT
J3 = JINT + 1
J4 = JINT + 2
IDU = IDUMMY + 1
A1 = ZSAV = Z(IDU, J2)
A2 = TH(J4) = TH(J3)
A1A2 = A1/A2
A2A1 = A2/A1
A1PA2 = A1A2
A12 = A1A2 = A2A1
UT = Q(IDU, J2) * COS(PHE(IDU, J2))
VTE = Q(IDU, J2) * SIN(PHE(IDU, J2))
WTE = Q(IDU, J2) * TAN(SI(IDU, J2))
G = SQRT(UT * UT + VTE * VTE)
PHET = TAN(WT / UT)
SIT = TAN(VT / UT)
P Q(I,J3) = (P(1, J4) * A1A2 = P(I, J3) * A12 = P(IDU, J2) * A2A1) / A1PA2
H Q(I,J3) = (H(I, J4) * A1A2 = H(I, J3) * A12 = H(IDU, J2) * A2A1) / A1PA2
G Q(I,J3) = (G(I, J4) * A1A2 = G(I, J3) * A12 = G(IDU, J2) * A2A1) / A1PA2
SI Q(I,J3) = (SI(I, J4) * A1A2 = SI(I, J3) * A12 = SI(IDU, J2) * A2A1) / A1PA2
PHEQ(I,J3) = (PHE(I, J4) * A1A2 = PHE(I, J3) * A12 = PHET) / A1PA2
PHIQ(I,J3) = (PHI(I, J4) * A1A2 = PHI(I, J3) * A12 = PHI(IDU, J2) * A2A1) / A1PA2
RHOG(I,J3) = (RH0(I, J4) * A1A2 = RH0(I, J3) * A12 = RH0(IDU, J2) * A2A1) / A1PA2
GAMQ(I,J3) = (GAM(I, J4) * A1A2 = GAM(I, J3) * A12 = GAM(IDU, J2) * A2A1) / A1PA2
IMAXJ = IMAX(J2 = 1)
DO 7979 I1 = 1, IMAXJ
Z R(I, J) = Z(I, J2 = 1)
P R(I, J) = P(I, J2 = 1)
Q R(I, J) = Q(I, J2 = 1)
H R(I, J) = H(I, J2 = 1)
SI R(I, J) = SI(I, J2 = 1)
PHTR(I, J) = PHI(I, J2 = 1)
PHER(I, J) = PHE(I, J2 = 1)
RHOR(I, J) = RH0(I, J2 = 1)
7979 CONTINUE
DO 7878 I1 = 1, IDUMMY
DO 3535 IJ = 1, IMAXJ
GAMRR(IJ) = THWR(IJ)
CALL TBLDUM(Z(I,J2) * PI * SI1 * HI * PHI1 * QI * PHE1 * RH01 * GAM1, 1, IMAX(J, J2))
DO 3536 IJ = 1, IMAXJ

3536 THWR(iJ)=GAMRR(IJ)

CALL TBLDUM(Z(I,J2),P2,S12,H2,PHI2,Q2,PHE2,RHO2,GAM2, 2*IMAX(I
J2)+2)
D1=TH(J2)-TH(J2-1)
D2=THP(J2)-TH(J2)
D1D2=D1/D2
D2D1=D2/D1
D12=D1D2=D2D1
D1PD2=D1+D2

P Q(I,J2)=(D1D2*P 2=D12*P (I,J2)=D2D1*P 1)/D1PD2
H Q(I,J2)=(D1D2*H 2=D12*H (I,J2)=D2D1*H 1)/D1PD2
O Q(I,J2)=(D1D2*O 2=D12*O (I,J2)=D2D1*O 1)/D1PD2
SI Q(I,J2)=(D1D2*SI 2=D12*SI (I,J2)=D2D1*SI 1)/D1PD2
PHIO(I,J2)=(D1D2*PHI2=D12*PHI(I,J2)=D2D1*PHI1)/D1PD2
PHEO(I,J2)=(D1D2*PHE2=D12*PHE(I,J2)=D2D1*PHE1)/D1PD2
RHO0(I,J2)=(D1D2*RHO2=D12*RHO(I,J2)=D2D1*RHO1)/D1PD2
GAMO(I,J2)=(D1D2*GAM2=D12*GAM(I,J2)=D2D1*GAM1)/D1PD2

7878 CONTINUE
955 CONTINUE
RETURN
END
SUBROUTINE CSUPF(K,JMW)

COMMON /FN/ FN(40,10),FMN(40,10)
COMMON /ALLR2/ PQN(40,10),QEH(40,10),SINQ(40,10),
1 PHQ(40,10),PHIQ(40,10),RHOQ(40,10),GAMQN(40,10)
COMMON /AV/ AV,AQV
COMMON /ALLR/ AN(40,10),TN(40,10),GAMN(40,10),XPLAMN(40,10)
COMMON /LAML/ LAML(40,10)

COMMON /IVY/ IVY,KCORR,IAV
COMMON /A/ XI,THMX,TH(10),R,Z(40,10),P(40,10),PHE(40,10),
1 Q(40,10),SIH(40,10),H(40,10),PHI(40,10),RHO(40,10),GAM(40,10)
COMMON /B/ PN(40,10),PHIN(40,10),RHON(40,10),HN(40,10),ZN(40,10)
COMMON /C/ IMAX(10),JMAX,ISTART,KOUNTF,KOUNTP
COMMON /H/ ISH

COMMON /I/ XJ
COMMON /J/ QNI(40,10),PHEN(40,10),SINN(40,10),XPLAM(40,10)
COMMON /K/ RN,SREL
COMMON /L/ ALPH(7,10),ALPHA(7,10),BETAN(7,10),BETA(7,10)
COMMON /M/ IS(7,10)
COMMON /N/ SIO(40,10),PQ(40,10),PHEQ(40,10),H(40,10),PHIQ(40,10),
1 Q(40,10),RHOQ(40,10),GAMQ(40,10)
COMMON /O/ ALP(7,10),ALPN(7,10)
COMMON /P/ ERZZZ
COMMON /V/ XJ1
COMMON /W/ ISMEMX,IDUMMY,JINT,JDUMM(40),THM(2),JD1,JD2
COMMON /SA/ XJTS

DIMENSION PIS(2),PHEIS(2),RHOZ(2),PZ(2),GAMZ(2),QDS(2),QDS(2),
1 SID(2),SIDQ(2),TIS(2),VCS(2),HD(2),HDQ(2),PHIZS(2)

1 DO 10 J=1,JMW
10 IF(J.GT.JINT) XJ=0.
1=IS(K,J)
KIL=1
A93=1.
B93=0.
IF(BAV.GT.0.) A93=5
IF(BAV.GT.0.) B93=5
IF(BAV.EQ.0.) BETAN(K,J)=BETA(K,J)
BT=BETAN(K,J)
IF(J.NE.JMW) GO TO 893

XR=r
CALL SWALL(RZ(I,JMW),XT,YT,GXI,GZI)
GG=TAN(GXI)
7DOT=7(I,JMW)+TAN(BETA(K,JMW))*SDEL/COS(GG)/COS(GG)
XR=r
CALL SWALL(RN*2DOT+XT,YDU,GX,GY)
X=x*G*SIN(BETA(K,JMW))
RATC=(TH(JMW)-YDU)/(TH(JMW)-YDU)
11=IS(K,J)+2
12=IS(K,J)+1
DO 892 IF=II,J2
P Q(I,J)=P Q(I,J)+Q(I,J,JMW)
H Q(I,J)=H Q(I,J)+H(I,J,JMW)
O Q(I,J)=O Q(I,J)+O(I,J,JMW)
SI Q(I,J)=SI Q(I,J)+SI(I,J,JMW)
PHEO(I,J)=PHEO(I,J,JMW)
PHIQ(I,J)=PHIQ(I,J,JMW)
892 CONTINUE
RH0Q(I, J) = RH0Q(I, JMAX)
GAMQ(I, J) = GAMQ(I, JMAX)
CONTINUE
CONTINUE
ZA = Z(I-1, J)
ZA = (Z(I-2, J) + Z(I-1, J)) / 2.

RAT = (ZA - Z(I-1, J)) / (Z(I-1, J) - Z(I-2, J))
ALAM = XPLAM(I-2, J) + RAT * (XPLAM(I-1, J) - XPLAM(I-2, J))
DUMP = A93 * ALAM + A93 * XPLAMN(I-1, J)
ZAT = Z(I-1, J) - DUMP * DELR
FR = ARS((ZAT - ZA) / (Z(I-1, J) - Z(I-2, J)))
IF (ER.LT.ERZZZ) GO TO 6

IT = IT + 1
ZA = ZAT
TF(25, IT, LE, 10) GO TO 5
WRITE(6, 200)
FORMAT (* ERROR IN A POINT ITERATION IN CSURF*)
CALL PNC

M = I - 1
BLAM = XMLAM(I-2, J) + RAT * (XMLAM(I-1, J) - XMLAM(I-2, J))
ZT = ZA
PA = P(I-2, J) + RAT * (P(I-1, J) - P(I-2, J))
PI = PA
QA = Q(I-2, J) + RAT * (Q(I-1, J) - Q(I-2, J))
QI = QA
HA = H(I-2, J) + RAT * (H(I-1, J) - H(I-2, J))
HI = HA
RHA = RHO(I-2, J) + RAT * (RHO(I-1, J) - RHO(I-2, J))
RHI = RHA
SI = SI(I-2, J) + RAT * (SI(I-1, J) - SI(I-2, J))
SI = SI
PHIA = PHI(I-2, J) + RAT * (PHI(I-1, J) - PHI(I-2, J))
PHI = PHIA
PHEA = PHE(I-2, J) + RAT * (PHE(I-1, J) - PHE(I-2, J))
RQ2 = QN(M, J) * QN(M, J) * RHON(M, J)
PHEI = PHEA
TA = FT(PA, PHIA, HA)
GAMA = FGAM(TA, PA, PHIA)
AA = SORT(GAMA, PA, RHA)
PQI = PQ(I-2, J) + RAT * (PQ(I-1, J) - PQ(I-2, J))
OOI = OQ(I-2, J) + RAT * (OQ(I-1, J) - OQ(I-2, J))
OOI = OQ(HQ(I-2, J) + RAT * (HQ(I-1, J) - HQ(I-2, J))
PHIQI = PHIQ(I-2, J) + RAT * (PHIQ(I-1, J) - PHIQ(I-2, J))
SIOI = SIO(I-2, J) + RAT * (SIO(I-1, J) - SIO(I-2, J))
CALL F(RHA, QA, P, QI, PHEA, ALAM, BI, AM, SIA, AA, SIOI, PQI, PHEIQI, FPA, FMA)
A1 = FPA / QA
A1 = AAV * A1 + BAV * FBN(M, J) / RQ2
A2 = SORT((QA / AA) ** 2 - 1, ) / RHA / QA / QA
A2 = A93 * A2 + B93 * SORT((QN(I-1, J) / AN(I-1, J)) ** 2 - 1, ) / RQ2
IT = 1
ZB = Z(I, J)
ZB = (Z(I-1, J) + Z(I, J)) / 2. 

RAT = (ZB - Z(I, J)) / (Z(I+1, J) - Z(I, J))
PLAM=XMLAM(I,J)*RAT*(XMLAM(I,J+1)-XMLAM(I,J))
DUMP=93*BLAM*93*XMLAMN(I,J)
ZAT=ZN(I,J)-DUMP*DELR
FR=ABS(ZB=ZAT/(Z(I+1,J)-Z(I,J)))
IF(ER,LE,ERZZZ)GO TO 10
IT=IT+1
78=ZAT
IF(IT.LE.10)GO TO 8
WRITE(6,201)

201 FORMAT(* ERROR IN B POINT ITERATION IN CSURF*)

CALL PNCH
9 PB=P(I,J)+RAT*(P(I+1,J)-P(I,J))
Q2=QN(I,J)+QN(I,J)*RAT*(Q(I,J))
ALAM=XMLAM(I,J)+RAT*(XMLAM(I,J)-XMLAM(I,J))
Q8=G(I,J)+RAT*(Q(I+1,J)-Q(I,J))
HB=H(I,J)+RAT*(H(I+1,J)-H(I,J))
RH0=RHO(I,J)+RAT*(RHO(I,J)-RHO(I,J))
SIB=S(I,J)+RAT*(S(I+1,J)-S(I,J))
PHT=PHT(I,J)+RAT*(PHT(I,J)-PHT(I,J))
PH=PH(I,J)+RAT*(PH(I,J)-PH(I,J))
PH=PH(I,J)+RAT*(PH(I,J)-PH(I,J))
CALL F(RH0,PH0,PH0,PH0,PH0,PH0,PH0,PH0,PH0,PH0)
SIB=SQRT(QN(I,J)/Q(I,J))
R2=SQR(T(QN(I,J)/93+1))
ACR=SQRT(QN(I,J)/Q(I,J))
R2=A93*Q2+AC

13 ZD=Z(M,J)/2.
18 RAT=(ZD-Z(M,J))/(ZD-Z(M,J))
DUM=XMLAM(M,J)+RAT*(XMLAM(M,J)-XMLAM(M,J))
ZAT=ZN(M,J)-DUMP*DELR
FR=ABS(ZAT-ZD)/(ZD-Z(M,J))
IF(ER,LT,ERZZZ)GO TO 19
IT=IT+1
IF(IT.GT.10)CALL ERROR(10)
ZD=ZAT
GO TO 18

19 CONTINUE
PD=P(M,J)+RAT*(P(M,J)-P(M,J))
OD=Q(M,J)+RAT*(Q(M,J)-Q(M,J))
HDH=H(M,J)+RAT*(H(M,J)-H(M,J))
RHO=RHO(M,J)+RAT*(RHO(M,J)-RHO(M,J))
SIB=S(M,J)+RAT*(S(M,J)-S(M,J))
PHI=PHI(M,J)+RAT*(PHI(M,J)-PHI(M,J))
PHED = PHE (M,J) * RAT* (PHEI-PHE (M,J))
TD = FT (PD*PHID*HD)
GAMD = FGAM (TD*PH*PHID)
AD = SORT (GAMD*PD/RHD)
PO = PQ (M,J) * RAT* (PQI-PQ (M,J))
HD = HQ (M,J) * RAT* (HQI-HQ (M,J))
QG = QG (M,J) * RAT* (QGI-QG (M,J))
RHD = RHO0 (M,J) * RAT* (RHOI-RHO (M,J))
SIDQ = SIQ (M,J) * RAT* (SIQI-SIQ (M,J))
PHIDQ = PHIQ (M,J) * RAT* (PHIQI-PHIQ (M,J))
RHDQ = RHO0 (M,J) * RAT* (RHOI-RHO (M,J))
SIDQ = SIQ (M,J) * RAT* (SIQI-SIQ (M,J))
V0 = QR * TAN (SID)
T1 = DE / COS (PHED)
IF (XJ.EQ.1) T1 = T1 / ZD
IF (XJ.EQ.1) T1 = T1 / R
T2 = PD0 / RHD / QD
T4 = QD0 / SIDQ / COS (STD) ** 2
T5 = QD0 / COS (PHED) * XJ
QD * SIN (PHED) * XJ
VC = VC * T1 * T2 * TAN (SID) * (T3 + T4 + T5) * AA
SPHE = SIN (PHEN) (M,J))
TSIN = TAN (TSIN) (M,J))
CSIN = COS (SINN) (M,J))
CPHEN = COS (PHEN) (M,J))
TT = DELR / CPHEN
IF (XJ1.GT.0.) TT = TT1 / ZN (M,J)
IF (XJ1.GT.0.) TT1 = TT1 / RN
T22 = PD1 / RHD / QN (M,J) / ON (M,J)
T33 = T3 * QN / QN (M,J)
T44 = QN (M,J) * SIN (M,J) / CSIN
T55 = QN (M,J) * (CPHEN * XJ * SPFHE) * XJ
DVC = T1 * (T22 + T33 + T44 + T55) * BAV
VC = VC * DVC
T11 = DELR * TAN (STNN (M,J)) / COS (PHEN) (M,J))
IF (XJ1.GT.0.) T11 = T11 / ZN (M,J)
IF (XJ1.GT.0.) T11 = T11 / RN
T1 = T1 + TAN (SID)
T1 = T1 + A93 + T11 * R93
RHOZ = RHD / RHDQ * T1
PZ = PD0 / PDQ * T1
HZ = HD / HDQ * T1
PHIZ = PHID / PHIDQ * T1
TZ = FT (PZ, PHIZ * HZ)
GAMZ = FGAM (TZ, PZ, PHIZ)
I6 = 1
IF (M.EQ.1) I6 = 2
PI S (I6) = PI
PHEIS (I6) = PHEI
RHOZS (I6) = RHOZ
PZ S (I6) = PZ
GAMZS (I6) = GAMZ
QD S (I6) = QD
OD S (I6) = OD
SID S (I6) = SID
SIDQS (I6) = SIDQ
T1  S(I6)=T1
VC  S(I6)=VC
HD  S(I6)=HD
HDQ S(I6)=HDQ
PHIZS(I6)=PHIZ
IF(I6.EQ.2) GO TO 1690
35 M=1
71=ZB
PI=PR
HI=MH
GI=OR
PHI=RHB
PHIQ=PHIA
GAM1=GAMB
PHEI=PHEB
SI1=S1B
PQ1=POB
GQ1=QOB
HQ1=HOB
RHQ1=RHQB
SI01=S10B
PHEIQ=PHEQOB
PHIQ1=PHIQB
GO TO 13
1690 CONTINUE
ITT=1
N=1
N=1
I6=1
16
PN(N,J)=PN(M,J)
PHEN(N+J)=PHEIS(2)*B1*DFLR-B2*PIS(2)-PN(N,J))
PHEN(M+J)=PHEIS(1)*A1*DFLR-A2*PN(M,J)-PIS(1))
1600 PHON(M,J)=RHQZS(I6)*(PN(M,J)/PZS(I6))**1/GAMZS(I6)
T2=TON5(I6)+QNS(I6)*TAN(STD(S(I4))*SinQ5S(I6))/Cos(STD(S(I4))
VVZ=PZS(I6)/Cos(STD(S(I6)))-T2*T1S(I6)
VVZ=VZ*VZ+2*(GAMZS(I6)/(GAMM(I6)-1)*PZS(I6)/RHOZS(I6)
1-PN(M,J)/RHON(M,J))
QN(M,J)=Sqrt(VVC-VCS(I6)*VCS(I4)
SINN(M,J)=ATAN(VCS(I6)/QN(M,J)
HN(M,J)=HDS(I6)*VVC-VVC)/2.-HDQS(I6)*T1S(I6)
PHIN(M,J)=PHIZS(I6)
IF((PHIN(M,J),LT.0.) .AND. (PHIN(M,J),GT.-0.1)) PHIN(M,J)=0.
TN(M,J)=FT(PN(M,J)*PHIN(M,J)+HN(M,J))
GAMN(M,J)=FGAM(TN(M,J)*PN(M,J)+PHIN(M,J))
AN(M,J)=SORT(GAMN(M,J)*PN(M,J)/RHON(M,J))
CALL XLAM(QN(M,J),AN(M,J)*PHEN(M,J),XPLAMN(M,J)*XMLAMN(M,J))
IF(I6.EQ.2) GO TO 1601
16=2
M=1
GO TO 1601
1601 CONTINUE
M=1
16=1
IF(J.EQ.1) BETAN(K,J)=PHEN(M,J)
IF(J.EQ.JMAX.AND.ISIM.EQ.1) BETAN(K,J)=PHEN(M,J)
\[ \text{\( \beta \equiv \text{tan}(\text{beta}(K,J)) \) \text{tan}(\text{tan}(K,J)) \text{DELR/2.} \]

\[ \text{\( \tilde{Z}(1,J) = \text{Z}(1,J) \times (\text{tan}(\text{beta}(K,J)) \times \text{tan}(\text{tan}(K,J))) \text{DELR/2.} \]

\[ \text{IF(J,EQ.JMAX+1) GO TO 4392} \]

\[ \text{BDU(BETAN(K,J)-RATC*BETAN(K,JMAX))/1= RATC) \]

\[ \text{ADU=ATAN(GX* SIN(BDU))} \]

\[ \text{ALPHAN(K,J)=ADU*RATC*(ALPHAN(K,JMAX)-ADU)} \]

\[ \text{GO TO 4483} \]

\[ \text{CONT} \]

\[ \text{IF(J,NE.JINT AND J,NE.JINT+1) \text{CALL PSOVL(J,TALP,I)}} \]

\[ \text{ALPHAN(K,J)=ATAN(TALP*COS(BETAN(K,J)))} \]

\[ \text{CONTINUE} \]

\[ \text{RPHE=BETAN(K,J)-PHEN(M,J)} \]

\[ \text{ERP=tan(sinn(M,J))sin(alphan(K,J))*cos(alphan(K,J))*cos(rphe)} \]

\[ \text{IF(ERS(ERP),LT.1.E-10) GO TO 1A02} \]

\[ \text{IK=IK+1} \]

\[ \text{IF(IK,GT.10) GO TO 100} \]

\[ \text{IF(IK,GT.2) GO TO 28} \]

\[ \text{F1=ERP} \]

\[ \text{BT1=BETAN(K,J)} \]

\[ \text{BETAN(K,J)=1.01*BETAN(K,J)*1.05} \]

\[ \text{GO TO 26} \]

\[ \text{1680 \text{WRITE}(6,1681)} \]

\[ \text{1681 \text{FORMAT}(* \text{ERROR IN PRESSURE ITERATION IN CSURF*)} \]

\[ \text{CALL PNC} \]

\[ \text{100 \text{WRITE}(6,202)} \]

\[ \text{202 \text{FORMAT}(* \text{ERROR IN BETA ITERATION IN CSURF*)} \]

\[ \text{CALL PNC} \]

\[ \text{28 \text{DUM2}=RT1-E1*(BETAN(K,J)-BT1)/(ERP-E1)} \]

\[ \text{F1=ERP} \]

\[ \text{RT1=BETAN(K,J)} \]

\[ \text{BETAN(K,J)=DUM2} \]

\[ \text{GO TO 26} \]

\[ \text{1602 \text{BETEST}=PHEN(N,J)*ASIN(TAN(SINN(N,J))*TAN(ALPHAN(K,J)))} \]

\[ \text{ERS=ERTAN(K,J)-BETEST} \]

\[ \text{IF(ABS(ERS),LT.1.E-10) \text{GO TO 1A03}} \]

\[ \text{ITT=ITT+1} \]

\[ \text{IF(ITT,GT.15) \text{GO TO 1680}} \]

\[ \text{IF(ITT,GT.2) \text{GO TO 22}} \]

\[ \text{ER1=ERS} \]

\[ \text{PH1=PN(M,J)} \]

\[ \text{P N(M,J)=1.2 \text{ P N(M,J)}} \]

\[ \text{GO TO 16} \]

\[ \text{22 \text{DUM1}=PH1-ER1*(P N(M,J)=PH1)/(ERS=ER1)} \]

\[ \text{FR1=ERS} \]

\[ \text{PH1=P N(M,J)} \]

\[ \text{P N(M,J)=DUM1} \]

\[ \text{GO TO 16} \]

\[ \text{1603 \text{IF(J,NE.JINT AND J,NE.JINT+1) \text{ALPN(K,J)=ATAN(TALP)}}} \]

\[ \text{IF(J,EQ.JMAX+1)ALPN(K,J)=ATAN(TAN(ALPHAN(K,J))/COS(BETAN(K,J)))} \]

\[ \text{1010 \text{ZN(I,J)=Z(I,J)*TAN(BETA(K,J))*TAN(BETAN(K,J))*DELR/2.} \]

\[ \text{ZN(I-1,J)=ZN(I,J)} \]

\[ \text{ET=ABS(1.-BT/BETAN(K,J))} \]

\[ \text{IF(IVY,EQ.0.OR.ET,LT.1.E-05) \text{GO TO 10}} \]

\[ \text{K1=K1+1} \]

\[ \text{IF(K1,GT.10) \text{GO TO 1493}} \]
A93= .5
A93= .5
RT=BETAN(K+J)
GO TO 2525

1493 WRITE(6,1393)
1393 FORMAT(* AVERAGING PROCESS DOES NOT CONVERGE IN CSURF *)
STOP
10 CONTINUE
XJ1=XJ1S
RETURN
END
SUBROUTINE HSHOCK(K,JL,JM,IFLG)

COMMON /FN/ FPN(40,10),FMN(40,10)
COMMON /AV/ AAV,BAV
COMMON /ALLR1/ TN(40,10),TN(40,10),GAMN(40,10),XPLMN(40,10)

1 XMNLN(40,10)
COMMON /J/ QN(40,10),PHEN(40,10),SINN(40,10),XPLAM(40,10)
1 XMNLN(40,10),FP(40),FM(40),A(40,10)

COMMON /IVY/ IIVY,KCORR,IAV
COMMON /A/ XT,THMAX,TH(10),R*Z(40,10),P(40,10),PHEN(40,10)
1 QN(40,10),SI(40,10),SH(40,10),P(40,10),PHEN(40,10),GAMN(40,10)
COMMON /B/ PN(40,10),PHEN(40,10),RHN(40,10),HN(40,10),ZN(40,10)
COMMON /C/ IMAX(10),JMAX,ISTART,KOUNTF,KOUNTP
COMMON /E/ UWN(40),VWN(40),WN(40),XWN(40),YWN(40),THWN(40)

COMMON /I/ XJ
COMMON /K/ RN,DELR
COMMON /L/ ALPHAN(7,10),ALPHA(7,10),BETAN(7,10),BETAN(7,10)
COMMON /M/ IS(7,10)
COMMON /N/ SQ(40,10),PQ(40,10),PHEN(40,10),HQ(40,10),PHIQ(40,10)
1 PQ(40,10),RHOQ(40,10),GAMQ(40,10)
COMMON /S/ RZD,KOUNT,ROUNTS,ICOUND
COMMON /U/ ERZZZ
COMMON /V/ XJ1
COMMON /W/ ISINDEX,UDUMMY,YINT,VMHMY,JDUMP(40),THW(2),JD1,JD2
COMMON /SA/ XJ1S

DO 10 J=JL,JM

10 IF (JG.T.10) XJ=0.
1=IS(K*J)
IF (J.M.EQ.JMAX+1.OR.IFLG.EQ.1) GO TO 3985

XTETR
CALL SWALL(RZ(I*J),XT,YT,GX,GZ)
ZDOTZ=Z(I*J)*TAN(BETA(K*J))*DELP/(COS((ATAN(GX)))**2
XTETR
CALL SWALL(RN,ZDOT,XT,YDU,GX,GZ)
CONTINUE

CONTINUE

IT1=1
KIL=1

R93=0.
IF (BAV.GT.0.) A93=5
IF (BAV.GT.0.) R93=5
IF (BAV.EQ.0.) AND.JL*NE.JMAX+1) BETAN(K,J)=BETAN(K,J)
BET=BETAN(K*J)
IF (I.EQ.JMAX+1.AND.IFLG.EQ.1) BET=BETAN(K*J)
RTEBET

4 IT=1
IF (J.M.EQ.JMAX+1.OR.IFLG.EQ.0.) GO TO 7999
PATS=(TH(JMAX)-YDU)/(TH(JMAX)-YDU)
RDU=(BET-RATS*BETAN(K*J))/(T-=-RATS)
ADU=TAN(GX*SIN(RDU))
ALPHAN(K*J)=ADU*RATS*ALPHAN(K,J)-ADU

CONTINUE

CA=COS(ALPHAN(K*J))
SA=SIN(ALPHAN(K*J))
VT=QN(I*J)*COS(BET-PHEN(I*J))
VL=QN(I*J)*(CA*TAN(SINN(I*J))=SA*SIN(BET-PHEN(I*J)))
UI=QN(I*J)*(SA*TAN(SINN(I*J))=CA*SIN(BET-PHEN(I*J)))
U1=ABS(U1)
XMS=RHON(I,J)*U1
TNSFT=PN(I,J)+PHIN(I,J)+HN(I,J)
GN=GMAM(TNSFT)
GPI=(GN+1.0)
GM1=GM=1.0
XM1=U1/GN/PN(I,J)*RHON(I,J)
U2=U1*(GM1*XN1+2.0)/GPI/XM1
5 RH2P=XMS/U2
P2H=XMS*(U1-U2)+PN(I,J)
V2=VT+2*VL*2
V1=V2+U1*2
V2=V2-U2*2
H2=HN(I,J)+(V1-V2)/2.
RH2=RH00(I,J)+PHIN(I,J)
FR=(RH2-RH2P)/RHO(I,J)
IF(ABS(ER).LT.1*10)GO TO 7
IT=IT+1
IF(IT.GT.10)GO TO 100
IF(IT.GT.2)GO TO 6
ER2=ER
U22=U2
U2=.99-U2
GO TO 5
100 WRITE(6,200)
200 FORMAT(* ERROR IN HUGONIOT LOOP IN HSHOCK*)
CALL PNCI
6 DUM=U2-ER2*(U2-U22)/(ER-ER2)
ER2=ER
U22=U2
U2=DUM
GO TO 5
7 CONTINUE
CB=COS(RET)
SB=SIN(RET)
IF((K/2)-2*EQ.K)U2=-U2
QN2P=U2+CA+VL+SA
UV=VT-CB-QN2P*SB
VV=VL+CA+U2+SA
WV=VT+SB-QN2P*CB
PHE2=ATAN(UV/VV)
Q2=SQR(UV*UV+VV*VV)
V2=VV
ST2=ATAN(V2/Q2)
L=1
IF((K/2)*2+NEK) L=-1
M=IS(K+J)+L
IF( IFLG.EQ.1) GO TO 46
40 RAT=(ZA-Z(M,J)+ZN(J))/2.
TN=1
41 RAT=(ZA-Z(M,J))/(Z(N,J)-Z(M,J))
ALAM=XPLAM(M,J)*RAT*(XPLAM(N,J)-XPLAM(M,J))
DUMP=93*ALAM+893*XPLAMN(M,J)
SLAM=DUMP
ALAM=XAMLAM(M,J)*RAT*(XAMLAM(N,J)-XAMLAM(M,J))
DUM1=A93*BLAM+R93*XMLAMN(M,J)
IF(K.EQ.2)DUMP=DUM1
ZAT=Z(N,J)-DUMP*DELR
FP=ABS((ZAT-ZA)/(Z(N,J)-Z(M,J)))
IF(FP,LT,ERZZZ)GO TO 9
ZAT=ZAT
IK=IK+1
IF(IK.LE.10)GO TO 40
WRITE(6,101)
101 FORMAT(* ERROR IN A POINT LOOP IN HSHOCK*)
CALL FNCN
9 PA=P(M,J)+RAT*(P(N,J)-P(M,J))
QA=Q(M,J)+RAT*(Q(N,J)-Q(M,J))
HA=H(N,J)+RAT*(H(M,J)-H(N,J))
RHA=RHO(M,J)+RAT*(RHO(N,J)-RHO(M,J))
SIA=SI(M,J)+RAT*(SI(N,J)-SI(M,J))
PHEA=PHE(M,J)+RAT*(PHE(N,J)-PHE(M,J))
PHIA=PHI(M,J)+RAT*(PHI(N,J)-PHI(M,J))
TA=FT*(PA,PHIA,HA)
GAMA=FGAM(TA,PA,PHIA)
AA=SQRT(GAMA/PA/RHA)
IF(J.NE.JMAX+1)GO TO 783
SI Q(M,J)=SI Q(M,J-1)
P Q(M,J)=P Q(M,J-1)
PHEQ Q(M,J)=PHEQ(M,J-1)
SI Q(N,J)=SI Q(N,J-1)
P Q(N,J)=P Q(N,J-1)
PHEQ Q(N,J)=PHEQ(N,J-1)
783 CONTINUE
CALL F (RHO(M,J),Q(M,J),R,Z(M,J),PHE(M,J),XPLAM(M,J),XMLAM(M,J),SI 1)
1A(M,J),SIQ(M,J),PQ(M,J),PHEQ(M,J),FP1,FM1)
CALL F (RHO(N,J),Q(N,J),R,Z(N,J),PHEQ(N,J),XPLAM(N,J),XMLAM(N,J),SI 1)
1A(N,J),SIQ(N,J),PQ(N,J),PHEQ(N,J),FP2,FM2)
FP1A=FP1 +RAT*(FP1 -FP1)
FM1A=FM1 +RAT*(FM2 -FM1)
RQ2=QN(M,J)+QN(M,J)*RHO(N,J)
A1=FP1/AQA/AQA*AN(M,J)*RHA/RQ2
IF((K/2)EQ.0)A1=FM1/AQA/AQA*FMN(M,J)*RHA/RQ2
A2=SQRT((QA/AQA)**2-1.)/RHA/AQA
AC=B9*SQRT((QN(M,J)/AN(M,J))**2-1.)/RQ2
A2=A93*A2+ AC
DELR=RN-R
OPT=1.
IF((K/2)EQ.0)OPT=1.
PSH=PA+ OPT*(PHE2-PHEA -A1*DELR)/A2
ER3=(PSH-P2H)/(M,J)
IF(ABS(ER3).LT.1.E-6)GO TO 9
IT1=IT1+1
IF(IT1.GT.15)GO TO 103
IF(IT1.GT.2)GO TO 14
ER1=ER3
RET1=RET
RET=1.* RET
GO TO 15
103 WRITE(6,220)

