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EFFECTS OF MASS TRANSFER INTO LAMINAR AND TURBULENT BOUNDARY LAYERS OVER CONES AT ANGLE OF ATTACK

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VIRGINIA POLYTECHNIC INSTITUTE
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BLACKSBURG, VIRGINIA 24061

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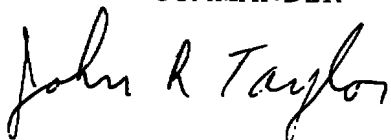
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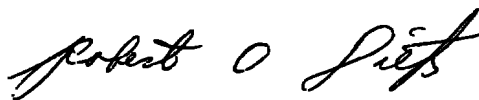
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20 ABSTRACT (Continue on reverse side if necessary and identify by block number) A computer program has been developed for full three-dimensional boundary-layer analysis of sharp and blunt cones at angle of attack to supersonic and hypersonic flows. This analysis includes laminar, transitional, and turbulent flows, with mass transfer of various foreign gases at the wall. The governing boundary-layer equations are integrated on a digital computer using a marching implicit finite-difference scheme. Turbulence has been modeled by a two-		

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20. ABSTRACT (Continued)

layer eddy viscosity-mixing length approach employing an intermittency factor in the transition region. Results of the program calculations are compared to available experimental and numerical data to show the program capabilities under various geometry and flow conditions. Some results are presented without comparison in those three-dimensional cases where no available data exist.

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PREFACE

This report was prepared by Virginia Polytechnic Institute and State University, Blacksburg, Virginia, under U.S. Air Force Contract No. F40600-73-C-0005. The work was sponsored by the Arnold Engineering Development Center, Air Force Systems Command, with Lt. Colonel John R. Taylor as Technical Representative. The Program Element Number was 65802F. This report covers work performed during the period December 7, 1972 to April 1, 1975.

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SECTION I INTRODUCTION

A computer program has been developed to simulate the reentry of sharp and blunt cones. This program includes the effects of surface mass transfer to simulate ablation during reentry, and also includes laminar, transitional and turbulent boundary-layer analysis. A program of this type is necessary since wind tunnels capable of providing the correct flight conditions for reentering supersonic or hypersonic cones are non-existent. The object of this investigation is to develop such a program with a prediction method which is as general as possible, allowing the solution of a wide class of flow problems.

In this report the fully three-dimensional laminar, transitional, and turbulent boundary-layer equations are formulated and include the effects of surface mass transfer, free-stream pressure gradient, and heat transfer at the wall. In addition, windward plane of symmetry equations are developed in similar manner for treating the windward plane of sharp and blunt cones under investigation. The geometries under consideration are sharp and spherically blunted cones at angle of attack to uniform supersonic or hypersonic free-streams.

The turbulent boundary layer has been modeled by using an invariant model of three-dimensional turbulence which employs the two-layer eddy-viscosity mixing-length approach. An intermittency factor has been used through the transition regime to express the probability of the flow being turbulent at each solution point.

The resulting boundary-layer equations are integrated using a marching implicit finite-difference scheme on an IBM 370 system-model 158 digital computer.

Following is a brief review of the work in both two and three dimensional boundary layers leading to this investigation.

1.1 BACKGROUND

The three-dimensional compressible turbulent boundary-layer equations have been presented by Vaglio-Laurin (Ref. 1) and by Braun (Ref. 2). In addition, the laminar, compressible three-dimensional equations were presented by Moore (Ref. 3). The laminar three-dimensional equations were integrated using a marching finite-difference scheme by McGowan and Davis (Ref. 4) for sharp cones at angle of attack. The McGowan and Davis report puts the governing equations in similarity variable form, reducing the number of independent variables from three to two in the transformed equations. Therefore their method becomes a two-dimensional scheme.

Adams (Ref. 5) extended the method of McGowan and Davis and a transformation similar to that used by Dwyer (Ref. 6) to include turbulent boundary layers with a variable normal grid spacing. The Adams method,

however, was still a locally similar solution representing the patching together of local solutions for sharp cones in hypersonic flow. Adams presented detailed, hypersonic, three-dimensional, turbulent boundary-layer profiles around a sharp cone at incidence which are compared to the results of the present investigation.

Frieders and Lewis (Ref. 7) developed a computer program for fully three-dimensional laminar boundary layers based on the method of McGowan and Davis mentioned above, and on the two-dimensional method of Anderson and Lewis (Ref. 8). This program extended the two-dimensional nature of the McGowan and Davis method to a true three-dimensional method for use on blunt cones at angle of attack, and for use in non-uniform flow fields. The Frieders and Lewis program was not extended to the present investigation due to the use of two different coordinate systems and transformations in order to patch together full three-dimensional solutions to blunt cones at incidence.

Mayne (Ref. 9) also used the method of McGowan and Davis to study streamline swallowing on blunt cones at angle of attack. His study was limited to the windward streamline and also involved the use of two different coordinate systems. Mayne also split the solution method for a blunt cone into three parts; 1) the stagnation point, 2) the axisymmetric sphere where the cross-flow momentum equation is not solved, and 3) the fully three-dimensional afterbody behind the sphere-cone tangent point. The present investigation also utilizes this procedure for blunt cone solutions.

Mass transfer has been investigated for two-dimensional boundary-layer flows over cones by a number of authors. Jaffe, Lind and Smith (Ref. 10) investigated the binary diffusion of He, Ar, and CO₂ into air as well as air into air for sharp cones at zero incidence. However, the species boundary condition at the wall was incorrectly stated. The correct wall boundary condition for the species equation was used by Lewis, Adams, and Gilley (Ref. 11), and by Mayne, Gilley and Lewis (Ref. 12). These two reports dealt with mass transfer effects on slender blunted cones and sharp cones at zero incidence to hypersonic flow. The results of these reports are compared to present results for zero incidence cones.

Mass transfer in turbulent boundary layers was investigated by Miner and Lewis (Ref. 13) for two-dimensional flow using a modified version of the computer program reported in Miner, Anderson, and Lewis (Ref. 14). The species equation wall boundary condition is also incorrect as reported in Miner and Lewis. The transformation of the governing equations in the present report is identical to that used by Miner and Lewis. The present computer program can be thought of as the three-dimensional analog of the program used by Miner and Lewis, with the exception of the species wall boundary condition.

Two recent papers by Adams (Ref. 15) and by Watkins (Ref. 16) make use of the Levy-Lees transformation to the governing equations. Adams developed an implicit finite-difference analysis of sharp cone windward streamline

flows including transition and turbulence. The Adams report utilizes the suggestion by Moore (Ref. 17) for dealing with the crossflow momentum equation at the windward streamline. The same method is used in the present investigation. Adams also develops the variable spaced grid system for the normal coordinate, which is also found in the present program.

Watkins developed the full three-dimensional laminar boundary-layer equations in a modified Levy-Lees coordinate system for use in studying spinning sharp bodies at angle of attack. The form of his transformed equations are very similar to the laminar version of the transformed equations as described in this report.

A report by Blottner and Ellis (Ref. 18) describes a computer program very similar to the present program in terms of numerical solution method, but is limited to laminar, incompressible boundary layers over blunt bodies.

The present analysis is the first to the author's knowledge to express the full three-dimensional compressible, turbulent boundary-layer equations including the effects of heat and mass transfer. The equations have been transformed using the Levy-Lees transformation equations. The finite-difference method follows the method of McGowan and Davis, utilizing an implicit scheme similar to that used by Dwyer (Ref. 6) as modified by Krause (Ref. 19).

Results of the present investigation are presented and compared to available experimental and numerical data. The full three-dimensional solution of a sharp cone at angle of attack with transition to turbulence is presented without comparison using computer drawn plots generated by the program. Some results are also presented to show the effects of using different turbulent Prandtl number profiles as provided for in the program.

The analysis and results are followed by four appendices describing the structure of the computer program, the input data, output data and the job control language. Two final appendices present sample runs of the program for four different problems, and a listing of the program itself.

SECTION II ANALYSIS

This section presents the three-dimensional conservation equations for laminar, transitional or turbulent flows of a two component mixture of nonreacting perfect gases. The procedure for transforming the equations for solution by a finite-difference method is also discussed along with the solution method itself. Following the development of the partial differential governing equations the calculation of the fluid properties will be presented. The eddy-viscosity laws, turbulent Prandtl number laws, transition models, and the boundary-layer parameters will also be covered in the analysis.

2.1 GOVERNING CONSERVATION EQUATIONS

The laminar compressible three-dimensional boundary-layer equations were presented by Moore (Ref. 3). Following Moore's laminar equations the governing equations have been developed for turbulent compressible flows and are presented here without derivation in terms of mean physical variables.

Continuity Equation

$$\frac{\partial}{\partial x} (\rho u r) + \frac{\partial}{\partial y} (\rho V r) + \frac{\partial}{\partial \phi} (\rho w) = 0 \quad (1)$$

Streamwise Momentum Equation

$$\rho u \frac{\partial u}{\partial x} + \rho V \frac{\partial u}{\partial y} + \rho \frac{w}{r} \frac{\partial u}{\partial \phi} - \rho \frac{w^2}{r} \frac{\partial r}{\partial x} = -\frac{\partial P_e}{\partial x} + \frac{\partial}{\partial y} \left[\mu \frac{\partial u}{\partial y} - \rho v'v' \right] \quad (2)$$

Transverse Momentum Equation

$$\rho u \frac{\partial w}{\partial x} + \rho V \frac{\partial w}{\partial y} + \rho \frac{w}{r} \frac{\partial w}{\partial \phi} + \rho \frac{uw}{r} \frac{\partial r}{\partial x} = -\frac{1}{r} \frac{\partial P_e}{\partial \phi} + \frac{\partial}{\partial y} \left[\mu \frac{\partial w}{\partial y} - \rho v'w' \right] \quad (3)$$

Normal Momentum Equation

$$\frac{\partial P}{\partial y} = 0 \quad (4)$$

Energy Equation

$$\begin{aligned} \rho u \frac{\partial H}{\partial x} + \rho V \frac{\partial H}{\partial y} + \rho \frac{w}{r} \frac{\partial H}{\partial \phi} = \frac{\partial}{\partial y} \left[\mu \left(\frac{\partial H}{\partial y} + \frac{1-Pr}{Pr} \frac{\partial h}{\partial y} \right) - \rho v'H' \right] \\ + \frac{\partial}{\partial y} \left[\frac{\mu}{Pr} (Le-1) (h_f - h_i) \frac{\partial C_f}{\partial y} + \sum_i h_i \rho v'C_i' \right] \end{aligned} \quad (5)$$

Species Equation

$$\rho u \frac{\partial C_i}{\partial x} + \rho V \frac{\partial C_i}{\partial y} + \rho \frac{w}{r} \frac{\partial C_i}{\partial \phi} = \frac{\partial}{\partial y} \left[Le \frac{\mu}{Pr} \frac{\partial C_i}{\partial y} + \rho v'C_i' \right] \quad (6)$$

where $V = v + \rho'v'/\rho$. The equation of state for each species is:

$$P_i = \frac{\rho_i}{M_i} RT \quad (7)$$

where R is the universal gas constant. Only one species equation is necessary since in a two component mixture the mass fractions sum to unity:

$$\sum_i C_i = 1 \quad (8)$$

The viscosity and thermal conductivity are related by the Prandtl number:

$$Pr = \mu C_p / k \quad (9)$$

where

$$C_p = \sum_i C_i C_{p_i}$$

Similarly diffusion and thermal conductivity are related by the Lewis number:

$$Le = \rho D_{if} C_p / k \quad (10)$$

The boundary conditions on the above equations are as follows:

Momentum Equations

$$\begin{aligned} y = 0 & : u = w = u'v' = v'w' = \rho'v' = 0, v = v_w \\ y \rightarrow \infty & : u = u_e, w = w_e \\ & u'v' = v'w' = \rho'v' = 0 \end{aligned}$$

Energy Equations

$$\begin{aligned} y = 0 & : H = H_w, v'H' = 0 \\ y \rightarrow \infty & : H = H_e, v'H' = 0 \end{aligned}$$

Species Equations

$$\begin{aligned} y = 0 & : C_f = C_{f_w} = \left(\frac{D_{if}}{v} \frac{\partial C_f}{\partial y} \right)_w, v'C'_i = 0 \\ y \rightarrow \infty & : C_f = 1.0, v'C'_i = 0 \end{aligned}$$

In the derivation of the conservation equations the usual assumptions regarding the fluctuating quantities have been employed. These are:

1) the turbulent level is small and therefore terms having the mean square of the velocity fluctuation are dropped from the equations.

2) molecular transport parameters are approximated by the mean flow counterparts.

3) the rate of change of mean flow properties in the normal direction is an order of magnitude greater than the rates of change in the stream-wise and transverse directions.

The solution of the governing equations requires the expression of the turbulent shear terms and the turbulent flux of total enthalpy in terms of the mean flow quantities. A popular concept used to obtain these expressions is the eddy viscosity, eddy conductivity analogy with the molecular viscosity and conductivity where:

$$-\rho u'v' = \epsilon_x \partial u / \partial y \quad (11)$$

$$-\rho v'w' = \epsilon_\phi \partial w / \partial y \quad (12)$$

and
$$-\rho v'H' = k_t \partial H / \partial y \quad (13)$$

and where the dimensionless transport parameters are:

$$Pr_t = C_p \epsilon / k_t \quad (14)$$

$$Le_t = \rho D_t C_p / k_t \quad (15)$$

The eddy viscosities ϵ_x and ϵ_ϕ in the x and ϕ directions will be shown to be equal later in this analysis. A model for the eddy viscosity, based on Prandtl's mixing-length hypothesis will also be presented later in the analysis.

Substituting directly, the governing equations in terms of mean physical variables and the turbulent transport terms described above are:

Continuity

$$\frac{\partial}{\partial x} (\rho u r) + \frac{\partial}{\partial y} (\rho v r) + \frac{\partial}{\partial \phi} (\rho w) = 0 \quad (16)$$

Streamwise Momentum Equation

$$\rho u \frac{\partial u}{\partial x} + \rho v \frac{\partial u}{\partial y} + \rho \frac{w}{r} \frac{\partial u}{\partial \phi} - \rho \frac{w^2}{r} \frac{\partial r}{\partial x} = -\frac{\partial P_e}{\partial x} + \frac{\partial}{\partial y} \left[(\mu + I_f \epsilon) \frac{\partial u}{\partial y} \right] \quad (17)$$

Transverse Momentum Equation

$$\rho u \frac{\partial w}{\partial x} + \rho v \frac{\partial w}{\partial y} + \rho \frac{w}{r} \frac{\partial w}{\partial \phi} + \rho \frac{uw}{r} \frac{\partial r}{\partial x} = -\frac{1}{r} \frac{\partial P_e}{\partial \phi} + \frac{\partial}{\partial y} \left[(\mu + I_f \epsilon) \frac{\partial w}{\partial y} \right] \quad (18)$$

Energy Equation

$$\rho u \frac{\partial H}{\partial x} + \rho v \frac{\partial H}{\partial y} + \rho \frac{w}{r} \frac{\partial H}{\partial \phi} = \frac{\partial}{\partial y} \left[(\mu + I_f \epsilon) \frac{\partial H}{\partial y} + \left\{ \mu \left(\frac{1-Pr}{Pr} \right) + I_f \epsilon \left(\frac{1-Pr_t}{Pr_t} \right) \right\} \frac{\partial h}{\partial y} \right] \\ + \frac{\partial}{\partial y} \left[\left\{ \frac{\mu}{Pr} (Le-1) + \frac{I_f \epsilon}{Pr_t} (Le_t-1) \right\} (h_f - h_i) \frac{\partial C_f}{\partial y} \right] \quad (19)$$

Species Equation

$$\rho u \frac{\partial C_f}{\partial x} + \rho \frac{w}{r} \frac{\partial C_f}{\partial \phi} + \rho v \frac{\partial C_f}{\partial y} = \frac{\partial}{\partial y} \left[\left(\frac{Le \mu}{Pr} + \frac{Le_t \epsilon I_f}{Pr_t} \right) \frac{\partial C_f}{\partial y} \right] \quad (20)$$

where I_f is the transition intermittency factor.

2.2 WINDWARD PLANE CONSERVATION EQUATIONS

On the windward plane of a cone the transverse (crossflow) velocity, w , and $\partial P_e / \partial \phi$ vanish due to symmetry; however, the crossflow velocity gradient does not vanish and still appears in the continuity equation. Under these conditions the transverse momentum equation would vanish completely at the windward plane where initial profiles are generated for the remaining integration of the governing equations. To avoid this problem, Moore (Ref. 17) has suggested that the transverse momentum equation first be differentiated with respect to ϕ before neglecting terms which vanish at the windward streamline. This procedure results in the following transverse momentum equation at the windward plane:

$$\rho u \frac{\partial}{\partial x} \left(\frac{\partial w}{\partial \phi} \right) + \rho \frac{w}{r} \left(\frac{\partial w}{\partial \phi} \right)^2 + \rho v \frac{\partial}{\partial y} \left(\frac{\partial w}{\partial \phi} \right) + \rho \frac{u}{r} \frac{\partial w}{\partial \phi} \frac{\partial r}{\partial x} \\ = -\frac{1}{r} \frac{\partial^2 P_e}{\partial \phi^2} + \frac{\partial}{\partial y} \left[(\mu + I_f \epsilon) \frac{\partial}{\partial y} \left(\frac{\partial w}{\partial \phi} \right) \right] \quad (21)$$

The remaining conservation equations reduce to the following at the windward plane where $w = 0$:

Streamwise Momentum

$$\rho u \frac{\partial u}{\partial x} + \rho v \frac{\partial u}{\partial y} = -\frac{\partial P_e}{\partial x} + \frac{\partial}{\partial y} \left[(\mu + I_f \epsilon) \frac{\partial u}{\partial y} \right] \quad (22)$$

Energy

$$\rho u \frac{\partial H}{\partial x} + \rho v \frac{\partial H}{\partial y} = \frac{\partial}{\partial y} \left[(\mu + I_f \epsilon) \frac{\partial H}{\partial y} + \left\{ \mu \left(\frac{1-Pr}{Pr} \right) + \epsilon \left(\frac{1-Pr_t}{Pr_t} \right) \right\} \frac{\partial h}{\partial y} \right] + \frac{\partial}{\partial y} \left[\left\{ \frac{\mu}{Pr} (Le-1) + \frac{\epsilon}{Pr_t} (Le_t-1) \right\} (h_f - h_i) \frac{\partial C_f}{\partial y} \right] \quad (23)$$

Species

$$\rho u \frac{\partial C_f}{\partial x} + \rho v \frac{\partial C_f}{\partial y} = \frac{\partial}{\partial y} \left[\left(\frac{Le \mu}{Pr} + \frac{Le_t \epsilon}{Pr_t} \right) \frac{\partial C_f}{\partial y} \right] \quad (24)$$

Continuity

$$\frac{\partial}{\partial x} (\rho u r) + \rho \frac{\partial w}{\partial \phi} + \frac{\partial}{\partial y} (\rho v r) = 0 \quad (25)$$

It can be seen that the conservation equations have been reduced to a quasi-two-dimensional form at the windward plane. The continuity equation serves as the only coupling between the transverse momentum equation and the remaining governing equations. For cones at zero angle of attack the transverse momentum equation in either form vanishes identically leaving a completely axisymmetric problem.

2.3 COORDINATE TRANSFORMATION

A more convenient form of the governing equations for numerical solution is obtained by introducing two stream functions defined as follows:

$$\psi(x, y) = \sqrt{2\xi} f(\xi, \eta) \quad (26)$$

and

$$\psi(x, y) = \sqrt{2\xi}/r g(\xi, \eta) \quad (27)$$

where ξ, η are the Lees-Dorodnitsyn (Levy-Lees) transformed coordinates defined as follows:

$$\xi(x) = \int_0^x \rho_r \mu_r u_r r^2 dx \quad (28)$$

$$\eta(x, \phi, y) = \rho_e u_e r / \sqrt{2\xi} \int_0^y \frac{\rho}{\rho_e} dy \quad (29)$$

This coordinate transformation removes the singularity at $x = 0$, and stretches the normal coordinate. Accordingly the transformed derivatives become:

$$\frac{\partial}{\partial x} = \rho_r u_r \mu_r r^2 \frac{\partial}{\partial \xi} + \frac{\partial \eta}{\partial x} \frac{\partial}{\partial \eta} \quad (30)$$

$$\frac{\partial}{\partial \phi} = \frac{\partial}{\partial \phi} + \frac{\partial \eta}{\partial \phi} \frac{\partial}{\partial \eta} \quad (31)$$

$$\frac{\partial}{\partial y} = \rho u_e r / \sqrt{2\xi} \frac{\partial}{\partial \eta} \quad (32)$$

Satisfying the continuity equation with above stream functions the following relations are obtained:

$$\rho u r = \frac{\partial \Psi}{\partial y} \quad (33)$$

$$\rho w = \frac{\partial \psi}{\partial y} \quad (34)$$

$$\rho v r = -\frac{\partial \Psi}{\partial x} - \frac{\partial \psi}{\partial \phi} \quad (35)$$

Using equations 35, 30, and 32 we obtain the following expression:

$$\frac{\rho v r \sqrt{2\xi}}{\rho_r u_r \mu_r r^2} + \eta_x \delta r f' + \eta_\phi \delta g' + 2\xi \frac{\partial f}{\partial \xi} + f + \delta \frac{\partial g}{\partial \phi} = 0 \quad (36)$$

or

$$V + 2\xi \partial f / \partial \xi + f + \delta \partial g / \partial \phi = 0 \quad (37)$$

where

$$V = \rho v r \sqrt{2\xi} / \rho_r u_r \mu_r r^2 + \eta_x \delta r f' + \eta_\phi \delta g' \quad (38)$$

and

$$\delta = 2\xi / \rho_r u_r \mu_r r^3 \quad (39)$$

Differentiation of equation (33) with respect to y using equation (32) gives the expression for f' :

$$f' = \frac{u}{u_e} \quad (40)$$

Similarly, differentiation of equation (34) with respect to y using equation (32) gives the expression for g' :

$$g' = \frac{w}{u_e} \quad (41)$$

Evaluating the momentum equations (2), (3) at the outer edge gives the pressure gradients as:

$$-\frac{\partial P_e}{\partial x} = \rho_e u_e \frac{\partial u_e}{\partial x} + \frac{\rho_e w_e}{r} \frac{\partial u_e}{\partial \phi} - \frac{\rho_e w_e^2}{r} \frac{\partial r}{\partial x} \quad (42)$$

$$-\frac{1}{r} \frac{\partial P_e}{\partial \phi} = \rho_e u_e \frac{\partial w_e}{\partial x} + \frac{\rho_e w_e}{r} \frac{\partial w_e}{\partial \phi} + \frac{\rho_e u_e w_e}{r} \frac{\partial r}{\partial x} \quad (43)$$

Using equations (30)-(43) the governing conservation equations in transformed variables become:

Continuity

$$V' + 2\xi \frac{\partial f'}{\partial \xi} + f' + \delta \frac{\partial g'}{\partial \phi} = 0 \quad (44)$$

Streamwise Momentum

$$2\xi f' \frac{\partial f'}{\partial \xi} + \beta_1 (f'^2 - \chi) + \delta \left(g' \frac{\partial f'}{\partial \phi} + \gamma_1 f' g' - \alpha \gamma_1 \chi \right) + (V - \ell^* \Omega) \frac{\partial f'}{\partial \eta} + \epsilon_1 (\alpha^2 \chi - g'^2) - \ell^* \Omega \frac{\partial^2 f'}{\partial \eta^2} = 0 \quad (45)$$

Transverse Momentum

$$2\xi f' \frac{\partial g'}{\partial \xi} + \beta_1 f' g' - \beta_2 \chi + (V - \ell^* \Omega) \frac{\partial g'}{\partial \eta} + \delta \left(g' \frac{\partial g'}{\partial \phi} + \gamma_1 g'^2 - \alpha \gamma_2 \chi \right) + \epsilon_1 (f' g' - \alpha \chi) - \ell^* \Omega \frac{\partial^2 g'}{\partial \eta^2} = 0$$

Species Equation

$$2\xi f' \frac{\partial z}{\partial \xi} + \left\{ V - \frac{\partial}{\partial \eta} \left[\ell \left(\frac{Le}{Pr} + \frac{Le_t \epsilon^+}{Pr_t} \right) \right] \Omega \right\} \frac{\partial z}{\partial \eta} + \delta g' \frac{\partial z}{\partial \phi} - \ell \Omega \left[\frac{Le}{Pr} + \frac{Le_t \epsilon^+}{Pr_t} \right] \frac{\partial^2 z}{\partial \eta^2} = 0 \quad (47)$$

Energy

$$\begin{aligned}
2\xi f' \frac{\partial \theta}{\partial \xi} + \delta g' \frac{\partial \theta}{\partial \phi} - \left[\left(\frac{\ell^{**}}{Pr} \right)' \Omega - v \right] \frac{\partial \theta}{\partial \eta} - \frac{\ell^{**}}{Pr} \Omega \frac{\partial^2 \theta}{\partial \eta^2} \\
+ \frac{u_e^2}{H_e} \Omega \frac{\partial}{\partial \eta} \left[\left(\frac{\ell^{**}}{Pr} - \ell^* \right) \left(f' \frac{\partial f'}{\partial \eta} + g' \frac{\partial g'}{\partial \eta} \right) \right] \\
- \frac{u_e^2}{H_e} \Omega \frac{\partial}{\partial \eta} \left[\left(\ell^{***} \frac{Le}{Pr} - \frac{\ell^{**}}{Pr} \right) (h_f - h_i) \frac{\partial z}{\partial \eta} \right] = 0
\end{aligned} \quad (48)$$

where

$$\begin{aligned}
\ell &= \rho u / \rho_r u_r, \quad \ell^* = \ell (1 + I_f \epsilon^+), \quad \ell^{**} = \ell \left(1 + I_f \epsilon^+ \frac{Pr}{Pr_t} \right) \\
\ell^{***} &= \ell \left(1 + I_f \epsilon^+ \frac{Pr Le_t}{Pr_t Le} \right), \quad \epsilon^+ = \frac{\epsilon}{\mu}, \quad \theta = \frac{H}{H_e}, \quad \Omega = \frac{u_e}{u_r} \\
\beta_1 &= \frac{2\xi}{u_e} \frac{\partial u_e}{\partial \xi}, \quad \chi = \frac{\rho_e}{\rho}, \quad \gamma_1 = \frac{1}{u_e} \frac{\partial u_e}{\partial \phi}, \quad \alpha = \frac{w_e}{u_e} \\
\beta_2 &= \frac{2\xi}{u_e} \frac{\partial w_e}{\partial \xi}, \quad \gamma_2 = \frac{1}{u_e} \frac{\partial w_e}{\partial \xi}, \quad \epsilon_1 = \frac{2\xi}{r} \frac{\partial r}{\partial \xi}
\end{aligned} \quad (49)$$

The boundary conditions for the transformed governing equations are:

Momentum Equations

$$\begin{aligned}
\eta = 0 &: f' = g' = 0 \\
\eta \rightarrow \eta_\infty &: f' = 1, g' = \alpha
\end{aligned}$$

Species Equation

$$\begin{aligned}
\eta = 0 &: z = \left[\frac{D_{if}}{v} \frac{\partial z}{\partial y} \right]_w \\
\eta \rightarrow \eta_\infty &: z = 1.0
\end{aligned}$$

Energy Equation

$$\begin{aligned}
\eta = 0 &: \theta = \frac{H_w}{H_e} \\
\eta \rightarrow \eta_\infty &: \theta = 1.0
\end{aligned}$$

For the case of a sharp cone the quantities δ and ϵ_1 take on the following simple values:

$$\delta = 2/3 \sin \theta_c \quad \epsilon_1 = 2/3$$

where θ_c is the cone half angle. Also, for a sharp cone in uniform flow the ξ derivatives of the edge quantities vanish due to conical flow conditions. In this case the variables β_1 , β_2 , ϵ are zero. In addition, at the windward streamline, γ , and α are zero by symmetry. The variable γ_2 is non-zero at the windward streamline. To obtain the transformed equations at the windward streamline two new stream functions are introduced in order to satisfy the windward plane continuity equation, as follows:

$$\Psi = \sqrt{2\xi} f \quad (50)$$

$$\psi = \sqrt{2\xi} g \quad (51)$$

and

$$\rho u r = \partial \Psi / \partial y \quad (52)$$

$$\rho w_\phi r = \partial \psi / \partial y \quad (53)$$

$$\rho v r = -\partial \Psi / \partial x - \psi / r \quad (54)$$

Using equations (54), (50) and (51) we can obtain the following equation:

$$V + 2\xi \partial f / \partial \xi + f + \delta g = 0 \quad (55)$$

where

$$V = \frac{\rho v r \sqrt{2\xi}}{\rho_r u_r u_r r^2} - \delta r \eta_x f'$$

By using equations (50)-(55), (21)-(25), and taking into account coefficients that are zero due to conical flow and symmetry, the transformed conservation equations become:

Continuity

$$V' + 2\xi \partial f' / \partial \xi + f' + \delta g' = 0 \quad (56)$$

Streamwise Momentum

$$2\xi f' \partial f' / \partial \xi + \beta_1 (f'^2 - \chi) + (V - \lambda^{*'} \Omega) \partial f' / \partial \eta - \lambda^{*'} \Omega \partial^2 f' / \partial \eta^2 = 0 \quad (57)$$

Transverse Momentum

$$\begin{aligned}
 -2\xi f' \partial g' / \partial \xi + (\ell^{*\prime} \Omega - V) \partial g' / \partial \eta - \delta [g'^2 + \epsilon_1 f' g' / \delta + \beta_3 \chi] - \beta_1 f' g' \\
 + \ell^{*\prime} \Omega \partial^2 g' / \partial \eta^2 = 0
 \end{aligned} \quad (58)$$

Species

$$2\xi f' \partial z / \partial \xi + [V - \Omega \{\ell^{***} Le / Pr\}'] \partial z / \partial \eta - \ell^{***} Le / Pr \Omega \partial^2 z / \partial \eta^2 = 0 \quad (59)$$

Energy

$$\begin{aligned}
 2\xi f' \partial \theta / \partial \xi - [\Omega \{\ell^{**} / Pr\}' - V] \partial \theta / \partial \eta - \ell^{**} / Pr \Omega \partial^2 \theta / \partial \eta^2 \\
 + u_e^2 / H_e \Omega \partial / \partial \eta [\{\ell^{**} / Pr - \ell^*\} f' \partial f' / \partial \eta] + u_e^2 / H_e \Omega \partial / \partial \eta \left\{ [\ell^{***} Le / Pr \right. \\
 \left. - \ell^{**} / Pr] (h_f - h_i) \partial z / \partial \eta \right\} = 0 \quad (60)
 \end{aligned}$$

where

$$\beta_3 = 1 / \rho_e u_e^2 \partial^2 p_e / \partial \phi^2$$

It can be shown through equations (32) and (53) that at the windward plane:

$$g' = w_\phi / u_e \quad (61)$$

and the boundary conditions on the transverse momentum equation are:

$$\eta = 0 : g' = 0$$

$$\eta \rightarrow \eta_\infty : g' = w_\phi / u_e$$

For a cone at zero angle of attack the system of equations (56)-(61) reduces to a fully axisymmetric system without a transverse momentum equation.

Equations at the Stagnation Point

At the stagnation point of a blunt cone the boundary-layer equations have a removable singularity. In the limit as $\xi \rightarrow 0$ the expressions for ξ and η are:

$$\xi(x) = \rho_e \mu_e \frac{du_e}{dx} x^4/4 \quad (62)$$

and

$$\eta(x,y) = \left[2\rho_e/\mu_e \frac{du_e}{dx} \right]^{1/2} \int_0^y \rho/\rho_e dy \quad (63)$$

Also at the stagnation point of a blunt cone the expression for V in the windward plane continuity equation becomes:

$$V = \frac{\rho V \frac{du_e}{dx}}{\left[2\rho_e \mu_e \frac{du_e}{dx} \right]^{1/2}} \quad (64)$$

In addition the following quantities from equations (39) and (49) take on limiting values at the blunt cone stagnation point as follows:

$$\begin{aligned} \delta &= 1/2 \\ \beta_1 &= 1/2 \\ \epsilon_1 &= 1/2 \\ \Omega &= 1.0 \end{aligned} \quad (65)$$

The quantities γ_1 , γ_2 , β_2 , and α from equations (49) need not be taken into account at the blunt cone stagnation point since the equations used there are fully axisymmetric.

2.4 EDDY VISCOSITY MODELS

Prandtl's mixing length hypothesis states that the eddy viscosity is the product of some characteristic length and the normal velocity gradient. The characteristic length is related to the size of the eddies of momentum flux normal to the body and is called the mixing length. For two-dimensional flow this concept leads to:

$$\epsilon = \rho \ell_*^2 \left| \partial u / \partial y \right| \quad (66)$$

Prandtl's studies assumed that the eddy viscosity should depend only on local eddy scale and on the properties of turbulence. Adams (Ref. 15) extended this concept to the three-dimensional case by assuming that the eddy viscosity is also independent of coordinate direction by writing the component of turbulent stress terms as:

$$\tau_{tx} = -\rho u'v' = \rho \ell_*^2 \frac{\partial E}{\partial y} \frac{\partial u}{\partial y} \quad (67)$$

$$\tau_{t\phi} = -\rho v'w' = \rho l_*^2 \frac{\partial E}{\partial y} \frac{\partial u}{\partial y} \quad (68)$$

where E is some scalar function. Therefore:

$$\epsilon = \epsilon_x = \epsilon_\phi = \rho l_*^2 \frac{\partial E}{\partial y} \quad (69)$$

The total shear in each direction is written as:

$$\tau_x = \mu \frac{\partial u}{\partial y} - \rho u'v' = \mu \frac{\partial u}{\partial y} + \epsilon_x \frac{\partial u}{\partial y} \quad (70)$$

$$\tau_\phi = \mu \frac{\partial w}{\partial y} - \rho w'v' = \mu \frac{\partial w}{\partial y} + \epsilon_\phi \frac{\partial w}{\partial y} \quad (71)$$

therefore the total resultant shear is written as:

$$\tau = [\tau_x^2 + \tau_\phi^2]^{1/2} = [(\mu + \epsilon_x)^2 \frac{\partial u}{\partial y}^2 + (\mu + \epsilon_\phi)^2 \frac{\partial w}{\partial y}^2]^{1/2} \quad (72)$$

Using equations (72) and (69) the total resultant shear becomes:

$$\tau = [\mu + \rho l_*^2 \frac{\partial E}{\partial y}] \left[\frac{\partial u}{\partial y}^2 + \frac{\partial w}{\partial y}^2 \right]^{1/2} \quad (73)$$

By analogy with the two-dimensional case where the eddy viscosity expression incorporates the velocity gradient of the shear component, the scalar E becomes:

$$\frac{\partial E}{\partial y} = \left[\frac{\partial u}{\partial y}^2 + \frac{\partial w}{\partial y}^2 \right]^{1/2} \quad (74)$$

and

$$\epsilon = \epsilon_x = \epsilon_\phi = \rho l_*^2 \left[\frac{\partial u}{\partial y}^2 + \frac{\partial w}{\partial y}^2 \right]^{1/2} \quad (75)$$

which reduces to the two-dimensional form when $w = 0$. This is referred to as the invariant turbulence model by Hunt, Bushnell, and Beckwith (Ref. 20), and was used with success by Adams (Ref. 15).

The model used in this investigation is the common two-layer inner-outer model which uses the Prandtl mixing length theory and the Van Driest or Reichardt damping near the wall. Following Patankar and Spalding (Ref. 21) and Adams (Ref. 15) the mixing length distribution is as follows:

$$\begin{aligned}
 \ell_* &= k_* y & \{0 < y \leq \lambda y_\ell / k_*\} \\
 \ell_* &= \lambda y_\ell & \{\lambda y_\ell / k_* < y\}
 \end{aligned}
 \tag{76}$$

where

$$k_* = 0.435$$

$$\lambda = 0.09$$

$$y_\ell = y \text{ when } \left[(u^2 + w^2) / (u_e^2 + w_e^2) \right]^{1/2} = 0.99$$

The inner law is damped near the wall so as to yield the exact laminar shear stress term at the wall. To accomplish this, two different damping factors have been used in this investigation, Van Driest's damping term with local shear stress, and Reichardt's (Ref. 39) damping term.

Van Driest's damping term for two-dimensional flow is:

$$\ell_{*i} = 1 - \exp \left(\frac{-y \sqrt{\tau \rho}}{\mu A^*} \right) \tag{77}$$

where τ is the local shear stress and A^* is 26.0. Therefore the total shear near the wall becomes:

$$\tau = \mu \partial u / \partial y + \rho k_*^2 y^2 \left[1 - \exp \frac{-y \sqrt{\tau \rho}}{\mu A^*} \right]^2 \partial u / \partial y^2 \tag{78}$$

for two-dimensional flow. Again, use is made of analogy to derive the form of the near wall shear for a three-dimensional flow. By analogy of equation (78) with equations (73) and (74) the three-dimensional form of the total shear becomes:

$$\tau_i = \mu \partial E / \partial y + \rho k_*^2 y^2 \left[1 - \exp \frac{-y \sqrt{\tau \rho}}{\mu A^*} \right]^2 \partial E / \partial y^2 \tag{79}$$

or

$$\epsilon_i = \rho k_*^2 y^2 \left[1 - \exp \frac{-y \sqrt{\tau \rho}}{\mu A^*} \right]^2 \partial E / \partial y \tag{80}$$

Cebeci (Ref. 22) developed a mass transfer correction to Van Driest's inner eddy viscosity law by modifying the damping constant A^* . For turbulent flows with mass transfer Cebeci determined the damping constant to be

$$A^* = 26 \exp (-5.9 v_w^+)$$

where

$$v_w^+ = v_w / (\tau_w / \rho)^{1/2}$$

Reichardt's expression for the inner eddy viscosity law was obtained by curve fitting experimental pipe flow data. The expression is:

$$\epsilon_i = \mu k_* \left[\frac{y \sqrt{\tau_w}}{\mu} - 11.0 \tanh \left(\frac{y \sqrt{\tau_w}}{11\mu} \right) \right] \quad (81)$$

As can be seen this expression does not involve the velocity gradient terms. For this reason it is preferred for use in numerical solutions, since it usually requires fewer iterations to converge.

Following equations (75) and (76) the outer eddy viscosity law is:

$$\epsilon_o = \lambda^2 y_\delta^2 \partial E / \partial y \quad (82)$$

and the total shear stress is:

$$\tau_o = \mu \partial E / \partial y + \lambda^2 y_\delta^2 (\partial E / \partial y)^2 \quad (83)$$

The outer eddy viscosity law is used in conjunction with the Klebanoff (Ref. 23) intermittency factor which assures a smooth approach of ϵ_o to zero as $y \rightarrow \delta$. The modified law is:

$$\epsilon_o = \lambda^2 y_\delta^2 \gamma \partial E / \partial y \quad (84)$$

where γ is Klebanoff's intermittency factor:

$$\gamma = \left[1 + 5.5 (y/\delta)^6 \right]^{-1} \quad (85)$$

Schetz and Favin (Ref. 24) have derived a correction to Reichardt's inner eddy viscosity law for cases of mass transfer. This correction has been used in the current investigation, giving this corrected expression for the inner eddy viscosity:

$$\epsilon_i = k\mu (1 + v_o^+ u^+)^{1/2} (y^+ - y_e^+ \tanh (y^+ / y_e^+)) \quad (86)$$

where

$$v_o^+ = v_w / \sqrt{\tau_w / \rho}$$

$$y^+ = y \sqrt{\tau_w / \rho} / \mu$$

and

$$y_e^+ = 3.65/(v_o^+ + 0.344)$$

The quantity u^+ is found by integration of the expression

$$\frac{du^+}{dy^+} = \frac{(1 + v_o^+ u^+)}{1 + k (1 + v_o^+ u^+)^{1/2} (y^+ - y_e^+ \tanh (y^+/y_e^+))} \quad (87)$$

or using equation (86):

$$\frac{du^+}{dy^+} = \frac{(1 + v_o^+ u^+)}{(1 + \epsilon_i)} \quad (88)$$

Since the eddy viscosity ϵ_i is implicit in the integration for u^+ , the calculation of ϵ_i is an iterative procedure for mass transfer cases.