220 FORMAT(* ERROR IN SHOCK ANGLE IN HSHOCK*)

14 DUM=RET1=ER1*(RET-BET1)/(ER3-ED1)

ER1=ER3
RET1=RET
RET=0

15 ZN(M,J)=Z(M,J)+5*(TAN(BETA(K,J)+TAN(BET)))*DELR
JS=JS(K,J)
ZN(K,J)=ZN(M,J)

CALL FSHOCK(K,J)
GO TO 4

19 BETAN(K,J)=BET

ZN(M,J)=5*(TAN(BETA(K,J)+TAN(BETAN(K,J)))*DELR+Z(M,J)
JS=JS(K,J)
ZN(K,J)=ZN(M,J)

GO TO 29

46 CONTINUE

UW(M)=UV
WN(M)=WW
VW(M)=VV

29 CONTINUE

PN(M,J)=PNH
QN(M,J)=Q2
UN(M,J)=H2

PHN(M,J)=PH1
PHN(M,J)=PH1
PHON(M,J)=RH2
STN1(M,J)=S12

FZ(M,J)=T(PN(M,J)+PH1(M,J)+RH1(M,J))
GAMN(M,J)=FGAM(TN(M,J)+PN(M,J)+PH1(M,J))

AN(M,J)=SQRT(GAMN(M,J)*PN(M,J)+RH1(M,J))

CALL XLAM(QN(M,J),AN(M,J)+PHN(M,J),XPLAMN(M,J),XPLAMN(M,J))

IF(IYY.EQ.0.OR.,ET.LT.1.E-05) GO TO 10

K河流=K河流

10 CONTINUE

GO TO 4

1493 WRITE(6,1393)

1393 FORMAT(* AVERAGING PROCESS DOES NOT CONVERGE IN HSHOCK*)

STOP

10 CONTINUE

XJ1=XJ15

RETURN

END
SUBROUTINE PNCH
COMMON /IVY, IVY, KCORR, IAV
COMMON /JF, JFINAL
COMMON /A1(3,9), A2(3,9), A3(3,9), RR1(3), RR2(3), RR3(3)
I NUMLWS, NUMULWS, NIMNW
COMMON /Q, XCOWL
COMMON /X, XF IN
COMMON /X, THM, TH(10) * R (40,10) * P (40,10) * PHE (40,10)
1 (40,10) * SI (40,10) * H (40,10) * PHI (40,10) * GAM (40,10)
COMMON /SCFI, ZLIFT, XTHRC, YMONC, ZLIFTS, XTURS, YMOMS
COMMON /MAX, IMA (10) * JMAX, ISTART, KOUNTF, KOUNTP
COMMON /U, UM (40) * V, VM (40) * W, WM (40) * X, XM (40) * Y, YW (40) * THW (40)
COMMON /ISIM
COMMON /X, XI
COMMON /J, QN (40,10) * PHEN (40,10) * SNN (40,10) * XPLAM (40,10)
1 XM (40,10) * FP (40) * FM (40) * A (40,10)
COMMON /X, ALPHAN (7,10) * ALPHA (7,10) * BFTAN (7,10) * BETA (7,10)
COMMON /IS (7,10)
COMMON /N, SIG (40,10) * PQ (40,10) * PHEQ (40,10) * H0 (40,10) * PHI0 (40,10)
1 (40,10) * RHOQ (40,10) * GAMQ (40,10)
COMMON /A, ALP (7,10) * ALPN (7,10)
COMMON /R, J, XCOW, XC, XI, J, XM, INT, ICOWL, RCOWL
COMMON /S, RI, KOUNT, KOUNTS, ICOWL
COMMON /V, XJ1
COMMON /W, ISIM, IDUMMY, JINT, IDUMMY (40) * THW (40) * JD1, JD2
COMMON /X, KTPUN (3)
COMMON /J, PINF, ZLIFT, XTHR, YMONC, JJI, ZSHIFT, XSHIFT
COMMON /IQ, NUMEXP, ZSAV
COMMON /SPE, KOUNTC
COMMON /WR, IWRAP
COMMON /TEM, T (40,10)
COMMON /STREAM, XMFT, XENT, FSX, FSZ
COMMON /X, XTP, XSTP
DIMENSION Hp (10)
DATA HE, 5Y, 5THETA, SMH 1.3H = 1.1H2, 1.1H3, 3HTHW, 3H Y * 13H Z /
BACKSPACE 7
73 CONTINUE
IF (XJ, EQ, 0.) GO TO 513
WRITE (6, 70) KOUNT, XI
70 FORMAT (1H1, 10X, * KOUNT = **, 14, 1AX, **R = **E13, 5)/*
GO TO 503
513 WRITE (6, 504) KOUNT, XI
504 FORMAT (1H1, 10X, * KOUNT = **, 14, 1AX, **X = **E13, 5)/*
503 CONTINUE
ISWEEP = 0
ISTART = 1
WRITE (7, 2929) KOUNTF, KOUNTP, ISTART, IVY, IAV, KCORR, JFINAL,
1 (KTPUN (1), I = 1, 3) * XSTP
2929 FORMAT (10I5, E10.2)
WRITE (7, 2) JMAX, ISIM, ISIM, IDAP, NUMEXP, ISWEEP, (IMAX (J) * J = 1, JMAX)
WRITE (7, 310) R, XJ, XV, JX, ICOWL, RCOWL, XFIN, ZSAV, PINF
310 FORMAT (AE10.3)
WRITE (7, 79) KOUNT, R
WRITE (7, 2) NUMLWS
DO 311 I = 1, NUMLWS
311 CONTINUE
311 WRITE(7,310) RR1(I)*(A1(I,J)*J=1,9)
WRITE(7,2) NUMWS
DO 312 I=1,NUMWS
312 WRITE(7,310) RR2(I)*(A2(I,J)*J=1,9)
IF(ISIM.EQ.1) GO TO 314
WRITE(7,2) NUMWS
DO 313 I=1,NUMWS
313 WRITE(7,310) RR3(I)*(A3(I,J)*J=1,9)
314 CONTINUE
WRITE(7,2) JINT,KOUNTC
WRITE(6,610) ZSHIFT,XSHIFT,XTHR,ZLIFT,YMOM
610 FORMAT(10X*,Z MOMENT AXIS = **F11.3,5X,*,X MOMENT AXIS = **F11.3,5X)
10X*,THRUST = **F11.3,5X,*,LIFT = **F11.3,5X
1,PITCHING MOMENT = **F11.3,3)
IF(IS(3).NE.0.AND.ISIM.EQ.0) WRITE(6,621) XTHRC,ZLIFTC,YMOMC
621 FORMAT(* CONTACT *,*THRUST = **F11.3,5X,*,LIFT = **F11.3,5X
1,PITCHING MOMENT = **F11.3,3)
IF(IS(1).NE.0.AND.ISIM.EQ.0) WRITE(6,622) XTHRC,ZLIFTC,YMOMC
622 FORMAT(* SHOCK *,*THRUST = **F11.3,5X,*,LIFT = **F11.3,5X
1,PITCHING MOMENT = **F11.3,3)
WRITE(6,623)
623 FORMAT(9)
WRITE(7,9) XMAST,XENT,FSX,FSZ
9 FORMAT(4E13.5)
WRITE(7,1) ZLIFT,XTHR,YMOM,ZSHIFT,XSHIFT
107 J=1,JW
IF(ISIM.EQ.0.AND.J.EQ.JW) GO TO 500
IF(J.GT.JINT) GO TO 2260
IF(XJ.NE.0).OR.XJ1.NE.0) GO TO 505
WRITE(6,506) J,HE(1)*HE(4)*TH(.J)*HE(5)
506 FORMAT(///10X*,J = *I2,24X,A5,/*,E13.5,/*,X**,*,I6,A1,10X,/*,
1,8X*,RHO**,8X**,6AH**,9X*,T*)
GO TO 510
505 IF(XJ1.EQ.0.) GO TO 507
WRITE(6,506) J,HE(2)*HE(4)*TH(.J)*HE(6)
GO TO 510
507 CONTINUE
WRITE(6,506) J,HE(2)*HE(4)*TH(.J)*HE(5)
GO TO 510
2260 ZIS=ZSAV-TH(J)
WRITE(6,506) J,HE(3)*HE(4)*ZIS,HE(7)
510 CONTINUE
WRITE(7,1) TH(J)
GO TO 501
500 CONTINUE
IF(J>L.T.JINT) GO TO 2270
WRITE(6,2300) JW,HE(10)*HE(7)
2300 FORMAT(///40X*,SIDEWALL/,10X,J = */I2,11X,**,9X,A3
10X**,V**,10X**,A1,10X,**
1,8X**,RHO**,8X**,6AH**,9X*,T*)
GO TO 6885
2270 CONTINUE
IF(XJ1.EQ.1) GO TO 6884
WRITE(6,2300) JW,HE(9),HE(5)
GO TO 6885
WRITE(6,2300) JW,HE(8),HE(6)
CONTINUE
WRITE(7,2) IMAX(J)
CONTINUE
IMAX=IMAX(J)
IF (ICOWLT.EQ.1) IMAXJ=IMAXJ+1
DO 172 I=1,IMAXJ
R = SORT(GAM(I,J)*I*J)/PHI(I,J)
EM=EM+R*SORT(I*J)/PHI(I,J)
IF (ISIM.EQ.1.OR.J.NE.JW) GO TO 502
EM=EM+(I*J)*I*J)*I*J)/PHI(I,J)
WRITE(6,302) XW(I),YW(I),ZW(T),UW(I)
CONTINUE
WRITE(6,79) IMAX(J)
CONTINUE
IF (ICOWLT.EQ.0) GO TO 71
WRITE(7,1) (ALPHA(M,J),M=1,7)
WRITE(7,1) (BETA(M,J),M=1,7)
WRITE(7,1) (IS(M,J),M=1,7)
IF (IS(3),NE.0.AND.ISIM.EQ.0) WRITE(7,1) ZLIFTC,XTHRC,YMOMC
IF (IS(1),NE.0.AND.ISIM.EQ.0) WRITE(7,1) ZLIFTS,XTHRS,YMOMS
WRITE(7,1) ZLIFTC,XTHRC,YMOMC
WRITE(7,1) ZLIFTS,XTHRS,YMOMS
CONTINUE
WRITE(6,400) J, (ALPHA(M,J),M=1,7)
CONTINUE
WRITE(6,400) J, (BETA(M,J),M=1,7)
CONTINUE
WRITE(6,400) J, (IS(M,J),M=1,7)
CONTINUE
WRITE(6,400) J, (ALPHA(M,J),M=1,7)
CONTINUE
WRITE(6,400) J, (BETA(M,J),M=1,7)
CONTINUE
WRITE(6,400) J, (IS(M,J),M=1,7)
WRITE(6,4004) J*(IS(M,J),M=1,7)

3009 CONTINUE
IF(IWRAP.EQ.1) GO TO 1532
WRITE(7,2) IDUMMY
1532 CONTINUE
WRITE(7,1) (ZDUMMV(I),I=1,NMEV)
4000 FORMAT(/10X,*ALPHA*/4X,*J*)
4001 FORMAT(/10X,*BETA*/4X,*J*)
4002 FORMAT(/10X,*IS*/4X,*J*)
4004 FORMAT(IS,7(I4,7X))
100 CONTINUE
IF(KOUNT.NE.KOUNTF) GO TO 7744
IF(ICOWLT.EQ.1.AND.IWRAP.EQ.0) CALL WRAP(1)
7744 CONTINUE
ENDFILE 7
IF(KOUNT.EQ.KTPUN(1).OR.KOUNT.EQ.KTPUN(2).OR.KOUNT.EQ.KTPUN(3)) 1 RETURN
CALL EXIT
END
SUBROUTINE FSHOCK(K, JL, JM)

COMMON /C/ IMAK(10), JMAX, ISTART, KOUNTF, KOUNTP
COMMON /FN/ FPN(40, 10), FMN(40, 10)
COMMON /ALLR2/ PPN(40, 10), PHN(40, 10), QGN(40, 10), SGN(40, 10),
  PHQ(40, 10), PHIQ(40, 10), RHOQ(40, 10), GAMQ(40, 10)
COMMON /AV/ AAV, BAV
COMMON /ALLR1/ TN(40, 10), TN(40, 10), GAMN(40, 10), XPLAMN(40, 10)

1XMLAM(40, 10)
COMMON /IVY/ IVY, KCORR, IAV
COMMON /A/ XL, THMAX, TH(10), R, Z(40, 10), P(40, 10), PHF(40, 10)
Q(40, 10), ST(40, 10), R(40, 10), PH(40, 10), RHO(40, 10), GAM(40, 10)
COMMON /B/ PN(40, 10), PHIN(40, 10), RHN(40, 10), HN(40, 10), ZN(40, 10)
COMMON /I/ XJ

COMMON /J/ ON(40, 10), PHEN(40, 10), SINN(40, 10), XPLAM(40, 10)
1XMLAM(40, 10), FP(40), FM(40), A(40, 10)
COMMON /K/ RN, RELR
COMMON /M/ IS(7, 10)
COMMON /N/ SQ(40, 10), PQ(40, 10), PHEQ(40, 10), QG(40, 10), PHIQ(40, 10),
1QO(40, 10), RHOQ(40, 10), GAMQ(40, 10)
COMMON /U/ ERZZZ
COMMON /V/ XJ1
COMMON /w/ ISMEX, IDUMMY, JINT, IDUMMY(40), THWW(2), JD1, JD2
COMMON /SA/ XJTS
DO 6 J = JL, JM
  KIL = 1
  A93 = 1.
  R93 = 0.
  IF(BAV .GT. 0.) A93 = .5
  IF(BAV .GT. 0.) R93 = .5
  IS = IS(K, J)
  SIT = SINN(I, J)
  PHE = PHEN(I, J)
  PT = PN(I, J)
  IF(J = T, JINT) XJ1 = 0.
  L = I + 1
  IF((K .GT. 2) .OR. EQ, K) L = I - 1
  Z3 = ZN(I, J)
  IF(J .NE. JMAX + 1) GO TO 3947
  P Q(I, JM) = Q(I, JMAX)
  H Q(I, JM) = H Q(I, JMAX)
  Q Q(I, JM) = Q(I, JMAX)
  SI Q(I, JM) = SI Q(I, JMAX)
  PHIQ(I, JM) = PHIQ(I, JMAX)
  RHOQ(I, JM) = RHOQ(I, JMAX)
  GAMQ(I, JM) = GAMQ(I, JMAX)
  P Q(L, JM) = Q(L, JMAX)
  H Q(L, JM) = H Q(L, JMAX)
  Q Q(L, JM) = Q(L, JMAX)
  SI Q(L, JM) = SI Q(L, JMAX)
  PHIQ(L, JM) = PHIQ(L, JMAX)
  RHOQ(L, JM) = RHOQ(L, JMAX)
  GAMQ(L, JM) = GAMQ(L, JMAX)
3947 CONTINUE
8 ZA = (Z(I, J) + Z(L, J))/2.
IT=1

10 RAT=(7A-Z(I,J))/(Z(L,J)-Z(I,J))
     ALAM=XPLAM(I,J)*RAT*(XPLAM(L,J)-XPLAM(I,J))
     DUMP=A93*ALAM+B93*XPLAMN(I,J)
     ZAT=DUMP*DELR
     ERR=ARS((ZAT-ZA)/(Z(L,J)-Z(I,J))
     IF(ERR.LE.ERZZZ)GO TO 9

     ZA=ZAT
     IT=IT+1
     IF(IT.LE.10)GO TO 10
     WRITE(6,200)

200 FORMAT(* ERROR IN A POINT ITERATION IN FSHOCK*)
     CALL PNCH

9 CONTINUE
     PA=P(L,J)+RAT*(P(L,J)-P(I,J))
     QA=Q(L,J)+RAT*(Q(L,J)-Q(I,J))
     HA=H(L,J)+RAT*(H(L,J)-H(I,J))
     RHA=RHO(I,J)+RAT*(RHO(I,J)-RHO(L,J))
     SIA=SI(I,J)+RAT*(SI(I,J)-SI(L,J))
     PHIA=PHI(I,J)+RAT*(PHI(I,J)-PHI(L,J))
     PHEA=PHE(I,J)+RAT*(PHE(L,J)-PHE(I,J))
     TA=TA(I,J)+RAT*(TA(I,J)-TA(L,J))
     GAMA=F7AM(TA+PA+PHIA)
     AA=SORT((GAMA+PA/RHA)
     CALL F(RHO(I,J),Q(I,J),RZ(I,J),PHE(I,J),XPLAM(I,J),XMLAM(I,J),HI)
1(I,J),
     1A(I,J),SIO(I,J),PO(I,J),PHEQ(I,J),FP1,FM1)
     CALL F(RHO(L,J),Q(L,J),RZ(L,J),PHE(L,J),XPLAM(L,J),XMLAM(L,J),SI
1(L,J),
     1A(L,J),SIO(L,J),PO(L,J),PHEQ(L,J),FP2,FM2)
     RQ2=QN(I,J)+QN(I,J)+RHON(I,J)
     FMA=FP1+RAT*(FP2-FP1)
     Q2=QA*QA
     A1=FMA/RHA/Q2
     A1=AA*1+BAV*FPN(I,J)/RQ2
     AC=B93*SORT((QN(I,J))/AA*(1)+RQ2)
     A2=SORT((QA/AA)**2-1.)*/RHA/Q2
     A2=A93*A2+AC
     IT=1
     ZB=(Z(I,J)+Z(L,J))/2.

12 RAT=(7B-Z(I,J))/(Z(L,J)-Z(I,J))
     BLAM=XPLAM(I,J)+RAT*(XPLAM(L,J)-XPLAM(I,J))
     DUMP=A93*BLAM+B93*XPLAMN(I,J)
     ZAT=DUMP*DELR
     ERR=ARS((ZAT-ZR)/(Z(L,J)-Z(I,J))
     IF(ERR.LE.ERZZZ)GO TO 14

     ZB=ZAT
     IT=IT+1
     IF(IT.LE.10)GO TO 12
     WRITE(6,201)

201 FORMAT(* ERROR IN B POINT ITERATION IN FSHOCK*)
     CALL PNCH

14 PB=P(I,J)+RAT*(P(L,J)-P(I,J))
     QB=Q(I,J)+RAT*(Q(L,J)-Q(I,J))
     HB=H(I,J)+RAT*(H(L,J)-H(I,J))
     RHR=RHO(I,J)+RAT*(RHO(L,J)-RHO(I,J))
SIB = SI(1,J) + RAT*(SI(L,J) - SI(1,J))

PHIE = PHI(1,J) + RAT*(PHI(L,J) - PHI(1,J))

PHEB = PHE(1,J) + RAT*(PHE(L,J) - PHE(1,J))

TA = TR(PB + PHIB + HB)

GAMB = GAMB(TB + PR + PHIB)

AB = SORT(GAMB*PB/RHB)

FMB = FMB1 + RAT*(FM2 - FM1)

Q2 = QB*OB

R1 = FMB/RHB/Q2

R1 = AA*V*B1 + BA*FMN(I,J)/RQ2

R2 = SORT((OB/AB) + 2 - 1)/RHB/Q2

R2 = AQ3*B2*AC

IT = 1

ZD = (ZA*ZB)/2

RAT = (ZD-ZA)/(ZP-ZA)

ALAMD = TAN(PHEA) + RAT*(TAN(PHEB) - TAN(PHEA))

DUMP = AQ3*ALAMD + B93*TAN(PHEN(I,J))

ZAT = Z3 = DUMP + DFLR

ERR = ABS((ZAT-ZD)/(ZB-ZA))

IF(ERR > LET.E = 16 TO 18

ZD = ZAT

IT = IT + 1

IF(IT > LE.10) GO TO 16

WRITE(6, 202)

202 FORMAT*(ERROR IN D POINT ITERATION IN FSHOC*)

CALL PNC

18 PD = PA + RAT*(PB - PA)

QD = QA + RAT*(QB - QA)

HD = HA + RAT*(HB - HA)

PHED = RHA + RAT*(RHB - RHA)

SID = STA + RAT*(SIB - SIA)

PHID = PHIA + RAT*(PHIB - PHIA)

PHEQ = PHEA + RAT*(PHEB - PHEA)

TD = FT(PD + PHID + HD)

GAMD = GAMB(TD + PD + PHID)

AD = SORT(GAMD*PD/RHD)

RAT = (ZD-Z(I,J))/Z(L,J)—Z(I,J))

PDO = PO(I,J) + RAT*(PQ(I,J) — PQ(I,J))

QD = QQ(I,J) + RAT*(QQ(I,J) — QQ(I,J))

HD = HO(I,J) + RAT*(HO(I,J) — HO(I,J))

RHD = RHO(I,J) + RAT*(RHOQ(I,J) — RHOQ(I,J))

SID = SIQ(I,J) + PAT*(SIQ(L,J) — SIN(I,J))

PHIQ = PHIQ(I,J) + RAT*(PHIQ(L,J) — PHIQ(I,J))

PHEQ = PHEQ(I,J) + RAT*(PHEQ(L,J) — PHEQ(I,J))

GAMDQ = GAMQ(I,J) + RAT*(GAMQ(L,J) — GAMQ(I,J))

PN(I,J) = P(I,J) + RAT*(PN(I,J) — PA)*A1*DELP

PHEN(I,J) = PHEA*A2*(PN(I,J) — PA)*A1*DELP

VD = QD*TAN(SID)

T1 = DFLR/COS(PHED)

IF(XJ1 = EQ.1.*) T1 = T1/ZD

IF(XJ1 = EQ.1.*) T1 = T1/R

T2 = PDO/RHD/QD

T3 = TAN(SID)*QD

T4 = QQ*SIDCOS(SID)**2

T5 = QQ*COS(PHED)*XJ

15 = QQ*TAN(PHED)*XJ1
VC=VD*T1+(T2*TAN(SID))*(T3*T4*T5)*AV
SPHENVsin(PHEN(I,J))
TSIN=TAN(SINN(J,J))
CSIN=COS(SINN(I,J))
CPHEN=COS(PHEN(I,J))
T1=DFLR/CPHEN
IF(XJ0 GT 0.) T1=TT1/ZN(I,J)
IF(XJ0 GT 0.) T1=TT1/RN
T2=PON(I,J)/RGN(I,J)/ON(I,J)
T3=TSIN*QNN(I,J)
T44=QNN(I,J)*SIN(I,J)/CSIN
T55=QNN(I,J)*(CPHEN*XV*SPHEN*XJ)
DVC=TT1*T22*TSIN*(T33*T44*T55)*BAV
VC=VVC-DVC
T11=DFLR*TAN(SI)/COS(PHET)
IF(XJ0 GT 0.) T11=TT1/ZN(I,J)
IF(XJ0 GT 0.) T11=TT1/RN
T1=T11/TAN(SID)
T11=T11*93*T11*93
RHOZ=RHD-RHDP*T1
PZ=PN-PDQ*T1
GAMZ=GAMD-GAMDO*T1
RHON(I,J)=RHOZ*(PN(I,J)/PZ)**(I*GAMZ)
T2=(QDQ+OD*TAN(SID)*SIDO)/COS(SID)
VZ=QD/COS(SID)-T2#T1
VVC=VVC*2.*GAMZ/(GAMZ-1.)*T/PZ/RHOZ-PN(I,J)/RHON(I,J))
ON(I,J)=SORT(VVC-VC*VC)
SINN(I,J)=ATAN(VVC/QN(I,J))
WN(I,J)=HD-HDQ*T1*(VVC*VVC)/2.
PHIN(I,J)=PHID-PHIDQ*T1
EC=ABS(1.-PT/PN(I,J))
TN(I,J)=FT(PN(I,J)*PHIN(I,J)+MN(I,J))
GAMN(I,J)=FGAM*TNTN(I,J)+PN(I,J)*PHIN(I,J))
AN(I,J)=SORT(GAMN(I,J)*PN(I,J)/RHON(I,J))
CALL XLMN(QN(I,J)+AN(I,J)*PHEN(I,J)*XPLAMN(I,J)*XMLAMN(I,J))
IF(EC.LT.1.E-04.OR.IVY.EQ.0.) GO TO 6
SIT=SINN(I,J)
PHET=PHEN(I,J)
PT=PN(I,J)
KIL=KIL+1
IF(KI L.GT.5) GO TO 1493
A93=.5
R93=.5
GO TO 8
WRITE(6,1393)
1393 FORMAT(* AVERAGING PROCESS DOES NOT CONVERGE IN FSHOCK*)
STOP
6 CONTINUE
XJ1=XJ1S
RETURN
END
SUBROUTINE WSHK(M,B)

COMMON /A/ XX,THMAX,TH10,R,
/ Z(40,10), P(40,10), PH(40,10),
/ Q(40,10), SI(40,10), T(40,10), PW1(40,10), RHO(40,10), GAM(40,10),
/ P(40,10), PHIN(40,10), RHON(40,10), HN(40,10), ZN(40,10),
/ C/ IMAX(10), JMAX, ISTART, KOUNTF, KOUNTP,
/ D/ UW(40), VW(40), WW(40), XW(40), YW(40), THW(40),
/ E/ UWN(40), VWN(40), WWN(40), XWN(40), YWN(40), THWN(40),
/ I/ XJ,
/ K/ RN, RELR,
/ L/ ALPHAN(7,10), ALPHA(*,10), B,
/ N/ ALP(7,10), ALPN(7,10),
/ O/ UW(40), VW(40), WW(40), XW(40), YW(40), THW(40),
/ P/ UWN(40), VWN(40), WWN(40), XWN(40), YWN(40), THWN(40),
/ S/ XJ,
/ T/ THM(10), IDUMX, IDUMY, JDUMMY(40), THW(2), JD1, JD2,
/ V/ XJ,
/ W/ SIMEX, IDUMMY, JINT, JDUMMY(40), THW(2), JD1, JD2,
/ X/ XJ,
/ Y/ XJ,
/ Z/ XJ,

JW=JMAX+1

IF(JW.GT.JINT) XJ1=0.
I=TS(M,JW)
K=TS(M,JMAX)
L=1
IF((M/2) #2, EQ, M) L=1
Z3=ZN(K,JMAX)
Z1=Z(I+JW)
THX=THW(I)*XJ1
Y1=YW(I)
X1=XW(I)
THX=TH(JMAX)*XJ
Y3=RN*COS(IN(THX)+TH(JMAX)*TH(JMAX)*XJ)
X3=RN*COS(THX)
FX1=TAN(RETA(M,JW))
FY1=TAN(ALP(M,JW))
FX2=TAN(BETAN(M,JW))
FY22=TAN(ALPHAN(M,JW))/COS(BETAN(M,JW))
NR=RN
Z2=ZN(I+JW)
IT=1

10 IF(XJ1.EQ.0.)
10 CALL SMALL(RN,Z2,X2,Y2,GX2,GZ2)
10 IF(XJ1.EQ.0.) CALL SMALL1(TH2,PN,Z2,GX2,GZ2)
10 IF(XJ1.EQ.0.)
10 TH2=ATAN(Y2/X2)
10 IF(XJ1.EQ.0.) TH2=Y2
TH2X=TH2*XJ
10 IF(XJ1.EQ.0.) Y2=RN*SIN(IN(TH2X)+TH2*(1.-XJ))
10 FY2=FX2*GX2-GZ2
10 Z2=ZN(I+JW)+(FX2+FY2)*(Y2-Y1)/2.
10 IT=IT+1
10 IF(IT.GT.3) GO TO 22
10 GOTO 10

22 GO TO 10
CONTINUE
10 IF(IT.GT.3) GO TO 25
RAT=(Y1-Y2)/(Y3-Y2)
RDU=(RETA(M,JW)-RAT*BETAN(M,JMAX))/(_IT-1)
FX2=TAN(RDU)
10 GO TO 10
25 FR2=FX2
    IF (ABS(FY2).LT.1.E-06) FY2=0.
    ALP2=FY2
14   THWN(I)=TH2
    ZN(I,JW)=Z2
    ZN(I+L,JW)=Z2
    XWN(I)=X2
    YWN(I)=Y2
    THWN(I+L)=TH2
    XWN(I+L)=X2
    YWN(I+L)=Y2
    ALPN(M,JW)=ATAN(ALP2)
    R2=FR2
    RETAN(M,JW)=ATAN(R2)
    ALPHAN(M,JW)=ATAN(ALP2*COS(BETH(M,JW))
    XJ1=XJ1S
    RETURN
    END
SUBROUTINE COWL(MM,IFS,OPT)
COMMON /A/ X1, THMAX, TH(10), R, Z(40,10), P(40,10), PH(40,10)
1 Q(40,10), SI(40,10), H(40,10), PUT(40,10), RHO(40,10), GAM(40,10)
COMMON /R/ PN(40,10), PHN(40,10), RHN(40,10), HN(40,10), ZN(40,10)
COMMON /C/ IMAX(10), JMAX, ISTART, KOUNT, KOUNTP
COMMON /D/ UW(40), VW(40), W(40), XW(40), YW(40), THW(40)
COMMON /H/ ISIM
COMMON /J/ QN(40,10), PHEN(40,10), SINN(40,10), XPLAM(40,10)
COMMON /L/ ALPHAN(7,10), ALPHA(7,10), BETAN(7,10), ETA(7,10)
COMMON /M/ ISIM, XPLAM(40,10), FMLAM(40,10,10)
COMMON /N/ ALP(7,10), ALPN(7,10)
COMMON /P/ K1, K2, KS1, KS2
COMMON /Q/ XCOWL
COMMON /V/ XJ1
COMMON /W/ ISIME, IDUMMY, JINT, IDUMMY(40), THW(2), JD1, JD2
COMMON /SA/ XJ15
COMMON /WR/ IWRAP
DIMENSION VL(9), VT(9), PM(9), UM(9), PHM(9), ZM(9), HM(9), RM(9), BM(9)
1, GMT(9), QM(9), AL(10), SIGNVL(9)
CALL INDAT2(MM, IFS, AL)
JW=JMAX
DO 89 I=1,9
89 SIGNVL(I)=1.
IF (ISIM.EQ.0) JW=JMAX+1
DO 666 J=1, JW
IS(1,J)=IMAX(J)
I=IMAX(J)
7N(I,J)=Z(I,J)
BETAN(I,J)=0.
666 CONTINUE
IF (IWRAP.EQ.0) CALL ALWRAP(1)
XW1=XCOWL
IF (ISIM.EQ.0) CALL SWALL(XCOWL,7,2, JW, XW1, YW1, GX, GZ)
DO 6 J=1, JW
1IF (J.GT.JINT) XJ1=0.
I=IMAX(J)
6 CONTINUE
1IF (P(I+MM+J)=P(I,J)) 4,39,5
39 WRITE(6,300)
300 FORMAT(* 2 SHOCKS NECESSARY FROM COWL LIP*)
CALL PNCH
5 NPT=1.
KC1=3
KS2=2
K=KS2
L=IMAX(J)
M=L+MM
GO TO 8
4 NPT=-1.
KC1=3
KS1=1
K=KS1
M=IMAX(J)
L=M+MM
8 VT=Q(L+J)*SORT(1.+TAN(SI(L,J))*2)
XH=ASIN(SORT(GAM(L,J)*P(L,J)/RHO(L,J))/VT)
IiT=1

IF(J.EQ.JINT OR J.EQ.JINT+1) AL(J)=ALDN(K,J)
ALPHA(K,J)=AL(J)
CA=cos(ALPHA(K,J))

RET=OPT*(XMU+.5/57.3*PHE(L,J))/CA
SA=sin(ALPHA(K,J))
TSI=tan(SI(L,J))
SPE=sin(PHE(L,J))
PCE=cos(PHE(L,J))
IFAN1=MM

IFAN=IFAN1-3
KP=1
JJ=1

IF(KP.EQ.1) JJ=0
II=IFAN1
IF((K/2)*2.EQ.K) II=1
II=II+1
II=II-1
IF((K/2)*2.EQ.K) II=II+1
VL(II)=Q(L,J)*(TSI*CA+SA*SPE)

IF(J.NE.JMAX+1) GO TO 5000
PE=atan(GX)
WB=Q(L,J)*SPE
UB=Q(L,J)*(cos(PE)*PCE+sin(PE)*TSI)
VB=Q(L,J)*tsi*cos(PE)-PCE*sin(PE))
PHEB=atan(wb/ub)
QB=UB/COS(PHEB)
TSI=VB/QB
CA=1.
SA=0.
SPE=sin(PHEB)
PCE=cos(PHEB)

VL(II)=VB
CONTINUE
SIGNVL(II)=SIGN(1.,VL(II))
VL(II)=VL(II)*S
ISAVE=II
ISAVE1=II

IT=1
II=ISAVE
II=ISAVE1
VT(II)=(Q(L,J)*(cos(BET)*PCE-sin(BET)*SA*TSI+SPE*CA))**2
U1=Q(L,J)*(sin(BET)*PCE+cos(BET)*(SA*TSI-CA*SPE))

IF(J.NE.JMAX+1) GO TO 5001
U1=QB*sin(BET-PHEB)
VT(II)=(QB*COS(BET-PHEB))**2
CONTINUE

U1=abs(U1)
GM1=GMAM(L,J)+1.
GP1=GMAM(L,J)+1.
XM1=U1/SORT(GAM(L,J)*P(L,J)/PHH(L,J))
XMS=RHO(L,J)+U1
IF(IT.EQ.1) UM(II)=U1*(GM1*XM1*XM1+2.)/GP1/XM1/XM

7 PH2=XM5/UM(II)
PM(II)=XMS*(U1-UM(II))*P(L,J)
V2=VT(II)+VL(II)
V1=V2+U1*U1
V2=V2+UM(II)*ER2
PM(II)=PHI(I,J)
ZM(II)=Z(I,J)
WM(II)=W(I,J)+(V1-V2)/2.
RM(II)=RHEG(HM(II),PM(II),PHM(II))
FR2=(RM2=RHM(II))/RHO(I,J)
IF((FR2=LT.1.E-04) GO TO 0
IT=IT+1
IF(IT.GT.10) GO TO 100
IF(IT.GT.2) GO TO 11
ER2=ER
UM(II)=UM(II)*.99
GO TO 7
100 WRITE(6,200)
200 FORMAT(* ERROR IN HUGONIOT LOOP IN COWL*)
CALL PNC
101 WRITE(6,201)
201 FORMAT(* SUBSONIC EDGE IN COWL AROUND STATEMENT NUMBER 13*)
CALL PNC
DUM2=UM2-ER2*(UM(II)-U2)/(ER-ER2)
6020 ER2=ER
UM(II)=DUM2
GO TO 7
PM(I,J)=PM(I,J)
WM(I,J)=WM(I,J)
ZM(I,J)=ZM(I,J)
RM(I,J)=RHM(I,J)
PHM(I,J)=PHM(I,J)
VL(I,J)=VL(I,J)
SIGMVL(I,J)=SIGMVL(I,J)
VT(I,J)=VT(I,J)
BM(I,J)=BM(I,J)
RM(I,J)=RM(I,J)
UM(I,J)=UM(I,J)
US2=SQRT(VT(I,J))*COS(RM(I,J))/UM(I,J)*SIN(BM(I,J))
WS2=SQRT(VT(I,J))*SIN(BM(I,J))/UM(I,J)*COS(RM(I,J))
PHES=ATAN(WS2/US2)
UM(I,J)=UM(I,J)
DP=(PM(I,J)-PHM(I,J))/FLOAT(IFAN=1)
VT=O(M,J)**2*(1.0+TAN(SI(M,J)))**2
II=1
IF((K/2)**2.EQ.K) II=IFAN1
ZM(I,J)=Z(M,J)
HM(I,J)=H(M,J)
PM(I,J)=PM(M,J)
PHM(I,J)=PHM(M,J)
GM(I,J)=GM(M,J)
PHM(I,J)=PHI(M,J)
UM(I,J)=UM(I,J)*PM(I,J)/RHM(I,J)
VL(I,J)=O(M,J)*(CA*TAN(SI(M,J))*SA*SIN(PHE(M,J))))
IF(J,NE,JMAX+1) GO TO 5002
WB=O(M,J)*SIN(PHE(M,J))
UB=O(M,J)*COS(PHE(M,J))*SIN(PHE(M,J))*TAN(SI(M,J))
VB=O(M,J)*TAN(SI(M,J))*COS(PHE(M,J))
VL(II)=VR

5002 CONTINUE

SIGNVL(II)=SIGN(VL(II))

VT(II)=VT=VL(II)=UM(II)

QMM=QMM(II)/UM(II)

13 XMM=QMM(II)/UM(II)

IF(XMM=.LT.1.) GO TO 101

RM(II)=OPT*ASIN(SORT(YMM/1.)+ATAN(1./A))

JF(J.EQ.JHA) RM(II)=OPT*ASIN(SORT(YMM/1.)+PHEB)

HTL=HM(II) *(VT=VL(II))*.2.

IFF=IFAN+1

IF1=IFF

IF((K/2).*2.EQ.K) IFF=IFAN1

DO 12 LL=2*IF1

N=LL

IF((K/2).*2.EQ.K) N=IFF=LL+1

KK=N-1

IF((K/2).*2.EQ.K) KK=N+1

IF((K/2).*2.EQ.K) KK=N+1

GM(N)=GM(KK)-.1.

HM(N)=HTL*(1.-GM(N))/2.

CL=UM(KK)*G1.*G1.*VT(KK)

PPH2=PFM(KK)

TH=F1(PM(N)+PHM(N)+HM(N))

GM(N)=GM(KK)*PM(N)/RHM(N)

VL(N)=VL(KK)

VTV=QMM=UM(N)

PN=SIGN(VTV)*UM(N)

ERR=PHEP=ERR

FJF=FF(Err .LT. 1.*E-0*) GO TO 16

IF1=101

IF((ITT).GT.15) GO TO 102

IF((ITT).GT.2) GO TO 14

ERR=ERR

RET1=RET
RET=1.01*BET
GO TO 3
102 WRITE(6,203)
203 FORMAT(1,10,ERROR IN BETA SHOCK IN COWL*)
CALL PNCH
14 NUM1=RET-ER1*(BET-BET1)/(ERR-ERR1)
ER1=ERR
RET1=BET
BET=NUM1
GO TO 3
15 CONTINUE
DO 16 LL=1*IF1
N=LL
IF((K/2)*2.EQ.K) N=IFF=LL+1
UM(N)=OPT*SORT(UUM(N))
16 CONTINUE
ALP(K,J)=AL(J)
TB=TAN(BET)*COS(ALP(K,J))
IF(J.EQ.JMAX+1) TB=TAN(BET)*COS(PH)
RETAN(K,J)=ATAN(TB)
BETA(K,J)=BETAN(K,J)
IF(J.EQ.JMAX+1) BETA(K,J)=ATAN(TAN(BET)*GX)
ALP(K,J)=ALP(K,J)
IF(J.EQ.JMAX+1) ALPH(K,J)=ATAN(GX*SIN(BETA(K,J)))
ALPH(K,J)=ALPH(K,J)
ALP(KC1+J)=AL(J)
TP=TAN(PH)*COS(ALP(KC1,J))
IF(J.EQ.JMAX+1) TP=TAN(PH)*COS(PH)
RETAN(KC1,J)=ATAN(TP)
BETA(KC1,J)=BETAN(KC1,J)
IF(J.EQ.JMAX+1) BETA(KC1,J)=ATAN(TAN(PH)*GX)
ALPH(KC1,J)=ALPH(KC1,J)
IF(J.EQ.JMAX+1) ALPH(KC1,J)=ATAN(GX*SIN(BETA(KC1,J)))
ALPH(KC1,J)=ALPH(KC1,J)
ISS=MAX(J)
IMAX(J)=IMAX(J)+MM+1
IS(K,J)=IMAX(J)+1
IF((K/2)*2.EQ.K) IS(K,J)=IMAX(J)-MM+1
IS(KC1,J)=IS(K,J)+2
IF((K/2)*2.EQ.K) IS(KC1,J)=IS(K,J)+3
IK=ISS
IF((K/2)*2.EQ.K) IK=ISS+1
DO 29 KK=1*IFAN1
IF((K/2)*2.EQ.KAND.KK.GE.(IFAN1-2)) GO TO 19
IF((K/2)*2.EQ.KAND.KK.GE.3) GO TO 19
IF((KK/KP)KPJJJ.NE.KK) GO TO 29
19 P(KJ)=PM(KK)
VT=SORT(UM(KK)*UM(KK)*VT(KK)+UL(KK))
CB=COS(BM(KK))
SB=SIN(BM(KK))
VV=SA*CB*(UM(KK))-SB*SA*SORT(VT(KK))*CA*SORT(VL(KK))*SIGNV(KK)
IF(J.EQ.JMAX+1) GO TO 5003
VB=UM(KK)+SB*SORT(VT(KK))*CB
VB=SORT(VL(KK))*SIGNV(KK)
VV=UB+Sin(PH)*VB*COS(PH)
5003 CONTINUE

SI (IK,J)=VW/VTT
SI (IK,J)=ASIN(SI (IK,J))
WV=CR*CA* (UM(KK))*SB*CA*SORT (VT(KK)) +SA*SQR(VL(KK))*SIGN(VL (KK))

UV=SB* (UM(KK))*CB*SORT (VT(KK))
IF (J, EQ, JMAX+1) UV=UB*COS(PE) -VB*SIN(PE)

q (IK,J)=SORT (UV*UV*WV*WV)
PHE (IK,J)=ASIN(WV/Q (IK,J))
PHI (IK,J)=PHM(KK)

Z (IK,J)=ZM(KK)
PHO (IK,J)=RHM(KK)
H (IK,J)=HM(KK)

T=FT(PM(KK)*PHM(KK)*HM(KK))
GAM (IK,J)=F*GAM(T,PM(KK)*PHM(KK))
E (IK,J)=SORT (GAM (IK,J)*P (IK,J)/PHO (IK,J))

CALL XLAM(Q (IK,J),E (IK,J),PHE (IK,J)*XPLAM (IK,J)*XMLAM (IK,J))
IF (J, NE, JMAX+1) GO TO 210

W (IK,J)=O (IK,J)*COS(PHE (IK,J))
XW (IK,J)=P
IF (XJ1.EQ.0.0) 1CALL SWALL (R*Z (IK,J),XW (IK),YW (IK),FX,FZ)
IF (XJ1.GT.0.0) CALL SWALL (THX*Z (IK,J),FX,FZ)
WV (IK,J) = UW (IK)*FX*WV (IK)*FZ

VW (IK,J) = VW (IK)*Z (IK,J)*XJ1
IF (XJ1.EQ.0.0) 1THW (IK) = VW (IK)
IF (XJ1.GT.0.0) THW (IK) = THX
SI (IK,J)=ATAN (VW (IK)/Q (IK,J))

210 CONTINUE

IK=IK+1
29 CONTINUE
JMAX (J)=JMAX (J)*IFS
6 CONTINUE
XJ1=XJ1S
RETURN

END
SUBROUTINE WDIcC(M)

COMMON /X/ X(1:*),THMAX,TH(10),R,THN(40,10),PH(40,10),PHN(40,10),PHM(40,10),PHN(40,10)
COMMON /Y/金银(40,10),PH(40,10),RHO(40,10),GAM(40,10)
COMMON /Z/ IMAX(10),JMAX,ISTART,KOUNT,KOUNTP
COMMON /U/ UW(40),VW(40),WW(40),XW(40),YW(40),THW(40)
COMMON /V/ VCN(40,10),VCN(40,10),VCN(40,10),VCN(40,10)

COMMON /I/ X(10),Y(10),Z(10)
COMMON /J/ PHN(40,10),PHM(40,10)

COMMON /K/ RN,RELK,RELK
COMMON /L/ ALPHAN(7,10),ALPHA(7,10),BETAN(7,10),BETA(7,10)
COMMON /M/ JMAX(7,10)
COMMON /O/ ALP(7,10),ALPN(7,10)
COMMON /P/ KCl,KC2,KS1,KS2
COMMON /Q/ J,W,SCN,WX,WX1,YJ,W,INT,ICOWL,MCOWL

COMMON /U/ ER22
COMMON /V/ XJ1
COMMON /W/ ISMEX,IDUMMY,JINT,JINTMY,DUMMY(40),THW(2),JD1,JD2
COMMON /SA/ XJJS

COMMON XRX JRX,INT,XOWL,PCOWL

XV+=XV

IF(JW.GT.JINT) XJ1=0.
I=IS(M,JW)

II=1
II=1

IF(M/2+2.EQ.M) L=1
K=I=L
LL=2*L
RAT=0.
WOU2=0.
PNK=0.

IF(I.EQ.IMAX(JW)-1) GO TO 41
IF(M.EQ.3) GO TO 42
RAT=(ZN(I,JW)+ZN(I+LL,JW))/(ZN(I+L,JW)-ZN(I-LL,JW))

PNK=PN(I+LL,JW)
PN(I,JW)=PN(I+LL,JW)+RAT*PN(I+L,JW)-PNK)
WOU2=UWW(I+LL)/UWW(I+L)
WOU=WOU2+RAT*(WOU1=WOU2)
GO TO 10

41 PAT=(THW(I)-TH(JMAX))/(THW(I)-TH(JMAX))
IS=IS(J,JMAX-1)
PN(I,JW)=PN(IS,JMAX)+RAT1*PN(IS,JW)-PN(IS,JMAX))
PN(K,JW)=PN(I,JW)
10 CONTINUE

THX=THWN(I)*XJ

THDNTHW(I)
YWN(1,J)=RN*SIN(THX)*THWN(I)*((1-XJ)
XWN(1,J)=RN*COS(THX)

IF(XJ+EQ.0.0.
CALL SWALL(RN,ZN(I,J),XWN(1,J),YWN(1),FX,FZ)
IF(XJ+GT.0.0.
CALL SWALL1(RN,ZN(I,J),XWN(1,J),YWN(1),FX,FZ)

TF(M,NE,KC1,ANDNE,KC2) GO TO 11
C1=THN(BETAN(M,JW))*COS(THX)+THN(ALPN(M,JW))*SIN(THX)
C2=THN(BETAN(M,JW))*SIN(THX)+THN(ALP(M,JW))*COS(THX)

ZNXJ=1
IF (XJ1 GT 0.0) ZNXJ = ZN (II, JW)

WOU = (C1 * FX * Z2 * ZNXJ) / (1 - FZ * C2 * ZNXJ)

11 VOU = FX * WOU * FZ

IF (XJ1 GT 0.0) VOU = VOU * ZN (II, JW)

ZSL = Z (II, JW)

USL = UW (II)

VSL = VW (II)

WSL = W (II)

XSL = XW (II)

TAUC = VOU

IT = 1

IF (M.EQ.KC1 .OR. M.EQ.KC2) GO TO 40

60 CONTINUE

IF (XJ1 EQ 0.0)

1 CALL SWALL (R, ZSL, XSL, YSL, FXSL, FZSL)

IF (XJ1 GT 0.0) CALL SWALL1 (THSL, R, ZSL, FXSL, FZSL)

DO = (WOU + WSL) / 2.

ZSLL = ZN (II, JW) / UOU * (XWN (I) = YSL)

RAT = (ZSLL - Z (II, JW)) / (Z (II, JW) - Z (II, JW))

WUSL = TAN (PHE (I, JW)) * RAT * (TAN (PHE (II, JW)) - TAN (PHE (II, JW)))

U1 = 0 (II, JW) * COS (PHE (I, JW))

U2 = 0 (II, JW) * COS (PHE (II, JW))

USL = U1 * RAT * (U2 - U1)

WSL = USL - WUSL

VU1 = TAN (SI (II, JW)) / COS (PHE (I, JW))

VU2 = TAN (SI (II, JW)) / COS (PHE (II, JW))

VUSL = VU1 * RAT * (VU2 - VU1)

VSL = VUSL + WUSL

ER = ABS((ZSLL - ZSL) / (Z (II, JW) - Z (II, JW)))

IF (ER .LT. ERVZZZ) GO TO 40

ZSL = ZSLL

IT = IT + 1

IF (IT LT 10) GO TO 60

WRITE (6, 1000)

000 FORMAT (* ERROR IN ITERATION LOOP IN WDISC*)

CALL PNCX

40 CONTINUE

IF (M.EQ.KC1 .OR. M.EQ.KC2) RAT = 0.

PSL = P (II, JW) + RAT * (P (II, JW) - P (II, JW))

HSL = H (II, JW) + RAT * (H (II, JW) - H (II, JW))

RHOSL = RHO (II, JW) + RAT * (RHO (II, LW, JW) - RHO (II, JW))

PHISL = PHI (II, JW) + RAT * (PHI (II, LW, JW) - PHI (II, JW))

TSL = FT (PSL, PHISL, HSL)

GAMS = FGAM (TSL, PSL, PHISL)

PHN (II, JW) = PHISL

RHON (II, JW) = RHO SL * (PNI II, JW) / PSL ** (1. / GAMS)

VVSL = USL * VSL * VSL * WSL

VVC = VVSL * 2. * GAMS / (GAMS - 1.) * (PSL / RHOSL * PN (II, JW) / RHON (II, JW))

HTSL = HSL * 5. * VVL S

HN (II, JW) = HTSL * 5. * VVC

UWN (II) = SQRT (VVC / (1. * TAUC * TAUC * WOU * WOU))

VWN (II) = UWN (II) * TAUC

WNN (II) = UWN (II) * WOU

PHEN (II, JW) = WOU / (COS (THX) * VOU * SIN (THX))

PHEN (II, JW) = ATAN (PHEN (II, JW))

VB = VWN (II) * COS (THX) - UWN (II) * SIN (THX)
\[ UB = UWN(I) \cdot \sin(THX) + UWN(I) \cdot \cos(THX) \]

\[ WR = UWN(I) \]

\[ QN(I, JW) = \sqrt{WR - WB + UB - UB} \]

\[ \sinh(I, JW) = \text{atan}(VB/QN(I, JW)) \]

\[ ITT = ITT + 1 \]

\[ I = I - 1 \]

\[ \text{IF (ITT GT 2) GO TO 80} \]

\[ \text{IF (M NE KC1 AND M NE KC2) CALL HSHOCK(M, JW, JW, I)} \]

\[ \text{IF (M EQ KC1 OR M EQ KC2) GO TO 10} \]

80  \( XJ1 = XJ1 \)

RETURN

END
SUBROUTINE PLAMES(IND)

COMMON /ALLR1/ AN(40,10), TN(40,10), GMN(40,10), XPLAMN(40,10)*
XXMLAMN(40,10)
COMMON /B/ PN(40,10), PHIN(40,10), RHON(40,10), HN(40,10), ZN(40,10)
COMMON /JF/ JFTNAL
COMMON /A/ X, ITHMAX, TH(10) * R, Z(40,10), P(40,10), PHF(40,10) *
1 Q(40,10), SI(40,10), H(40,10), PH(40,10), RH(40,10), GM(40,10)
COMMON /C/ IMAV(10), JMAX, ISTART, KOUNT, KOUNTP
COMMON /H/ ISIM
COMMON /J/ QN(40,10), PHN(40,10), SINN(40,10), XPLAM(40,10)*
1XMLAM(40,10), FP(40), FM(40), A(40,10)
COMMON /IS/ ISM(7,10)
COMMON /S/ RI, KOUN, KOUNP, ICOWL, PCOWL
COMMON /V/ XJ1
COMMON /W/ ISIMEX, IDUMMY, JINT, JINDEX(40) * THWW(2), JD1, JD2
COMMON /JO/ NUMEXP * ZSAV
COMMON /PS/ ZR(40,2), PR(40,2), QR(40,2), SR(40,2), RHOR(40,2)
1, PHIR(40,2), PHER(40,2), THR(2), THWR(40)
COMMON /SPE/ KOUNTC
COMMON /PL/ DELTH
IF(IND-EQ.0) ZDUMMY(1) = Z(1, JINT)
IF(IND-EQ.1) ZDUMMY(1) = ZN(1, JINT)
J1 = JINT
J2 = JINT + 1

DO 461 I = NUMEXP * IMAXJ
L = I
Z X = Z/I, JINT/
IF(IND-EQ.1) ZX = ZN/I, JINT/
IF(ZX GT 0.0) ZSAV GO TO 465

461 CONTINUE

462 IDUMMY = L = 1
IF(IND-EQ.1) GO TO 34

DELTH = 1000.0
DO 1000 J = J2, JMAX
I = JMAX + 2 - J
IF(JMAX-EQ.0) I = I - 1
DEL(T = 2 * J)
IF(XJ GT 0.0) DEL = ATAN(DEL/ZDUMY(I))
IF(DEL + LT = DELTH) DELTH = DEL
CONTINUE
DELTH = 99 * DELTH
IF(DELTH GT TH(JINT) - TH(JINT - 1)) DELTH = TH(JINT) - TH(JINT - 1)
34 CONTINUE
ZDUM = DELTH
ZDUMZDUM
J = 1
DO 25 I = 1, NUMEXP
IF(THJ GT 0.0) ZDUM = ZDUMMY(I) * TAN(ZDUM)
J = J + 1
CALL TBL(ZDUM, PR(I, J), SR(I, J), HR(I, J), PHIR(I, J), QR(I, J), PHER(I, J)
1, RH(1) = GA/TX, J = IMAX(JM) + 2
PHOR(IRE) = RHEQ(HR(I, J), PR(I, J), PHIR(I, J))
T = FT(PR(I, J), PHIR(I, J), HR(I, J))
THWR(I, J) = FGAM(T, PR(I, J), PHIR(I, J))

}
7R(I,J)=ZDUMMY(I)
    IF(XJ*GT*0.) ZR(I,J)=ZR(I,J)/COS(ZDUMS)
    IF(I.NE.1) GO TO 1500
    IF(ISYM.EQ.1) GO TO 1500

    XTER
    IF(XJ.EQ.0.) CALL SWALL(R*ZDUM*,XT,VT,FX,FZ)
    IF(XJ.GT.0.) CALL SWALL1(THX,R*ZDUM*,FX,FZ)

    TSI=COS(PHER(I,J))*FX+SIN(PHER(I,J))*FZ

    SIR(I,J)=ATAN(TSI)
1500 CONTINUE

    UI=QR(I,J)*COS(PHER(I,J))
    IF(XJ.GT.0.) GO TO 2001
    V1=QR(I,J)*SIN(PHER(I,J))

    WI=QR(I,J)*TAN(SIR(I,J))
    GO TO 2002

2001 WI=QR(I,J)*SIN(PHER(I,J))
    VT=QR(I,J)*TAN(SIR(I,J))
    V1=VT*COS(ZDUMS)+VT*SIN(ZDUMS)
    WI=VT*COS(ZDUMS)+VT*SIN(ZDUMS)

2002 CONTINUE

    QR(I,J)=Sqrt(UJ*UJ+W1*W1)
    PHER(I,J)=ATAN(W1/U1)
    SIR(I,J)=ATAN(V1/OR(I,J))

26 CONTINUE

    DO 1001 I=1,IDUMMY
    IF(INN.EQ.0) CALL TBLDUM(Z(I,JNT),PR(I,J),SIR(I,J),WR(I,J),PHIR(I,J),RHOR(I,J),THWP(I),I,1,IDUMMY,I)
    IF(INN.EQ.1) CALL TBLDUM1(ZN(I,JNT),PR(I,J),SIR(I,J),WR(I,J),PHIR(I,J),RHOR(I,J),THWP(I),I,1,IDUMMY,I)
    IF(INN.EQ.0) ZR(I,J)=Z(I,JNT)
    IF(INN.EQ.1) ZR(I,J)=ZN(I,JNT)
1001 CONTINUE

    THR(?)=TH(JNT)*DELT
    RETURN

    END
SUBROUTINE ALWRAP(M)
COMMON /A/ X1*, THMAX, TH(10), R, Z(40,10), P(40,10), PHF(40,10),
Q(40,10), S1(40,10), H(40,10), PH1(40,10), RH0(40,10), GAM(40,10)
COMMON /R/ P1N(40,10), PHIN(40,10), RHON(40,10), HN(40,10), ZN(40,10)
COMMON /L/ ALPHAN(7,10), ALPHA(7,10), BETAN(7,10), BETA(7,10)
COMMON /IS/ IS(7,10)
COMMON /ALP/ ALP(7,10), ALPN(7,10)
COMMON /W/ ISIMEX, IDUMMY, JINT, JDUMMY(40), THWW(2), JD1, JD2
COMMON /IQ/ NUMEXP, ZSAV
COMMON /XJ/ XJ1
J1=JINT-1
J2=JNT
J3=JINT+1
J4=JINT+2
I1=IS(M+J1)
I2=IS(M+J2)
I3=IS(M+J3)
I4=IS(M+J4)
P2=ZN(I2,J2)-ZSAV
P3=ZN(I3,J3)
PQ2= (ZN(I2,J2)-ZN(I1,J1))/(TH(J2)-TH(J1))
PQ3= (ZN(I4,J4)-ZN(I3,J3))/(TH(J4)-TH(J3))
F1=1.5707963
F2=F1+F1
AL3=RQ3
AL2=RQ2
ALPN(M+J2)=ATAN(AL2)
ALPN(M+J3)=ATAN(AL3)
ALPHAN(M+J2)=ATAN(AL2*COS(BETAN(M+J2)))
ALPHAN(M+J3)=ATAN(AL3*COS(BETAN(M+J3)))
RETURN
END
SUBROUTINE ADDSUP

COMMON /ALLR1/ AN(40,10), TN(40,10), GAMN(40,10), XPLAMN(40,10)
COMMON /TEM/ T(40,10)
COMMON /X/ X(40,10)*THMAX(10)*R, Z(40,10)*P(40,10)*PHF(40,10)
COMMON /Y/ Sl(40,10)*H(40,10)*PHF(40,10)*RHO(40,10)*GAY(40,10)
COMMON /Z/ PN(40,10)*PHN(40,10), RHON(40,10)*H(40,10)*ZN(40,10)
COMMON /C/ IMAX(10), JMAX, ISTART, KOUNT, KOUNTP
COMMON /D/ UW(40)*VW(40)*WW(40)*XW(40)*YW(40)*THW(40)
COMMON /E/ ON(40,10)*PHEN(40,10), XPLAM(40,10)
COMMON /F/ PN(40,10)*PHIN(40,10)*RHON, ZN(40,10)*SHORT
COMMON /G/ UW(4), VW(40)*WW(40)*XW(40)*YW(40)*THW(40)
COMMON /H/ DS(40,10)*PHN(40,10), SINN(40,10)
COMMON /I/ ALPHAN(7,10)*ALPHA(7,10), BPTAN(7,10)*BETA(7,10)

DO 30 I=1, NUMEXP
NUMEXP=NUMEXP+1
GO TO 36

520 IT=IT+1
510 CONTINUE
IF (IT.EQ.0) GO TO 502
GO TO 600

100 JMAX=JMAX+1

IF (ICOWL.EQ.0) GO TO 505
DO 30 I=1, NUMEXP
30 JUMMY(I)=Z0*NUMMY(I)
NUMEXP=NUMEXP+1
GO TO 505

502 IF (JW.LT.2) GO TO 36
WRITE(*,37)
37 FORMAT(' PROGRAM ATTEMPTING TO ADD REFERENCE PLANE - DIMENSION TOO')

CALL PNCHE
STOP

36 CONTINUE
JMAX=JMAX+1
JW=JW+1
JMAX(JW)=IMAX(JW-1)
JZ=JW+1
IF (ICOWL.EQ.0) GO TO 505
DO 40 I=1, NUMEXP
40 IT=NUMEXP+1
GO TO 36
40 ZDUMMY(II)=ZDUMMY(II)

NUMEXP=NUMEXP+1

505 CONTINUE
TH(JW)=TH(JZ)
IF (ICNWLT.EQ.1) TMAXJ=TMAXJ+1
DO 535 I=1,TMAXJ
Z(I,JW)=Z(I,JZ)

P(I,JW)=P(I,JZ)
PHE(I,JW)=PHE(I,JZ)
SI(I,JW)=SI(I,JZ)

H(I,JW)=H(I,JZ)
O(I,JW)=O(I,JZ)
PHI(I,JW)=PHI(I,JZ)

RHO(I,JW)=RHO(I,JZ)
L=JW
T(I,JW)=FP(I,L)*PHI(I,L)*H(I,J)

535 CONTINUE
IF (ICNWLT.EQ.1) GO TO 20
DO 12 I=1,7
ALP(I,JW)=ALP(I,JZ)
ALPHA(I,JW)=ALPHA(I,JZ)
RETA(I,JW)=RETA(I,JZ)

12 I=12*JW
10 CONTINUE
TH(JZ,GT.JW) GO TO 601
TH(JMAX)=TH(JMAX-1)+DELT
IF (ICNWLT.EQ.1) ZDUMMY(2)=ZDUMMY(3)-DELT
J=JMAX
JL=J-7
DO 540 I=1,TMAXJ
Z(I,J)=Z(I,JW)

IF (ICNWLT.EQ.1) GO TO 31
IF (I.EQ.1) CALL RWALL(R,TH(J),T(I,J),DUM,DUMJ)

IF (I.EQ.TMAX(JW)) CALL T WALL(R,TH(J),T(I,J),DUM,DUM)
GO TO 32

31 IF (I.NE.1) GO TO 32
Z(I,J)=0
CALL TBL(ZDUMMY(2),P(I,J),SI(I,J),H(I,J),PHI(I,J),Q(I,J),PHE(I,J)
1,RHO(I,J),GAMX,THX,JINT,IDUMMY,2)
U1=Q(I,J)*COS(PHE(I,J))
V1=Q(I,J)*TAN(SI(I,J))
W1=Q(I,J)*SIN(PHE(I,J))