2.5 TRANSITION MODELS

Two models of transition from laminar to turbulent flow have been used in this investigation. One model is a simply instantaneous transition to turbulent flow, and there really is no transition region or zone at all. In the second case a smooth transition to turbulent flow occurs over a prescribed distance. This distance is known as the transition zone and is defined as the distance between the onset of transition at $x = X_t$ and the beginning of fully turbulent flow at $x = X_T$ at some point downstream.

The probability of turbulent flow at any point is expressed by a model by Dhawan and Narasimha (Ref. 25) as:

$$I_f(x) = 1 - \exp (-\phi ((X - X_t)/\bar{X})^2) \quad (89)$$

where $I_f(x)$ is the transition intermittency factor,

and

$$\phi = 0.412$$

$$\bar{X} = X_{I_f = 0.75} - X_{I_f = 0.25}$$

and where

$$I_f(X_t) = 0$$

$$I_f(X_T) = 0.97 \quad (90)$$

By substituting equation (90) into (89) an expression for $\bar{x}$ can be found based on the transition zone length:

$$\bar{x} = (x_T - x_t)/2.917 \quad (91)$$

Now, substituting (91) back into (89) the final expression for the transition intermittency factor as used in this investigation is obtained:

$$I_f(x) = 1 - \exp \left[0.412 (2.917)^2 ((x-x_t)/(x_T-x_t))^2 \right] \quad (92)$$

The transition intermittency factor is employed as a simple multiplier of the eddy viscosity in the governing equations and therefore acts as a damping coefficient for the fully turbulent eddy viscosity. It is an expression relating the fraction of time any particular point spends in turbulent flow, and therefore the probability of turbulent flow existing at that point.

2.6 TURBULENT PRANDTL NUMBER LAWS

Five different turbulent Prandtl numbers have been provided for in this investigation. One of the models employs a constant Prandtl number:

$$Pr_t = 0.9$$

as recommended by Patankar and Spalding (Ref. 21) for two-dimensional boundary-layer flows. Other authors have derived models for the distribution of the turbulent Prandtl number normal to the wall. These models show the Prandtl number varying from near 0.8 at the wall to nearly 1.4 at the outer edge. The models presented here are by Rotta; Shang; Meier, Voisinot and Gates; and by Cebeci.

Rotta (Ref. 26) has suggested an empirical formula for the turbulent Prandtl number distribution as follows:

$$Pr_t = 0.95 - 0.45 (y/\delta)^2 \quad (93)$$

which gives a value of 0.5 at the outer edge and 0.95 near the wall.

A similar empirical formula was developed by Shang (Ref. 27) to study the sensitivity of a solution to the turbulent Prandtl number:

$$Pr_t = Pr_1 \exp (-10 (y/\delta)) + Pr_2 (1 - 0.2 (y/\delta)) \quad (94)$$

where

$$0.2 \leq Pr_1 \leq 0.4 \text{ and } 0.8 \leq Pr_2 \leq 1.0$$

Shang's formula allows the user to specify the constants in the formula, so that the difference in the values at the wall is between 1.0 and 1.4 and between 0.65 and 0.95 at the outer edge. Both Rotta's and Shang's formulas fall within the turbulent Prandtl number uncertainty envelope as established by Simpson et al. (Ref. 28). Shang's data follow the boundaries of Simpson's envelope very well at both the upper and lower boundaries, while Rotta's formula falls between the boundaries in the outer region and undershoots Simpson's lower boundary at the wall.

Meier et al. (Ref. 29) applied Prandtl's mixing length concept as modified by Van Driest to define a mixing length for both turbulent momentum and heat transport. Writing the turbulent Prandtl number based on mixing lengths that produced the following expression:

$$Pr_t = \left[\frac{k (1 - \exp(-y^+/A))}{k_q (1 - \exp(-y^+/A_q))} \right]^2 \quad (95)$$

The limiting case as $y^+ \rightarrow \infty$ is:

$$Pr_{t_\infty} = (k/k_q)^2$$

The limiting case as $y^+ \rightarrow 0$ is found by series expansion of equation (95) to be:

$$Pr_t = Pr_{t_\infty} (A_q/A)^2$$

where:

$$A = 26.0, \quad y^+ = \frac{y \sqrt{\tau_p}}{\mu}, \quad \text{and} \quad k = 0.4$$

$$A_q = 34.4 \quad k_q = 0.447$$

Using this Prandtl number model, Meier et al. found they could accurately describe experimental temperature distributions from the wall up to the fully turbulent part of the boundary layer.

Cebeci (Ref. 30) based his model of the turbulent Prandtl number on the considerations of a Stokes type flow. In Cebeci's model the Prandtl number is strongly affected by the molecular Prandtl number near the wall, and is a constant away from the wall. Cebeci's model for the turbulent Prandtl number is:

$$Pr_t = \frac{k_m (1 - \exp(-y/A))}{k_h (1 - \exp(-y/B))} \quad (96)$$

where

$$A^+ = 26 + \frac{14}{1 + Z^2}, \quad k_m = 0.4 + \frac{0.19}{1 + 0.49 Z^2}$$

$$B^+ = 35 + \frac{25}{1 + 0.55 Z^2}, \quad k_h = 0.44 + \frac{0.22}{1 + 0.42 Z^2}$$

and

$$A = A^+ v (\tau_s / \rho)^{-1/2}, \quad B = B^+ v (\tau_s / \rho)^{-1/2}$$

In these expressions $(\tau_s / \rho)^{1/2}$ is the friction velocity at the edge of the sublayer. The value Z is:

$$Z = Re_\theta \times 10^{-3}$$

Cebeci's study using this Prandtl number model showed good agreement with experiment and also confirmed that mass transfer has no effect on the turbulent Prandtl number.

2.7 FLUID PROPERTIES

The development of the fluid property calculations in this investigation follow closely those of Jaffe, Lind, and Smith (Ref. 10). Fluid properties are developed for a binary gas mixture consisting of either helium, argon, or carbon dioxide being injected into a free stream of air.

The fluid properties necessary to this investigation are C_{p_f} , C_{p_i} , C_p ; C_{v_f} , C_{v_i} , C_v ; h , h_i , h_f ; k_f , k_i , k ; μ_i , μ_f , μ ; and D_{fi} .

The mixture of gases is composed of perfect gas species where the total pressure is equal to the sum of the partial pressures of the individual species and where the specific enthalpies are functions of temperature only. Individual species molecular weights are necessary to calculate the mixture density from the following expression:

$$\rho = \frac{P}{RT} \left[\frac{M_f M_i}{C_f (M_i - M_f) + M_f} \right] \left(\frac{\text{slugs}}{\text{ft}^3} \right) \quad (97)$$

where

$$M_f = M_{\text{air}} = 28.966$$

$$M_i = M_{\text{Ar}} = 39.948$$

$$M_{\text{He}} = 4.0026$$

$$M_{\text{CO}_2} = 44.00995$$

The specific heat capacities at constant pressure and at constant volume are:

$$C_p = (1 - C_f) C_{p_i} + C_f C_{p_f} \quad (98)$$

$$C_v = (1 - C_f) C_{v_i} + C_f C_{v_f} \quad (99)$$

The heat capacities at constant pressure for carbon dioxide and air are obtained from a polynomial as follows:

$$C_{p_j} = A + BT + CT^2 + DT^3 + ET^4 + FT^5 \left(\frac{ft^2}{sec^2 \text{ } ^\circ R} \right) \quad (100)$$

Coefficients A through F are given in Table I. The coefficients in the polynomial are valid for temperatures from 0° to 12,000 °R for air, and from 0° to 6300 °R for carbon dioxide. For the monotonic gases, helium and argon, the heat capacities, are obtained from:

$$C_{v_j} = 3/2 \ R/M_j \quad (101)$$

$$C_{p_j} = C_{v_j} + R/M_j \quad (102)$$

due to the fact that the translational mode is the only contribution.

For air and carbon dioxide the specific enthalpies are obtained from the integral:

$$h_j = \int_0^T C_{p_j} dT \quad (103)$$

where this integral is approximated by the integral of equation (100) so that:

$$h_j = AT + \frac{BT^2}{2} + \frac{CT^3}{3} + \frac{DT^4}{4} + \frac{ET^5}{5} + \frac{FT^6}{6} \left(\frac{ft^2}{sec^2} \right) \quad (104)$$

The specific enthalpies for helium and argon are:

$$h_j = C_{p_j} T \left(\frac{ft^2}{sec^2} \right) \quad (105)$$

The mixture enthalpy is obtained from the specific enthalpies and the respective mass fractions:

$$h = (1 - C_f) h_i + C_f h_f \quad (106)$$

The viscosity of a mixture is calculated from Wilke's (Ref. 31) formula as follows:

$$\mu = \frac{\mu_i}{1 + G_{if} (X_f/X_i)} + \frac{\mu_f}{1 + G_{fi} (X_i/X_f)} \quad (107)$$

where:

$$X_i = \frac{(1 - C_f)/M_i}{C_f/M_f + (1 - C_f)/M_i}$$

$$X_f = \frac{C_f/M_f}{C_f/M_f + (1 - C_f)/M_i}$$

and

$$G_{if} = 1/\sqrt{8} \left(1 + M_i/M_f \right)^{-1/2} \left(1 + (\mu_i/\mu_f)^{1/2} (M_f/M_i)^{1/4} \right)^2$$

The individual specie viscosities have all been fit to a fifth degree polynomial similar to that used for the heat capacities:

$$\mu_j = A + BT + CT^2 + DT^3 + ET^4 + FT^5 \left(\frac{1 \text{ b sec}}{\text{ft}^2} \right) \quad (108)$$

Coefficients A through F are given in Table II, and are valid for the same temperature ranges as given for the heat capacities.

The thermal conductivity of a mixture is obtained from Wilke's formula (107) in which the individual specie viscosities are replaced with the individual conductivities. The individual specie thermal conductivities are calculated with the Eucken (Ref. 32) equation:

$$k_j = \frac{1}{4} \left[9 \frac{C_{pj}}{C_{vj}} - 5 \right] C_{vj} \mu_j \quad (109)$$

The calculation of the binary diffusion coefficient has also been fit to a fifth degree polynomial:

$$PD_{fi} = A + BT + CT^2 + DT^3 + ET^4 + FT^5 \quad (110)$$

where P is the local pressure and coefficients A through F are given in Table III. Applicable temperature ranges are the same as those for viscosity already given.

The polynomial coefficients given in Tables I-III are taken from tables developed by Lewis, Adams, and Gilley (Ref. 11), and by Jaffe, Lind, and Smith (Ref. 10). Lewis et al. extended the data of Jaffe et al. to a maximum temperature of 12,600 °R for helium and argon. The original data of Jaffe et al. for carbon dioxide to 6300 °R has been used in this investigation.

2.8 FINITE-DIFFERENCE METHOD

The finite-difference method used in this investigation follows the method used by McGowan and Davis (Ref. 4), which is similar to the method developed by Dwyer (Ref. 6) with modifications by Krause (Ref. 19). The method has been further modified to include variable spacing for the normal coordinate. The accuracy of this method is of order Δ^2 where Δ is $\Delta\xi$ or $\Delta\phi$. The method is stable for negative transverse velocities when proper step sizes are chosen.

The momentum, species, and energy equations are written in standard parabolic form as:

$$A_0 \frac{\partial^2 w}{\partial \eta^2} + A_1 \frac{\partial w}{\partial \eta} + A_2 w + A_3 + A_4 \frac{\partial w}{\partial \xi} + A_5 \frac{\partial w}{\partial \phi} = 0 \quad (111)$$

and w is the dependent variable in each case. Using equations (45) through (48) and equations (57) through (60) the coefficients A_0 through A_5 are determined as follows:

<u>Streamwise Momentum</u>	<u>General</u>	<u>Windward</u>
A_0	$-\ell^* \Omega$	$-\ell^* \Omega$
A_1	$V - \ell^{*'} \Omega$	$V - \ell^{*'} \Omega$
A_2	$\delta \gamma_1 g' + \beta_1 f'$	$\beta_1 f'$
A_3	$-\beta_1 x + \epsilon_1 (\alpha^2 x - g'^2) - \delta \alpha \gamma_1 x$	$-\beta_1 x$
A_4	$2\xi f'$	$2\xi f'$
A_5	$\delta g'$	0

Transverse
MomentumGeneralWindward A_0

$$-\ell^* \Omega$$

$$-\ell^* \Omega$$

 A_1

$$V - \ell^{*'} \Omega$$

$$V - \ell^{*'} \Omega$$

 A_2

$$f' (\beta_1 + \epsilon_1) + \delta \gamma_1 g'$$

$$f' (\beta_1 + \epsilon_1) + \delta g'$$

 A_3

$$-\delta \alpha \gamma_2 \chi - \beta_2 \chi - \epsilon_1 \alpha \chi$$

$$\delta \beta_3 \chi$$

 A_4

$$2\xi f'$$

$$2\xi f'$$

 A_5

$$\delta g'$$

$$0$$

Species
EquationGeneralWindward A_0

$$-\ell^{***} \Omega \text{ Le/Pr}$$

$$-\ell^{***} \Omega \text{ Le/Pr}$$

 A_1

$$V - (\ell^{***} \text{ Le/Pr})' \Omega$$

$$V - (\ell^{***} \text{ Le/Pr})' \Omega$$

 A_2

$$0$$

$$0$$

 A_3

$$0$$

$$0$$

 A_4

$$2\xi f'$$

$$2\xi f'$$

 A_5

$$\delta g'$$

$$0$$

Energy
EquationGeneralWindward A_0

$$-\ell^{**} \Omega/\text{Pr}$$

$$-\ell^{**} \Omega/\text{Pr}$$

 A_1

$$V - (\ell^{**}/\text{Pr})' \Omega$$

$$V - (\ell^{**}/\text{Pr})' \Omega$$

 A_2

$$0$$

$$0$$

Energy
Equation

	<u>General</u>		<u>Windward</u>
A_3	$\frac{u_e^2}{H_e} \Omega \frac{\partial}{\partial \eta} \left[\left\{ \frac{\ell^{**}}{Pr} - \ell^* \right\} \left\{ f' \frac{\partial f'}{\partial \eta} + g' \frac{\partial g'}{\partial \eta} \right\} \right]$ $+ \frac{u_e^2}{H_e} \Omega \frac{\partial}{\partial \eta} \left[\left\{ \ell^{***} \frac{Le}{Pr} - \frac{\ell^{**}}{Pr} \right\} (h_f - h_i) \frac{\partial z}{\partial \eta} \right]$	$\frac{u_e^2}{H_e} \Omega \frac{\partial}{\partial \eta} \left[\left\{ \frac{\ell^{**}}{Pr} - \ell^* f' \right\} \frac{\partial f'}{\partial \eta} \right]$ $+ \frac{u_e^2}{H_e} \Omega \frac{\partial}{\partial \eta} \left[\left\{ \ell^{***} \frac{Le}{Pr} - \frac{\ell^{**}}{Pr} \right\} (h_f - h_i) \frac{\partial z}{\partial \eta} \right]$	
A_4	$2\xi f'$		$2\xi f'$
A_5	$\delta g'$		0

The derivatives in equation (111) are replaced with finite difference expressions which are:

$$\frac{\partial^2 w}{\partial \eta^2} = \frac{2\lambda (w_{2,n+2} - (1+k) w_{2,n} + k w_{2,n-1})}{(\eta_{n+1} - \eta_n)^2 + k (\eta_n - \eta_{n-1})^2}$$

$$+ 2(1-\lambda) \frac{(w_{3,n+1} - (1+k) w_{3,n} + k w_{3,n-1})}{(\eta_{n+1} - \eta_n)^2 + k (\eta_n - \eta_{n-1})^2} \quad (112)$$

$$\frac{\partial w}{\partial \eta} = \lambda \frac{(w_{2,n+1} - (1-k^2) w_{2,n} - k^2 w_{2,n-1})}{(\eta_{n+1} - \eta_n) + k^2 (\eta_n - \eta_{n-1})}$$

$$+ \frac{(1-\lambda) (w_{3,n+1} - (1-k^2) w_{3,n} - k^2 w_{3,n-1})}{(\eta_{n+1} - \eta_n) + k^2 (\eta_n - \eta_{n-1})} \quad (113)$$

$$w = \lambda w_{2,n} + (1-\lambda) w_{3,n} \quad (114)$$

$$\frac{\partial w}{\partial \xi} = \frac{w_{2,n} - w_{3,n}}{\Delta \xi} \quad (115)$$

$$\frac{\partial w}{\partial \phi} = \frac{(w_{2,n} - w_{1,n}) + (w_{4,n} - w_{3,n})}{2\Delta \phi} \quad (116)$$

where $k = (\eta_{n+1} - \eta_n)/(\eta_n - \eta_{n-1})$.

Subscripts refer to grid locations as indicated in figure 1, which shows the finite difference grid. The weighting factor, λ , indicates a fully implicit solution when set to 1 and a Crank-Nicolson averaging solution when set to 1/2.

By substituting equations (112) through (116) into equation (111) a finite difference form of eq. (111) is obtained:

$$\tilde{A}_n w_{2,n-1} + \tilde{B}_n w_{2,n} + \tilde{C}_n w_{2,n+1} = \tilde{D}_n \quad (117)$$

where

$$\tilde{A}_n = \lambda \left[\frac{2 k A_{0n}}{N_2} - \frac{k^2 A_{1n}}{N_1} \right]$$

$$\tilde{\tilde{B}}_n = \lambda \left[\frac{-2 (1+k) A_{0n}}{N_2} - \frac{(1-k^2)}{N_1} A_{1n} + A_{2n} \right]$$

$$\tilde{B}_n = \tilde{\tilde{B}}_n + \frac{A_{4n}}{\Delta \xi} + \frac{A_{5n}}{2\Delta \phi}$$

$$\tilde{C}_n = \lambda \left[\frac{2 A_{0n}}{N_2} + \frac{A_{1n}}{N_1} \right]$$

$$\begin{aligned} \tilde{D}_n = & \frac{-(1-\lambda)}{\lambda} \left[\tilde{A}_n w_{3,n-1} + \tilde{C}_n w_{3,n+1} + \tilde{\tilde{B}}_n w_{3,n} \right] - A_{3n} \\ & + \frac{A_{4n}}{\Delta \xi} w_{3,n} + \frac{A_{5n}}{2\Delta \phi} (w_{1,n} - w_{4,n} + w_{3,n}) \end{aligned}$$

$$N_2 = (\eta_{n+1} - \eta_n)^2 + k (\eta_n - \eta_{n-1})^2$$

$$N_1 = (\eta_{n+1} - \eta_n) + k^2 (\eta_n - \eta_{n-1})$$

Three special cases of this general procedure take advantage of similarity in the ξ and ϕ directions. At the tip of a sharp cone where there is no variation with ξ the above scheme is used in the transverse or cross flow direction and the derivatives are replaced by:

$$\begin{aligned} \frac{\partial^2 w}{\partial \eta^2} = \frac{2\lambda}{N_2} (w_{2,n+1} - (1+k) w_{2,n} + k w_{2,n-1}) + \frac{2(1-\lambda)}{N_2} (w_{1,n+1} \\ - (1+k) (w_{1,n} + k w_{1,n-1})) \end{aligned} \quad (118)$$

$$\begin{aligned} \frac{\partial w}{\partial \eta} = \frac{\lambda}{N_1} (w_{2,n+1} - (1-k^2) w_{2,n} - k^2 w_{2,n-1}) + \frac{(1-\lambda)}{N_1} (w_{1,n+1} \\ - (1-k^2) w_{1,n} - k^2 w_{1,n-1}) \end{aligned} \quad (119)$$

$$w = \lambda w_{2,n} + (\lambda - 1) w_{1,n} \quad (120)$$

$$\frac{\partial w}{\partial \xi} = 0, \quad \frac{\partial w}{\partial \phi} = \frac{w_{2,n} - w_{1,n}}{\Delta \phi} \quad (121)$$

The governing equations are now written in the standard form with $A_4 = 0$ and substitution of equations (118) through (121) into equation (111) yields equation (117) where:

$$\begin{aligned} \tilde{A}_n &= \lambda \left[\frac{2 k A_{0n}}{N_2} - \frac{k^2 A_{1n}}{N_1} \right] \\ \tilde{\tilde{B}}_n &= \lambda \left[-2 (1+k) \frac{A_{0n}}{N_2} - (1-k^2) \frac{A_{1n}}{N_1} + A_{2n} \right] \end{aligned}$$

$$\tilde{B}_n = \tilde{\tilde{B}}_n + A_{5n} / \Delta \phi$$

$$\tilde{C}_n = \lambda \left[\frac{2 A_{0n}}{N_2} + \frac{A_{1n}}{N_1} \right]$$

$$\tilde{D}_n = -A_{3n} + \frac{A_{5n}}{\Delta\phi} w_{1,n} - \frac{(1-\lambda)}{\lambda} (\tilde{A}_n w_{1,n-1} + \tilde{B}\tilde{B}_n w_{1,n} + \tilde{C}_n w_{1,n+1})$$

Along the windward streamline similarity exists with respect to ϕ . In this case the general scheme, equation 112-115 is used with $A_{5n} = 0$.