WT=W1
Q(I,J)=SORT(U1*U1+WT*WT)
PHE(I,J)=ATAN(WT/U1)
SI(I,J)=ATAN(VT/Q(I,J))
GO TO 33

32 CONTINUE
RAT=DELT/(THW(I)-TH(JMAX-1))
SI(I,J)=SI(I,J1)+RAT*(SI(I,JW)-SI(I,J1))
Q(I,J)=Q(I,J1)+RAT*(Q(I,JW)-Q(I,J1))
H(I,J) = H(I,J) + RAT*(H(I,JW) - H(I,J))
PHE(I,J) = PHE(I,J) + RAT*(PHE(I,JW) - PHE(I,J))
PHI(I,J) = PHI(I,J) + RAT*(PHI(I,JW) - PHI(I,J))
RHO(I,J) = RHO(I,J) + RAT*(RHO(I,JW) - RHO(I,J))

CONTINUE

1 = J
T(I,L) = FT(P(I,L) + PHI(I,L) + H(I))
GAM(I,L) = FGAM(T(I,L) + P(I,L) + PHI(I,L))
A(I,L) = SQRT(GAM(I,L)^2 + P(I,L)^2 + RHO(I,L))
CALL XLAM(Q(I,L), A(I,L) + PHE(I,L), XPLAM(I,L), XMLAM(I,L))
T(I,NE,IS(I,J)) = T(I,NE,IS(I,J)) + T(I,NE,IS(3,J))
GO TO 540
M = 1
IF(I, EQ, IS(3,J)) M = 3
TANALP = TAN(ALP(M,J)) + RAT*(TAN(ALP(M,JW)) - TAN(ALP(M,J)))
7(I,J) = 2(I,J) + (TAN(ALP(M,J)) - TAN ALP) * DELTH/2.
Z(I,J) = Z(I,J) + TAN(ALP(M,J))

IF(M.EQ.3) GO TO 402
CALL HSHOCK(M,J)

P(I-1,J) = P(I-1,J)
G(I-1,J) = G(I-1,J)
H(I-1,J) = H(I-1,J)
T(I-1,J) = T(I-1,J)
A(I-1,J) = A(I-1,J)
SI(I-1,J) = SI(I-1,J)
PHA(I-1,J) = PHA(I-1,J)
PHI(I-1,J) = PHI(I-1,J)
RHO(I-1,J) = RHO(I-1,J)
GAM(I-1,J) = GAM(I-1,J)
XPLAM(I-1,J) = XPLAMN(I-1,J)
XMLAM(I-1,J) = XMLAMN(I-1,J)
GO TO 540

402 CONTINUE

540 CONTINUE
GO TO 600

601 IF(IMAX(JMAX), EQ, IMAX(JW)) GO TO 600
DO 602 IMAX = 1, IMAX
CALL TABL(Z(I,JW), P(I,JMAX), SI(I,JMAX), HN(I,JMAX), PHIN(I,JMAX),
IGN(I,JMAX), PHEN(I,JMAX), RHON(I,JMAX), THX, JMAX, IMAX, JMAX, I)
CONTINUE
DO 603 IMAX = 1, IMAX
Z(I,JMAX) = Z(I,JW)
P(I,JMAX) = PN(I,JMAX)
H(I,JMAX) = HN(I,JMAX)
G(I,JMAX) = GN(I,JMAX)
SI(I,JMAX) = SI(I,JMAX)
PHE(I,JMAX) = PHEN(I,JMAX)
PHI(I,JMAX) = PHIN(I,JMAX)
RHO(I,JMAX) = RHON(I,JMAX)
L = JMAX
T(I,L) = FT(P(I,L) + PHI(I,L) + H(I))

402 CONTINUE

540 CONTINUE
GO TO 600
GAM(I*L) = FGAM(T(I*L) * P(I*L) * PHI(I*L))
A(I*L) = SQRT(GAM(I*L) * P(I*L) / RHQ(I*L))
CALL XLM(Q(I*L) * A(I*L) * PHE(I*L) * XPLAM(I*L) * XMLAM(I*L))

CONTINUE

I MAX(J MAX) = I MAX(J W)
CONTINUE
RETURN

END
SUBROUTINE EMBFD

COMMON /A/ XI,THXX,TH(10),R
1 Z(40,10),P(40,10),PH(40,10)
1 0(40,10),S1(40,10),H(40,10),PM(40,10),RH(40,10),GAM(40,10)

COMMON /C/ IMA(10),JMAX,ISTART,KOUNT, KOUNT

COMMON /J/ QN(40,10),PHEN(40,10),SINN(40,10),XPLAM(40,10)
1 XMLAM(40,10),FP(40),FM(40),A(40,10)

COMMON /L/ ALPHAN(7,10),ALPHA(7,10),BFTAN(7,10),BETA(7,10)

COMMON /M/ IS(7,10)

COMMON /O/ ALP(7,10),ALPN(7,10)

COMMON /R/ JXCN,XCXX,JW,INIT,ICW,L,RCWL

COMMON /S/ RI, KOUNT, KOUNTS, ICWL, RT

DATA TM2/0/; IM2/0/

DPHES=7.5757.3

DO 500 M=1,17

IF(M .NE. 2 .AND. M .NE. 7) GO TO 500

IF(M .EQ. 1 .AND. M .EQ. 7) GO TO 500

IF(M .EQ. 2 .AND. M .EQ. 7) GO TO 500

IF(M .EQ. 2 .AND. M .EQ. 7) GO TO 500

IFS=J1,06

DELRR=1.,E+06

IM=IMAX(J)+1

DO 1 I=1,IM

1 DZ=Z(I+1,J)-Z(I,J)

IF(DZ.LT.1.E-04) GO TO 1

DZLAM=XPLAM(I,J)=XPLAM(I,J)

IF(M .EQ. 2) DZLAM=XPLAM(I,J)=XPLAM(I,J)

IF(DZLAM .LT. 1.E-10) GO TO 1

DI=DI+1

IF(DI .LT. DELRR) 17,17,1

17 DELRR=DI

IS(M,J)=I+1

IF(M .EQ. 2) IS(M,J)=I

1 CONTINUE

DJ=DELRR

IF(DJ .GT. DELJ) 5,5,6

5 DELJ=DELJ

JS=J

6 CONTINUE

IF(DFL .GT. 10.) GO TO 502

K=IS(M,J)

L=1

IF(M .EQ. 2) L=1

PHET=XPLAM(K,J)=XPLAM(K,l,J)

IF(M .EQ. 2) PHET=XPLAM(K,JS)=XPLAM(K,J)

IF(ABS(PHET/DPHES) .GT. 1.) GO TO 501

GO TO 502

501 J=JS

WRITE(6,503)

503 FORMAT(1H1)

IF(M .EQ. 7) GO TO 506

WRITE(6,505) IS(M,J)+J

505 FORMAT(10X,9D15.6X)

1+J = #I2)

GO TO 11
506 WRITE(6,508) IS(M,J),J
508 FORMAT(10X,*UPRUNNING EMBEDDED SHOCK FOUND AT I = *,I3,6X,
1*J = **I2)
11 CONTINUE
IF(M.EQ.2) IM2=1
IF(M.EQ.7) IM7=1
502 DO 509 J=1,JW
509 IS(M,J)=0
500 CONTINUE
RETURN
END
SUBROUTINE DERIVN(MM)

COMMON /SIG/ NUMEXP,ZINV
COMMON /WR/ IWRAP
COMMON /ALLR1/ AN(40,10),TN(40,10),GAN(40,10),XPLAMN(40,10)
IYMLAMN(40,10)
COMMON /ALLR2/ PON(40,10),HON(40,10),AQ(40,10),SIGN(40,10)
1PHON(40,10),PHIQN(40,10),RHQN(40,10),GAMQN(40,10)
COMMON /A/ XI,THMN,TH(10),Z(40,10),P(40,10),PHE(40,10)
1(40,10),SI(40,10),H(40,10),PUL(40,10),RHO(40,10),GAM(40,10)
COMMON /B/ PN(40,10),PHIN(40,10),RHON(40,10),HN(40,10),ZN(40,10)
COMMON /C/ IHMAX,JSMAX,START,KOUNT,KOUNTP
COMMON /D/ UW(40),VW(40),WW(40),XW(40),YW(40),THW(40)
COMMON /E/ UWN(40),VWN(40),WWN(40),XWN(40),YWN(40),THWN(40)
COMMON /F/ ISIM
COMMON /G/ XCOLW
COMMON /H/ STM
COMMON /I/ XJ
COMMON /J/ ON(40,10),PHEN(40,10),SINN(40,10),XPLAM(40,10)
IYMLAM(40,10),FP(40),FM(40),A(40,10)
COMMON /K/ RN,ELR
COMMON /M/ IS(7,10)
COMMON /N/ SIQ(40,10),PQ(40,10),PHEQ(40,10),HQ(40,10),PHIQ(40,10)
1QQ(40,10),RHOQ(40,10),GAMQ(40,10)
COMMON /Q/ XCOLW
COMMON /S/ JCOLQ,JCQ,JCALQ,ISQ,JSQ,ISTEM,ISTEMR
COMMON /T/ IB,IMAX,IS1,IS2,ISL1,ISL2
COMMON /U/ JCALC,ISW,ISW1,IFR
COMMON /V/ JNDERV,DPZN(40),DUZN(40),DVZN(40),DWZN(40)
COMMON /W/ JFINF
COMMON /X/ RI,KOUNT,KOUNTS,ICOLW
COMMON /Y/ DE,TH
COMMON /Z/ XJ1
COMMON /S/ PZR(40,2),PR(40,2),OR(40,2),HR(40,2),SIR(40,2),RHR(40,2)
1PHIR(40,2),PHER(40,2),THR(2),THWR(40)
COMMON /P/ SSS,GAMR(40)
DO 10 J=1,IMAX
JSOQ=0
IF(J.EQ.JCALC) GO TO 10
IF(J.EQ.JCALC.AND.IFR.EQ.1) GO TO 10
JM=J
JPEJ+1
IF(J.EQ.JCALC) JP=J
IF(J.EQ.1) JM=JP
IF(ISIM.EQ.1.AND.J.EQ.IMAX) JP=JM
IMAX J =IMAX(J)
DO 20 I=1,IMAX,J
THJ=THWN(I)
IF(JP.NE.JW) THJ=TH(JP)
IF(ISIM.EQ.1.AND.JP.EQ.JMAX) THJ=TH(JMAX)
IF(J.EQ.1.AND.I.EQ.IDUMMY) GO TO 20
DZ=ZN(I,J)-ZN(I,JM)
DTH=TH(J)-TH(JM)
NUMZ=1
IF(XJ.GT.0.) NUMZ=5*(ZN(I,J)+ZN(I,JM))
NUMR=1
IF(XJ.GT.0.) NUMR=R
10 CONTINUE
\[nS1=\sqrt{(DZ^2 + DZ^2 + (DTH^2 + DUMZ^2 + DUMR^2))^{**2}}\]

IF (J, EQ, JINT, AND, I, GT, IDUMMY) GO TO 901

\[nZ = ZN(I, JP) - ZN(I, J)\]

\[nDTH = TH(J) - TH(J)\]

\[nUMZ = 1\]

IF (XJ, GT, 0.) NUMZ = 5*(ZN(I, J) - ZN(I, JP))

\[nD2 = \sqrt{(DZ^2 + DZ^2 + (DTH^2 + DUMZ^2 + DUMR^2))^{**2}}\]

IF (J, EQ, JINT + 1) GO TO 900

\[n1 = DS1/DS2\]

\[n2 = DS2/DS1\]

\[n3 = D1 - D2\]

GO TO 902

901

\[n1 = 0,\]

\[n2 = 1,\]

\[n3 = 1,\]

IF (I, LT, IS(3, J) - 1) GO TO 909

JSHOC = 1

\[nJ = J\]

\[nI = I\]

\[nD1 = DS1/DS2\]

\[n2 = DS2/DS1\]

\[n3 = D1 - D2\]

909 CONTINUE

GO TO 902

900

\[n1 = 1,\]

\[n2 = 1,\]

\[n3 = 1,\]

IF (I, LT, IS(3, J) - 1) GO TO 910

JSHOC = 2

\[nJ = J\]

\[nI = I\]

\[nD1 = DS1/DS2\]

\[n2 = DS2/DS1\]

\[n3 = D1 - D2\]

910 CONTINUE

902 CONTINUE

M = I

nI = I

IF (JSHOC.EQ.1) M = IA

IF (JSHOC.EQ.2) N = IB

\[nDTH = TH(J)\]

IF (ISIM.EQ.1, AND, J, EQ, JMAX) DTH = TH(JMAX) = TH(JMAX)

IF (JSHOC.EQ.1) DTH = (ZN(I, J) - ZSAV) * 3.142/2. * D1 + (TH(J) - TH(JM)) * D2

IF (JSHOC.EQ.2) DTH = (TH(JP) - TH(J)) * D1 + ZN(I, J) * 3.142/2. * D2

IF (JSHOC.EQ.1) DSZ = (ZN(I, J) - ZN(I, JM)) * D2 + (ZN(M, JP) - ZN(I, J) + ZSAV) * D1

IF (JSHOC.EQ.2) DSZ = (ZN(I, J) - ZN(I, JM)) * D2 + (ZN(M, JP) - ZN(I, J) + ZSAV) * D1

IF (JSHOC.EQ.1) DZP = D1 + P

IF (JSHOC.EQ.2) DZP = D1 + P

IF (N, LT, J) DZP = D2 + P

IF (N, GT, J) DZP = D3 + H

IF (N, EQ, J) DZP = D2 + H

N
DO S=D1*Q N(M,JP)=D3*Q N(I,J)=D2*Q N(N,JM)
DPHES=D1*PHEN(M,JP)=D3*PHEN(I,J)=D2*PHEN(N,JM)
DPHIS=D1*PHIN(M,JP)=D3*PHIN(I,J)=D2*PHIN(N,JM)
DRO=0=D1*RHON(M,JP)=D3*RHON(I,J)=D2*RHON(N,JM)
DGAMS=D1*GAMN(M,JP)=D3*GAMN(I,J)=D2*GAMN(N,JM)
DSI S=D1*SINN(M,JP)=D3*SINN(I,J)=D2*SINN(N,JM)
IF (I.EQ.1) DSI S=SINN(I,J)
IF (STM.EQ.1.AND.J.EQ.MAX) DST S=SINN(I,JMAX=1)
40 IF (I.EQ.1) GO TO 50
IF (I.EQ.IMAXJ) GO TO 50
IF (ICNE{NLE1)) GO TO 400
IF (L.1.IS(I,J)=MM.OR.I.GT.IS/I,J)) GO TO 400
DP ZN=0.
DH ZN=0.
DQ ZN=0.
DPHEZN=0.
DPHIZN=0.
DROHZN=0.
DGAMZN=0.
GO TO 60
400 CONTINUE
IF (I.EQ.IS(I,J)OR.I.EQ.IS/I,J)-1) GO TO 50
IF (I.EQ.IS(3,J)OR.I.EQ.IS/I,J)-1) GO TO 50
1P=I+1
IM=1
D1Z1=ZN(IP, J)=ZN(I,J)
D2Z2=ZN(21,JJ)=ZN(IM,J)
D1=D1Z1/D2Z2
D2=D2Z2/D1Z1
D3=D1/D2
D1PD2=D1+D2
DP ZN = (DI*P N(IP,J)=D3*P N(I,J)=D2*P N(N,JM))/D1PD2
DH ZN = (DI*H N(IP,J)=D3*H N(I,J)=D2*H N(N,JM))/D1PD2
DQ ZN = (DI*Q N(IP,J)=D3*Q N(I,J)=D2*Q N(N,JM))/D1PD2
DPHEZN = (DI*PHEN(IP,J)=D3*PHEN(I,J)=D2*PHEN(N,JM))/D1PD2
DPHIZN = (DI*PHIN(IP,J)=D3*PHIN(I,J)=D2*PHIN(N,JM))/D1PD2
DROHZN = (DI*RHON(IP,J)=D3*RHON(I,J)=D2*RHON(N,JM))/D1PD2
DGAMZN = (DI*GAMN(IP,J)=D3*GAMN(I,J)=D2*GAMN(N,JM))/D1PD2
DSI ZN = (DI*SINN(IP,J)=D3*SINN(I,J)=D2*SINN(N,JM))/D1PD2
GO TO 60
50 CONTINUE
! = !
IF (I.EQ.IMAXJ) GO TO 100
DO 421 M=1,7
IF ((M/2)#2.EQ.KA1.AND.I.EQ.IS(M,J)-1) GO TO 100
421 CONTINUE
! = #
1L=I+L
I2L=I2+L
DZ=ZN(I,J)=ZN(1L,J)
D7L=ZN(I,J)=ZN(I2L,J)
IF (ABS(DZL).GT.1.E-10) GO TO 5000
DEL=0.
GO TO 5001
1A2
RHOGN(I,J3)=(RHN0(I,J4)*A1A2-RHN0(I,J3)*A12-RHN0(IDU,J2)*A2A1)/A1P
1A2
GAMGN(I,J3)=(GAMN(I,J4)*A1A2-GAMN(I,J3)*A12-GAMN(IDU,J2)*A2A1)/A1P
1A2
IMAXJ2=IMAX(J2-1)
DO 7979 I=1,IMAXJ2
7 P(R(I,J1)=Z N(I,J2)=1)
P R(I,J1)=P N(I,J2)=1
Q R(I,J1)=Q N(I,J2)=1
H R(I,J1)=H N(I,J2)=1
SI R(I,J1)=SINN(I,J2)=1
PHIR(I,J1)=PHIN(I,J2)=1
PHER(I,J1)=PHEN(I,J2)=1
RHOR(I,J1)=RHON(I,J2)=1
7979 CONTINUE
DO 7878 I=1,IMAXJ2
DO 3535 J=1,IMAXJ2
GAMRP(I,J)=THWR(I,J)
3535 THWR(I,J)=GAMM(I,J2-1)
CALL TBLDUM(ZN(I,J2),P1,S1,H1,PH1,Q1,PHE1,RHO1,GAM1,1,IMAX(1,J2-1))
3536 THWR(I,J)=GAMMR(I,J)
CALL TBLDUM(ZN(I,J2),P2,S2,H2,PH2,Q2,PHE2,RHO2,GAM2,2,IMAX(1,J2-1))
D1=TH(J2)-TH(J2-1)
D2=THR(J2-1)-TH(J2)
D1D2=D1/D2
D2D1=D2/D1
D12=D1D2-D2D1
D1PD2=D1+D2
P QN(I,J2)=(D1D2*P 2-D12*P N(I,J2)=D2D1*P 1)/D1PD2
H QN(I,J2)=(D1D2*H 2-D12*H N(I,J2)=D2D1*H 1)/D1PD2
Q QN(I,J2)=(D1D2*Q 2-D12*Q N(I,J2)=D2D1*Q 1)/D1PD2
SI QN(I,J2)=(D1D2*SI 2-D12*SI N(I,J2)=D2D1*SI 1)/D1PD2
PHIQN(I,J2)=(D1D2*PH12-D12*PH1 N(I,J2)=D2D1*PH1 1)/D1PD2
PHEQN(I,J2)=(D1D2*PHE2-D12*PHE2 N(I,J2)=D2D1*PHE2 1)/D1PD2
RHOQN(I,J2)=(D1D2*RHO2-D12*RHO2 N(I,J2)=D2D1*RHO2 1)/D1PD2
GAMQN(I,J2)=(D1D2*GAM2-D12*GAM2 N(I,J2)=D2D1*GAM2 1)/D1PD2
7878 CONTINUE
955 CONTINUE
IF(I*STM.EQ.1) RETURN
IMXI=IMAX(JW)-1
DO 1234 I=2,IMX1
IF(I*EQ.IS(3*JW))=1,OR.I*EQ.IS(3*JW)
OP*I*EQ.IS(3*JW)
1234 GO TO 1234
TSI=TAN(SINN(I,JMAX))
THJ=TH(JMAX)*XJ
STW=STN(THJ)
CTH=COS(THJ)
CPHEP=COS(PHEN(I,JMAX))
UP1=ON(I,JMAX)*(CPHEP*CTH-TSI*STH)
VP1=ON(I,JMAX)*(CPHEP*STH+TSI*CTH)
WP1=ON(I,JMAX)*STN(PHEN(I,JMAX))
YDUM=THWN(I)-THWN(I-1)
ZDUM={}

IF(XJ>GT.0.) ZDUM=(ZN(I+JW)+ZN(I-1+JW))/2.
IF(XJ.EQ.0.) YDUM=YWN(I)-YWN(I-1)
DS1=(ZN(I+JW)-ZN(I-1+JW))*2*(YDUM*ZDUM)**2
DS1=SORT(DS1)
YDUM=THWN(I+1)-THWN(I)
ZDUM=1.

IF(XJ>GT.0.) ZDUM=(ZN(I+1+JW)+ZN(I+JW))/2.
IF(XJ.EQ.0.) YDUM=YWN(I+1)-YWN(I)
DS2=(ZN(I+1+JW)-ZN(I+JW))*2*(YDUM*ZDUM)**2
DS2=SORT(DS2)
D1=DS1/DS2
D2=DS2/DS1

D3=D1-D2
DY=THWN(I)-TH(JMAX)
Y1=TH(J)
IF(XJ>GT.0.) Y1=DN*SIN(Y1)
IF(XJ.EQ.0.) DY=YWN(I)-Y1
DY=VWN(I)-UP1)/DY
DY=VWN(I)-VP1)/DY
DY=WWN(I)-WP1)/DY
DP Y=(P N(I+JW)-P N(I,JMAX))/DY
Y3=THWN(I+1)
IF(XJ>GT.0.) Y3=YWN(I+1)
Y2=THWN(I)

IF(XJ>GT.0.) Y2=YWN(I)
Y1=THWN(I-1)
IF(XJ.EQ.0.) Yj=YWN(I-1)
DY=DI*Y3=D3*Y2=DP1*Y1
D2 S=D1*Z N(I+1+JW)-D3*Z
DP S=D1*P N(I+1+JW)-D3*P

D3*UWN(I+1)-D*UWN(I)=D2*UWN(I-1)
DVS=D1*UWN(I+1)-D3*UWN(I)=D2*UWN(I-1)
DWS=D1*UWN(I+1)-D3*UWN(I)=D2*UWN(I-1)

DP ZN(I) =(DP S=DP Y*DYS)/DZS
DZN(I) =(DUS=DUY*DYS)/DZS
DYN(I) =(DVS=DVY*DYS)/DZS

123 CONTINUE
RETURN
END
SUBROUTINE WALL (RN*ICOWL+IIT+ITT)

COMMON /AV/AAV+RAV
COMMON /ALLR1/VN(40,10),TN(40,10),GAMN(40,10),XPLAMN(40,10)

1XM&NN(40,10)

COMMON /ZNDERV/ DPZN(40),DUZN(40),DVZN(40),NWZN(40)

COMMON /J/ QN(40,10),PHEN(40,10),SINN(40,10),XPLAM(40,10)

1XM&NN(40,10),FP(40),FM(40),A(40,10)

COMMON /IVY/ IVY+KCORR+AV

COMMON /TEM/ T(40,10)

COMMON /A/ X1,THMA,TH(10),P(40,10),PH(40,10)

COMMON /R/ PN(40,10),PHI(40,10),RH(40,10),ZP(40,10)

COMMON /C/ IMAX(10),JMAX,ISTART,IONTF,KOUNTP

COMMON /D/ UW(40),VW(40),WW(40),XW(40),YW(40),THW(40)

COMMON /E/ UMN(40),WMN(40),WWM(40),XWM(40),YN(40),TWH(40)

COMMON /F/ XPF(40)

COMMON /I/ XJ

COMMON /M/ IS(7,10)

COMMON /S/ RI,KOUNTS,THMAX,ICOWLT

COMMON /U/ ERZZZ

COMMON /V/XJ1

COMMON /W/ SIMEX,IDUMMY,JINT,7DIMMY(40),THWW(2),JD1,JD2

COMMON /SA/ XJIS

COMMON /FWA/ ISOP

DIMENSION XPLN(40),BN(40)

DIMAX=JMAX

IF(JW.GT.JINT) XJ1=0.

MMAX=MAX(JMAX)

DO 5 J=JMAX+JW

JJ=1

TF(J*,EQ,JW) JJ=2

II=2

DO 10 IN=1,MMAX

IF(ICOWL.EQ,1.AND.I.GT.IIT+AND.I.LT.IIT) GO TO 10

DO 89 M=1,7

IF(IS(M,MAX)).EQ.0) GO TO 89

TTEST=IS(M,J)-1

IF((M+2)*2.EQ.M) TTEST=IS(M,J)

IF(I.EQ.ITEST) AND.I.E.Q.ITEST+1) GO TO 89

II=1

RAT=1.

GO TO 200

CONTINUE

IF(I.EQ.1.OR.I.EQ.MMAX) GO TO 16

IF(J.EQ.JW) ZN(I,J)=ZN(I,JMAX)

12 IF(ZN(I,J)+LE.Z(I,J)) GO TO 16

II=II+1

GO TO 12

15 RAT=(ZN(I,J)-Z(I,J-1,J))/Z(I,J)-Z(I-1,J))

16 IF(I.EQ.1)RAT=0.

IF(I.EQ.MMAX) RAT=1.

IF(I.EQ.MMAX) II=I

200 IF(XJ1.EQ.0.)
GO TO 9
8   THWN(I) = YWN(I)
9   CONTINUE
   RAT = .E
   IT = 1
   THA = TH(JMAX) + RAT * (THP(I, 2) - TH(JMAX))
25  U = U + RAT * (UP(I, 2) - V + P(I, 1))
   V = V + RAT * (V P(I, 2) - V + P(I, 1))
   H = H + RAT * (H P(I, 2) - H + P(I, 1))
   D = D + RAT * (D P(I, 2) - D + P(I, 1))
   W = W + RAT * (WP(I, 2) - W + P(I, 1))
   RHOP = RHOP(I, 2) - RHOP(I, 1) + RAT * (RHOP(I, 2) - RHOP(I, 1))
   THAX = THA * XJ
   XA = COS(THAX)
   VA = SIN(THAX) + THA * (1.0 - XJ)
   PHIA = PHI(I, 1) + RAT * (PHIP(I, 2) - PHI(I, 1))
   TA = FT(PA, PHIA, HA)
   GAMMA = GAM(TA, PA, PHIA)
   AA = SQRT(GAMMA / PHOA)
   TAU = VA / AA
   UA2 = UA * UA
   AA2 = AA * AA
   VA2 = VA * VA
   ETA = SQRT((UA2 + VA2)/(AA2 - 1.0))
   ALAM = (UA + VA + AA2 * ETA) / (UA2 - AA2)
   DUMP = A93 * ALAM + B93 * XPLN(I)
   IF (XJ, EQ, 0.0) GO TO 32
   THAT = YWN(I) = XWN(I) - XA) * DUMP
   THAT = SIN(THAT/R)
   GO TO 33
32  IF (XJ, EQ, 0.0)
1   THAT = YWN(I) = (XWN(I) - XA) * DUMP
   IF (XJ, EQ, 0.0) THAT = YWN(I) = DUMP * (RN - R) / ZN(I, JW)
33  CONTINUE
   FP = ABS(1.0 - THAT / THA)
   IF (FP, LT, 1.0E - 04) GO TO 30
   THAT = THA
   RAT = (THA - TH(JMAX)) / (THP(I, 2) - TH(JMAX))
   IT = IT + 1
   IF (IT, GT, 15) CALL ERROR(33)
   GO TO 25
30  RAT = (THA - TH(JMAX)) / (THP(I, 2) - TH(JMAX))
   RAT = (THA - TH(JMAX)) / (THP(I, 2) - TH(JMAX))
   D2 = ZP(I, 1) + ZP(I, 1)
   N1 = ZP(I, 1) - ZP(I, 1)
   U2 = UP(I, 1) + RAT2 * (UP(I, 2) - UP(I, 1))
   V2 = VP(I, 1) + RAT2 * (VP(I, 2) - VP(I, 1))
   W2 = WP(I, 1) + RAT2 * (WP(I, 2) - WP(I, 1))
   P2 = PP(I, 1) + RAT2 * (PP(I, 2) - PP(I, 1))
   U1 = UP(I, 1) + RAT1 * (UP(I, 1) - UP(I, 1))
   V1 = VP(I, 1) + RAT1 * (VP(I, 1) - VP(I, 1))
   W1 = WP(I, 1) + RAT1 * (WP(I, 1) - WP(I, 1))
   P1 = PP(I, 1) + RAT1 * (PP(I, 1) - PP(I, 1))
   D1D2 = D1 / D2
   D2D1 = D2 / D1
   D1PD2 = D1 * D2
D12=D1*D2-D2*D1
D1=(I2*O1* D2=(UA*D12 -v1*D2 D1)/((D1*D2)
D2=(I2*O1* D2=(WA*D12 -w1*D2 D1)/((D1*D2)
D1-D1-D1-D2
TF(B93*EQ.0.)BN(1)=BETA
A22=A43* (RH0A+AA2/BETA) +B93*RH0N(1*JW)*UWN(1)**2/BN(1))
FPA=ALAM*RH0A*WA+DU-RH0A*WA+DV-
1(ALAM=VA/UA)*(WA*DP*AA2 *RH0A+DW)*UA/(AA2 )
FPA=FPA/BETA
IF(BAV*EQ.0.)FPNN=FPA
IF(BAV*EQ.0.) GO TO 362
RN(I)=SORT((UWN(I)**2+UWN(I)**2)/AN(I,JW)**2-1)
XPLN(I)=(UWN(I)*UWN(I)+AN(I,JW)**2*BN(I))/(UWN(I)**2-AN(I,JW)**2)
FPNN=XPLN(I)*RH0N(I)*JW*UWN(I)*UWN(I)*AU7N(I)-RH0N(I*JW)*UWN(I)**2*BN(1)
1XPLN(I+1)=UWN
1(I)/UWN(I)**2*(UWN(I)*UWN(I)+AN(I,JW)**2*RH0N(I*JW)**2*BN(1)**2)*UWN
1(I)/AN(I,JW)/AN(I,JW)/BN(1)
362 CONTINUE
A1=AAl*FPA+BAF*FPNN
IT=1
VU=SP(I,2)/UP(I,2)
35 VOU=FX+WOU*FZ
IF(XJI*EQ.0.*GO TO 64
THWQ=ATAN(FX)
XSL=UWN(I)=(RN-R)*COS(THWQ)/COS(THWQ+THWN(I))
GO TO 63
62 XSL=XW(I)
63 CONTINUE
CALL SWALL(R,ZSL,XSL,YSL,FXSL,FZSL)
NUM=.5*(WOU+WSL/U SL)
IF(DUM*GT.0.)*II=II+1
IF(XJI*EQ.0.)*17SL=ZN(I,JW)-NUM*(XWN(I)-XSL)
IF(XJI*EQ.0.)*ZSLT=ZN(I,JW)-(RN-R)*DUM
RAT=(ZSLT-ZP(I,2))/ZP(I,2)-ZP(I,2))
USL=UP(I,2)+RAT*(UP(I,2)-UP(I,1))
VSL=VP(I,2)+RAT*(VP(I,2)-VP(I,1))
WSL=VP(I,2)+RAT*(VP(I,2)-VP(I,1))
EP=ABS((ZSLT-ZSL)/(ZP(I,2)-ZP(I,1)))
IF(EPL,LT,ERZZZ) GO TO 40
ZSL=ZSLT
ITT=ITT+1
IF(ITT,GT,10) CALL ERROR(40)
GO TO 60
40 IF(XJ1*EQ.0.) BN(I,JW)=PA+A1 *(XWN(I)=XA)-A22*(TAC=TUA)
IF(XJ GT 0.0) PN(I,JW)=PA*(A*RN_R)*A22*(TAUC-TAUA)

PSL=PP(I+1,2)+RAT*(PP(I+1,2)-PP(I,1,2))

HSL=HP(I+1,2)+RAT*(HP(I+1,2)-HP(I,1,2))

RHOSL=RHOP(I+1,2)+RAT*(RHOP(I+1,2)-RHOP(I,1,2))

PHISL=PHIP(I+1,2)+RAT*(PHIP(I+1,2)-PHIP(I,1,2))

TSL=FT(PSL,PHISL,HSL)

GAMSL=FGAM(TSL,PSL,PHISL)

PHYN(I,JW)=PHISL

RHON(I,JW)=RHOSL*(PN(I,JW)/PSL)**(1/GAMSL)

VVS=SL**2+VSL**2+WSL**2

VVC=VVS+2*GAMSL/(GAMSL-1)*PSL/RHOSL-PN(I,JW)/RHON(I,JW))

HTS=SL**5*VVS

HN(I,JW)=HTSL+5*VVC

UWN(I)=SORT(VVC/(I+1,2+WO1**2))

VWN(I)=UWN(I)+TAUC

WOU(I)=UWN(I)-WOU

IF(XJ EQ 0.0) THD=THSL

IF(XJ LT 0.0) ANX=J1,EQ 0.0) THD=YSL

IF(XJ GT 0.0) THD=ATAN(YSL/XSL)

RAT=(THD=TH(JMAX))/(THP(I+1,2)-TH(JMAX))

PD=PP(I,1)+RAT*(PP(I,2)-PP(I,1))

W/W=P(I,1)+RAT*(W P(I,2)=W P(I,1))

U/U=P(I,1)+RAT*(U P(I,2)=U P(I,1))

V/V=P(I,1)+RAT*(V P(I,2)=V P(I,1))

RHOD=RHOP(I,1)+RAT*(RHOP(I,2)-RHOP(I,1))

GD=SQR(T(VD**2+VD**2))

RAT2=(THD=TH(JMAX))/(THP(I+1,2)-TH(JMAX))

RAT1=(THD=TH(JMAX))/(THP(I+1,2)-TH(JMAX))

W2=W P(I+1,1)+RAT2*(W P(I+1,2)-W P(I+1,1))

Z2=PP(I+1,1)+RAT2*(ZP(I+1,2)-ZP(I+1,1))

W1=W P(I+1,1)+RAT1*(W P(I+1,2)-W P(I+1,1))

Z1=PP(I+1,1)+RAT1*(ZP(I+1,2)-ZP(I+1,1))

DP=(P2*01 D2=PD*01)

DP=(P2*01 D2=PD*01)

IF(XJ EQ 0.0)

10=SQRT(XWN(I)-XSL)**2+(YWN(I)-YSL)**2

IF(XJ GT 0.0) nELS=SQRT(ZN(I,JW)**2*(THWN(I)-THD)**2+(RN-R)**2)

VDZN=*

QWN= SQRT(UWN(I)**2+VWN(I)**2)

IF(XJ GT 0.0) VDZN=(VD**2*AV3+UWN(I)**2*V3)*DELS/ZN(I,JW)

WTEST=VD+VDZN

QWN= (DP/RHOD/GD+WD*DW/QD)*AV3*(DPZQ(I)/RHON(I,JW)/QWN)

2*AV3*DELS

WTEST=WTEST+DWT

ERR=WWN(I)-WTEST

IT=IT+1

EP=ABS(WWN(I)-WTEST)/UW(I)

IF(EP LT 1,E-10) GO TO 36 11

IF(IT GT 2) GO TO 80

WOU=WOU1

WOU1=0.01*WOU

IF(WOU LT 1,E-4) WOU=0.01

F1=ERR

GO TO 35

80 WOUN=WOUN+ERR*(WOUN-WOUN1)/(ERR-F1)

ERR=ERR
WOU1=WOU
WOU=WOUN
IF(IT.GT.10) CALL ERROR(80)
GO TO 35
3611 CONTINUE
ET=ABS(1.-PT/PN(I,JW))
TN(I,JW)=FT(PN(I,JW),PHN(I,JW),HN(I,JW))
GAMN(I,JW)=FGAM(TN(I,JW),PHN(I,JW),HN(I,JW))
AN(I,JW)=SORT(GAMN(I,JW),PHN(I,JW),HN(I,JW))
UW2=UWN(I)*UWN(I)
VW2=VWN(I)*VWN(I)
RD=SORT((UW2+VW2)/AN(I,JW)**2-1.)
XPLN=(UWN(I)*VWN(I)*AN(I,JW)**2*BN)/(UW2-AN(I,JW)**2)
IF(IVY.EQ.0.OR.ET.LT.1.E-04) GO TO 20
KIL=KIL+1
IF(KI.LT.10) GO TO 1493
A93=.,5
B93=.,5
PT=PN(I,JW)
GO TO 9
1493 WRITE(*,1393)
1393 FORMAT(* AVERAGING PROCESS DOES NOT CONVERGE IN WALL *)
WRITE(*,4949) KOUNT,AAV,A93
4949 FORMAT(* KOUNT=75.5*I=15.5*AAV=*.Ei3.5*A93=.Ei3.5)
STOP
20 CONTINUE
IDUMMMAX=1
ZDUM1=ZN(I,JMAX)
ZDUM2=ZN(MMAX,JMAX)
IF(IOCW.LT.EQ.0)
CALL CORNER(I,RN,THWN(2),ZDUM1)
IF(ISOP.NE.0) GO TO 250
IF(IOCW.LT.EQ.1) THDUM=THWN(IDUM)
IF(IOCW.EQ.1) THDUM=TH(JMAX)
CALL CORNER(IMAX(JW),RN,THDUM,ZDUM2)
250 CONTINUE
XJ1=XJ1S
IMAX=IMAX(JW)
DO 7502 I=1,IMAX
THWN=THWN(I)*XJ1
PHEN(I,JW)=ATAN(UWN(I)/UWN(I)*COS(THWN) )*VWN(I)*
1SIN(THWN)
VDUM=VWN(I)*COS(THWN)-UWN(I)*SIN(THWN)
QN(I,JW)=SORT(UWN(I)**2+VWN(I)**2+VWN(I)**2-VDUM**2)
SINN(I,JW)=ATAN(VDUM/QN(I,JW))
7502 CONTINUE
RETURN
END
SUBROUTINE S WALL1(TH,X1,Z1,FX,F7)
COMMON /G/A1(3,9)*A2(3,9)*A3(3,9)*RR1(3)*RR2(3)*RR3(3)
I*NUMUS*NUMUS*NUMWS
L=1
XTT=E6
IF (L*LT*NUMUS) XTT=RR3(L+1)
IF (X1*GE*XTT) L=L+1
IF (L*LT*NUMUS) XTT=RR3(L+1)
IF (X1*GE*XTT*AND*L*LT*NUMUS) I=I+1
X=X1
Z=Z1
ZZ=Z*Z
XX=XX
VAR=A3(L+1)*XX*ZZ+A3(L+2)*XX*Z+A3(L+3)*XX*ZZ+A3(L+4)*XX*Z+A3(L+5)*ZZ+
A3(L+6)*XX*Z+A3(L+7)*XX*A3(L+8)*XX*A3(L+9)
TH=TH
FX=2*A3(L+1)*XX*ZZ+2*A3(L+2)*XX*Z*A3(L+3)*XX*Z+2*A3(L+4)*XX*A3(L+6)
1*Z*A3(L+7)
FZ=A3(L+1)*XX*Z*A3(L+2)*XX*Z*A3(L+3)*XX*Z+A3(L+5)*Z
1*A3(L+6)*XX+A3(L+8)
RETURN
END
SUBROUTINE BWAU(L(R1*TH1*Z*FR1*FT1))

COMMON /6/ A1(3,9), A2(3,9), A3(3,9), RRI(3), RRI(3), RRI(3)

1, NUMLWS, NUMUWS, NUMWS

COMMON /I/ XJ

COMMON /R/ J, XCN, XCS, XSI, J, INT, ICOWL, ICOWL

COMMON /V/ XJ1

COMMON /T5W/ JCALC, ISWEEP, XINS(10), X2

L = 1

PTT = 1, E + 06

THX = H1 * XJ

P = R1 * COS(THX)
R = R1 * XINS(P)

IF (XJ . EQ. 0.0) T = TH1

IF (XJ . EQ. 1.) T = R1 * SIN(TH1)

IF (L . LT. NUMLWS) R = R1(1) + L

IF (R . GE. RRI) L = L + 1

IF (L . LT. NUMLWS) R = R1(L + 1)

IF (R . GE. RRI + AND . LT. NUMLWS) L = L + 1

RR = R * T


RETURN

END
SUBROUTINE TBLNUM(ZX, PX, SIX, HX, PHI, QX, PHE, RHO, GAM, IMAX, I)

COMMON/Z(40, 2), P(40, 2), Q(40, 2), S(40, 2), H(40, 2), PH(40, 2), RHO(40, 2), GAM(40)

K = L

DO 10 J7 = 1, IMAX
    J5 = J7
    IF(ZX - Z(J5, L)) 8, 9, 12

8    J6 = J5 = 1

7    IF(I .EQ. 1) J6 = J5 + 1

RAT = (Z(J6, K) - Z(J5, L)) / (Z(J5, L) - Z(J6, K))

P = P(J6, K) + P(J5, L) - P(J6, K) * PAT
H = H(J6, K) + H(J5, L) - H(J6, K) * PAT
Q = Q(J6, K) + Q(J5, L) - Q(J6, K) * PAT

SI = SI(J6, K) + SI(J5, L) - SI(J6, K) * PAT
PHI = PHI(J6, K) + PHI(J5, L) - PHI(J6, K) * PAT
PHE = PHE(J6, K) + PHE(J5, L) - PHE(J6, K) * PAT
RHO = RHO(J6, K) + RHO(J5, L) - RHO(J6, K) * PAT
GAM = GAM(J6) + GAM(J5) - GAM(J6) * PAT

GO TO 11

9    CONTINUE

P = P(J5, L)
H = H(J5, L)
Q = Q(J5, L)
SI = SI(J5, L)
PHI = PHI(J5, L)
PHE = PHE(J5, L)
RHO = RHO(J5, L)
GAM = GAM(J5)

GO TO 11

12   IF(J5 .EQ. IMAX) GO TO 8

CONTINUE

11 RETURN

END
SUBROUTINE ALSHOC(K)

COMMON /A/ X1, THMAX, TH(10), R, Z(40,10), P(40,10), PHF(40,10),
       Q(40,10), SI(40,10), H(40,10), PHI(40,10), RH0(40,10), GAM(40,10),
       COMMON /B/ PN(40,10), PHIN(40,10), RHON(40,10), HN(40,10), ZN(40,10),
       COMMON /C/ IMAX(10), JMAX, ISTAR, KOUNTF, KOUNTP,
       COMMON /D/ UW(40), VW(40), WW(40), XW(40), YW(40), THW(40),
       COMMON /E/ UWN(40), VWN(40), WWN(40), XWN(40), YWN(40), THWN(40),
       COMMON /F/ ISIM,
       COMMON /G/ XJ
       COMMON /H/ XJ
       COMMON /K/ R, N, ELR
       COMMON /L/ ALPHAN(7,10), ALPHA(7,10), BETAN(7,10), ETA(7,10),
       COMMON /M/ IS(7,10)
       COMMON /N/ ALP(7,10), ALPN(7,10)
       COMMON /O/ XJ1
       COMMON /P/ ISIMEX, IDUMMY, JINT, ZDUMMY(40), THW(2), JD1, JD2,
       COMMON /Q/ SA, XJTS
       COMMON /R/ WR, IWRAP
       DO 13 J=1, JMAX
       IF(J.EQ. JINT OR J.EQ. JINT+1) GO TO 13
       IF(J.GT. JINT) XJ1=0.
       IF(IS(K,J))
       IF(ISIM.EQ.1 AND J.EQ. JMAX) GO TO 100
       IF(J.GT.1) GO TO 15

100 ALPN(K,J)=0.

15 JP=J+1
       JM=J-1
       IF(JP.NE. JMAX+1) THP=TH(JP)
       IF(JP.EQ. JMAX+1) THP=THW(I)

       D2=THP - TH(J)
       D1=TH(J)-TH(JM)
       D1=ABS(D1)
       D2=ABS(D2)
       D1D2=D1/D2
       D2D1=D2/D1
       D1PD2=D1*D2
       D12=D1D2-D2D1
       J2=IS(K,JP)
       J1=IS(K,JM)
       IF(XJ1.EQ.0.)

       1ALPN(K,J)=IZN(J2,JP)*D1D2=ZN(I,J)*D12=ZN(I,J)*D2D1/D1PD2/RN*EXJ
       IF(XJ1.EQ.1.) ALPN(K,J)=(ALOG(7N(I2,JP))*D1D2=ALOG(7N(I,J))*D12
       1=ALOG(7N(I,JM))*D2D1/D1PD2
       ALPHAN(K,J)=ATAN(ALPN(K,J)*COS*ETAN(K,J))
       ALPN(K,J)=ATAN(ALPN(K,J))

16 CONTINUE
13 CONTINUE
       IF(IWRAP.EQ.0.) CALL ALWRAP(K)
       XJ1=XJ15
       RETURN
END
FUNCTION RHEQ(H*P1*F)
T=1.5*F/9.
P=P(1*0.1325*E*5/2116.
IF(F/T>T*E) GO TO 2260
FNM=1.5*F*F=5.895*F*28.965
FNN=1.6*F*F=10.6*F*33.6
IF(T. GT. 2000.) GO TO 2030
XM=FMN
IF(F. LT. 1.) GO TO 2160
XM=FNN
GO TO 2160
2030 FF=F*F

A=2.3*FF+4.01*F+1.736
B=8.61*FF=15.4*F=6.66
C=16.88*FF+33.21*F+14.58
XN=-0.375*F++0.625*F+2.08
D=A*1.5+(ALOG(P)/2.3)*1.5*B*1.5+(ALOG(P)/2.3)*C
XM=FNM*(T-2000.)/1000.)*1*NN
IF(F. LT. 1.) GO TO 2160
A=2.2*FF+2.363*F+1.905
B=2.7*FF=7.56*F=8.68
C=3.6*FF+7.36*F+27.15
XN=.47*FF+1.825*F+33.5
D=A*1.5+(ALOG(P)/2.3)*1.5*B*1.5+(ALOG(P)/2.3)*C
XM=FNM*(T-2000.)/1000.)*1*NN
GO TO 2160
2260 K=1.5
IF(K=1.0) XM=16.043
IF(K=2.0) XM=28.054
2160 RHEQ=8*XM/T/8314.3*6.2428E=02/22.174
RETURN
END
FUNCTION FGAM(T1, P1, F)

COMMON /THE/ A1, A2, A3, A4, A5, A6, XMM1

T2 = T * T
XN = 0.

IF (F .LE. 0.) GO TO 550
IF (T .LE. 1000.) GO TO 440
XN = 2.15E-08 * T2 .+ .000091 * T .-.0605
440 XN = 4. * E-.09 * T2 .-.00002 * T .+.019

IF (F .LE. 1.) GO TO 470
XN = .039 * SQRT(T) .-.000391 * T .-.681
470 G = 1.33E-07 * T2 .-.000075 * T .+.137

IF (T .LT. 500.) GO TO 520
G = 2.E-.08 * T2 .-.00138 * T .+.423
IF (T .LT. 2000.) GO TO 520
G = 7.267E-.08 * T2 .-.00457 * T .+.85
520 G = G .* XN .* (ALOG(P) / 2.3 .-.5.) .* XN .* (F .-.1.)

GO TO 530

550 T3 = T2 .* T
T4 = T3 .* T
G = CP .* (CP .-.1.)

530 CONTINUE
FGAM = G
RETURN
END
SUBROUTINE ERROR(I)

IF(I.EQ.171) GO TO 2
IF(I.EQ.200) GO TO 3
IF(I.EQ.300) GO TO 6
IF(I.EQ.500) GO TO 8
IF(I.EQ.18) GO TO 10
IF(I.EQ.16) GO TO 12

WRITE(6,1) I
1 FORMAT(* ERROR IN ITERATION LOOP IN WALL ROUTINE AT STATEMENT NUMBER *I5)

CALL PNCH

WRITE(6,2) I
2 FORMAT(* ERROR IN V/U ITERATION IN MAIN - STATEMENT NUMBER *I5)

CALL PNCH

WRITE(6,3) I
3 FORMAT(* ERROR IN SIDE WALL LOCATION IN CORNER - STATEMENT NUMBER *I5)

CALL PNCH

WRITE(6,4) I
4 FORMAT(* ERROR IN THETA A PLANF IN CORNER - STATEMENT NUMBER *I5)

CALL PNCH

WRITE(6,5) I
5 FORMAT(* ERROR IN A POINT ITERATION IN CORNER - STATEMENT NUMBER *I5)

CALL PNCH

WRITE(6,6) I
6 FORMAT(* ERROR IN D POINT ITERATION IN CSURF - STATEMENT NUMBER *I5)

CALL PNCH

WRITE(6,7) I
7 FORMAT(* ERROR IN NORMAL TO CONTACT SURFACE IN CSURF - STATEMENT NUMBER *I5)

CALL PNCH

END
SUBROUTINE XLAM(Q, A, PHE, XPLAM, YMLAM)
CPHE = COS(PHE)
DUM1 = (Q/A) ** 2
DUM = DUM1 * CPHE * SIN(PHE)
DUM2 = SQRT(DUM1 - 1.)
NUM3 = DUM1 * CPHE ** 2 - 1.
XPLAM = (DUM + DUM2) / DUM3
YMLAM = (DUM - DUM2) / DUM3
RETURN
END
SUBROUTINE F(RHO, O, R, Z, PHE, XPLAM, XLMAM, SI, A, SIG, PO, PHEO, FP, FM)
COMMON /Y/ XJ
COMMON /V/ XJ1
CPHE = COS(PHE)
SPHE = SIN(PHE)
TSI = TAN(SI)
TSI2 = TSI * TSI
DUM1 = RHO * O * Q
IF (XJ1 .EQ. 1.) DUM1 = DUM1 / Z
IF (XJ .EQ. 1.) DUM1 = DUM1 / R
DUM2 = SPHE - CPHE       * XPLAM
DUM2M = SPHE - CPHE       * XLMAM
DUM3 = SIG / COS(SI) ** 2 * TSI       * PO / RHO / A / A + CPHE * XJ
1 * SPHE * XJ1
DUM4 = TSI       * PHEO
DUM5 = SPHE       * XPLAM + CPHE
DUM5M = SPHE       * XLMAM + CPHE
DUM6 = XPLAM * TSI2 * XJ
1 - TSI2 * XJ1
DUM6M = XLMAM * TSI2 * XJ
1 - TSI2 * XJ1
FP = DUM1 * (DUM2M * DUM3 - DUM4 * DUM6M)
FM = DUM1 * (DUM2M * DUM3 - DUM4 * DUM6M)
RETURN
END
SUBROUTINE INTER

COMMON /TEM/ T(40,10)
COMMON /JF/ JFINAL
COMMON /A// X1.THMAX,TH(10),R(40,10),P(40,10),PH(40,10)
COMMON /B// SI(40,10),TH(40,10),PM(40,10),RHO(40,10),GAM(40,10)
COMMON /C// IMAX(10),JMAX,ISTART,KOUNT,KOUNTP
COMMON /D// UW(40),VW(40),WW(40),XW(40),YW(40),THW(40)
COMMON /E// UWN(40),VWN(40),WWN(40),XWN(40),YWN(40),THWN(40)
COMMON /H// ISIM
COMMON /I// XJ
COMMON /J// QN(40,10),PHEN(40,10),SINN(40,10),XPLAM(40,10)
COMMON /Q// XCOWL
COMMON /R// JXCN,XCXXJXJWJINT,ICOWL,RCOWL
COMMON /S// XJ1
COMMON /T// ISIMEX,IDUMMY,JINT,NUMM(40),THW(2),JD1,JD2
COMMON /U// NUMEXP,THW
COMMON /W// WR

COMMON /PS// ZR(40,2),PR(40,2),OR(40,2),WR(40,2),SIR(40,2),RHR(40,2)

1,PHI(40,2),PHER(40,2),TH(2),THW(40)
IMAX=IMAX(J)
THI=TH(J)
IF(XJ,NE,0)THI=XI*TAN(THI)
RAT=(XJ-XC)/(XC-XC)

DO 3698 I=1,IMAX
Z(I,J)=RAT*(Z(I,J)-Z(I,J))
P(I,J)=RAT*(P(I,J)-P(I,J))
Q(I,J)=RAT*(Q(I,J)-Q(I,J))
H(I,J)=RAT*(H(I,J)-H(I,J))
SI(I,J)=RAT*(SI(I,J)-SI(I,J))
RHO(I,J)=RHO(I,J)*RAT*(RHO(I,J)-RHO(I,J))
PHI(I,J)=PHI(I,J)*RAT*(PHI(I,J)-PHI(I,J))
PH(I,J)=PH(I,J)*RAT*(PH(I,J)-PH(I,J))

IF(XJ.EQ.0)GO TO 3697

UI=OT*COS(TH(0))+COS(PHEI)*TAN(SII)*TAN(TH(0))
VI=OT*COS(TH(0))*COS(PHEI)*TAN(TH(0))
WI=QT*SIN(PHEI)
QT=QT=ATAN(VI/QI)
SII=ATAN(VI/QI)

3697 PHEI=ATAN(WL/UI)
WRITE(55)ZI,PQHISII*RHOI,PHELPHI*THTI
IF(JLJ,LT,JMAX,OR,IWRAP,EQ,1)GO TO 3698
L=1
IF(J,EQ,JW)L=2
Z R(I,J)=Z(I,J)
P R(I,J)=P(I,J)
Q R(I,J)=Q(I,J)
H R(I,J)=H(I,J)
SI R(I,J)=SI(I,J)
RHO(I,J)=RHO(I,J)
PHI(I,J)=PHI(I,J)
PH(EI,I,J)=PH(EI,I,J)
TH(L,J)=TH(J)
IF(L.EQ.2)THW(0)=THWN(I)
IF(L.EQ.2.AND.XJ,NE,0)THW(0)=XII*TAN(THWN(I))
3698 CONTINUE

IF(J(J,JW)) RETURN
YJ=0.
INT=2

1COIL=1
IF(IWRAP#EQ.1) GO TO 4
IMAXJ=IMAX(JMAX)

500 CONTINUE
NO 500 L=1+2
NO 500 I=1+IMAXJJ
JP=JMAX

IF(L.EQ.2) JP=JW
Z(I,JP)=Z(R(I,L))
P(I,JP)=P(R(I,L))
O(I,JP)=O(R(I,L))
H(I,JP)=H(R(I,L))
SI(I,JP)=SI(R(I,L))
PHO(I,JP)=PHOR(I,L)
PHI(I,JP)=PHIR(I,L)
PHE(I,JP)=PHER(I,L)

TH(JP)=THW(I)
IF(L.EQ.2) THW(I)=THWR(I)

500 CONTINUE
JINT=JMAX
JWW=JW*NUMEXP-1
TMAXX=IMAX(JINT)

DO 461 I=1+IMAXX
L=I
IF(Z(I,JINT).GT.ZSAV) GO TO 463

461 CONTINUE
462 IDUMMY=L=1
IF(IDUMMY.LT.NUMEXP) IDUMMY=NUMEXP
IM=IDUMMY
JT=1
2 JS=JMAX

IF(JT.EQ.2) JS=JW
DEZ=ZSAV-Z(1,JMAX)

DO 3 I=1+NUMEXP
ZDUMY(I)=Z(1,JMAX)+DEZ*FLOAT(I-1)/FLOAT(NUMEXP-1)
J=JWW+I-1
IF(JJFT.JW) J=JFINAL
ZD=ZDUMY(I)
IF(I.EQ.1.AND.JS.EQ.JW) ZD=Z(1,JW)
IF(XIJ.EQ.0.) GO TO 301

302 IR=1
CALL SWALL1(THGR,ZD,FX,FZ)
ZDT=ZD/COS(THG-TH(JMAX))
CALL SWALL1(THGG,R,ZDT,FX,FZ)
FP=THG-THG
IR=IR+1

IF(ABS(FP).LT.1.E-10) GO TO 301
IF(IR.GT.2) GO TO 303
NUM=j.01*ZD
ZD=ZD
FP=FP
GO TO 302
ZD1=ZD
EP1=EP
ZD=DUM
IF(IIF.LE.10) GO TO 302
WRITE(6,304)
304 FORMAT(* ERROR IN ITERATION LOOP IN SUBROUTINE INTER*), CALL PCH
301 CONTINUE
CALL TBL(ZD, P(IT,J), SI(IT,J), H IT,J), PHI( IT,J), Q( IT,J),
PHI<IT,J), RHO<IT,J), GAM<IT,J), THX<JS), JMAX(J), I)
Z(IT,J)=0.
IF(XJ1*GT.0.AND.JS.EQ.JW) THX=THG
IF(IT.EQ.2) Z(IT,J)=THX+TH<IT,JMAX)
IF(IT.EQ.2.AND.XJ1.GT.0.) Z(IT,J)=SIN(Z(IT,J))*ZD
TH<IT,J)=ZSAV-ZDUMY(J)
IF<IT.EQ.1.AND.JS.EQ.JMAX) THWW<IT,J)=ZSAV=Z(1,JMAX)
THUDA(THW<1,J)=TH<1,JMAX)*XJ1
THWW(2)=ZSAV-7(1,JW)*COS(THDUM)
UT<IT,J)=COS(PHE<IT,J))
IF(XJ1.EQ.0) GO TO 306
W1=S<IT,J)*SIN(PHE<IT,J))
V1=S<IT,J)*TAN<IT,J))
VTH=THX=TH<1,JMAX)
WT=W1*COS(DTTH)+W1*SM(DTTH)
VT=W1*SIN(DTTH)=W1*COS(DTTH)
GO TO 307
306 CONTINUE
V=O<IT,J)*SIN<PHE<IT,J))
WT=O<IT,J)*TAN<IT,J))
307 CONTINUE
IF(IIF.LE.1) GO TO 300
UW<IT)=UT
VW<IT)=VT
WW<IT)=WT
XY<IT)=XOWL
YW<IT)=THWW<IT)
300 CONTINUE
O<IT,J)=SORT<UT*UT+WT*WT)
PH<IT,J)=ATAN<WT/UT)
SI<IT,J)=ATAN<VT/QT,J))
T<IT,J)=GT(P<IT,J)*PH<IT,J)*H<IT,J))
GAM<IT,J)=FGAM<IT,J)*P<IT,J)*PH<IT,J))
A<IT,J)=SORT<GM<IT,J)*P<IT,J)*RHO<IT,J)>
CALL XLM(A<IT,J)*A<IT,J)*PHE<IT,J)*XPLAM<IT,J)*XMLAM<IT,J))
JMAX(J)=2
3 CONTINUE
IF<IT,J.EQ.2) GO TO 4
IT=2
GO TO 2
4 CONTINUE
RETURN
END
SUBROUTINE L TH W

COMMON /X/ X0, THMX, TH(10), R, Z(40,10), P(40,10), PHE(40,10),
1 Q(40,10), SI(40,10), H(40,10), PHI(40,10), RHO(40,10), GAM(40,10),
COMMON /Y/ PN(40,10), PHIN(40,10), RHON(40,10), HN(40,10), ZN(40,10),
COMMON /C/ ZLIFTC, XTHRC, YMOMC, ZLIFTS, XTHRS, YMOMS
COMMON /M/ IS(7,10)
COMMON /C/ IMAX(10), JMAX, ISTART, KOUNTF, KOUNTP
COMMON /D/ UW(40), VW(40), WW(40), YW(40), THW(40)
COMMON /E/ UWN(40), VWN(40), WWN(40), YWN(40), THWN(40)
COMMON /J/ XJ
COMMON /J/ QN(40), PHEN(40,10), SINN(40,10), XPLAM(40,10),
1 XLMAM(40,10), FP(40), FM(40), A(40,10)
COMMON /K/ RN, DELR
COMMON /S/ JXCN, XC, XXI, JWI, HCN, RCOWL, RCOWL
COMMON /K/ RI, KOUNT, KOUNTS, ICOWL
COMMON /V/ XJ1
COMMON /G/ IS1MEX, IDUMMY, JINT, 1DUMMY(40), THW(2), JD1, JD2
COMMON /R/ NUMEXP, ZSAV
COMMON /X/ IWRAP
COMMON /N/ JCSW, JCALC, ISWEEP, XINST(10), X2
COMMON /T/ PNF, ZLIFTS, XTHR, YMOM, JJI, ZSHIFT, XSHIFT
COMMON /O/ XJSS

IF(I.COWL.EQ.1. AND. XJSS.GT.0.) RETURN
JJK=0
IF(XJ.EQ.0. OR. JJI.LT.2) GO TO 11
JJK=JJI+1
IF(JJI.GE.JW) RETURN

11 CONTINUE
JWW=JW
NUMR=0
IF(XJ.EQ.0.) NUMR=1

12 CONTINUE
IF(K.GT.1) OPT=1.
IF(I.COWL.EQ.1. AND. IWRAP.EQ.0.) JWW=JINT
DO 1 J=JJK, JWW
IF(J.GT.JCALC) GO TO 1
IF(J.EQ.JMAX+1) THJ=TH(J)
IF(J.EQ.JMAX+1) THJ1=THJ
II=IMAX(J)
I1=IMAX(J-1)
IF(K.GT.1) GO TO 50
II=1
END DO
50 CONTINUE
IF(J.EQ.JMAX+1) THJ=THW(II)
IF(J.EQ.JMAX+1) THJ1=THWN(II)
THX=THJ*SUMXJ
THX1=THJ1*SUMXJ
THX2=TH(J-1)*SUMXJ
DUM1=Z(II*J)
```
NUM2=7N(I*I+J)
NUM3=7N(I*I+J-1)
NUM4=7(I*I+J-1)
IF(XJ*GT.0.) GO TO 51
NUM1=1.
NUM2=1.
NUM3=1.
NUM4=1.
CONTINUE
Y1=DUMR*DUM1*SIN(THX)+DUMX*THJ
Y2=DUMR*DUM2*SIN(THX)+DUMX*THJ
Y3=DUMR*DUM3*SIN(THXX)+DUMX*TH(J-1)
Y4=DUMR*DUM4*SIN(THXX)+DUMX*TH(J-1)
Z1=Z(I*I+J)
Z2=ZN(I*I+J)
Z3=ZN(I*I+J-1)
Z4=Z(I*I+J-1)
IF(XJ*EQ.0.) GO TO 6
Z1=Z1+COS(THJ)
Z2=Z2+COS(THJ)
Z3=Z3+COS(TH(J-1))
Z4=Z4+COS(TH(J-1))
CONTINUE
P1=P(I*I+J)-PINF
P2=PN(I*I+J)-PINF
P3=PN(I*I+J-1)-PINF
P4=P(I*I+J-1)-PINF
XX1=X1
XX2=X2
XX3=X3
XX4=X4
IF(XJ*EQ.0.) GO TO 3
XX1=RN*COS(THJ)
XX2=RN*COS(THJ)
XX3=RN*COS(TH(J-1))
XX4=RN*COS(TH(J-1))
CONTINUE
TERM1=Y4=Y2
TERM3=Y3=Y1
DAX=I(Z1-Z3)*TERM1+(Z4-Z2)*TERM3)/2.
DAZ=(XX1-XX3)*TERM1+(XX4-XX2)*TERM3)/2.
DAX=ARS(DAX)
DAZ=ARS(DAZ)
DAZ=DAX*OPT
PH1=PHE(I*I+J)
PH2=PHE(I*I+J)
PH3=PHE(I*I+J-1)
PH4=PHE(I*I+J-1)
PHAV=(PH1+PH2+PH3+PH4)/4.
OPT1=SIGN(1.*PHAV)
DAX=OPT1*DAZ*OPT
PAV=(P1+P2+P3+P4)/4.
NLE=PAV*DAX
DT=PAV*DAX
XAV=(XX1+XX2+XX3+XX4)/4.
ZAV=(Z1+Z2+Z3+Z4)/4.
```
DL=DL
DT=DT
ZAV=ZAV-ZSHIFT
XAV=XAV-XSHIFT
YAV=XAV
ZAV=ZAV
DM=DM*XAV+DT*ZAV
ZLXFT=ZLXFT+DL
XTHR=THR+DT
YMOM=YMOM+DM

CONTINUE
K=K+1
IF (ICOUNT.EQ.1) K=3
IF (K.EQ.2) GO TO 12
IF (JW.EQ.JMAX) RETURN
J=JMAX+1
IF (J.GT.JCALC) RETURN
JMAX=JMAX(J)
DO 2 I=2,JMAX
THX=THW(I)*SUMXJ
THXN=THWN(I)*SUMXJ
THX1=THW(I-1)*SUMXJ
THXN1=THWN(I-1)*SUMXJ
NUM1=DUM1(I,J)
NUM2=DUM2(I,J)
NUM3=DUM3(I-1,J)
NUM4=DUM4(I-1,J)
IF (XJ.GT.0.) GO TO 8
NUM1=DUM1(I,J)
NUM2=DUM2(I,J)
NUM3=DUM3(I-1,J)
NUM4=DUM4(I-1,J)

8  YS1=MR*DUM1*SIN(THX)*DUMX*THW(I)
YS2=MR*DUM2*SIN(THXN)*DUMX*THWN(I)
YS3=MR*DUM3*SIN(THXN1)*DUMX*THWN(I-1)
YS4=MR*DUM4*SIN(THX1)*DUMX*THW(I-1)

10  P1=P(T,I,J)-PINF
P2=PN(I,J)-PINF
P3=PN(I-1,J)-PINF
P4=P(T-1,I,J)-PINF
ZS1=Z(I,J)
ZS2=Z(I,J)
ZS3=Z(I-1,J)
ZS4=Z(I-1,J)

IF (XJ.GT.0.) GO TO 7
CALL SWALL(R,ZS1,XX1,YZ,FX1,FZ1)
CALL SWALL(RN,ZS2,XX2,YZ,FX2,FZ2)
CALL SWALL(RN,ZS3,XX3,YZ,FX3,FZ3)
CALL SWALL(R,ZS4,XX4,YZ,FX4,FZ4)
GO TO 9
CALL SWALL1(THZ+R,ZS1,FX1,FZ1)
CALL SWALL1(THZ+RN,ZS2,FX2,FZ2)
CALL SWALL1(THZ+PN,ZS3,FX3,FZ3)
CALL SWALL1(THZ,R,ZS4,FX4,FZ4)
ZS1=ZS1*COS(THX)
ZS2=ZS2*COS(THXN)
ZS3=ZS3*COS(THXN1)
ZS4=ZS4*COS(THX1)
FX=(FX1+FX2+FX3+FX4)/4.
FZ=(FZ1+FZ2+FZ3+FZ4)/4.