When similarity exists in both variables such as the stagnation point of a blunt cone or a sharp cone a fully implicit set of ordinary differential equations is used. In this case the general procedure is again used with $\lambda = 1$, and $A_{4n} = A_{5n} = 0$.

Equation 117 results in simultaneous linear algebraic equations of tridiagonal form which are solved by a method developed by Richtmyer (Ref. 33). The boundary conditions at both the wall and the outer edge must be specified for this method. The general solution to equation (117) is

$$w_{2,n} = E_n w_{2,n+1} + F_n \quad 2 < n < N - 1 \quad (122)$$

where

$$E_n = \frac{\tilde{C}_n}{\tilde{A}_n E_{n-1} + \tilde{B}_n}$$

$$F_n = \frac{\tilde{D}_n - \tilde{A}_n F_{n-1}}{\tilde{A}_n E_{n-1} + \tilde{B}_n}$$

By using the wall boundary conditions the values of E_n and F_n are found:

$$E_n = 0$$

$$F_n = 0, 0, H_w/H_e \quad \text{for } f', g', \text{ and } \theta \text{ respectively.}$$

Using the outer edge boundary conditions allows the calculation of $w_{2,n-1}$ thereby completing the profile.

The ability to variably space the normal grid allows closer spacing of grid points near the wall where variations in properties are greater. The method used is taken from Cebeci, Smith, and Mosinskis (Ref. 34) and has been successfully used by Anderson and Lewis (Ref. 8) and Adams (Ref. 15).

Using this procedure results in a constant ratio of succeeding normal grid intervals such that:

$$k = \frac{\Delta \eta_n}{\Delta \eta_{n-1}} \quad (123)$$

Therefore the value of η at infinity is given by:

$$\eta_\infty = \Delta \eta_1 \frac{k^N - 1}{k - 1}$$

where N is the total number of intervals across the layer.

2.9 BOUNDARY-LAYER PARAMETERS

Local boundary-layer parameters are determined at a given point following the converged solution of the boundary-layer equations at that point. These parameters include heat transfer, heat-transfer coefficients, skin-friction coefficients, displacement thicknesses and momentum thicknesses.

The heat transfer at the wall is:

$$-\dot{q}_w = \left[k \frac{\partial T}{\partial y} + (h_f - h_i) \rho D_{fi} \frac{\partial C_f}{\partial y} \right]_w \left(\frac{ft-lb}{ft^2-sec} \right) \quad (124)$$

In transformed variables this becomes:

$$-\dot{q}_w = \frac{k_w}{C_{pW}} \left. \frac{\partial \eta}{\partial y} \right|_w \left[H_e \frac{\partial \theta}{\partial \eta} + (Le-1) (h_f - h_i) \frac{\partial C_f}{\partial \eta} \right]_w \left(\frac{ft-lb}{ft^2-sec} \right) \quad (125)$$

Coefficients associated with the heat transfer at the wall are:

Local Heat Transfer Coefficient

$$Q_{w_\infty} = \dot{q}_w / \rho_\infty U_\infty^3 \quad (126)$$

Heat-Transfer Coefficient Based on Free-Stream Conditions and Adiabatic Wall Enthalpy

$$Ch_\infty = \frac{-\dot{q}_w}{\rho_\infty u_\infty (H_{aw} - H_w)} \quad (127)$$

or

$$Ch_\infty = \frac{-\dot{q}_w}{\rho_\infty u_\infty C_{p_{fw}} (T_{aw} - T_w)}$$

where

$$T_{aw} = T_o r_f + T_\infty (1 - r_f)$$

and

$$r_f = \sqrt{Pr} \quad \text{for laminar flow}$$

$$r_f = 3\sqrt{Pr} \quad \text{for turbulent flow}$$

Heat Transfer Coefficient Based on Edge Conditions and Adiabatic Wall Enthalpy:

$$C_{he} = \frac{-\dot{q}_w}{\rho_e u_e (H_{aw} - H_w)}$$

or

$$C_{he} = \frac{-\dot{q}_w}{\rho_e u_e C_{p_w} (T_{aw} - T_w)} \quad (128)$$

Stanton Number Based on Free-Stream Conditions:

$$St_\infty = \frac{-\dot{q}_w}{\rho_\infty u_\infty (H_e - H_w)}$$

or

$$St_\infty = \frac{-\dot{q}_w}{\rho_\infty u_\infty H_e (1 - \theta_w)} \quad (129)$$

Stanton Number Based on Edge Conditions:

$$St_e = \frac{-\dot{q}_w}{\rho_e u_e (H_e - H_w)}$$

or

$$St_e = \frac{-\dot{q}_w}{\rho_e u_e H_e (1 - \theta_w)} \quad (130)$$

Skin-friction coefficients are based on the calculation of the skin friction in the free-stream and transverse directions as follows:

$$\tau_{w_x} = \mu_w \partial u / \partial y \quad (131)$$

$$\tau_{w\phi} = \mu_w \partial w / \partial y \quad (132)$$

In transformed variables these become:

$$\tau_{w_x} = \frac{\bar{\rho}_e \mu_e u_e^2 r}{\sqrt{2\xi}} \frac{\partial f'}{\partial \eta} \left(\frac{1b}{ft^2} \right) \quad (133)$$

$$\tau_{w_\phi} = \frac{\bar{\rho}_e \mu_e u_e^2 r}{\sqrt{2\xi}} \frac{\partial g'}{\partial \eta} \left(\frac{1b}{ft^2} \right) \text{ where } g' = \frac{w}{u_e} \text{ and } \bar{\rho} = \frac{\rho \mu}{\rho_e \mu_e} \quad (134)$$

Skin-friction coefficients are defined as follows:

Based on Free-Stream Conditions:

$$C_{f_{x_\infty}} = \frac{2 \tau_{w_x}}{\rho_\infty u_\infty^2} \quad C_{f_{\phi_\infty}} = \frac{2 \tau_{w_\phi}}{\rho_\infty u_\infty^2} \quad (135)$$

Based on Edge Conditions:

$$C_{f_{x_e}} = \frac{2 \tau_{w_x}}{\rho_e u_e^2} \quad C_{f_{\phi_e}} = \frac{2 \tau_{w_\phi}}{\rho_e u_e^2} \quad (136)$$

The physical normal distance across the boundary layer is found from:

$$y = \frac{\sqrt{2\xi}}{\rho_e u_e r} \int_0^\eta \frac{\rho_e}{\rho} d\eta \quad (\text{ft}) \quad (137)$$

which can be evaluated using the trapezoidal rule.

The compressible two-dimensional boundary-layer displacement thickness is used to obtain the displacement thickness in each of the two directions:

$$\delta_x^* = \int_0^\infty \left[1 - \frac{\rho u}{\rho_e u_e} \right] dy \quad (\text{ft}) \quad (138)$$

$$\delta_\phi^* = \int_0^\infty \left[1 - \frac{\rho w}{\rho_e w_e} \right] dy \quad (\text{ft}) \quad (139)$$

or in transformed variables:

$$\delta_x^* = \int_0^{\eta_\infty} \left[\frac{\rho_e}{\rho} - f' \right] \frac{\sqrt{2\xi}}{\rho_e u_e r} d\eta \quad (\text{ft}) \quad (140)$$

$$\delta_\phi^* = \int_0^{\eta_\infty} \left[\frac{\rho_e}{\rho} - \frac{g'}{g_e} \right] \frac{\sqrt{2\xi}}{\rho_e u_e r} d\eta \quad (\text{ft}) \quad (141)$$

Neither δ_x^* or δ_ϕ^* completely define the actual displacement thickness at any point. For axisymmetric bodies Cebeci and Mosinskis (Ref. 35) define a δ^* as a function of δ_x^* . For a sharp cone at angle of attack an expression for δ^* on the windward stream-line only was developed by Moore (Ref. 36) as a function of both δ_x^* and δ_ϕ^* .

Momentum thicknesses have been defined similar to the displacement thicknesses for both directions:

$$\theta_x = \int_0^\infty \frac{\rho u}{\rho_e u_e} \left[1 - \frac{u}{u_e} \right] dy \quad (\text{ft}) \quad (142)$$

$$\theta_\phi = \int_0^\infty \frac{\rho w}{\rho_e w_e} \left[1 - \frac{w}{w_e} \right] dy \quad (\text{ft}) \quad (143)$$

or in transformed variables:

$$\theta_x = \int_0^{\eta_\infty} f' (1 - f') \frac{\sqrt{2\xi}}{\rho_e u_e r} d\eta \quad (\text{ft}) \quad (144)$$

$$\theta_\phi = \int_0^{\eta_\infty} \frac{g'}{g_e} \left[1 - \frac{g'}{g_e} \right] \frac{\sqrt{2\xi}}{\rho_e u_e r} d\eta \quad (\text{ft}) \quad (145)$$

The boundary-layer thickness is defined as the value of y at which $f' = 0.995$. This value is determined by interpolation in the $y(\eta)$ profile.

SECTION III RESULTS AND DISCUSSION

Figures 2 through 8 present some boundary-layer solutions as calculated by the computer program described in this report. Solutions are presented for both sharp and blunt cones at zero and non-zero angles of attack and with mass transfer and transition to turbulence.

Figure 2 shows calculations made for a sharp cone at zero angle of attack in hypersonic laminar flow. This is the same cone solved by Jaffe, Lind, and Smith in reference 10; however, the species equation wall boundary condition has been corrected in the current calculations. The current results are compared to results obtained from the Miner, Anderson, Lewis axisymmetric computer program (Ref. 14), which also uses the corrected boundary condition for the species equation.

In figure 2a the concentration of air at the wall is plotted versus the nondimensional slant length. The results for argon and carbon dioxide show complete agreement between the present results and those from Ref. 14. Excellent agreement is also obtained with helium injection at a lower injection rate.

A sharp drop in the wall heat transfer rate is shown in the mass transfer area of the cone in figure 2b. In figures 2b through 2e no plottable differences were observed between the current results and those of reference 14. Figure 2c shows the effect of mass transfer on the longitudinal skin friction coefficient. Again a significant decrease in skin friction is gained by mass transfer over the cone afterbody. Injection of air is seen to have the most effect on the skin friction, with argon and carbon dioxide having identical effects. This trend of data was also observed in Ref. 10. Jaffe et al. point out in Ref. 10 that when considering the effect of a foreign gas on the skin friction coefficient one must take into account not only the molecular weight of the gas but the heat capacity as well. Therefore, while the molecular weight of carbon dioxide is higher than that of argon, its higher heat capacity causes a lower temperature distribution and a slightly greater effect on the skin friction. This effect is not plottable in these figures but is evidenced by the actual numbers.

A similar heat capacity effect is caused relative to the heat transfer rate at the wall. The heat transfer calculation contains a temperature gradient term and a concentration gradient term. When a foreign gas is introduced at the wall, and it has a specific heat greater than that of air, the concentration gradient will contribute to a transfer of heat from the surface, thereby lowering the heat transfer to the surface. Therefore, the best coolant under particular conditions would be the gas with the highest specific heat. The curves for Stanton number confirm this in figure 2b. Of the three gases carbon dioxide, which has the highest specific heat, has the most effect on the Stanton number. Next is air and then argon in the order of decreasing specific heats.

The displacement thickness is plotted for air, argon, carbon dioxide and no injection in figure 2d. The effect of mass transfer is to increase the displacement thickness in the region of injection. There is no plottable difference in displacement thickness in this region for argon and air injection. As expected the heavier gases have a smaller effect on the displacement thickness for a given mass transfer rate. The heat capacities of the injected gases also play a part in the displacement thickness by influencing the density profile through the temperature. A cooler temperature profile should contribute to the decreasing of the displacement thickness. Figure 2d shows the displacement thickness for carbon dioxide being smaller than for air or argon, which probably reflects the specific heat effect as well as the effect of molecular weight on blowing rate.

Figure 2e shows the air concentration profiles for argon and carbon dioxide injection at the end of the cone. The heavier gas, carbon dioxide has a higher concentration near the wall, but argon has a higher concentration near the outer edge of the boundary layer.

In figure 3 the results for a blunt cone at zero angle of attack and with mass transfer are compared to the results obtained by Lewis, Adams, and Gilley (Ref. 11). The data of reference 11 includes the effects of transverse curvature (TVC), and therefore a one to one comparison of data with the present results is not possible. However, the trend of the data and the effects of TVC on the solutions can be observed.

In reference 10 the authors report on the effects of TVC on the results obtained for mass transfer over a sharp cone. They report that the effects are significant and increase with decreasing molecular weight. Solutions were shown to yield higher values of skin friction and heat transfer, and lower values of the displacement thickness when TVC was included. Probstein and Elliot (Ref. 41) make the observation that the addition of the TVC terms to the governing equations causes behavior similar to that produced by a favorable pressure gradient.

The results of reference 10 as well as the present results confirm the observations of Probstein and Elliot. In figure 3a the concentration of air at the wall is plotted versus surface distance for argon and helium injection over a blunt cone. The pressure-gradient-like effect of the TVC present in reference 11 yields a slightly higher air concentration at the wall for both gases. A slightly larger difference between present results and those of reference 11 is seen for the injection of helium, the lighter gas.

The effects of the higher injection rate for argon are evident in figure 3. The argon concentration approaches 100% near the end of the cone. The resulting significant decreases in heat transfer and skin friction are shown in figures 3b and 3c. The effect of TVC on the results is also evident in these two figures; as observed in reference 10 the inclusion of TVC increases both heat transfer and skin friction for a given injected

gas. The displacement thickness data are presented in figure 3d. The effects of TVC observed for the sharp cone by Jaffe, Lind, and Smith (Ref. 10) are not evident in this figure since the present results yield a smaller thickness than the results reported in reference 11. The higher injection rate of argon is responsible for the greater thickness relative to the helium injection curve. Differences in the calculation of the displacement thickness between the present program and that used in reference 11 are probably responsible for the turnabout in the relative thicknesses for TVC and no TVC; however, the important fact is that the trend of the data is the same in both cases.

Figures 4 and 5 show the comparison of fully three-dimensional solutions using the present program and the experiment of Cleary (Ref. 40). Cleary presented rather complete heat transfer data for both sharp and blunt cones at angle of attack in laminar flow. Points were chosen on the afterbody, and comparison is made in the circumferential direction for the heat transfer rate at the wall. Reasonably good agreement has been obtained for these cases. These figures show the dropping of the leeward solution plane for the sharp cone flow, and for the blunt cone flow far downstream. Similar problems were reported by McGowan and Davis (Ref. 4), and Adams (Ref. 5). Difficulties on the leeward ray have been attributed to defects in the boundary-layer model as applied to leeward ray flows of cones at angle of attack. This problem is discussed by Moore in reference 17.

Figure 6 presents heat-transfer data and profile data for regions of laminar and turbulent flow for a sharp cone at angle of attack. The cone used in these solutions is the one used by Adams (Ref. 15) in his figure 6 of that report. The present results were obtained using the Reichardt inner eddy viscosity law. This law was chosen over the Van Driest law due to the time consuming nature of the Van Driest law.

In figure 6a present wall heat-transfer rate data are compared to the results obtained by Adams. Differences in the results are almost certainly attributable to the fact that the present program uses variables property air and Adams does not. Some small differences can be expected as a result of using two different viscosity laws.

Profile data for the same cone at both zero and non-zero angles of attack are presented in figures 6b through 6d. Present results at zero angle of attack are compared to data obtained from the Miner et al. program (Ref. 14). Non-zero angle of attack data are compared to Adams (Ref. 15). Zero angle of attack results from ref. 14 are also obtained using the Reichardt law. Data for this case are shown where the flow is approximately 83% turbulent. Differences in results are attributable to the higher value of η_{∞} used in the program of ref. 14.

Non-zero angle of attack data are presented for locations $S/L = 0.4$ for laminar flow, and $S/L = 1.0$ for turbulent flow. Differences in the actual data are attributable to the different calculations of fluid

properties and eddy viscosity laws already discussed. Fuller profiles and a thicker boundary layer are turbulent flow characteristics also evident in these profile figures.

Figure 7 presents computer drawn plots without comparison for the cone and conditions of figure 6. In this case a fully three-dimensional solution was obtained using 13 planes in the transverse direction. A complete solution was obtained for this case in 97 minutes and in 296K of core on the VPI&SU 370/158 IBM digital computer. Transition to turbulence occurs over the last half of the vehicle and is complete at $S/L = 1.0$. The effect of using the large transverse step size can be seen in the circumferential plots as a loss of smoothness near the leeward streamline.

Data in figure 7 are presented in three different ways; 1) data versus ϕ , the transverse coordinate, at three different values of S/L , 2) data versus S/L , the streamwise coordinate, at three different values of ϕ , and 3) data versus Y/L , the normal coordinate, at constant values of S/L and ϕ . In this way, heat transfer, skin friction, displacement thickness, boundary-layer thickness, and eddy viscosity are presented as they vary in both the streamwise and transverse direction.

The final two figures presented show the turbulent Prandtl number profiles and corresponding temperature profiles for each of the turbulent Prandtl number laws included in the program. Figure 8a shows the four Prandtl number profiles versus Y/δ for the conditions and geometry of figure 6, also using the Reichardt law. The Pr_t is seen to vary from 1.38 to 0.95 at the wall, and from 0.9 to 0.45 at the outer edge. The corresponding temperature profiles show that there is little effect on the temperature profile due to varying the turbulent Prandtl number. The slightly higher temperatures correspond to the higher Prandtl number profiles. No plottable differences were obtained in boundary-layer parameters such as skin friction, heat transfer, and displacement thickness due to varying the Pr_t law. Shang (Ref. 27) concluded that there was a very weak dependence of boundary-layer parameters on turbulent Prandtl number. He cited a 6% change in skin friction and heat transfer rate corresponding to a 40% change in turbulent Prandtl number.

Following is a table of approximate time and core requirements for running various cases using the present program on an IBM 370 System - model 158 digital computer as installed at VPI&SU in Blacksburg, Virginia. Sizable savings can be had in core requirements by not utilizing the plotter package. Details on this can be obtained in the Appendices.

Approximate Time and Core Requirements

CASE	TIME ² (MIN.)	CORE ¹ W/PLOTS	CORE ¹ W/O PLOTS
4' sharp cone, $\alpha = 0^\circ$, w/transition (Fig. 6)	10-12	296 K	252 K
.2' sharp cone, $\alpha = 0^\circ$, w/injection (Fig. 2)	CO ₂ :21 Ar:17 Air:4	274 K	230 K
.4' blunt cone, $\alpha = 0^\circ$, w/injection (Fig. 3)	He:25 Ar:50 :5	310 K	266 K
blunt cone, $\alpha \neq 0^\circ$, laminar (Fig. 4)	2 ³	310 K	266 K
sharp cone, $\alpha \neq 0^\circ$, laminar (Fig. 5)	2 ³	296 K	252 K

1. Assuming an overlaid program as in Appendix VI under Fortran G.
2. Execution times only, running under Fortran G.
3. Time for one 13 plane excursion from windward to leeward rays.