IF(IWRAP.EQ.0 .AND. ICOLF.LT.EQ.1) IWF=0
TH1=0.
IF(IWF.EQ.0 .AND. ICOLF.EQ.1) TH1=TH(JINT)
Z 1=ZS1*FLOAT(IWF)*ZSAV-YS)*FLOAT(1-IWF)
Z 2=ZS2*FLOAT(IWF)*ZSAV-YS)*FLOAT(1-IWF)
Z 3=ZS3*FLOAT(IWF)*ZSAV-YS)*FLOAT(1-IWF)
Z 4=ZS4*FLOAT(IWF)*ZSAV-YS)*FLOAT(1-IWF)
Y 1=Y5*FLOAT(IWF)*TH1+ZS4)*FLOAT(1-IWF)
Y 2=Y5*FLOAT(IWF)*TH1+ZS4)*FLOAT(1-IWF)
Y 3=Y5*FLOAT(IWF)*TH1+ZS4)*FLOAT(1-IWF)
Y 4=Y5*FLOAT(IWF)*TH1+ZS4)*FLOAT(1-IWF)
TERM1=Z2-Y1
TERM3=Z3-Y1
DAX=((Z1-Z3)*TERM1+(Z2-Z4)*TERM3)/2
DAZ=((XX1-XX3)*TERM1+(XX2-XX4)*TERM3)/2
DAX=ARS(DAX)
DAX=ARS(DAZ)
OPT3=1.
OPT4=1.
IF(IWF.EQ.0 .AND. ICOLF.EQ.1) OPT3=SIGN(1.FX)
IF(IWF.EQ.0 .AND. ICOLF.EQ.1) OPT4=SIGN(1.FZ)
DAZ=-OPT4*DAZ
DAX=-OPT3*DAX
PAV=(PAV+P2+P3+P4)/4.
DL=PAV*DAZ
DT=PAV*DAX
XAV=(XX1+XX2+XX3+XX4)/4.
ZAV=(Z1+Z2+Z3+Z4)/4.
DL=DL
DT=DT
ZAV=ZAV-ZSHIFT
XAV=XAV-XSHIFT
XAV=XAV
ZAV=ZAV
DM=DL*XAV+DT*ZAV
ZLIFT=ZLIFT+DM
XTHR=XTHR+DT
Ymom=Ymom+DM
IF(I.EQ.IS(3,J)=1) GO TO 132
IF(I.EQ.IS(1,J)=1) GO TO 92
GO TO 2
132 ZLIFT=ZLIFT
XTHRF = XTHR
YMOMS = YMOM
GO TO 2
92 ZLIFT$ = ZLIFT
XTHR$ = XTHR
YMOMS$ = YMOM
2 CONTINUE
RETURN
END
SUBROUTINE MOTHER

COMMON /STREAM/ XMAST, XENT, FSX, FSZ
COMMON /H/ ISIM
COMMON /M/ IS(7,10)
COMMON /THR/ PTHN, ZLIFT, XTHR, YHOM, ZJII, ZSHIFT, XSHIFT
COMMON /S/ RI, KOUNT, KOUNTS, IICOWLT
COMMON /A/ Q1, THM, TH1, TH2, KOUNT, KOUNTP
COMMON /D/ UW(40), VW(40), WW(40), XW(40), YW(40), THW(40)
COMMON /I/ XJ
COMMON /V/ XJ1
COMMON /W/ XJO(3), XI(3), P1W(20), Q1W(20), H1W(20), S1W(20)
1 PH1W(20), PHE1W(20), RHO1W(20)
COMMON /PS/ ZR(40,2), PR(40,2), OR(40,2), HR(40,2), SIR(40,2), RHR(40,2)
1, PH1(40,2), PHE1(40,2), THR(2), THWR(40)
COMMON /R/ XCN, XCI, XXI, JW, INT, ICOWLT, RCOWL
COMMON /W/ ISIMEX, IDUMMY, JINT, TDUMMY(40), THWW(2), JD1, JD2
COMMON /IQ/ NUMEXP, ZSAV
COMMON /WR/ IWRAP
XJ2=1=XJ
YJ3=1=XJ1

IF(IWRAP.EQ.0)) GO TO 50
IMAS=IMAX(JINT)+1
DO 51 I=1,IMAS
2 R(I1)=Z(I+JINT)
3 P(I1)=P(I+JINT)
4 Q(I1)=Q(I+JINT)
5 H(I1)=H(I+JINT)
6 SI(R(I1)=SI(I+JINT)
7 PHIR(I1)=PHI(I+JINT)
8 PHER(I1)=PHE(I+JINT)
9 RHOR(I1)=RHO(I+JINT)
10 Z R(I2)=Z(I+JINT+1)
11 P R(I2)=P(I+JINT+1)
12 Q R(I2)=Q(I+JINT+1)
13 H R(I2)=H(I+JINT+1)
14 SI R(I2)=SI(I+JINT+1)
15 PHIR(I2)=PHI(I+JINT+1)
16 PHER(I2)=PHE(I+JINT+1)
17 RHOR(I2)=RHO(I+JINT+1)
51 CONTINUE
XJ1S=XJ1
XJ2S=XJ2
XJ3S=XJ3
XJS=XJ

300 XMASS=0.
ICHECK=1
2 CONTINUE
JG=JMAX-1
3 IF(ISTYM.EQ.0)) JG=JMAX
4 DO 1 J=1,JG
5 I=0
6 NUMZ=I
7 IF(XJ1.GT.0)) NUMZ=NUMZ+(Z(I+1,J)+Z(I+1,J+1))
NZ=Z(I+1,J)-Z(I+1,J+1)
IF(ISTM.NE.0.OR.J.NE.JMAX) THP3=TH(J+1)
IF(ISTM.EQ.0.AND.J.EQ.JMAX) THP3=THW(I+1)
DTH=THP3-TH(J)
IF(J.EQ.JINT.AND.ICOWLT.EQ.1) DTH=3.14 15926/18.
NUM=1
IF(XJ.GT.0.) DUM=R
S3=DZ*DZ+(DTH*DUM*DUM)*2
S3=SQRT(S3)
IF(ICOWLT.EQ.1) MAX=IS(3,J)
IF(J.EQ.JINT.AND.ICOWLT.EQ.1) MAX=IS(3,J)-1
IF(J.NE.JINT.OR.ICOWLT.EQ.0) GO TO 53
XJ1=1.
XJ=0.
XJ2=1.
XJ3=0.
T33J=IF(S(3,J).EQ.1)
IDUM1=IDUMMY+1
DO 55 I=IDUM1,IS3J
L=I-IDUMMY+1
Z(L,J)=Z(I+J)*2SAV
P (L,J)=P (I+J)
Q (L,J)=Q (I+J)
H (L,J)=H (I+J)
SI (L,J)=SI (I+J)
PHI (L,J)=PHI (I+J)
PHE (L,J)=PHE (I+J)
RHO (L,J)=RHO (I+J)
55 CONTINUE
Z (1,J)=Z (1,2)
P (1,J)=P (1,2)
Q (1,J)=Q (1,2)
H (1,J)=H (1,2)
SI (1,J)=SI (1,2)
PHI (1,J)=PHI (1,2)
PHE (1,J)=PHE (1,2)
RHO (1,J)=RHO (1,2)
KK=1
56 KK=KK+1
THT=DTH*FLOAT(KK-1)
DO 54 I=IDUMM1,IS3J
L=I-IDUMMY+1
C=(ZR(I,1)-ZSAV)/XO(1)
D=C*xi(1)
D2=D*D
RDUM=XO(1)*C
NUM=RDUM*SQRT(RDUM*RDUM+D2)
R3=C*XO(1)+XI(1,1)*THT)
S=.5/P*(R3*SQRT(R3*R3*D2)=DUM)
P (L,J+1)=P (R(I+1)+P) 1W(L)*S
Q (L,J+1)=Q (R(I+1)+Q) 1W(L)*S
H (L,J+1)=H (R(I+1)+H) 1W(L)*S
SI (L,J+1)=SI (R(I+1)+SI) 1W(L)*S
PHI (L,J+1)=PHI(R(I+1)+PHI 1W(L)*S
PHE (L,J+1)=PHE(R(I,1)+PHE1W(L)*S
$\Phi_{0}(L, J+1) = \Phi_{0}(I, I) + \Phi_{0}(L) \circ \Phi$

$Z(L, J+1) = R3$

CONTINUE

$Z(I+1, J) = Z(I, J)$

P (I, J+1) = P (I, J)
H (I, J+1) = H (I, J)
O (I, J+1) = O (I, J)
SI (I, J+1) = SI (I, J)
PHI (I, J+1) = PHI (I, J)
PHE (I, J+1) = PHE (I, J)

$\Phi (I, J+1) = \Phi (I, J)$

CONTINUE

DO 6 I=1, IMAX

IF (J.EQ.0) S2 = 7 (I+1, J) - Z (I, J)
S1 = S3
S4 = S2

NUMZ = I

IF (XJ.GT.0) NUMZ = 5 * (Z (I+1, J) + Z (I-1, J))

IZ = 7 (I+1, J) - 2 (I-1, J)

IF (JSTM.EQ.0.OR. J.NE.JMAX) THP3 = TH (J+1)
IF (JSTM.EQ.0.AND. J.EQ.JMAX) THP3 = THW (I)

IF (XJ.GT.0.AND. JSM.EQ.0.AND. J.EQ.JMAX) THP3 = (THW (I+1) + THW (I)) / 2.

STH = (THP3 - TH (J))

IF (J.EQ.0.JINT.AND. ICWLT.EQ.0) STH = 3.141592618.
S3 = D7 * DZ / DTH * NUMZ * DUMR ** 2

S3 = SORT (S3)

IF (JSTM.EQ.0.OR. J.NE.JMAX) THP2 = TH (J+1)
IF (JSTM.EQ.0.AND. J.EQ.JMAX) THP2 = THW (I)

XX2 = (XJ2 + XJ * COS (THP2 * XJ)) * R
YY2 = XJ2 + THP2 * XJ * R * SIN (THP2 * XJ) + XJ * Z (I, J+1) * SIN (THP2 * XJ)

ZZ2 = (XJ2 + XJ * COS (THP2 * XJ)) * Z (I+1, J+1)

DZ = ZZ3 - ZZ2
DZY = YY3 - YY2
DXY = XX3 - XX2

S2 = DZ * DZ * DY * DY + DX * DX
S3 = SORT (S2)
ST = S1 + S3 + S4

U1 = 0 (I+J) * COS (PHE (I+J))
IF (XJ, GT, 0) U1 = U1 * COS (TH (J)) + N (I, J) + TAN (SI (I, J)) * SIN (TH (J))
RU1 = RH0 (I, J) * U1

U2 = 0 (I+J) * COS (PHE (I+J))
IF (XJ, GT, 0) U2 = U2 * COS (THP2) + Q (I+1, J+1) + TAN (SI (I+J+1)) * SIN (THP2)
RU2 = RH0 (I, J+1) * U2

U3 = 0 (I+1, J+1) * COS (PHE (I+J+1))
IF (XJ, GT, 0) U3 = U3 * COS (THP3) - Q (I+1, J+1) + TAN (SI (I+J+1)) * SIN (THP3)
RU3 = RH0 (I+1, J+1) * U3

U4 = 0 (I+1, J+1) * COS (PHE (I+J+1))
IF (XJ, GT, 0) U4 = U4 * COS (TH (J)) - Q (I+1, J+1) + TAN (SI (I+1, J)) * SIN (TH (J))
RU4 = RH0 (I+1, J+1) * U4

RU = (RU1 + RU2) * SI + (RU2 + RU3) * SI + (RU3 + RU4) * SI / S (** 2)
ZZ1 = (XJ3 + XJ * COS (TH (J) * XJ)) * Z (I, J)
ZZ4 = (XJ3 + XJ * COS (TH (J) * XJ)) * Z (I+1, J)
YY1 = XJ2 + TH (J) * XJ * R * SIN (TH (J) * XJ) + XJ * Z (I, J) * SIN (TH (J) * XJ)
YY4= XJ2*TH(J)+XJR*SIN(TH(J)*XJ)+XJ1*Z(I+1,J)*SIN(TH(J)*XJ1)

DAX=((ZZ1-ZZ3)*(YY2-YY4)+(ZZ2-ZZ4)*(YY3-YY1))/2.

DAX=ARS(DAX)

IF(XJ1+EQ+0. )  GO TO 60

ZL=(Z(I,J)+Z(I,J+1))/2.

ZU=(Z(I+1,J)+Z(I+1,J+1))/2.

DAX=(ZU-ZL-ZL)*DTH/2.

GO TO (3,4,5,6)

CONTINUE

3 DM=RU*DAX

XMASS=XMASS+DM

GO TO 6

4 V1=(Q(I,J))/COS(ST(I,J))**2

H1=(H(I,J)+V1/2.)*RU1

V2=(Q(I,J+1))/COS(ST(I,J+1))**2

H2=(H(I,J+1)+V3/2.)*RU2

V3=(Q(I+1,J+1))/COS(ST(I+1,J+1))**2

H3=(H(I+1,J+1)+V3/2.)*RU3

V4=(Q(I+1,J))/COS(ST(I+1,J))**2

H4=(H(I+1,J)+V4/2.)*RU4

HT=Q*(H1+H2)*S1*(H2+H3)*S2*(H3+H4)*S3*(H4+H1)*S4)/2./ST

DTH=HT*DAX

XEN=XEN+DTH

GO TO 6

5 RUU1=RU1*U1

W1=Q(I,J)*SIN(PHE(I,J))

IF(XJ1+GT+0. ) W1=W1*COS(TH(J))*Q(I,J)*TAN(ST(I,J))*SIN(TH(J))

RUW1=RU1*W1

RUU2=RU2*U2

W2=Q(I,J+1)*SIN(PHE(I,J+1))

IF(XJ1+GT+0. ) W2=W2*COS(TH(J))*Q(I,J+1)*TAN(ST(I,J+1))*SIN(TH(J))

RUW2=RU2*W2

RUU3=RU3*U3

W3=Q(I+1,J+1)*SIN(PHE(I+1,J+1))

IF(XJ1+GT+0. ) W3=W3*COS(TH(J))*Q(I+1,J+1)*TAN(ST(I+1,J+1))*SIN(TH(J))

RUW3=RU3*W3

RUU4=RU4*U4

W4=Q(I+1,J)*SIN(PHE(I+1,J))

IF(XJ1+GT+0. ) W4=W4*COS(TH(J))*Q(I+1,J)*TAN(ST(I+1,J))*SIN(TH(J))

RUW4=RU4*W4

POW=(RUW1+RUW2)*S1+(RUW2+RUW3)*S2+(RUW3+RUW4)*S3+(RUW4+RUW1)*S4

1/2./ST

PAV=(P(I,J)+P(I+1,J)*S1+(P(I+1,J+1)+P(I+1,J+1))*S2+(P(I+1,J+1)+

P(I+1,J)+S3+(P(I+1,J)+P(I,J))*S4)

1/2./ST

PAV=PAV-PINF

XX1=(XJ2+XJ1*COS(TH(J)*XJ1))/R

XX4=XX1

DAX=((ZZ1-ZZ3)*(YY2-YY4)+(ZZ2-ZZ4)*(YY3-YY1))/2.

DAX=ARS(DAX)

IF(XJ1+EQ+0. )  GO TO 61

ZL=(Z(I,J)+Z(I,J+1))/2.
7U=(Z(I+1,J)+Z(I+1,J))/2,

DAZ=7U*2-2*ZL*ZL*DTH/2.

CONTINUE

DAZ=((XX1-XX3)*(YY2-YY4)+(XX2-XX4)*(YY3-YY1))/2.

DSX=DSX+DAZ

CONTINUE

IF(J.NE.JINT.OR.ICOWLT.EQ.0) GO TO 1

IF(KK.GE.9 ) GO TO 64

IMAX=1

DO 62 I=1,IMAX

Z(I,J)=Z(I+J+1)

P(I,J)=P(I+J+1)

Q(I,J)=Q(I+J+1)

H(I,J)=H(I+J+1)

SI(I,J)=SI(I+J+1)

PHI(I,J)=PHI(I+J+1)

PHE(I,J)=PHE(I+J+1)

RHO(I,J)=RHO(I+J+1)

CONTINUE

GO TO 56

DO 65 IS=1,IMAS

Z(I,J)=Z(I+J+1)

P(I,J)=P(I+J+1)

Q(I,J)=Q(I+J+1)

H(I,J)=H(I+J+1)

SI(I,J)=SI(I+J+1)

PHI(I,J)=PHI(I+J+1)

PHE(I,J)=PHE(I+J+1)

RHO(I,J)=RHO(I+J+1)

CONTINUE

GO TO 56

DO 65 IS=1,IMAS

Z(I,J)=Z(I+J+1)

P(I,J)=P(I+J+1)

Q(I,J)=Q(I+J+1)

H(I,J)=H(I+J+1)

SI(I,J)=SI(I+J+1)

PHI(I,J)=PHI(I+J+1)

PHE(I,J)=PHE(I+J+1)

RHO(I,J)=RHO(I+J+1)

CONTINUE

GO TO 56

DO 65 IS=1,IMAS

Z(I,J)=Z(I+J+1)

P(I,J)=P(I+J+1)

Q(I,J)=Q(I+J+1)

H(I,J)=H(I+J+1)

SI(I,J)=SI(I+J+1)

PHI(I,J)=PHI(I+J+1)

PHE(I,J)=PHE(I+J+1)

RHO(I,J)=RHO(I+J+1)

CONTINUE

GO TO (10,11,12),ICHECK

10 IF(KOINT.EQ.0 ) XMAST=XMASS

XEN=0.

ICHECK=2

GO TO 2

11 IF(KOINT.EQ.0 ) XENT=XEN

C2=XENT/XEN

IF(KOINT.NE.0 ) CALL UNOWAT(C1,C2)
IF (KOUNT .NE. 0) GO TO 12
FSX=0.
FSZ=0.
TCHECK=3
GO TO 2
12 CONTINUE
RETURN
END
SUBROUTINE SETN(10)

COMMON /WR/ IWRAP
COMMON /ZNDERV/ DPZN(40), DUZN(40), DVZN(40), NWZN(40)
COMMON /R/ JXCN, XC, XXI, JW, INT, ICOWL, PCOWL
COMMON /ALLR1/ AN(40,10), TN(40,10), GAMN(40,10), XPLAMN(40,10),

1 XMAMN(40,10)
COMMON /ALLR2/ PON(40,10), HON(40,10), QN(40,10), SION(40,10),
1 PHEQN(40,10), PHIQN(40,10), RHQMN(40,10), GAMQN(40,10)
COMMON /A/ X1, THMX, TH(10), R, Z(40,10), P(40,10), PHF(40,10),
1 Q(40,10), SI(40,10), H(40,10), P(40,10), RHQ(40,10), GAM(40,10)
COMMON /R/ PHN(40,10), PHIN(40,10), RHQN(40,10), HN(40,10), ZN(40,10)
COMMON /C/ IMAX(10), JMAX, ISTAR, KOUNT, KOUNTP
COMMON /D/ UW(40), VV(40), WW(40), XM(40), VV(40), THW(40)
COMMON /E/ UWN(40), VWN(40), WWN(40), XWN(40), YWN(40), THWN(40)
COMMON /H/ ISIM
COMMON /J/ QN(40,10), PHEN(40,10), SINN(40,10), XPLAM(40,10),
1 XMAM(40,10), FQ(40,10), FM(40,10), A(40,10)
COMMON /L/ ALPHAN(7,10), ALPH(7,10), BETAN(7,10), BETA(7,10)
COMMON /M/ ISM(7,10)
COMMON /N/ QSN(40,10), PQ(40,10), PHQ(40,10), WQ(40,10), PHIQ(40,10),
1 PQ(40,10), RHQ(40,10), GAMQ(40,10),
COMMON /O/ ALP(7,10), ALPN(7,10),
COMMON /Q/ XCPWL
COMMON /S/ RISTKOUNT, KOUNTS, ICOWL
COMMON /T/ (40,10)
COMMON /V/ FSN(40,10), FMN(40,10), IF (T, EQ, 1) GO TO 1
IF (R.EE RCPOWL) GO TO 100
DO 7675 M = 1, 7
DO 7677 J = 1, 10
ALP(M, J) = 0
ALPN(M, J) = 0
ALPHAN(M, J) = 0
BETAN(M, J) = 0
ALPHA(M, J) = 0
BETA(M, J) = 0
7677 ISM(M, J) = 0
7675 CONTINUE
100 DO 3535 M = 1, 40
DO 3536 J = 1, 10
FPN(M, J) = 0
FMN(M, J) = 0
Q(M, J) = 0
PHIQ(M, J) = 0
PHEQ(M, J) = 0
RHQ(M, J) = 0
GAMQ(M, J) = 0
3536 CONTINUE
DPZN(M) = 0
DUZN(M) = 0
DVZN(M) = 0
NWZN(M) = 0
3535 CONTINUE
CONTINUE

IF(I5*J.M.EQ.1) JW=JMAX
DO 2 J=1.JW
IMAX=IMAX(J)
IF(R.EQ.T.XCOWL.EQ.1.E-06.AND.ICOWLT.EQ.1) IMAX=IMAX+1
DO 3 I=1.IMAX
2 N(I,J)=Z (I,J)
P N(I,J)=P (I,J)
Q N(I,J)=Q (I,J)
H N(I,J)=H (I,J)
A N(I,J)=A (I,J)
T N(I,J)=T (I,J)
SINN(I,J)=S (I,J)
PHEN(I,J)=PHE (I,J)
PHIN(I,J)=PHI (I,J)
RHON(I,J)=RHO (I,J)
GAMN(I,J)=GAM (I,J)
XPLAMN(I,J)=XPLAM (I,J)
XMLAMN(I,J)=XMLAM (I,J)
PQ N(I,J)=PQ (I,J)
HQ N(I,J)=HQ (I,J)
GO N(I,J)=GO (I,J)
SIGN(I,J)=SIG (I,J)
PHIQ N(I,J)=PHIQ (I,J)
PHEQN(I,J)=PHEQ (I,J)
RHOG N(I,J)=RHOQ (I,J)
GAMQ N(I,J)=GAMQ (I,J)
IF(J.M.EQ.JMAX+1) GO TO 3
U WN(I)=U W(I)
V WN(I)=V W(I)
W WN(I)=W W(I)
X WN(I)=X W(I)
Y WN(I)=Y W(I)
THWN(I)=THW(I)
CONTINUE
DO 4 M=1.7
ALP N(M+J)=ALP (M+J)
BETA N(M+J)=BETA (M+J)
ALPHAN(M+J)=ALPHA (M+J)
CONTINUE
RETURN
END
SUBROUTINE INDATA

COMMON /STREAM/ XMST, XNST, FSX, FSZ
COMMON /JF/, JFINAL
COMMON /JQ/ QN(40,10), PHEN(40,10), SINN(40,10), XPLAM(40,10)
COMMON /FM/ FM(40), A(40,10)
COMMON /T/ T(40,10)
COMMON /IVY/, KCORR, TAV
COMMON /X/ XL, MAXTH(10), TH(10), R  Z(40,10), P(40,10), PHE(40,10),
1 Q(40,10), SI(40,10), H(40,10), PNI(40,10), RHQ(40,10), GAM(40,10)
COMMON /C/ IMAX(10), JMAX, ISTART, KOUNT, KOUNTP
COMMON /D/ UW(40), VW(40), WW(40), X선(40), THM(40)
COMMON /G/ A1(3,9), A2(3,9), A3(3,9), R4J(3), RR2(3), RR3(3)
1 NUMWS, NUMUWS, NUMWS
COMMON /H/ ISIM
COMMON /I/ XJ
COMMON /L/ ALPHAN(7,10), ALPHA(7,10), BETAN(7,10), BETA(7,10)
COMMON /M/ IS(7,10)
COMMON /O/ ALP(7,10), ALPN(7,10)
COMMON /P/ K, KC2, KS1, KS2
COMMON /Q/ XCOWL
COMMON /R/ JXCNXCXXI, JW, INT, ICOWL, RCOWL
COMMON /S/ R, KOUNT, KOUNTS, ICOWLT
COMMON /V/ XJ1
COMMON /W/ ISIMEX, IDUMMY, INT, IDUMMY(40), THW(2), JD1, JD2
COMMON /EX/ KTPUN(3)
COMMON /TH/ PIN, ZLIFT, XTHM, YMOM, JJI, ZSHIFT, XSHIFT
COMMON /X/ XF, XFIN
COMMON /IO/ NUMEXP, ZSAV
COMMON /WR/ IWRAP
COMMON /IS/ JCALC, ISWEEP, XINSW(10), X2
COMMON /SE/ KOUNTC
COMMON /ISE/ KOUNTS
COMMON /WO/ XJSS
COMMON /SCLTM/ ZLIFTC, XTHR, YMOMC, ZLIFTS, XTHS, YMOMS
COMMON /XSTP/XSTP
DATA XINSW(10=0), KOUNTS/0/
DATA THW(40,10)
100 FORMAT(16I5)
101 FORMAT(7E10.3)
102 FORMAT(8E10.3)
DATA XIMSP/10#6/10
KOUNT=0
JCALC=100
READ(5,9100) KOUNT, KOUNTP, ISTART, IVY, JAV, KCORR, JFINAL;
9100 FORMAT(1015=10.0)
READ(5,100) JMAX, ISIM, ISIMEX, IWRAP, NUMEXP, ISWEEP, (IMAX(J), J=1, JMAX
1)
READ(5,102) R*XJ, XJ1, XCOWL, RCOWL, XFIN, ZSAV, PINF
XJSS=XJ
RJE-R
IF(ISTART.EQ.1) READ(5,210) KOUNTR
210 FORMAT(15=11.3)
IF(RGTRCOWL) ISIM=ISIMEX
JW=JMAX
IF(ISIM.EQ.1) JW=JMAX
IF(ISWEEP.EQ.1) READ(5,101) (XTNSW(J), J=1, JW)
IF(ISWEEP.EQ.1) KOUNTS=10000
KOUNTF=KOUNT
I1=F
IF(ISSTART.EQ.1) GO TO 211
IF(ISWEEP.NE.1) GO TO 1900
JCALC=1
JMAX=JMAX+1
JWE=JWE+1
JMAX(JMAX)=JMAX(JMAX-1)
1900 CONTINUE
READ(5*101) ZLIFT,XTHR,VMOM,SHIFT,XSHIFT
DO 5 J=1,JMAX
IF(ISWEEP.EQ.1.AND.J.EQ.2) GO TO 5
MMAX=MAX(J)
READ(5*101) TH(J),Z(I,J),I=1,MMAX
IF(XJ.EQ.0.AND.XJ1.EQ.0.)GO TO 5
TH(J)=TH(J)/57.3
5 CONTINUE
IF(ISM.EQ.0)
1READ(5*106) MMAX *(Z(I,JW)+1=MMAX)
106 FORMAT(IS,7E10.3)
JMAX(JW)=MMAX
211 CONTINUE
WRITE(6,400)
400 FORMAT(1H1*24X,*THREE DIMENSIONAL CHARACTER
1F I R I S T I C S**//)
IF(XJ,EQ.0) WRITE(6,401) RI,R
IF(XJ,NE.0) WRITE(6,402) RI,R
401 FORMAT(10X,*THE INITIAL CARTESIAN X COORDINATE IS*E13.5//10X,
1*THIS RUN STARTED AT X COORDINATE*E13.5/)
402 FORMAT(10X,*THE INITIAL RADIUS OF CURVATURE IS*E13.5//10X,
1*THIS RUN STARTED WITH A RADIUS OF*E13.5/)
WRITE(6,403) KOUNT,KOUNTF,KOUNTP
403 FORMAT(10X,*THIS RUN WAS STARTED AT KOUNT = IS, WILL RUN TO KOU
1NT = **I5** AND WILL PRINT EVERY**I5** KOUNTS*/)
ISMP=ISTMP+1
WRITE(6,404) ISIMP
404 FORMAT(10X,*THERE ARE**I5** WALLS OF SYMMETRY IN THE INTERNAL FLO
1W*/)
WRITE(6,405) XCOWL
405 FORMAT(10X,*THE X COORDINATE OF THE COWL IS*E13.5/)
IF(XJ,NE.0) WRITE(6,406) RCOWL
406 FORMAT(10X,*THE RADIAL DISTANCE TO INTERSECTION OF COWL LIP AND SI
1DE WALL IS*E13.5/)
WRITE(6,2072) XFIN
2072 FORMAT(10X,*THE X COORDINATE OF THE END OF THE VEHICLE UNDERSURFAC
1E IS*E13.5)
IF IS*E13.5)
C LOWER WALL GEOMETRY
READ(5*100) NUMLWS
DO 250 I=1,NUMLWS
READ(5*102) RR1(I), (A1(I,J),J=1,9)
250 CONTINUE
C UPPER WALL GEOMETRY
READ(5*100) NUMUWS
DO 251 I=1,NUMUWS
READ(5*102) RR2(I), (A2(I,J),J=1,9)
```fortran
251 CONTINUE
IF(ISIM.EQ.1) GO TO 53
C SIDE WALL GEOMETRY
READ(5*100) NUMSW
DO 252 I=1,NUMSW
READ(5*102) RR3(I),(A3(I,J),J=1,9)
252 CONTINUE
53 CONTINUE
WRITE(6,2010)
2010 FORMAT(//, 'LOWER WALL COORDINATES')
WRITE(6,2071)
DO 2040 I=1,NUMLWS
IF((I+1).GT.NUMLWS) GO TO 2041
WRITE(6,2042) RR1(I),RR1(I+1),(A1(I,J),J=1,9)
GO TO 2040
2041 WRITE(6,2043) RR1(I),(A1(I,J),J=1,9)
2040 CONTINUE
WRITE(6,2020)
2020 FORMAT(//, 'UPPER WALL COORDINATES')
WRITE(6,2071)
DO 2050 I=1,NUMUWS
IF((I+1).GT.NUMUWS) GO TO 2051
WRITE(6,2042) RR2(I),RR2(I+1),(A2(I,J),J=1,9)
GO TO 2050
2051 WRITE(6,2043) RR2(I),(A2(I,J),J=1,9)
2050 CONTINUE
IF(ISIM.EQ.1) GO TO 54
WRITE(6,2030)
2030 FORMAT(//, 'SIDE WALL COORDINATES')
IF(XJ.EQ.0.) WRITE(6,2071)
IF(XJ.EQ.1.) WRITE(6,2070)
DO 2060 I=1,NUMSW
IF((I+1).GT.NUMSW) GO TO 2061
WRITE(6,2042) RR3(I),RR3(I+1),(A3(I,J),J=1,9)
GO TO 2060
2061 WRITE(6,2043) RR3(I),(A3(I,J),J=1,9)
2060 CONTINUE
2042 FORMAT(10X, 'END', 1X)
2043 FORMAT(10X, 'END', 4X, 9F11.3)
2070 FORMAT(15X, 'COORDINATES')
2071 FORMAT(15X, 'COORDINATES')
54 CONTINUE
IF(ISTART.EQ.1) GO TO 212
TEMP=0
TTEMP=0
DO 6 J=1,JMAX
IF(ISWEEP.EQ.1.AND.J.EQ.2) GO TO 6
MMAX=JMAX(J)
READ(5*101) (P(I,J),I=1,MMAX)
READ(5*101) (PHE(I,J),I=1,MMAX)
READ(5*101) (Q(I,J),I=1,MMAX)
READ(5*101) (SIG(I,J),I=1,MMAX)
READ(5*101) (H(I,J),I=1,MMAX)
READ(5*101) (PHI(I,J),I=1,MMAX)
DO 531 I=1,MMAX
PHE(I,J)=PHE(I,J)/57.3
6 CONTINUE
`````
SI(I,J) = SI(I,J) / 57.3
IF(H(I,J) .LT. 10000.0) TEMP = 1.
IF(H(I,J) .LT. 10000.0) TEMP = H(I,J)
T(I,J) = FT(P(I,J) * PHI(I,J) * H(I,J))
IF( TEMP .EQ. 1.0 ) H(I,J) = T(I,J)
IF(TEMP .EQ. 1.0) T(I,J) = TEMP
TEMP = 0.
PHO(I,J) = PHO(I,J) * P(I,J) * PHI(I,J)
GAM(I,J) = GAM(I,J) * P(I,J) * PHI(I,J)
CALL XPLAM(Q(I,J), A(I,J), PHE(I,J), XPLAM(I,J), XMLAM(I,J))
CONTINUE
TH(J) = THW(I)
RETURN
IF(R.GT.(RCOWL-1.E-05)) ISIM=I+1
READ(5*100) JINT,KOUNTC
READ(5*9) XMAST,XENT,FSX,FSZ
9 FORMAT(4E13.5)
READ(5*216) ZLIFT,XTHR,YMOM,ZSHIFT,XSHIFT
DO 213 J=1,JW
IF(ISIM.EQ.1.OR.J.NE.JW) GO TO 300
READ(5*100) IMAX(J)
GO TO 301

300 CONTINUE
READ(5*216) TH(J)
301 CONTINUE
IF(R.GT.RCOWL) IMAX(J)=IMAX(J)+1
IMAXJ=IMAX(J)
DO 214 I=1,IMAXJ
IF(ISIM.EQ.1.OR.J.NE.JW) GO TO 303
READ(5*302) UW(I),WW(I),VW(I),THW(I)
302 FORMAT(6E11.3)
303 CONTINUE
READ(5*215) Z(I,J),P(I,J),O(I,J),PHE(I,J),SI(I,J),H(I,J),
1 PHX(I,J),RHO(I,J)
631 CONTINUE
T(I,J)=FT(P(I,J),PHI(I,J),H(I,J))
GAM(I,J)=FGAM(T(I,J),P(I,J),PHI(I,J))
A(I,J)=SORT(GAM(I,J),P(I,J)/RHO(I,J))
CALL XLAM(QT(I,J),A(I,J),PHE(I,J),XPLAM(I,J),XMLAM(I,J))
215 FORMAT(5E11.3,11X,E11.3/2E11.3)
214 CONTINUE
IF(R.GT.RCOWL) GO TO 213
IMAX(J)=IMAX(J)+1
READ(5*216) (ALPHA(M,J)*M=1,7)
READ(5*216) (BETA(M,J)*M=1,7)
READ(5*217) (IS(M,J)*M=1,7)
IF(IS(3),NE.0.AND.ISIM.EQ.0) READ(5*216) ZLFTC,XTHRC,YMOMC
IF(IS(1),NE.0.AND.ISIM.EQ.0) READ(5*216) ZLFTS,XThRS,YMOMS
213 CONTINUE
IF(R.LT.RCOWL) RETURN
ICOWLT=1
INT=2
KCI=3
IF(IWRAP.EQ.1) RETURN
READ(5*217) IDUMMY
READ(5*216) (ZDUMMY(I)*I=1,NUM*EXP)
216 FORMAT(7E11.3)
217 FORMAT(7I5)
RETURN
END
SUBROUTINE TBL(ZX, PX, SIX, HX, PHIX, OX, PHEX, RX, GAMX, TX, I, IMAX, I)

COMMON /A/ XI, THMAX, TH(I), R, S(Z, P, PHIX, RX, GAMX, TX, L, IMAX, I)

COMMON /D/ UW, VU, WW, XW, YW, THW, (40)

COMMON /R/ JXCN, XC, XXI, JW, INT, ICOWL, RCOWL

COMMON /TB/ IMAXJ, IS1, IS2, ISL1, ISL2

THL = 0

IF(L .NE. JW .OR. TSIM .EQ. 1) THL = TH(L)

10 J7 = 1, IMAX

J5 = J7

IF(ZX .EQ. J5(L)) 8, 9, 10

8 J6 = J5 - 1

7 IF(I .EQ. 1) J6 = J5 + 1

12 CONTINUE

RAT = ((ZX - Z(J6, K)) / (Z(J5, L) - Z(J6, K)))

P = EXP ((J6, K) + (P, J5, L) - P, J6, K) * RAT

H = EXP ((J6, K) + (H, J5, L) - H, J6, K) * RAT

O = EXP ((J6, K) + (O, J5, L) - O, J6, K) * RAT

SI = EXP ((J6, K) + (SI, J5, L) - SI, J6, K) * RAT

PHIX = EXP ((PHI, J5, L) - PHI, J6, K) * RAT

PHEX = EXP ((PHE, J5, L) - PHE, J6, K) * RAT

RHOX = EXP ((RHO, J5, L) - RHO, J6, K) * RAT

GAMX = EXP ((GAM, J5, L) - GAM, J6, K) * RAT

IF(K .NE. JW .OR. TSIM .EQ. 1)

1 THX = TH(TH(K)) * RAT * (THL - TH(K))

IF(L .NE. JW .OR. TSIM .EQ. 1) GO TO 11

THX = THW(J6) + RAT * (THW(J5) - THW(J6))

GO TO 11

9 IF(ICOWL .EQ. 1) J5 = I

P = EXP (J5, L)

H = EXP (J5, L)

O = EXP (J5, L)

SI = EXP (J5, L)

PHIX = EXP (J5, L)

PHEX = EXP (J5, L)

RHOX = EXP (J5, L)

GAMX = EXP (J5, L)

THX = TH(L)

IF(L .NE. JW .OR. TSIM .EQ. 1) GO TO 11

THX = THW(J5)

GO TO 11

10 CONTINUE

11 RETURN

END
SUBROUTINE WRAP(M)

COMMON /4/ Q(40,10), TH4X4,T(10), R, Z(40,10), P(40,10), PHE(40,10),
  Q(40,10), S(40,10), H(40,10), P HI(40,10), RHO(40,10), GAM(40,10)

COMMON /C/ IMA(10), IMAX, ISTART, KOUNT, KOUNTP

COMMON /S/ R1, KOUNT, KOUNTS, IJOMLT

COMMON /I / IMAX, IDUMMY, JINT, DUMMY(40), THWW(2), JD1, JD2

COMMON /T/ NUMEXP, ZSAV

COMMON /W/ IWTOMO, X0(3), X1(3), P1W(20), Q1W(20), H1W(20), S1W(20),
  PIIW(20), PHE1W(20), RHO1W(20)

IF(M.EQ.0) GO TO 321

WRITE(6,1201)

1201 FORMAT (1H1,30X,*EXTERNAL_WRAP_AROUND_REGION*)

321 CONTINUE

J2=JINT
J3=J2+1

PI2=2., J3=1.4159266
PI3=3., J3=1.4159266/18.
IMAX2=IMAX(J2)

IMAX1=IMAX(J3)

ISS=IS(1,J2)
ISS1=ISS(1,J3)

IC1=IS(J3+1)
X0(1)=Z(1C+J2)-ZSAV

X1(1)=Z(Ic+13)-X0(1)*PI2
X0(2)=Z(ISS+J2)-Z(Ic+J2)
X1(2)=Z(ISS1+J3)-Z(IC1+J3)-X0(2)*PI2
X0(3)=Z(IMAX2+J2)-Z(ISS+J2)
X1(3)=Z(IMAX1+J3)-Z(ISS1+J3)-X0(3)*PI2

IF(M.EQ.0) IMAX2=IC1

DO 100 I=1, IMAX2

TF(I,J1+2) GO TO 1

100 CONTINUE

ZL=ZSAV

XN0=X0(1)

XN1=X1(1)

G1=0.

C=(Z(I,J2)-ZL)/XN0

D=C*X1(1)*G1

T1=X0(1)*C

T2=X1(1)*C

GO TO 2

1 IF(I.GT.ISS) GO TO 3

ZL=Z(I,J2)

XN0=X0(2)

XN1=X1(2)

G1=X1(1)

C=(Z(I,J2)-ZL)/XN0

D=C*X1(2)*G1

T1=X0(1)+X0(2)*C

T2=X1(1)+X1(2)*C

GO TO 2

3 ZL=Z(ISS,J2)

XN0=X0(3)

XN1=X1(3)
G1 = X1(1) * X1(2)
C = (Z(I+J2) - ZL) / XN0
D = C * X1(3) + G1
T1 = XN(1) * X0(2) + X0(3) * C
T2 = X1(1) + X1(2) + X1(3) * C
2 CONTINUE
R3 = T1 + T2 / PI2
R2 = T1
D2 = D * R2
NUM = R2 * SQRT(R2 + R2 + D2)
ST = 0.5 / D * (R3 * SQRT(R3 * R3 + D2) - DUM)
CALL TBL (R3, PS, ST, HS, PHIS, QS, PHES, RHOS, GAMS, THX, J3, IMAX(J3) + 1, 2)
P S = P S = P (I + J2) / ST
Q S = Q S = Q (I + J2) / ST
H S = H S = H (I + J2) / ST
SI S = SI S = SI (I + J2) / ST
PHI = PHI (I + J2) / ST
PHES = PHES (I + J2) / ST
RHOS = RHOS (I + J2) / ST
GAMS = GAMS = GAMS (I + J2) / ST
IF (I, GE, IC OR, MwNE, 0) GO TO 322
I = I = DUMMY + 1
P 1 = W(I2) = P
Q 1 = W(I2) = Q
H 1 = W(I2) = H
SI 1 = W(I2) = SI
PHI 1 = W(I2) = PHI
PHES 1 = W(I2) = PHES
RHOS 1 = W(I2) = RHOS
322 IF (Mw, EQ, 0, N) GO TO 100
WRITE (6, 1200) I
DO 101 K = 1, 10
THT = T1 + FLOAT(K = 1)
D3 = T1 + T2 + THT
S = 0.5 / D * (R3 + SQRT(R3 + R3 + D2) - DUM)
P S = P (I + J2) + P
Q S = (I + J2) + Q
H S = H (I + J2) + H
SI S = SI (I + J2) + SI
PHI = PHI (I + J2) + PHI
PHES = PHES (I + J2) + PHES
RHOS = RHOS (I + J2) + RHOS
GAMS = GAMS (I + J2) + GAMS
WRITE (6, 1202) R3, THT, PB, Q8, PHER, SI, H, PHIS, RHOB, GAMS
1202 FORMAT (10E11.3)
101 CONTINUE
100 CONTINUE
RETURN
END
SUBROUTINE INDFT2(MM,IFS,BM)

COMMON /JF/ JFINAL
COMMON /XJ/ THMAX,TH(10),R,Z(40,10),P(40,10),PHF(40,10)
COMMON /CF/ TMAX(10), JMAX, ISTART, KCOUNT, KOUNTP
COMMON /W/ UW(40), VW(40), WW(40), XW(40), YW(40), THW(40)
COMMON /G/ A1(3,9), A2(3,9), A3(3,9), RRT(3), RR2(3), RR3(3)

1, NUMLWS, NUMUWS, NUMSWS

COMMON /ISIM/

COMMON /XJ/ XMAX
COMMON /J/ QN(40,10), PHEN(40,10), SINN(40,10), XPLAM(40,10)

COMMON /V/ VXCN, VXCI, XW
COMMON /W/ ISIMEX, IDUMMY, JINT, IDUMMY(40), THW(2), JD1, JD2

COMMON /SA/ XJTS
COMMON /I/ NUMEXP, ZSAV

DIMENSION BM(10)

102 FORMAT(AF10.3)

PEWIND 55

DO 5333 J=1,JW

IMAX=IMAX(J)

DO 5333 I=1,IMAX(J)

READ(ES) Z(I,J), P(I,J), Q(I,J), H(I,J), SI(I,J), RHO(I,J), PHI(I,J), P

THE(I,J), TH(J)

T(I,J)=FT(P(I,J), PHI(I,J), H(I,J))

GAM(I,J)=FGAM(T(I,J), P(I,J), PHI(I,J))

A(I,J)=SORT(GAM(I,J), P(I,J), RHO(I,J))

CALL XPLAM(Q(I,J), A(I,J), PHE(I,J), XPLAM(I,J), XPLAM(I,J))

5333 CONTINUE

CALL MOTHER

READ(ES) IFSS, MM

104 FORMAT(AF15)

IF(IEWAP .EQ.1) GO TO 2

L=JFINAL

DO 1600 J=1,2

T(I,J)=T(I,L)

1600 FORMAT

Z(I,JW)=Z(I,L)

P(I,JW)=P(I,L)

H(I,JW)=H(I,L)

Q(I,JW)=Q(I,L)

A(I,JW)=A(I,L)

SI(I,JW)=SI(I,L)

PHI(I,JW)=PHI(I,L)

PHE(I,JW)=PHE(I,L)

RHO(I,JW)=RHO(I,L)

GAM(I,JW)=GAM(I,L)

XPLAM(I,JW)=XPLAM(I,L)

XPLAM(I,JW)=XPLAM(I,L)

IMAX(JW)=IMAX(L)

TH(JW)=TH(L)

THW(1)=THWW(1)

THW(2)=THWW(2)
CONTINUE
ISTM=ISTMEX
JMAX=JW
IF (ISTM .EQ. 0) JMAX = JW + 1
DO 500 J = 1, JMAX
IMMM = MAX (J) + MM
IMMM = IMM + IFSS = 1
READ (5, 103) (Z (I, J), I = IMM, IMM)
READ (5, 103) (P (I, J), I = IMM, IMM)
READ (5, 103) (Q (I, J), I = IMM, IMM)
READ (5, 103) (SI (I, J), I = IMM, IMM)
READ (5, 103) (H (I, J), I = IMM, IMM)
READ (5, 103) (PHI (I, J), I = IMM, IMM)
READ (5, 103) (PM (I, J), I = IMM, IMM)
103 FORMAT (7E10.3)
DO 1 T = IMM, IMM
IF (J, GT, JNT, AND, I. LT, IMM - J) Z (I, J) = Z (2, J)
PH (I, J) = RHEG (H (I, J), P (I, J), PHT (I, J))
SI (I, J) = SI (I, J) / 57.3
T (I, J) = FT (P (I, J), PHI (I, J) * H (I, J))
GAM (I, J) = FGAM (T (I, J), P (I, J), PHT (I, J))
A (I, J) = SORT (GAM (I, J), P (I, J) / RHEG (I, J))
CALL XLAM (Q (I, J), A (I, J), PHI (I, J), XPLAM (I, J), XMLAM (I, J))
1 CONTINUE
500 CONTINUE
IF (ISTMEX .EQ. 1) GO TO 600
J = JW
IMMM = MAX (J) + MM
IMMM = IMM + IFSS = 1
READ (5, 103) (Z (I, J), I = IMM, IMM)
READ (5, 103) (P (I, J), I = IMM, IMM)
READ (5, 103) (H (I, J), I = IMM, IMM)
READ (5, 103) (PHI (I, J), I = IMM, IMM)
READ (5, 103) (PM (I, J), I = IMM, IMM)
READ (5, 103) (PM (I, J), I = IMM, IMM)
600 CONTINUE
READ (5, 103) (BM (J10), J10 = 1, JW)
DO 7639 J11 = 1, JW
7639 RM (J11) = RM (J11) / 57.3
READ (5, 104) NUMUWS
DO 251 I = 1, NUMUWS
251 READ (5, 102) RR2 (I), (A2 (I, J), J = 1, 9)
IF (ISTMEX .EQ. 1) GO TO 3
READ (5, 104) NUMUWS
DO 252 I = 1, NUMUWS
252 READ (5, 102) RR3 (I), (A3 (I, J), J = 1, 9)
J = JW
XJ1 = 0
DO 7 T = IMM, IMM
IF (I .EQ. T .AND. IMM = J) Z (I, J) = Z (2, J)
PHO (I, J) = RHEG (H (I, J), P (I, J), PHT (I, J))
TSH = TSH (JMAX) * XJ
XW (I) = R * COS (TSH)
IF (XJ1 .EQ. 0.)
1CALL SWALL(ROZ(I+J)XW(I)YW(I)FX+FZ)

IF(XJ+GT.0.)
1CALL SWALL1(YW(I)ROZ(I+J)FX+FZ)

IF(XJ.EQ.0.) GO TO 200

THW(I)=ATAN(YW(I)/XW(I))
GO TO 201

200 THW(I)=YW(I)

201 CONTINUE

VW(I)=UW(I)*FX+YW(I)*FZ

IF(XJ.EQ.1.) VW(I)=VW(I)@Z(I+J)

THWG=THW(I)*XJ

UT=UW(I)*COS(THWG)+YW(I)*SIN(THWG)

VT=YW(I)*COS(THWG)-UW(I)*SIN(THWG)

O(I,J)=SORT(UT,UT+YW(I)*WW(I))

PHE(I,J)=ATAN(WW(I)/UT)

SI(I,J)=ATAN(VT/O(I,J))

PHE(I,J)=FT(P(I,J)+PHI(I,J)+H(I,J))

GAM(I,J)=FGAM(T(I,J)+P(I,J)+PH(I,J))

A(I,J)=SORT(GAM(I,J)+P(I,J)+RH(I,J))

7 CONTINUE

CALL XLAB0(Q(I,J)+A(I,J)+PHE(I,J)+XPLAB(I,J)+XLAB(I,J))

3 CONTINUE

RETURN

END
FUNCTION FH(P1,F,T1)

COMMON /THE/ A1,A2,A3,A4,A5,A6,XMM1
T=T1*8./9.
F2=F*F
IF(F*(T*0.)) GO TO 400
IF(T*.GT.2000.0) GO TO 190
IF(F*.GT.1.) GO TO 191
B=.01167*F2 *.1503*F*.932
C=-.384*F2 *.6731*F*.4293
GO TO 290
191 A=1.E-07*(1.787*F2 -.548*F*.54)
B=-.1867*F2 +1.11*F*.176
C=-.0333*F2 +3.975*F=2.808
GO TO 290
190 IF(F*.GT.1.) GO TO 192
A=0.00001*(1.79*F2 +.3983*F*.31)
B=.001*(-.5*F2 -.07917*F*.248)
C=.18*F2 -.1783*F+.97
GO TO 290
192 A=0.00001*(4.8*F2 -13.9*F*11.49)
B=.001*(-.23*F2 +.6682*F*.52*.A1)
C=27.65*F2-.73.73*F+58.39
290 H1=A*E*T4+8*T+C
IF(T*.LE.2000.) GO TO 370
A10=A10000(P)/2.3=5.
79=.155*A10/10=2.75*A10
H1=H1+(1.*E)*(T/2000.-1.)*79
370 H1=H1+1.E+06
GO TO 340
400 T2=T*4
T3=T2+T
T4=T3+T
T5=T4+T
H1=H1*8.314./XMM1
340 CONTINUE
FH=H1*10.*7639
RETURN
END
SUBROUTINE SOLVE (A11, A12, A13, A21, A22, A23, A31, A32, A33, DET)


RETURN
END
SUBROUTINE SWAL(X1,Z1,X,Y,FZ)

COMMON /G/ A1(3,9), A2(3,9), A3(3,9), RR1(3), RR2(3), RR3(3)

COMMON /I/ X

L=1
PRT=1.E-06
IF (L.LT.NUMSWS) PRT=RR3(L+1)
IF (R1.GE.PRT) L=L+1
IF (L.LT.NUMSWS) RLI=RR3(L+1)
IF (R1.GE.PRT AND L.LT.NUMSWS) I=L+1

X=X1
Z=Z1
IF (L.LT.NUMSWS) L=L+1

21 XX=X*X

Y=A3(L+1)*XX*Z+A3(L+2)*XX*Z+A3(L+3)*Z*Z+A3(L+4)*XX*A3(L+5)*Z

1A3(L+4)*XX*Z+A3(L+7)*X*Z+A3(L+8)*Z*Z+A3(L+9)

IF (XJ.E0.0.) GO TO 20

RT=SQR(T(XX+YY))

ERR=(RT-R1)/R1
IF (ABS(1.RR)*L.1.E-10) GO TO 21

IT=IT+1
IF (IT.GT.2) GO TO 22
FR1=ERR
X1=X
Y1=Y
GO TO 22

20 CONTINUE

X1=X
Y1=Y
RETURN
END
SUBROUTINE TWALL(R1,THX,Z,FR1,FT1)

COMMON C/11(3,9),A2(3,9),A3(3,9),RR1(3),RR2(3),RR3(3)
1,NUMWLS,NUMUWS,NUMSWS
COMMON C/1/ XJ

COMMON C/R,JCX,NCX,XXJ,INT,ICOWL,OCOWL
COMMON C/XJ1
COMMON C/ISW/ JCALC,ISWEEP,XINS(10),X2

L=1
RTT=R+06
THX=TH1*XJ
R=R*XNSP(J)
IF (XJ,0) TH1=TH1
IF (XJ,0) R=R1*SIN(TH1)
IF (LLT.NUMUWS) RTT=RR2(L+1)
IF (R,GE,RTT) L=L+1
IF (L,LT,NUMUWS) RTT=RR2(L+1)
IF (R,GE,RTT) AND (L,LT,NUMUWS) =L+1
PR=PR+R

TT=T*T
7=A2(L+1)*RR+TT*2(A2(L+2)*RR*2*A2(L+3)*R*2*A2(L+4)*RR*2(A2(L+5))*TT+
1*A2(L+6)*R*2*A2(L+7)*R*2*A2(L+8)*T*A2(L+9)

FR =A2(L+1)*R*2*A2(L+2)*R*2*A2(L+3)*T*2*A2(L+4)*R*A2(L+5)
1*T*A2(L+7)
FT=A2(L+1)*RR*T+A2(L+2)*RR*2*A2(L+3)*R*2+A2(L+5)*T*A2(L+6)
1*R+A2(L+7)
FR=FR*CO(SXH)*FT*SIN(THX)
FT=FR*SIN(THX)*FT*CO(SXH)
IF (XJ,0) FT1=FT1/R1
IF (XJ,0) FT1=FT1/Z
RETURN
END
SUBROUTINE SWEFP(TII35)

COMMON /TEM/ T(I40,10)
COMMON /J/ QN(40,10), PHEN(40,10), SINN(40,10), XPLAM(40,10), XMLAM(40,10), FP(40), FM(40), Δ(40,10)
COMMON /X/ XH, THMAX, TH(10), R, Z(40,10), P(40,10), PHE(40,10), HI(40,10), RHO(40,10), GAM(40,10)
COMMON /C/ IMAX(10), JMAX, ISTAR, KOUNT, KOUNTP
COMMON /N/ SIQ(40,10), PQ(40,10), PHEQ(40,10), SQ(40,10), PHIQ(40,10)
COMMON /S/ RI, RCOUNT, COUNTS, ICOWNL, PCOWNL
COMMON /PS/ ZR(40,10), PR(40,10), OR, Z(40,10), PHICR(40,10)
COMMON /IS/ JC, ISW, JSW, XSW, X1K(40), RED, X1K(40), X1K(40,10)
COMMON /I;/ JCALC, ISWEEP, XINS(10), XR
COMMON /ISE/ XUNSP
IF (II35.EQ.1) GO TO 1
JKE=JCALC+1
XC=XCALC+1
XR=XR
IF (RAT.LT.1.E-10) RAT=1.
TH(JC)=THR(1), RAT*(TH(JK)=THR(1))
IM=IMAX(JCALC)
IF (RAT.LT.1.E-10) RETURN
JCALC=JCALC+1
TH(10)=1. RETURN
JFR=1
IF (JCALC.LT.JW+1) GO TO 1
JFR=0
JCALC=100
JW=JW+1
JMAX=JW
TF(1STM.EQ.0) JMAX=JW+1
KUnSp=KOUNT
ISWEEP=0
RETURN
IMAX=IMAX(1)
NO 2 I=1, IMAX
Q (I*JC)=Q (I,J) + RAT*(Q (I,JK)=Q (I,J))
Z (I*JC)=Z (I,J) + RAT*(Z (I,JK)=Z (I,J))
SI (I*JC)=SI (I,J) + RAT*(SI (I,JK)=SI (I,J))
PHI (I*JC)=PHI (I,J) + RAT*(PHI (I,JK)=PHI (I,J))
PHE (I*JC)=PHE (I,J) + RAT*(PHE (I,JK)=PHE (I,J))
PHR (I*JC)=PHR (I,J) + RAT*(PHR (I,JK)=PHR (I,J))
RHO (I*JC)=RHO (I,J) + RAT*(RHO (I,JK)=RHO (I,J))
RE =JC
T(I*L)=P(I*L)+PHI (I*L)+H(I*L)
GAM (I*L)=FGAM(T(I*L), P(I*L)+PHI (I*L))
D(I*L)=SQRT(GAM (I*L)*P(I*L)+RHO (I*L))
CALL X1AM(Q(I*L), D(I)L)+PHE (I*L), XPLAM(I*L), XMLAM(I*L)
CONTINUE
IF (RAT.LT.1.E-10) RETURN
JCALC=JCALC+1
IFR=1
IF (JCALC.LT.JW+1) GO TO 1
IFR=0
JCALC=100
JW=JW+1
JMAX=JW
TF(1STM.EQ.0) JMAX=JW+1
KUnSp=KOUNT
ISWEEP=0
RETURN
1 IMAX=IMAX(1)
NO 2 I=1, IMAX
P (I*JC)=P (I,J) =0.
H (I*JC)=H (I,J) =0.