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APPENDICES

- I. ILLUSTRATIONS
- II. TABLES
- III. DESCRIPTION OF THE COMPUTER PROGRAM
- IV. DESCRIPTION OF INPUT DATA
- V. DESCRIPTION OF OUTPUT DATA
- VI. JOB CONTROL LANGUAGE
- VII. SAMPLE RUNS OF THE COMPUTER PROGRAM
- VIII. LISTING OF THE COMPUTER PROGRAM

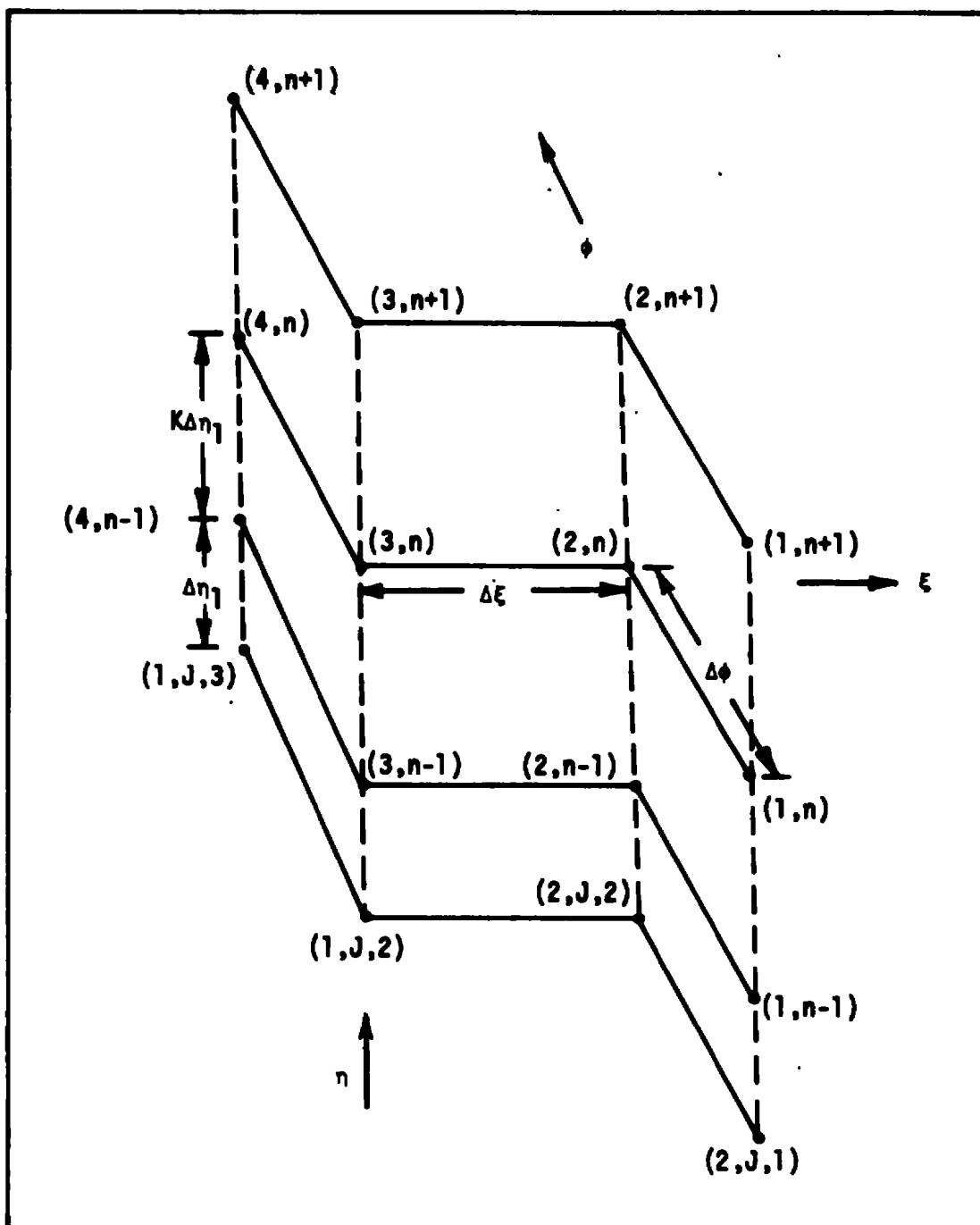


Figure 1. Finite Difference Grid and Notation

Bottom grid shows notation used in the computer program.

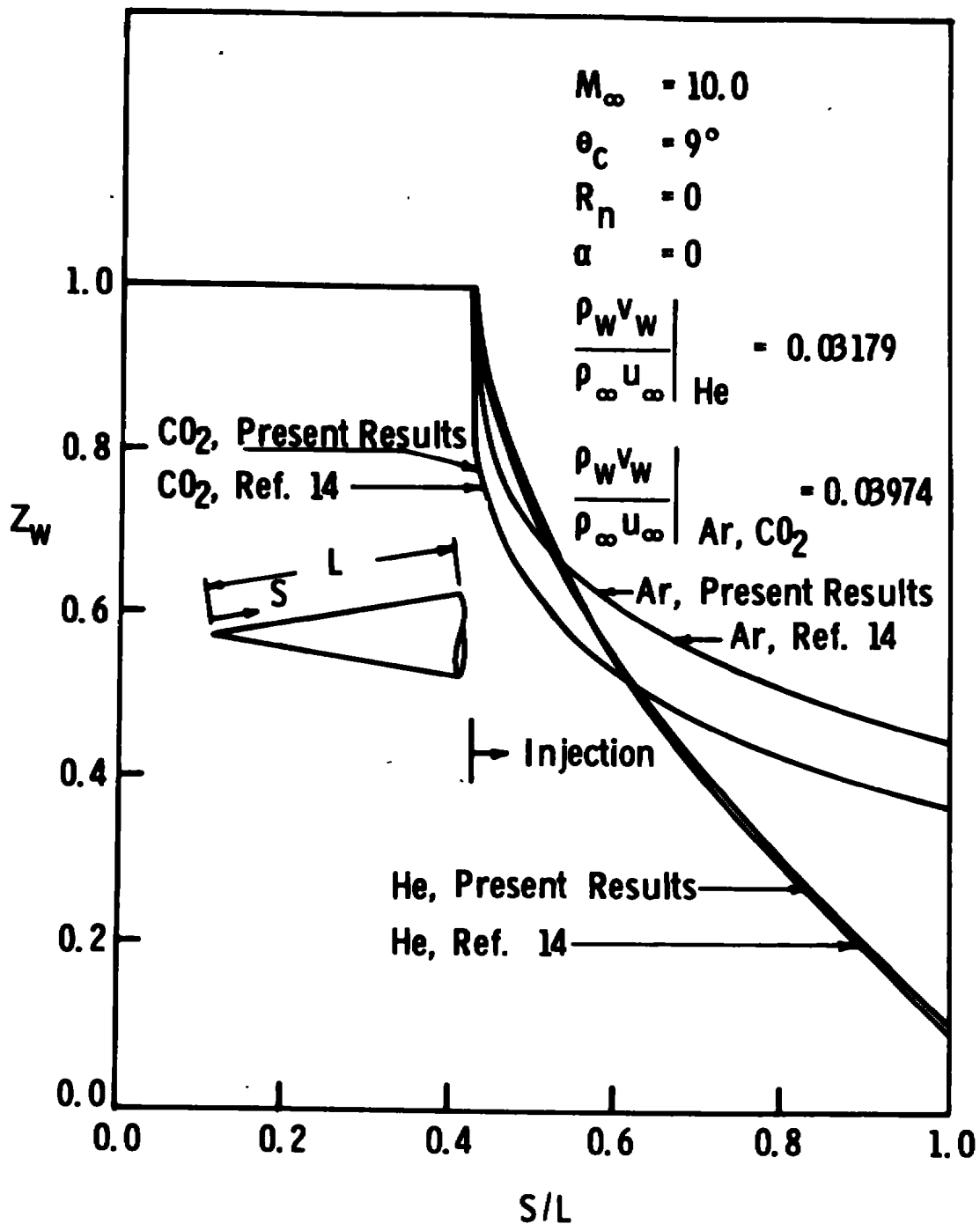


Figure 2. Comparison of Boundary-Layer Parameters for Mass Transfer over a Sharp Cone at Zero Incidence.
 a) Concentration of Air at the Wall

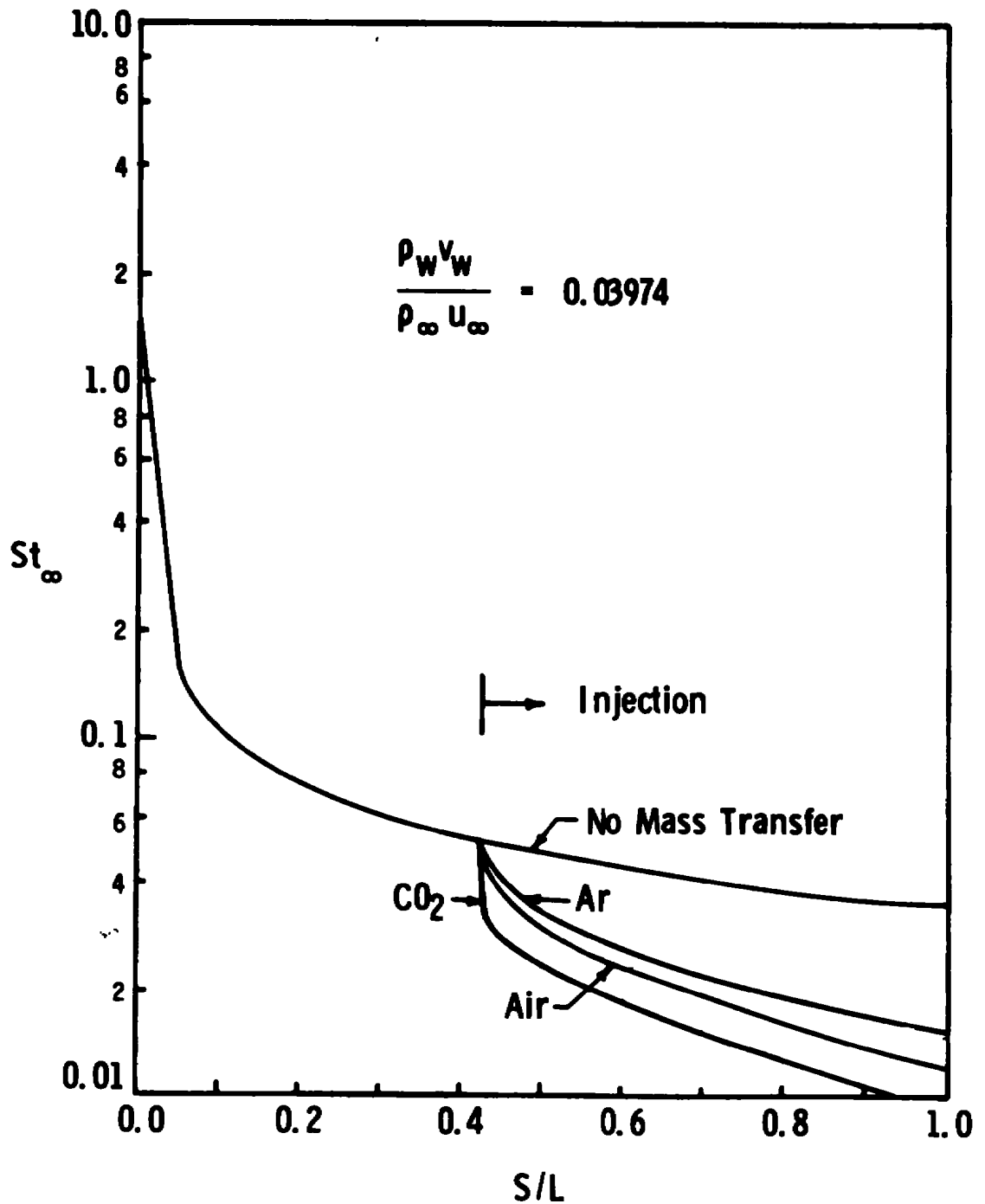


Figure 2. Cont'd.
b) Stanton Number Based on Free-Stream Conditions

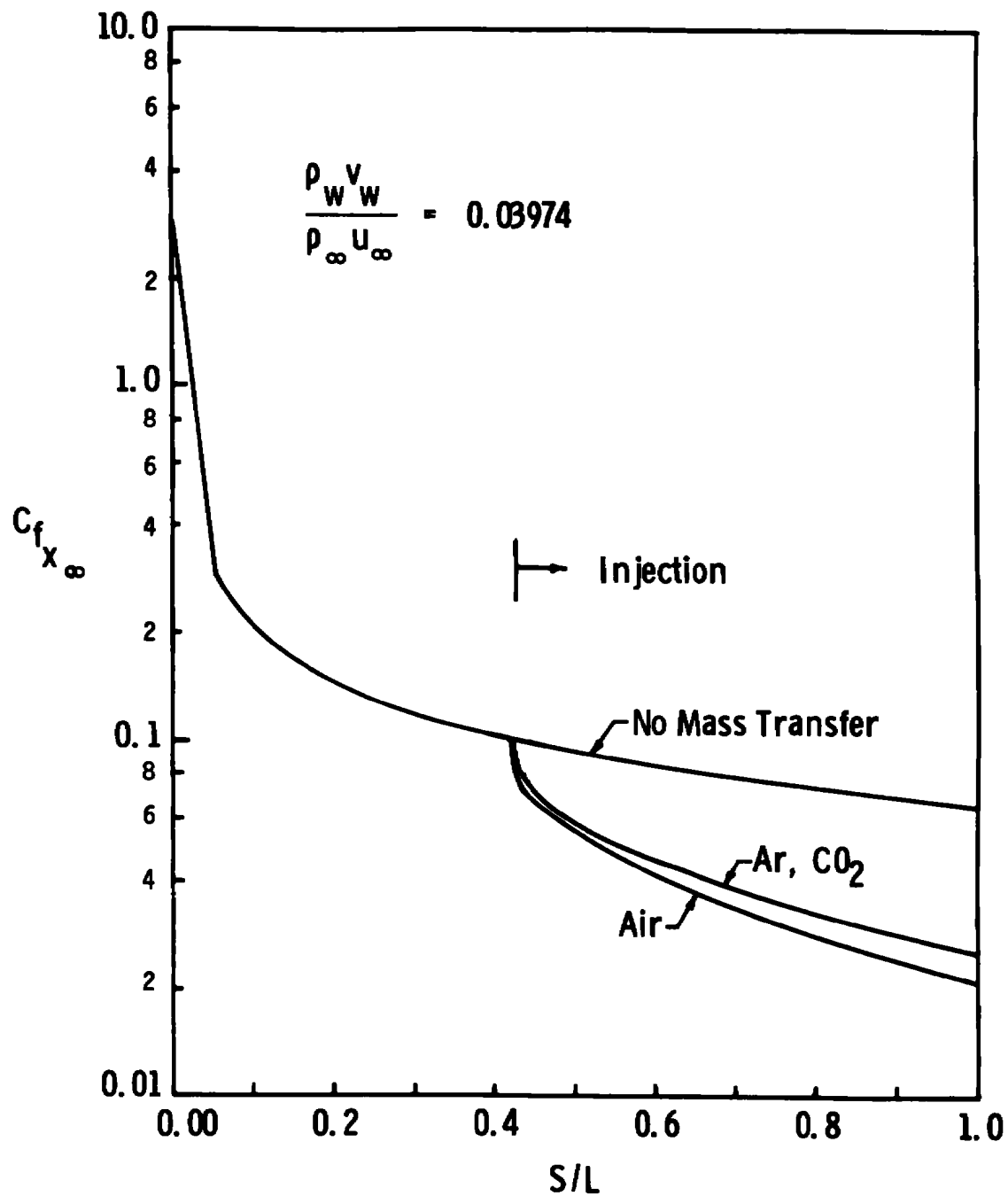


Figure 2. Cont'd.
 c) Longitudinal Skin-Friction Coefficient Based on Free-Stream Conditions