Q(T*JCALC) = 0.
SI Q(T*JCALC) = 0.
PHIQ(T*JCALC) = 0.
PHEG(T*JCALC) = 0.
RHOQ(T*JCALC) = 0.
GAMQ(T*JCALC) = 0.
2 CONTINUE
RETURN
END
FUNCTION FT(P1,F,H5)
COMMON /C/ IMAX(21),JMAX,ISTART,KOUNTF,KOUNTP
COMMON /S/ RI,KOUNT,KOUNTS,ICOL,LT
COMMON /THE/ A1,A2,A3,A4,A5,A6,XMM1
DATA T63/0/
P=P1*1.0325E5/2116.
H=H5/1.7639/1.E+06
F2=F/F
A10=ALOG(P)/2.3-5.
79=125*A10*A10 -.275*A10
IT=1
IF(I63.EO.D) GO TO 1000
I63=1
T=1500.
T0=1500.
IF(F,.E.0.) GO TO 120
T=600.
T0=T
1000 IF(F,.L.T.0.) GO TO 400
GO TO 120
50 E0=(H-H1)/H
IF(ABS(E0)*LT.1.E-04) GO TO 345
T=T0*1.1
T=2
IF(F,.L.T.0.) GO TO 400
GO TO 120
100 E1=(H-H1)/H
IF(ABS(E1)*LT.1.E-04) GO TO 345
IT=IT+1
IF(IT.LT.21) GO TO 10
WRITE(6,11)
11 FORMAT(* ERROR IN TEMPERATURE ITERATION IN FT*)
STOP
10 T9=T0-E0*(T-T0)/(E1-E0)
F0=E1
T0=T
T=T9
120 A=1.E-07*(-1.1467*F2 +1.5242*F*.987)
R=.001*(-.01466*F2 +1.503*F*.931)
C=-.6284*F2 +.6731*F*.4293
IF(F,.E.0.) GO TO 190
A=1.E-07*(1.787*F2 -5.48*F+5.4)
B=.01*(-1.867*F2 +1.11*F*.176)
C=-.0933*F2 +3.975*F2 +2.808
190 IF(T,.E.2000.) GO TO 290
A=0.000001*(-1.192*F2 +.3983*F*.31)
R=.001*(-9.05*F2 -.07917*F*.245)
C=10.62*F2 -.1183*F*.97
IF(F,.E.1.) GO TO 290
A=0.000001*(-.81*F2 -1.9*F+1.59)
R=.001*(-13.88*F2 +4.6*F+5.841)
C=27.85*F2 -.73.73*F+.58.39
290 H1=A*F*T*B*T+C
IF(T,.E.2000.) GO TO 370
H1=H1*{(1.*F)}.{T/2000.}*.79)
370 CONTINUE
   GO TO 350
400 T2=T*T
   T3=T2*T
   T4=T3*T
   T5=T4*T
   IF (T*LT.-1.5) GO TO 450
   XMM1=16.043
   A1=4.2497678
   A2=6.9126562E-03
   A3=3.1602134E-05
   A4=2.9715432E-08
   A5=9.5103580E-12
   A6=1.0186632E+04
   GO TO 460
450 CONTINUE
   A1=1.1202436
   A2=1.3905716E-02
   A3=2.6569374E-06
   A4=1.1560272E-08
   A5=5.2386929E-12
   A6=5.3328896E+03
   XMM1=28.054
   H1=H1*8314./XMM1/1.E+06
350 IF (T.EQ.1) GO TO 50
   GO TO 100
340 T0=T
   FT=0.*T/5.
   RETURN
END
SUBROUTINE STEP(TFS,MM, DFIX, X2, KOUNT)

COMMON /X/ XH, XHMAX, TH(10), R
COMMON /A/ XI, THMAX, TH(10), R, Z(40,10), P(40,10), PH(40,10),
COMMON /B/ PN(40,10), PHN(40,10), RN(40,10), PRN(40,10), RHO(40,10), GAM(40,10),
COMMON /C/ IMAX(10), JMAX, ISTART, KOUNT, KOUNTP
COMMON /D/ UW (40), VW (40), WW (40), XW (40), YW (40), THW (40)
COMMONT/H/ 
COMMON /I/ XJ
COMMON /J/ QN(40,10), PHEN(40,10), SINN(40,10), XPLAM(40,10),
COMMON /K/ RN, RELR
COMMON /L/ ALPHAN(7,10), ALPH(7,10), BETA(7,10), ETA(7,10)
COMMON /M/ IS(7,10)
COMMON /P/ KC1, KC2, KS1, KS2
COMMON /Q/ QCWL, QCW
COMMON /R/ R = N, NT, KOUNTP, ICWL, IPCWL
COMMON /S/ XJ
COMMON /W/ ISIMEX, IDUMMY, JINT, JDUMMY(40), THW(2), JD1, JD2
COMMON /SA/ XJIS
COMMON /T/ NSTP
COMMON /TB/ IMAXJ, IS1, IS2, ISLT, ISL2
COMMON /ISW/ JCALC, JSWEEP, XINSP(10), X9
COMMON /SPE/ KOUNTC
COMMON /ISE/ KOUNTP
COMMON /PL/ DE TH
COMMON /XSTP/XSTP

NY=1000,
IOUT=1,
IFLAG=0

1 DELX=1.E+06
DELR=1.E+06
IF(IFLAG.EQ.1) IOUT=0
DO 3 J=1, JMAX
IF(J.GT.JCALS) GO TO 3
IF(J.GT.JINT) XJ=0.
IMAXJ=IMAX(J)
IF(IMAXJ.LT.39) GO TO 1111
3 ISTOP=1
1112 RETURN

CONTINUE
JM=J-1
JP=J+1
IF(ISWEEP.EQ.1.AND.J.EQ.JCALS) JP=J+2
IF(J.EQ.1) JM=JP
IF(ISWEEP.EQ.1.AND.J.EQ.JMAX) JM=JM
IF(J.EQ.1.EQ.0) GO TO 5777
IS1=IS(3,J)
IS2=IS(J,j)
CONTINUE
IIT=IMAX(J)-IFS+1
IITT=IIT-MM-1
4 DO 5 MM=1,7
IF(ICWL.EQ.1.AND.I.GT.IITT.AND.I.LE.IIT) GO TO 4
5 CONTINUE
IF(IS(M,I),EQ.0) GO TO 5

TF ((M/2)*2.0 .EQ. M) ITEST=IS (M,J) + 1
TF((M,J) .LT. 2.0) GO TO 112
TF(I,J) .EQ. 1.0 GO TO 4

5 CONTINUE

OZ = (I,J) - (I-1,J)

TF(I,J) .LT. JMAX) OY1 = TH(JP) - TH(J)
TF(1 = 0.0 AND J = JMAX) DYZ = THW (I) - TH(JMAX)
TF(I,J) .EQ. 1.0 AND I,J .EQ. (I+1,J) OY1 = TH(JMAX) - TH(JM)

TF(J,J) .LT. JMAX .OR. ISM .EQ. (I+1)) GO TO 6
TF(I,J) .EQ. 1.0 GO TO 6
TF(I,J) .EQ. IS1 .OR. I,J .EQ. (IS1-1)) GO TO 6
TF(I,J) .EQ. IS2 .OR. I,J .EQ. (IS2-1)) GO TO 6

MAXM = MAX(JM)

ISL1 = IS (3*JM)

ISL2 = IS (1*JM)

TF (ICNWL .EQ. 1) ISL1 = 0
CALL TBL (Z(I,J) ,P1 ,S11 ,H1 ,PHI1 ,Q1 ,PHE1 ,RHO1 ,GAM1 ,THX ,JM ,IMAX ,JM ,I)

IMAX,J = MAX(JP)

ISL1 = IS (3*JP)

ISL2 = IS (1*JP)

TF (ICNWL .EQ. 1) ISL1 = 0
CALL TBL (Z(I,J) ,P2 ,S12 ,H2 ,PHI2 ,Q2 ,PHE2 ,RHO2 ,GAM2 ,THX ,JP ,IMAX ,JP ,I)

DT = THX - TH(J)

D1 = TH(J) - THY

D2 = ABS (D1)

D2 = ABS (D2)

IF (JP,EQ.JMAX+I) TH(JP) = THX

IF (D2 .LT. 1.0) D2 = TH(J) - 1.0 . E-05

IF (D1 .LT. 1.0) O1 = D1 / 2.

DY = AMIN (DY*D1,D2)

NY = DY * 75

6 CONTINUE

TF (X,J) .LT. JMAX . AND. J .LT. JINT) OZ = OZ*(I,J)

TF (X,J) .EQ. 1.0) DY = DY*R

TF (D,Y) .LT. D) D = DY

DR = (D7 / (XPLAM(I-1, J) - XPLAM(I , J))

4 CONTINUE

DX = DELR

TF (DX .LT. DELX) DELX = DX

3 CONTINUE

XJ1 = XJ1S

DELX = DELX * XSTP
IF (X2 .GT. XFIN) DELX = XFIN - X1
IF (X2 .GT. XFIN) X2 = XFIN

IF (INT .EQ. 2) GO TO 340
IF (ISWEEP .EQ. 0) GO TO 341
IF (X2 .LE. XINSPI (JCALC+1) + RI - 1.0E-05) GO TO 340
X2 = XINSPI (JCALC+1) + RI
DELX = XINSPI (JCALC+1) - X1 * RI
GO TO 340

340 CONTINUE
RETURN
END
SUBROUTINE CORNER(IC, R1, TH1, Z1)

COMMON /AV/ AV=AV
COMMON /ALR/ ALN(40,10), TN(40,10), GAMN(40,10), XPLMN(40,10)
 COMMON /ML/ MLAM(40,10), FD(40), FM(40), A(40,10)

COMMON /IV/ IV,KCORR,IV

COMMON /JQ/ QN(40,10), PHEN(40,10), SINN(40,10), XPLMN(40,10)
 COMMON /JQ/ JQ40,10), FD(40), FM(40), A(40,10)

COMMON /K/ RN, RELR

COMMON /T/ PP(40,2), ZP(40,2), PIP(40,2), PHEP(40,2)

COMMON /S/ S(40), VW(40), WW(40), XW(40), YW(40), THW(40)

COMMON /E/ UW(40), VW(40), WW(40), XW(40), YW(40), THW(40)

COMMON /K/ RN, RELR

COMMON /V/ XJ

DIMENSION YPLAM(J), YMLAM(J)

KIX=1

A93=1, A93=0.

IF(BAv.GT.0.) A93=.5

IF(BAv.GT.0.) A93=.5

.JW=JMAX+1

PTE=PN(IC,JW)

XPLMN=XPLMN(IC,JW)

II=I=1

IF(IC.EQ.1) II=IC+1

IF(XJ.EQ.0.) 1XWN(I)=XWN(I)

I=1

THG=TH1

CONTINUE

THGX=THG*XJ

YR1=OS(THGX)

Y=RI*IN(THGX)*THG*(1-XJ)

IF(IC.EQ.1) CALL RWALL(R1,THG*71,FR*FH)

IF(IC.EQ.1) CALL TWALL(R1,THG*71,FR*FH)

IF(XJ.EQ.0.) CALL SWALL(R1, Z1, X, YT, FX, FZ)

IF(XJ.EQ.0.) CALL SWALL1(YT, R1, Z1, FX, FZ)

ERR=(YT)/R1*XJ

IF(ABS(ERR).LT.1.E-10) GO TO 20

I=1

TH2=THG

ERR2=ERR

THG=1.01*THG*1.0E-4

GO TO 5

20 NUM=TH2*ER2*(THG-TH2)/(ERR-ER2)

ERR=ERR

TH2=THG

THG=NUM
IF(IT, GT, 10) CALL ERROR(20)

GO TO 5

10 CONTINUE

THG = THG * XJ

THWN(1C) = THG

TF(XJ, EQ. 0.)

1XWN(1C) = X

TF(XJ, EQ. 0.)

2N(1C, JW) = Z1

ZDUM = 1.

TF(XJ, EQ. 1.) ZDUM = Z1

WOU = (FR*(COS(THGX)) + FX*SIN(THGX) + FT*ZDUM*

1 (FX*COS(THGX) - SIN(THGX)

2)) / (FX * T'S(THGX) + FT*COS(THGX) + ZDUM)

WOU = WU * WOU * FZ

WOU = VN* U * ZDUM

COPPER PRESSURE (Z = const)

IM, MAX = IMAX(JMAX)

TD = IMAX(JJ) + 1

TD = ZN(1C, JW)

DO 3 J = 1, 2

RAT = (7D-ZP(II, JJ))/(ZP(1C, JJ) = ZP(II, JJ))

UP(II, JJ) = UP(II, JJ) * RAT*(UP(1C, JJ) = UP(II, JJ))

VP(IJ, JJ) = VP(1I, JJ) * RAT*(VP(1C, JJ) = VP(II, JJ))

WP(IJ, JJ) = WP(1I, JJ) * RAT*(WP(1C, JJ) = WP(II, JJ))

PP(IJ, JJ) = PP(1I, JJ) * RAT*(PP(1C, JJ) = PP(II, JJ))

HP(IJ, JJ) = HP(1I, JJ) * RAT*(HP(1C, JJ) = HP(II, JJ))

RHOP(II, JJ) = RHOP(II, JJ) * RAT*(RHOP(1C, JJ) = RHOP(II, JJ))

PHIP(II, JJ) = PHIP(II, JJ) * RAT*(PHIP(1C, JJ) = PHIP(II, JJ))

THP(II, JJ) = THP(II, JJ) * RAT*(THP(1C, JJ) = THP(II, JJ))

IF(JJ, EQ. 1) THP(II, JJ) = TH(JMAX)

TP(II, JJ) = ZD

D1 = ZD - ZP(II, JJ)

IF(JJ, EQ. 2) GO TO 4

DUP = (UP(II, JJ) = UP(II, JJ))/D1

DV = (VP(II, JJ) = VP(II, JJ))/D1

DW = (WP(II, JJ) = WP(II, JJ))/D1

DP = (PP(II, JJ) = PP(II, JJ))/D1

GO TO 3

4 D2 = (UP(II, JJ) = UP(II, JJ))/D1

D2 = (VP(II, JJ) = VP(II, JJ))/D1

D2 = (WP(II, JJ) = WP(II, JJ))/D1

D2 = (PP(II, JJ) = PP(II, JJ))/D1

CONTINUE

RAT = 5

I = ID

IT = 1

THA = TH(JMAX) + RAT*(THW(1C) - TH(JMAX))

25 V = P(I*, I) + RAT*(U P(I*, 2) - P(I*, I))

W = P(I*, I) + RAT*(V P(I*, 2) - V P(I*, I))

W = P(I*, I) + RAT*(W P(I*, 2) - W P(I*, I))

RHOA = RHOP(I*, I) + RAT*(RHOP(I*, 2) - RHOP(I*, I))

THA = THA * XJ
\[
\begin{align*}
\text{Y} & = \text{R} \cdot \cos(\text{THAX}) \\
\text{Y} & = \text{R} \cdot \sin(\text{THAX}) \cdot \frac{\text{THA} \cdot (1 - \text{XJ})}{\text{PSV}} \cdot \text{PA} \\
\text{PHIA} & = \text{HIP} (I, 1) + \text{RAT} \cdot (\text{PHIP}(I, 2) - \text{PHIP}(I, 1)) \\
T & = \text{FT} (\text{PA} \cdot \text{PHIA} \cdot \text{W}) \\
\text{GAMA} & = \text{FGAM} (\text{TA} \cdot \text{PA} \cdot \text{PHIA}) \\
\text{AA} & = \text{SQR} (\text{GAMA} \cdot \text{PA} / \text{RHOA}) \\
\text{TAU} & = \text{VA} / \text{UA} \\
\text{UA} & = \text{AA} \cdot \text{UA} \\
\text{AA} & = \text{AA} \cdot \text{AA} \\
\text{V2} & = \text{VA} \cdot \text{VA} \\
\text{BETA} & = \text{SQRT} ((\text{UA} + \text{VA}^2) / (\text{AA} + 1)) \\
\text{ALAM} & = (\text{UA} \cdot \text{VA} + \text{AA} \cdot \text{BETA}) / (\text{UA} - \text{AA}^2) \\
\text{DUMP} & = \text{R} \cdot \text{TAU} \cdot \text{R} \cdot \text{PHIP}(I, 1) - \text{PHIP}(I, 1) \\
\text{IF} (\text{XJ}, \text{EQ}, 0) & \text{ GO TO 32} \\
\text{THAT} & = \text{VWN}(I, C) - (\text{XWN}(I, C) - \text{X}) \cdot \text{DUMP} \\
\text{THAT} & = \text{SIN}(\text{THAT}/\text{R}) \\
\text{GO TO 33} \\
\text{32 IF} (\text{XJ}, \text{EQ}, 0) & \text{ GO TO 33} \\
\text{IF} (\text{XJ}, \text{GT}, 0) & \text{ THAT} = \text{THWN}(I, C) = \text{DUMP} \cdot (\text{R} - \text{R}) / \text{ZN}(I, C, JW) \\
\text{THAT} & = \text{THWN}(I, C) - \text{DUMP} \cdot (\text{R} - \text{R}) / \text{ZN}(I, C, JW) \\
\text{CONTINUE} \\
\text{FP} & = \text{ABS}(1 - \text{THAT}/\text{THA}) \\
\text{IF} (\text{EP}, \text{LT}, 1 \cdot 1 \cdot 04) & \text{ GO TO 30} \\
\text{THA} & = \text{THAT} \\
\text{RAT} & = (\text{THA} - \text{TH}(\text{JMAX}))/ (\text{THP}(I, 2) - \text{TH}(\text{JMAX})) \\
\text{IT} & = \text{IT} + 1 \\
\text{IF} (\text{IT}, \text{GT}, 15) & \text{ CALL ERROR} (30) \\
\text{GO TO 25} \\
\text{30 DU} & = \text{DU} \cdot \text{RAT} \cdot (\text{DU} + \text{DU}) \\
\text{DV} & = \text{DV} \cdot \text{RAT} \cdot (\text{DV} + \text{DV}) \\
\text{DW} & = \text{DW} \cdot \text{RAT} \cdot (\text{DW} + \text{DW}) \\
\text{DP} & = \text{DP} \cdot \text{RAT} \cdot (\text{DP} + \text{DP}) \\
\text{IF} (\text{BETA}, \text{EQ}, 0) & \text{ BN=ERROR} \\
\text{A2} & = \text{A3} \cdot (\text{RHOA} \cdot \text{A2} \cdot \text{BETA}) + \text{B93} \cdot (\text{RHOA} \cdot \text{IC} \cdot \text{W}) \cdot \text{THWN}(I, C) \cdot \text{W} \cdot 1 \cdot (\text{ALAM} \cdot \text{VA} \cdot \text{UA}) \cdot (\text{UA} + \text{AA} \cdot \text{RHOA} \cdot \text{W}) \cdot \text{UA} / (\text{AA} \cdot \text{AA} \\
\text{FP} & = \text{FP} \cdot \text{BETA} \\
\text{TAC} & = \text{WOU} \\
\text{THWN} & = \text{THWN}(I, C) \cdot \text{XJ} \\
\text{THAX} & = \text{THA} \cdot \text{XJ} \\
\text{TSV1} & = (\text{V01} + \text{TAN}(\text{THWNX})) / (1 + \text{V01} + \text{TAN}(\text{THWNX})) \\
\text{TSV2} & = (\text{VA} / \text{VA} + \text{TAN}(\text{THAX})) / (1 + \text{VA} / \text{VA} \cdot \text{TAN}(\text{THAX})) \\
\text{DV} & = \text{DV} - \text{TSV2} \\
\text{IF} (\text{XJ}, \text{EQ}, 0) & \text{ NRRR=THWN}(I, C) = \text{X} \\
\text{IF} (\text{XJ}, \text{EQ}, 0) & \text{ NRRR=RNN-R} \\
\text{PC} & = \text{PA} \cdot \text{FP} \cdot \text{ROP} \cdot (\text{THA} - \text{THA}) \cdot \text{THWN}(I, C) \\
\text{C} & \text{ CORNER PRESSURE (THETA = CONSTANT)} \\
\text{T} & = \text{THWN}(I, C) \\
\text{TH} & = \text{TH} \cdot (\text{JMAX}) \\
\text{DO} & \text{ 40 IK}=1+2 \\
\text{IT} & = \text{IK} \\
\text{IF} (\text{IC}, \text{EQ}, \text{IMAXI}) & \text{ ICXMAXI}=\text{IK}+1 \\
\text{RAT} & = \text{TH} / (\text{THP}(I, 2) - \text{THP}(I, 1)) \\
\text{HP} & = (\text{I, 2}) = \text{H} \cdot \text{P}(I, 1) + \text{RAT} \cdot (\text{H} \cdot \text{P}(I, 2) - \text{H} \cdot \text{P}(I, 1)) \\
\text{PP} & = \text{PP}(I, 1) + \text{RAT} \cdot (\text{PP}(I, 2) = \text{PP}(I, 1)) \\
\end{align*}
\]
\[
\begin{align*}
\text{PHOP}(t+2) &= \text{RHOP}(t+1) + \text{RAT}\text{*}(\text{RHOP}(t+2) - \text{RHOP}(t+1)) \\
\text{ZP}(t+2) &= \text{ZP}(t+1) + \text{RAT}\text{*}(\text{ZP}(t+2) - \text{ZP}(t+1)) \\
\text{QP}(t+2) &= \text{QP}(t+1) + \text{RAT}\text{*}(\text{QP}(t+2) - \text{QP}(t+1)) \\
\text{SI}(t+2) &= \text{SI}(t+1) + \text{RAT}\text{*}(\text{SI}(t+2) - \text{SI}(t+1)) \\
\text{PHEP}(t+2) &= \text{PHEP}(t+1) + \text{RAT}\text{*}(\text{PHEP}(t+2) - \text{PHEP}(t+1)) \\
\text{PHEP}(t+2) &= \text{PHEP}(t+1) + \text{RAT}\text{*}(\text{PHEP}(t+2) - \text{PHEP}(t+1)) \\
\text{\_} &= \text{FT}(\text{PP}(t, j) \times \text{PHIP}(t, j) \times \text{RP}(t, j)) \\
\text{GAMP}(t, j) &= \text{FGAM}(t, j) + \text{PP}(t, j) \times \text{PHIP}(t, j) \\
\text{AP} &= \text{SORT} (\text{GAMP}(t, j) + \text{PP}(t, j) / \text{RHOP}(t, j)) \\
\text{CALL}_x \text{LAM}(\text{QP}(t, j), \text{AP} + \text{PHEP}(t, j) \times \text{YPLAM}(ik), \text{YMLAM}(ik)) \\
\text{CONTINUE} \\
\text{THT} &= \text{THT} \times j \\
\text{PHEP} &= \text{ATAN}(\text{WOU} / (\text{COS}(\text{THT}) \times \text{VOU} \times \text{SIN}(\text{THT}))) \\
\text{TH} &= \text{IC} \\
\text{ZP} &= \text{ZP}(t+2) \times \text{ZP}(t+2) \\
\text{IT} &= 1 \\
\text{RATA} &= (\text{ZA} - \text{ZP}(t+2)) / (\text{ZP}(t+2) - \text{ZP}(t+2)) \\
\text{IT} &= 1 \\
\text{ALAM} &= \text{YPLAM}(2) + \text{RATA}\text{*}((\text{YPLAM}(t) - \text{YPLAM}(2)) \\
\text{RMI} &= \text{YMLAM}(2) + \text{RATA}\text{*}((\text{YMLAM}(t) - \text{YMLAM}(2)) \\
\text{CLAM} &= \text{ALAM} + A93 \times \text{XPLAM}(t) \times \text{JW} \\
\text{IF} &= \text{EQ}(\text{IC}, \text{EQ}1) = \text{CLAM} + \text{A93} \times \text{B93} \times \text{YMLAM}(t) \times \text{JW} \\
\text{ZAT} &= \text{ZU}(t, \text{JW}) = \text{CLAM} + \text{DEL} \\
\text{EFEARS} &= (\text{ZAT} - \text{ZA}) / (\text{ZP}(t+2) - \text{ZP}(t+2)) \\
\text{IF} &= (\text{EFEARS} \times \text{LT} - \text{ER} \times \text{ZZZ}) \text{ GO TO 55} \\
\text{ZM} &= \text{ZAT} \\
\text{IF} &= (\text{IT}, \text{LT} - \text{LT} \times \text{L}, \text{ZM} \times \text{LT}) \text{ GO TO 55} \\
\text{CALL}_x \text{FROR}(\text{ST}) \\
\text{ZP} &= (\text{ZA} - \text{Z}(t, \text{MAX})) / (\text{Z}(t, \text{MAX}) - \text{Z}(t, \text{MAX})) \\
\text{QP} &= \text{Q}(t+2) + \text{RATA}\text{*}(\text{QP}(t+2) - \text{QP}(t+2)) \\
\text{PA} &= \text{PA}(t+2) + \text{RATA}\text{*}(\text{PA}(t+2) - \text{PA}(t+2)) \\
\text{GAM} &= \text{GAMP}(t+2) + \text{RATA}\text{*}(\text{GAMP}(t+2) - \text{GAMP}(t+2)) \\
\text{SI} &= \text{SI}(t+2) + \text{RATA}\text{*}(\text{SI}(t+2) - \text{SI}(t+2)) \\
\text{PHEA} &= \text{PHEP}(t+2) + \text{RATA}\text{*}(\text{PHEP}(t+2) - \text{PHEP}(t+2)) \\
\text{Rbbox} &= \text{Rbbox}(t+2) + \text{RATA}\text{*}(\text{Rbbox}(t+2) - \text{Rbbox}(t+2)) \\
\text{AA} &= \text{SORT} (\text{GAMP}(t, \text{PA}) / \text{Rbbox}) \\
\text{PA} &= \text{PA}(t, \text{MAX}) + \text{RATA}\text{*}(\text{PA}(t, \text{MAX}) - \text{PA}(t, \text{MAX})) \\
\text{SI} &= \text{SI}(t, \text{MAX}) + \text{RATA}\text{*}(\text{SI}(t, \text{MAX}) - \text{SI}(t, \text{MAX})) \\
\text{PHEA} &= \text{PHEP}(t, \text{MAX}) + \text{RATA}\text{*}(\text{PHEP}(t, \text{MAX}) - \text{PHEP}(t, \text{MAX})) \\
\text{DP} &= \text{DP}(t, \text{PA}) / \text{DTH} \\
\text{DSI} &= \text{DSI}(t, \text{PA}) / \text{DTH} \\
\text{DPHE} &= \text{DPHE}(\text{PHEA}) / \text{DTH} \\
\text{CALL}_x \text{FROR}(\text{Rbbox} = \text{QA}, \text{RZ} = \text{PHEA}, \text{ALAM} = \text{PLAM}, \text{SIA} = \text{AA}, \text{DSI} = \text{DP}, \text{DPHE} = \text{FP}, \text{FMC} = \text{MC} \\
\text{RQ} &= \text{QN}(t, \text{JW}) \times \text{ON}(t, \text{JW}) \times \text{Rbbox}(t, \text{JW}) \\
\text{QP} &= \text{QA}(t, \text{QA}) \\
\text{AL} &= \text{AL}(t, \text{QA}) \\
\text{RI} &= \text{RI}(t, \text{QA}) \\
\text{AZ} &= \text{SORT} ((\text{QA} / \text{AA}) = 2 - 1) / (\text{Rbbox} = \text{QA}) \\
\text{A2} &= \text{A2} + \text{A93} \times \text{SORT} ((\text{QN}(t, \text{JW}) / \text{AN}(t, \text{JW}) = (t, \text{JW}) = 2 - 1) / \text{B93} / \text{RQ} \\
\text{IF} &= (\text{IC}, \text{EQ}1, \text{MAX}) = \text{PC} = \text{PA} + (\text{PHEA} = \text{PHEA} + \text{A1} / \text{DTH} / \text{A2} \\
\text{IF} &= (\text{IC}, \text{EQ}1, \text{PC} = \text{PA} + (\text{PHEA} = \text{PHEA} + \text{B1} / \text{DTH} / \text{A2} \\
\text{NWU} &= \text{TAN}(\text{PHEN}1) + \text{TAN}(\text{PHEA}) \\
\text{NVU} &= \text{AS}(\text{PNU}) \\
\text{NWU} &= \text{AS}(\text{PN}) \\
\text{NANG} &= \text{DVU} + \text{DWU}
IF (DANG.EQ.0.) GO TO 60
RAT1=DUU/DANG
RAT2=DUU/DANG
GO TO 70
60 RAT1=.5
RAT2=.5
70 P1=PSV*RAT1+PA*RAT2
P2=(PC1-P1)/P1
P2=(PC2-P1)/P1
P2=PC2*RAT1+PA*RAT2
PN(IC,JW)=P1 *(IC+DPC)
RHON(IC,JW)=RHO(IC,JW)*(PN(IC,JW)/P(IC,JW))**2*(1/GAM(IC,JW))
VVSL=UW(IN)**2*VW(IC)**2*UW(IC)**2
VVC=VVSL+2.GAM(IC,JW)/(GAM(IC,JW)=1.)*(P(IC,JW)/RHO(IC,JW)=1PN(IC,JW)/RHON(IC,JW))
UWN(IC)=SORT(VVC/(1+VOU*VOU*WOU*WOU))
VWN(IC)=UWN*UWN(EC)
WNN(IC)=UWNU*UWN(EC)
WNN(EC)=H(EC,JW)**5*(VVSL=VVC)
PHI(IC,JW)=PH(IC,JW)
THWN=THWN(EC)*XJ
PHED=UWN(EC)/(UWN(EC)*COS(THWN)*UWN(EC)*SIN(THWN))
PHEN(EC,JW)=ATAN(PHED)
VDMU=UWN(EC)*COS(THWN)=UWN(EC)*SIN(THWN)
QG(IN,JW)=SQRT(VVC=VDMU**2)
SIINN(EC,JW)=ATAN(VDMU/AN(IN,JW))
TN(EC,JW)=F(I(P(IN,JW)*PHN(IN,JW)*H(N(IN,JW))
GAMN(EC,JW)=FGAM(TN(IN,JW)*PN(IN,JW)*PHN(IN,JW))
AN(IN,JW)=SQRT(GAMN(IN,JW)*AN(IN,JW)*PHN(IN,JW))
CALL XLAM(QN(IN,JW)*AN(IN,JW)*PHEN(IN,JW)*XPLAMN(IN,JW)*XMLAMN(IN,JW))
ET=ABS((PT-PN(IN,JW))/P(IN,JW))
IF (IVY.EQ.0.OR.ET.LT.1.E-04) Go TO 2648
KIL=KIL+1
IF (KIL.GT.5) Go TO 2648
A93=.5
R93=.5
PT=PN(IN,JW)
UAN2=UWN(IN)*UWN(IN)
VAN2=UWN(IN)*UWN(IN)
AN2=AN(IN,JW)*AN(IN,JW)
RETN=SORT((UNA2+VNA2)/AN2-1)**2
XPLN=(UWN(IN)*VWN(IN)*AN2+RBTN)/(UNA2-AN2)
GO TO 3
1493 WRITE(*,1393)
1393 FORMAT(* AVERAGING PROCESS DOES NOT CONVERGE IN CORNER*)
STOP
2648 CONTINUE
RETURN
END
VW(I) = U1 - SSI + VI * CSI

WW(I) = W1
GO TO 1

88 UW(I) = U1
VW(I) = VI
WW(I) = W1
1 CONTINUE
RETURN
END
SUBROUTINE UNOWAT(C1,C2)

COMMON /ST/ (7,10)
COMMON /UW (40), VW (40), WW (40), YW (40), THW (40)
COMMON /V/ XJ1
COMMON /S/ Rl, KOUNT, KOUNTS, ICOWLT
COMMON /A/ X1, THMAX, TH(10)*R, Z(40,10), P(40,10), PHIE(40,10)
1 Q(40,10), SI(40,10), H(40,10), PUL(40,10), RHO(40,10), GAM(40,10)
COMMON /C/ IMAX(10), JMAX, ISTART, KOUNTF, KOUNTP
COMMON /R/ JC, XCN, XC, X1, JW, INT, ICOWL, RCOWL
COMMON /TEM/ T(40,10)

DO 1 J=1, JW
IMAX = IMAX(J)
1 IF (ICOWLT.EQ.1) IMAX1 = IS(3, J)
DO 1 I=1, IMAX1
KIT = 1
1 W1 = H(I, J)
C4 = C2*(H(I, J) + (Q(I, J))/COS(SI(I, J)))**2/2.0
C3 = C1*RHO(I, J)*Q(I, J)/COS(SI(I, J))
C5 = P(I, J)/RHO(I, J)/T(I, J)
C6 = P(I, J)/RHO(I, J)**2/GAM(I, J)
V1 = SORT(2.0*(C4+C1))
RH1 = C2/V1
P1 = C4*RHO(I, J)**2/GAM(I, J)
T1 = P1/RH1/C5
H2 = (P1*RHO(I, J))*T1
ERR = (H2-H1)/H(I, J)
IF (ABS(ERR) > 1.E-05) GO TO 4
KIT = KIT + 1
IF (KIT.GT.5) GO TO 4
IF (KIT.GT.2) GO TO 6
FERR = ERR
H11 = H1
W1 = 1.01*H1
GO TO 2
10 WRITE(6, 11)
1
FORMAT(* ERROR IN ENTHALPY ITERATION IN SUBROUTINE UNOWAT*)
STOP
6 NUM = H1 - ERR1*(H1 - H11)/(ERR = ERR)
FRR1 = ERR
H11 = H1
W1 = DUM
GO TO 2
4 CONTINUE
P(I, J) = P1
W(I, J) = H1
T(I, J) = T1
RHO(I, J) = RH1
Q(I, J) = V1*COS(SI(I, J))
IF (J .NE. JMAX + 1) GO TO 1
U1 = Q(I, J)*COS(PHE(I, J))
V1 = Q(I, J)*TAN(SI(I, J))
W1 = Q(I, J)*SIN(PHE(I, J))
IF (XJ1.GT.0.0) GO TO 88
CSI = COS(THW(I))
SSI = SIN(THW(I))
UW(I) = U1*CSI - V1*SSI