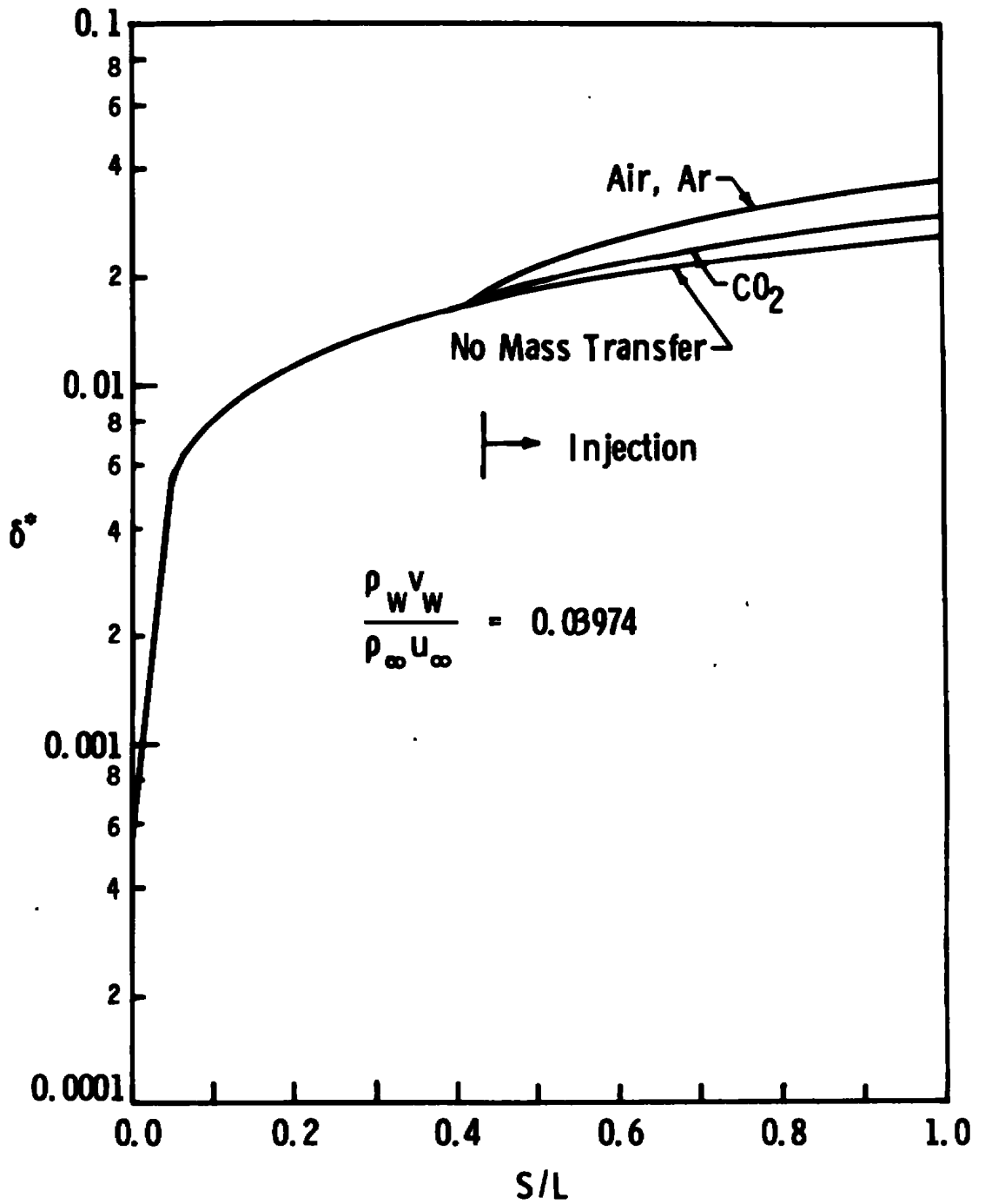


Figure 2. Cont'd.
d) Displacement Thickness

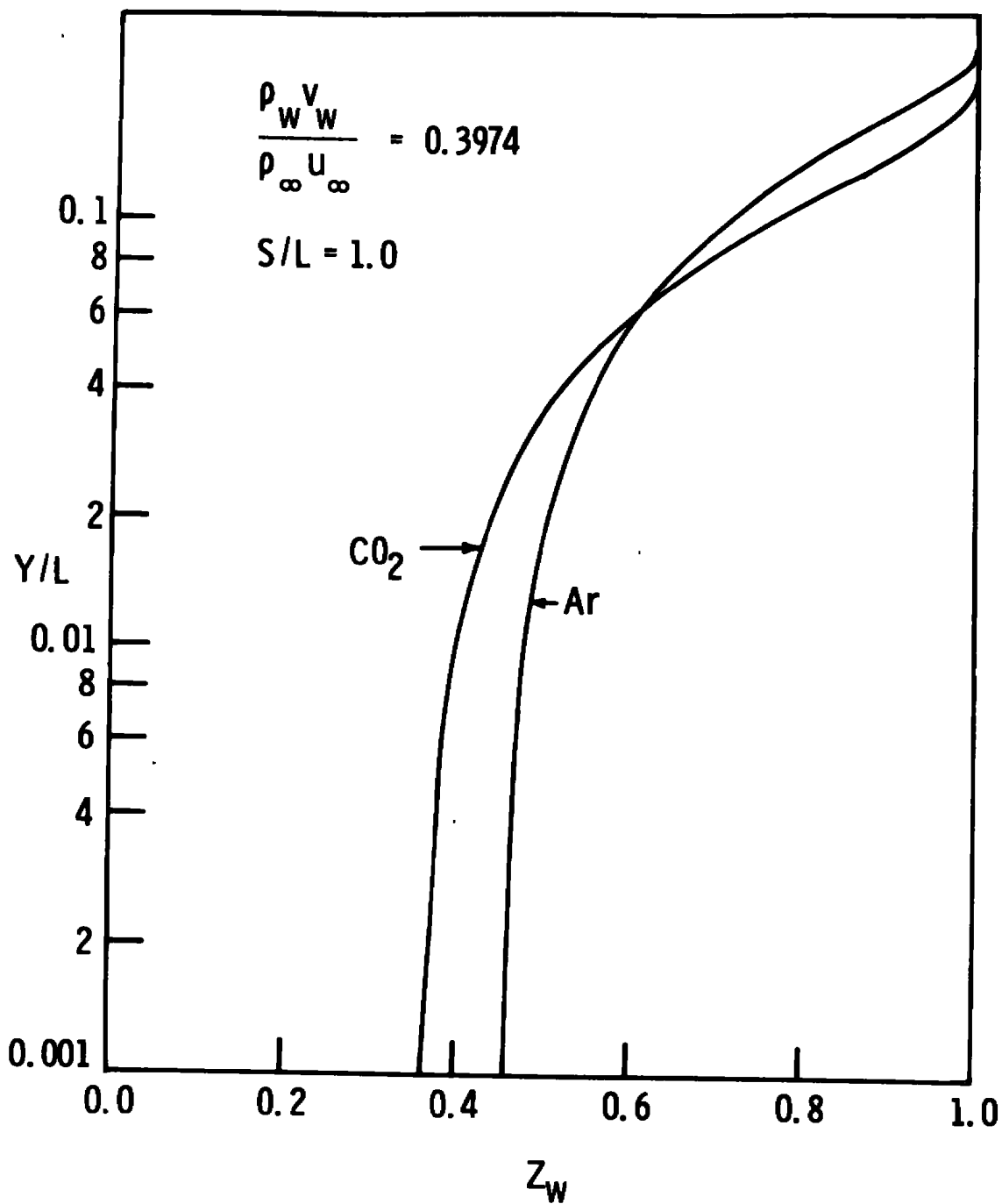


Figure 2. Concluded.
 e) Profile of the Concentration of Air

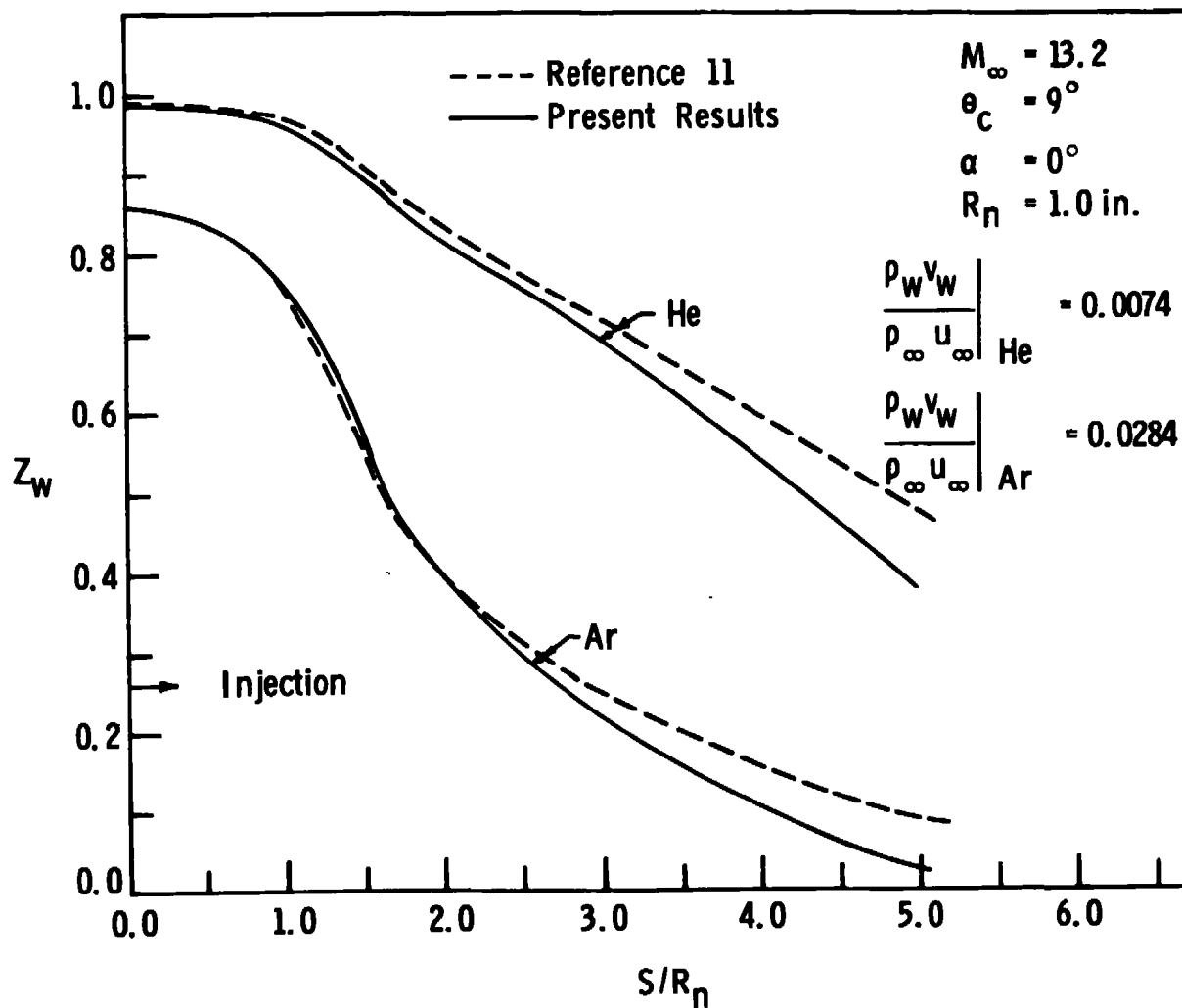


Figure 3. Comparison of Boundary-Layer Parameters for Mass Transfer over a Blunt Cone at Zero Incidence.
 a) Concentration of Air at the Wall

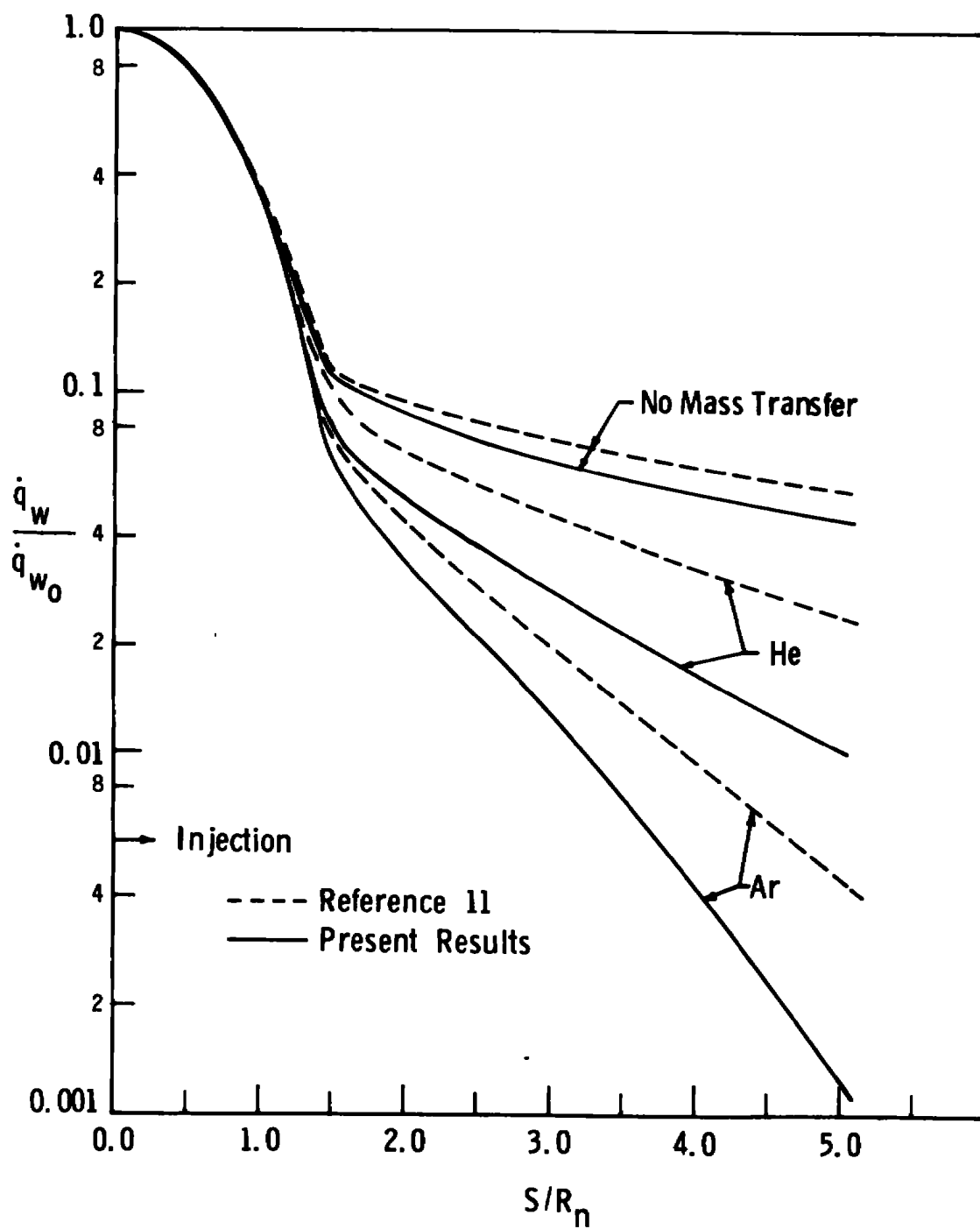


Figure 3. Cont'd.
b) Dimensionless Wall Heat Transfer Rate

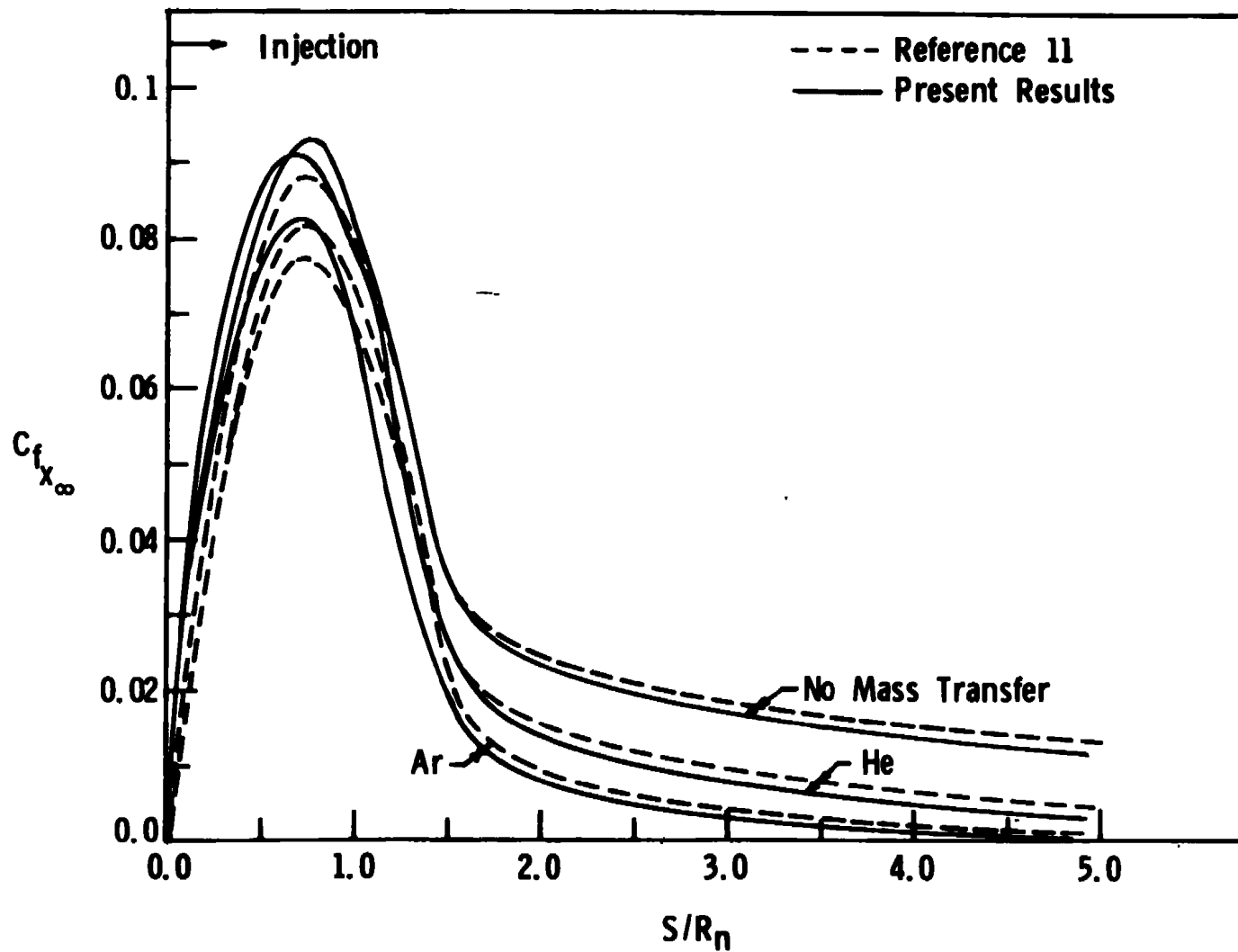


Figure 3. Cont'd.
c) Longitudinal Skin Friction-Coefficient Based on Free-Stream Conditions

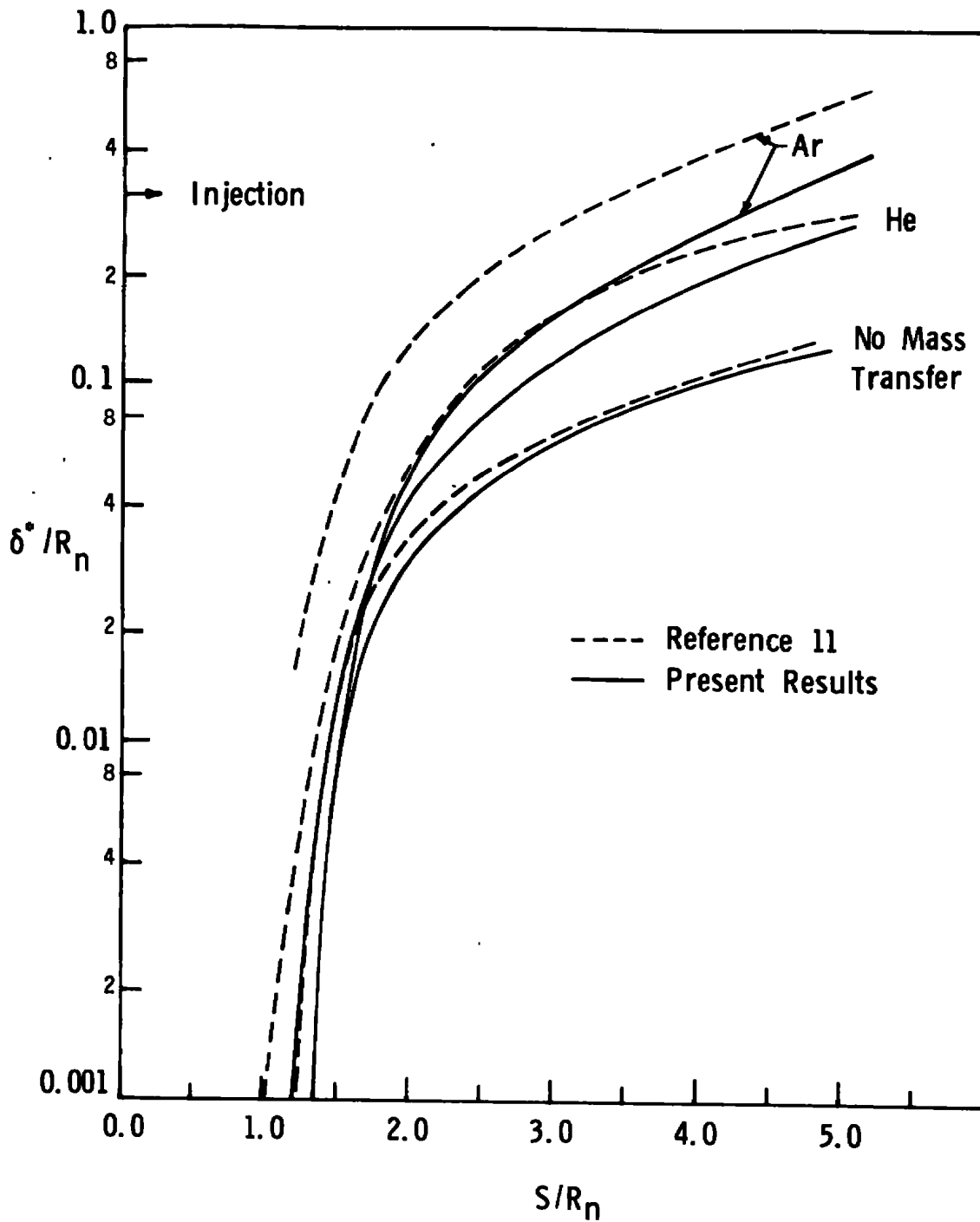


Figure 3. Concluded.
d) Displacement Thickness

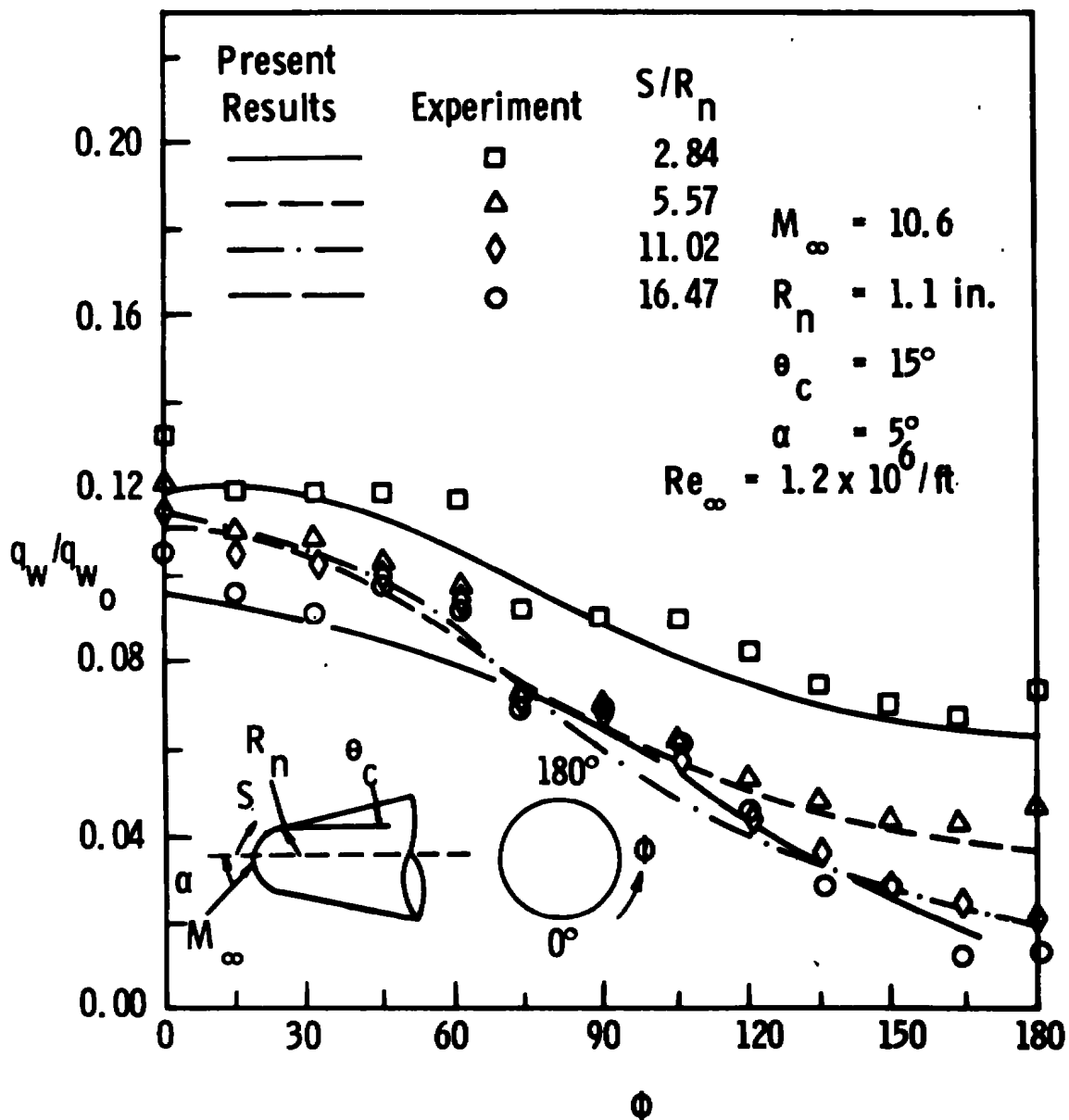


Figure 4. Wall Heat Transfer Rate over a Blunt Cone at Angle of Attack; Present Results versus Experiment of Cleary (Ref 40).

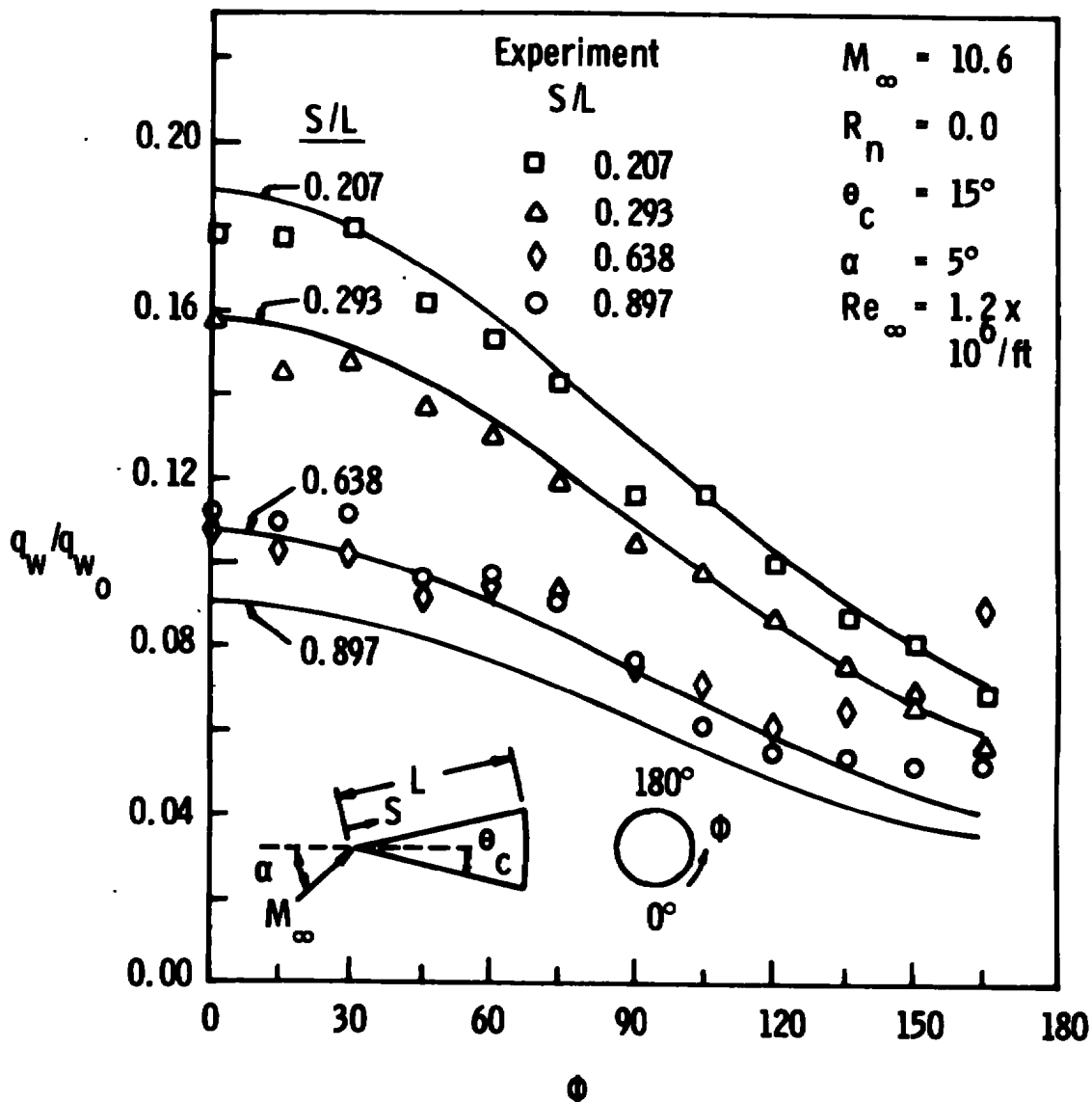


Figure 5. Wall Heat Transfer Rate over a Sharp Cone at Angle of Attack; Present Results versus Experiment of Cleary (Ref. 40).

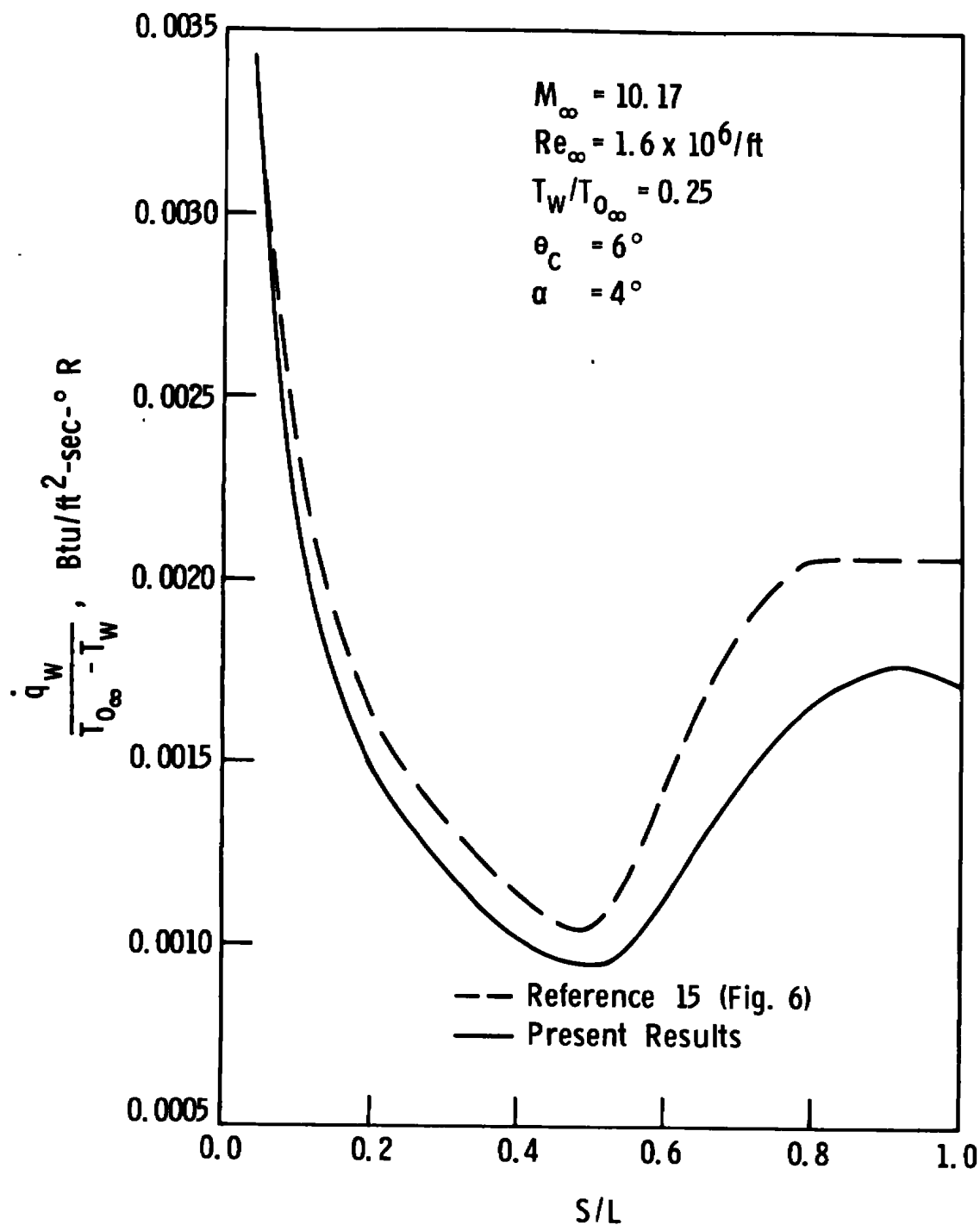


Figure 6. Boundary-Layer Parameters for Laminar and Turbulent Flows Over a Sharp Cone at Zero and Non-Zero Angles of Attack
 a) Heat Transfer Rate for a Cone at Angle of Attack

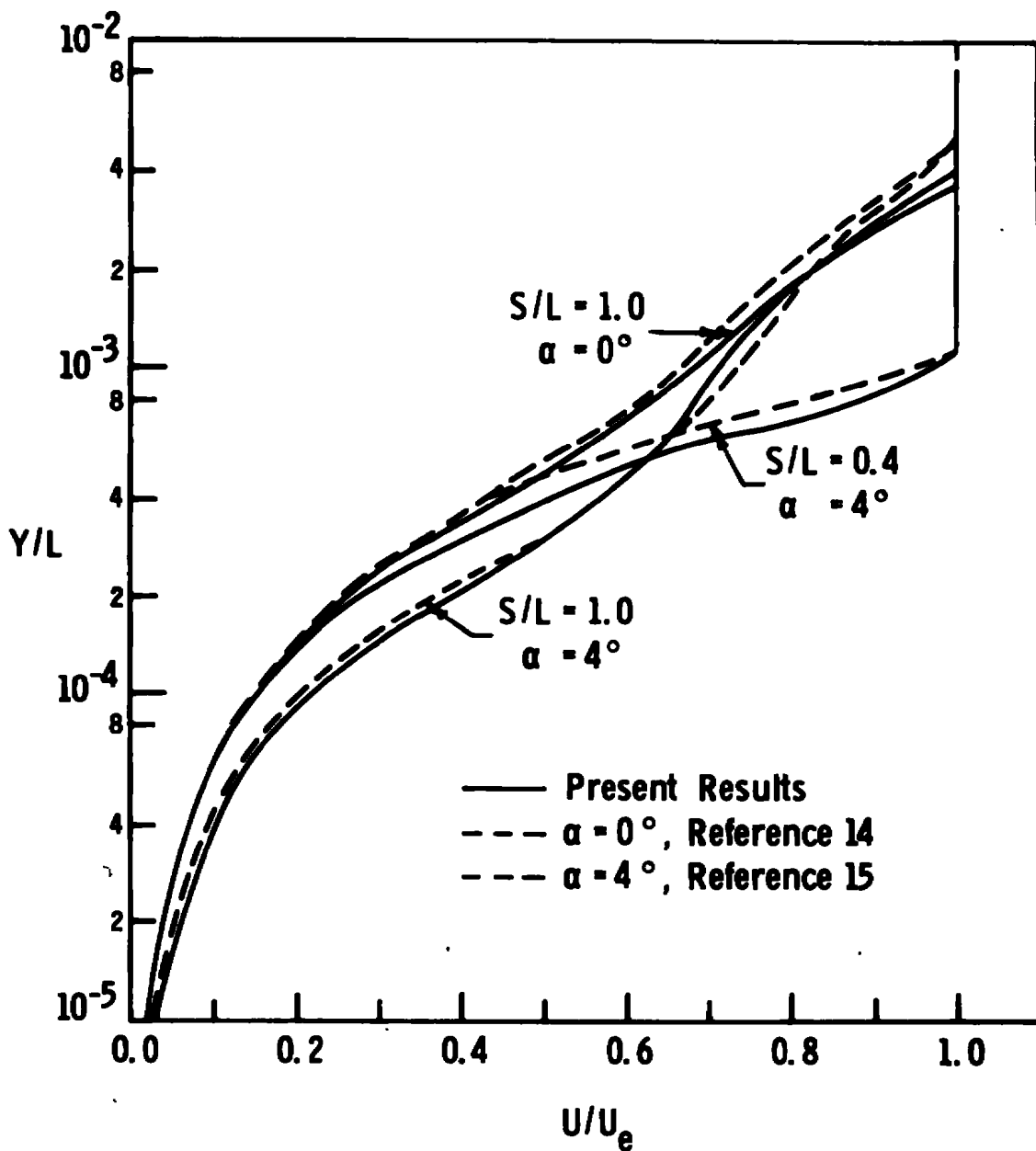


Figure 6. Cont'd.
 b) Longitudinal Velocity Profiles for Zero and Non-Zero Angles of Attack

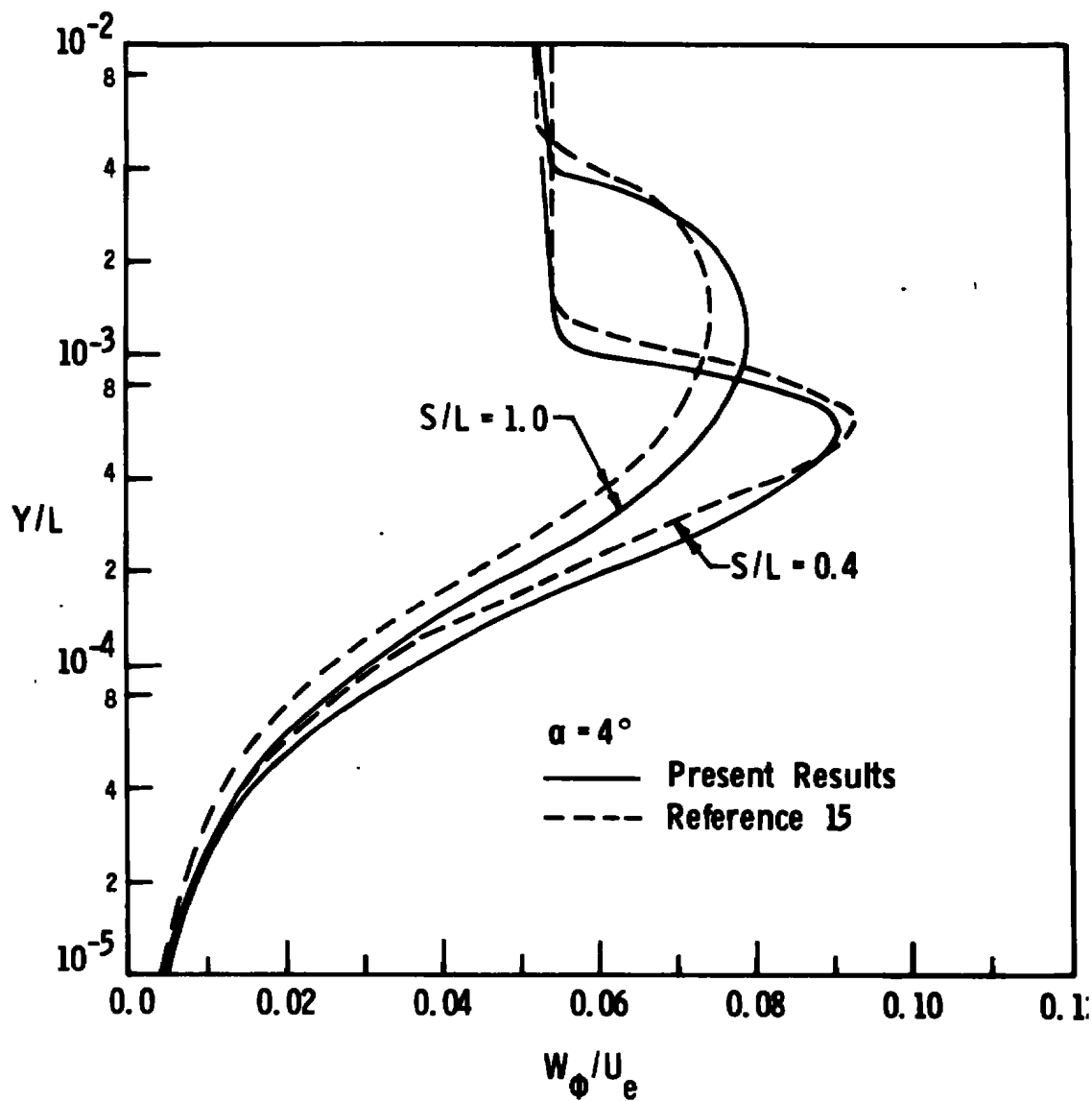


Figure 6. Cont'd.

c) Transverse Velocity Derivative Profile for Non-Zero Angle of Attack

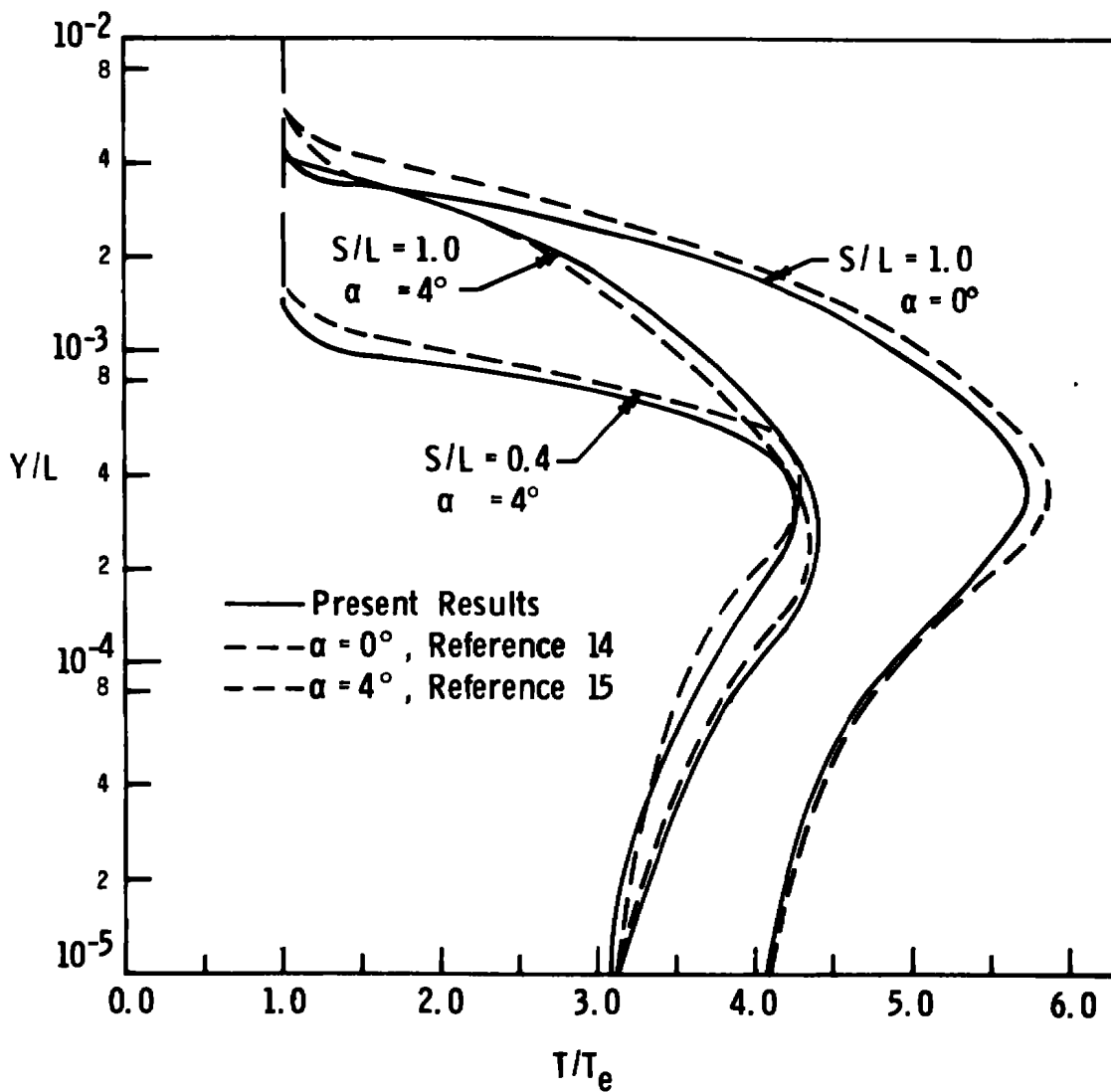


Figure 6. Concluded.

d) Temperature Profiles for Zero and Non-Zero Angles of Attack

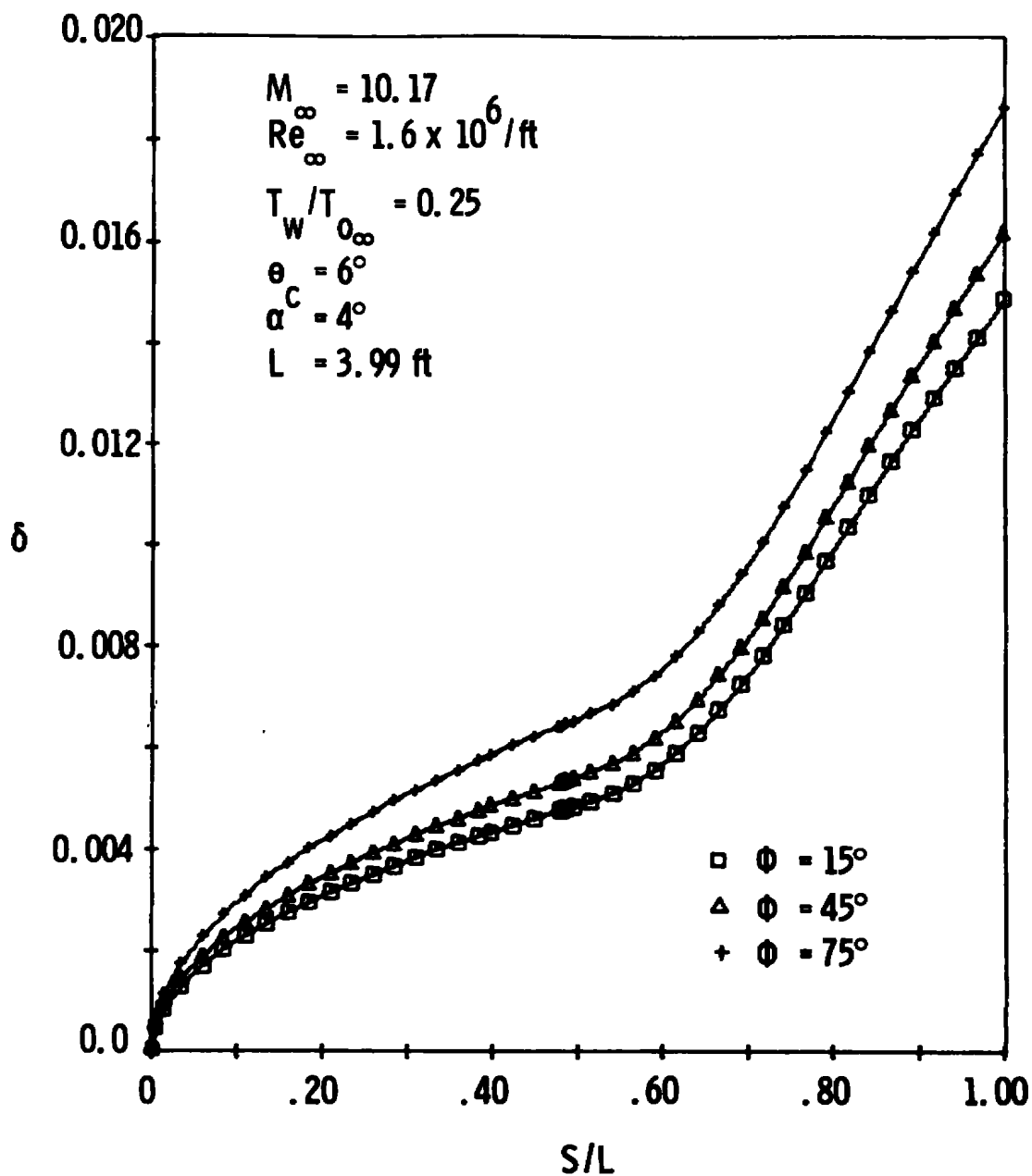


Figure 7. Three-Dimensional Solution of a Sharp Cone at Angle of Attack with Transition to Turbulence.
a) Boundary-Layer Thickness vs. S/L

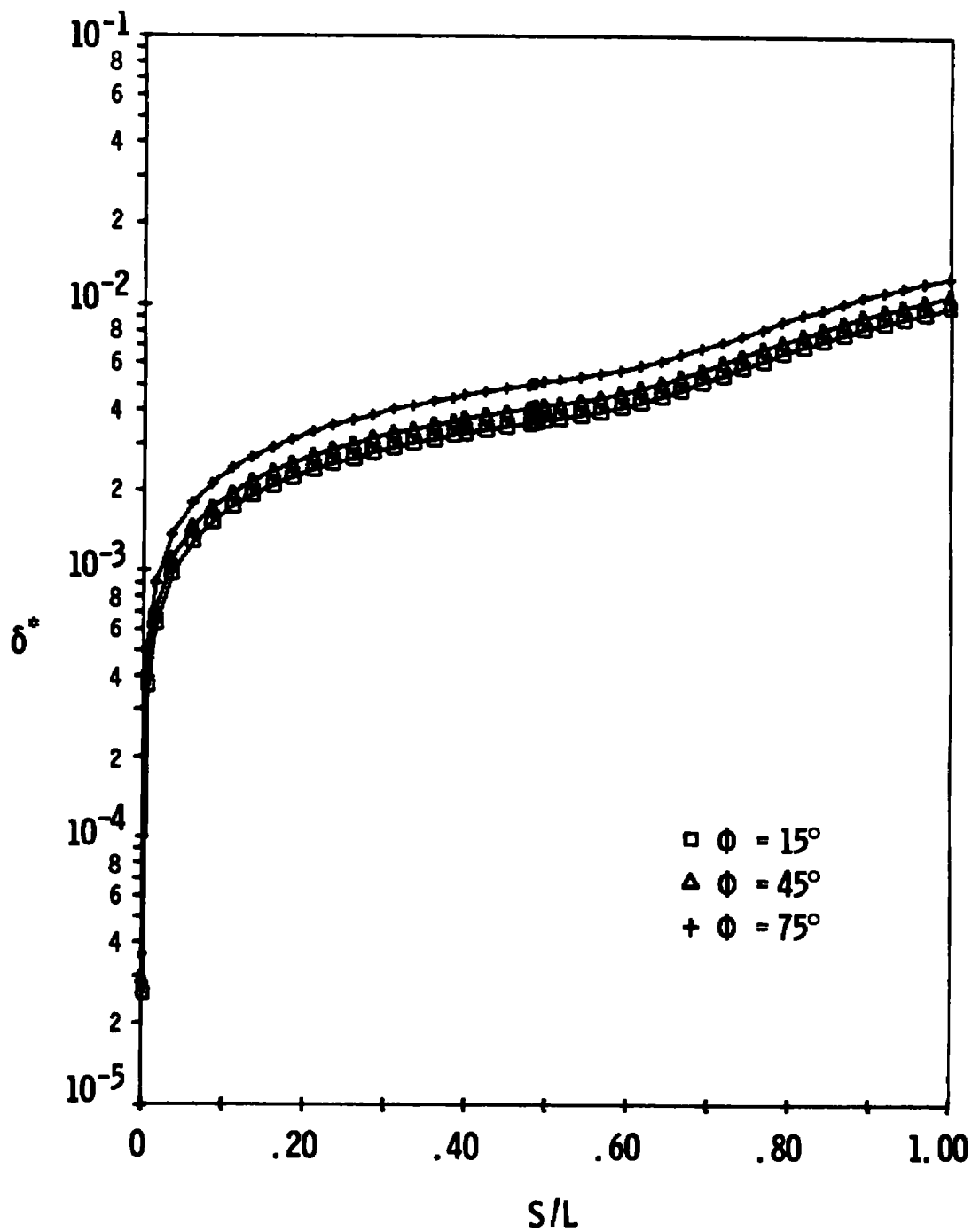


Figure 7. Cont'd.
b) Displacement Thickness vs. S/L

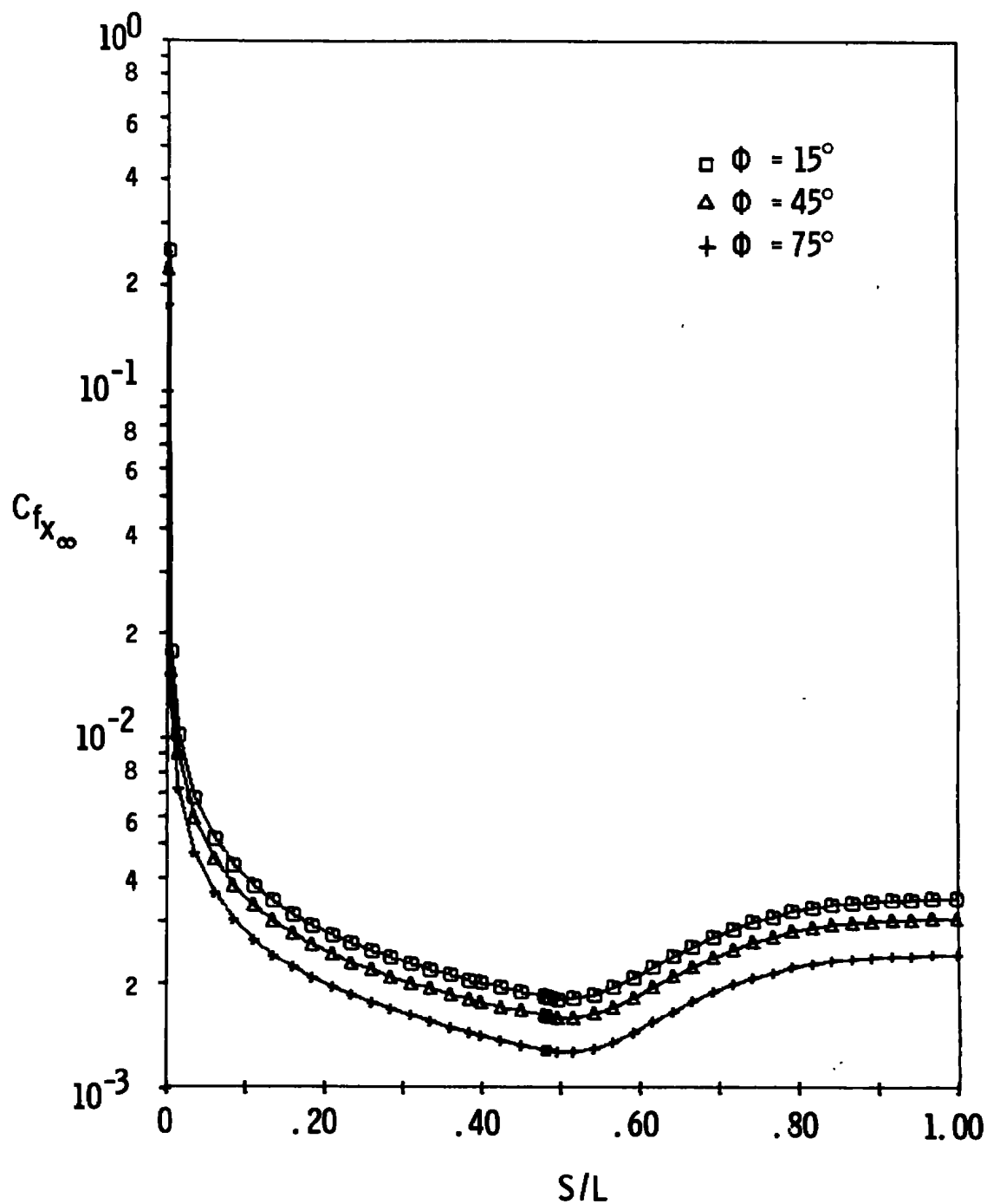


Figure 7. Cont'd.
c) Longitudinal Skin Friction Coefficient vs. S/L

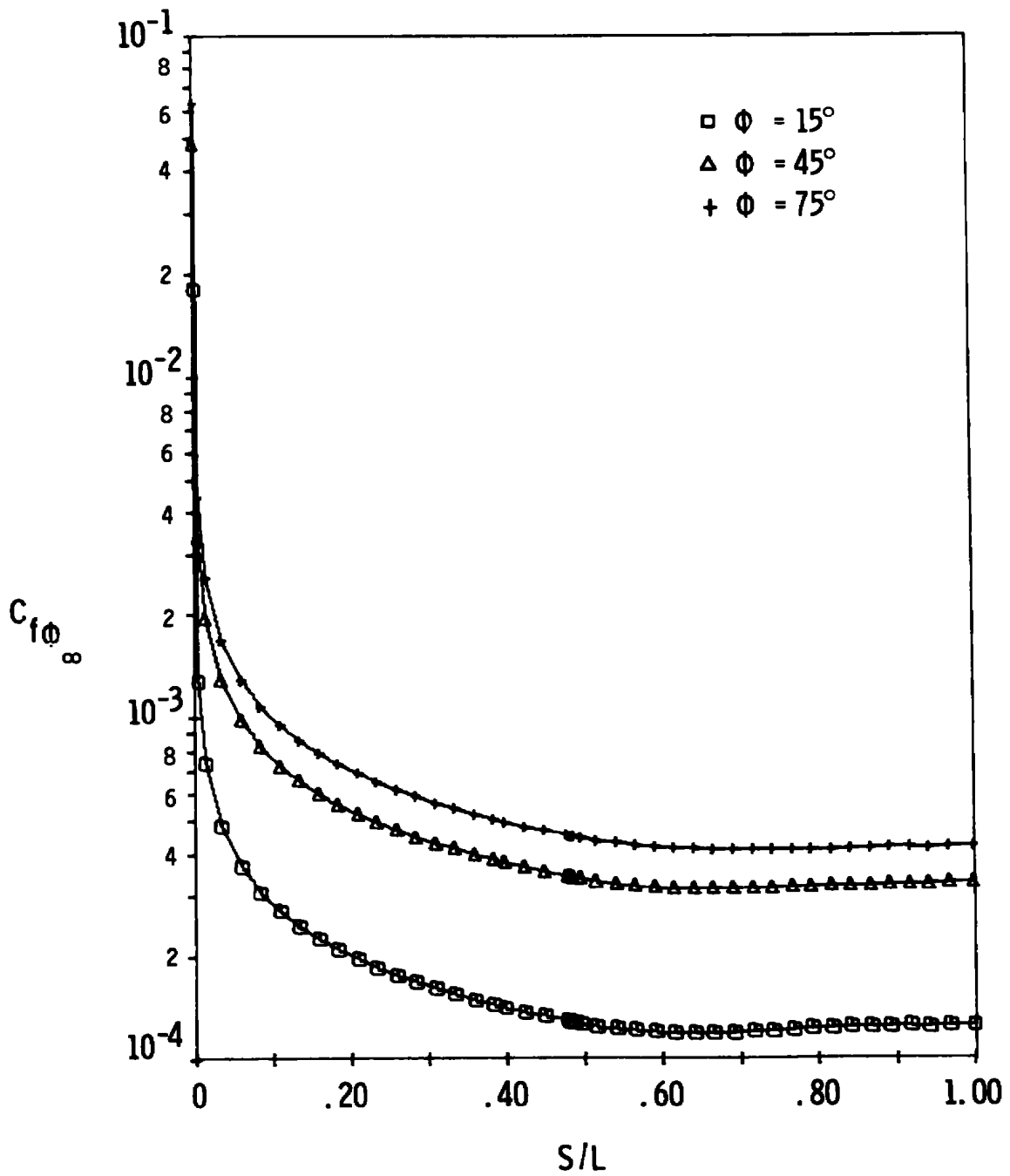


Figure 7. Cont'd.
d) Transverse Skin Friction Coefficient vs. S/L

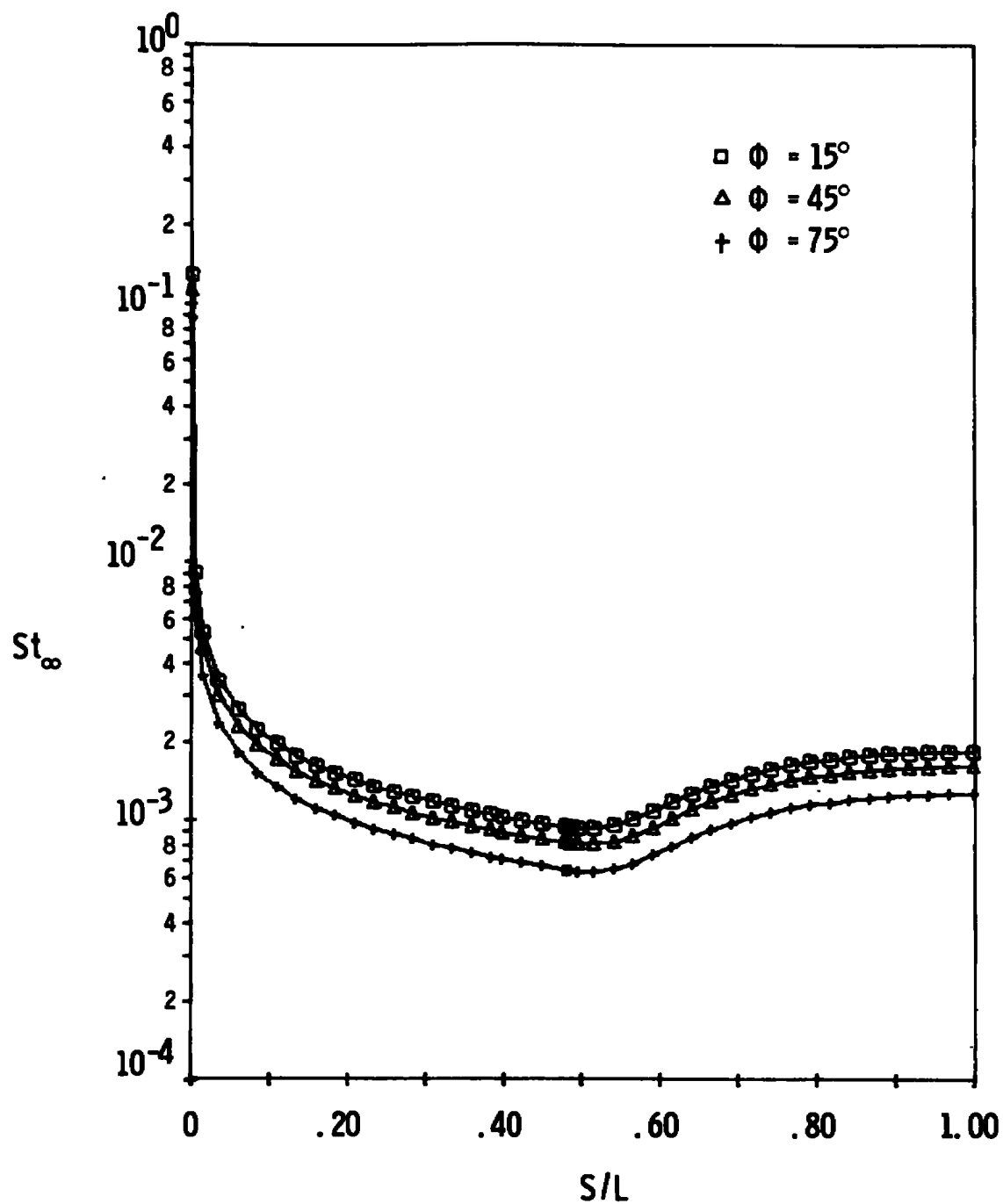


Figure 7. Cont'd.
e) Stanton Number vs. S/L

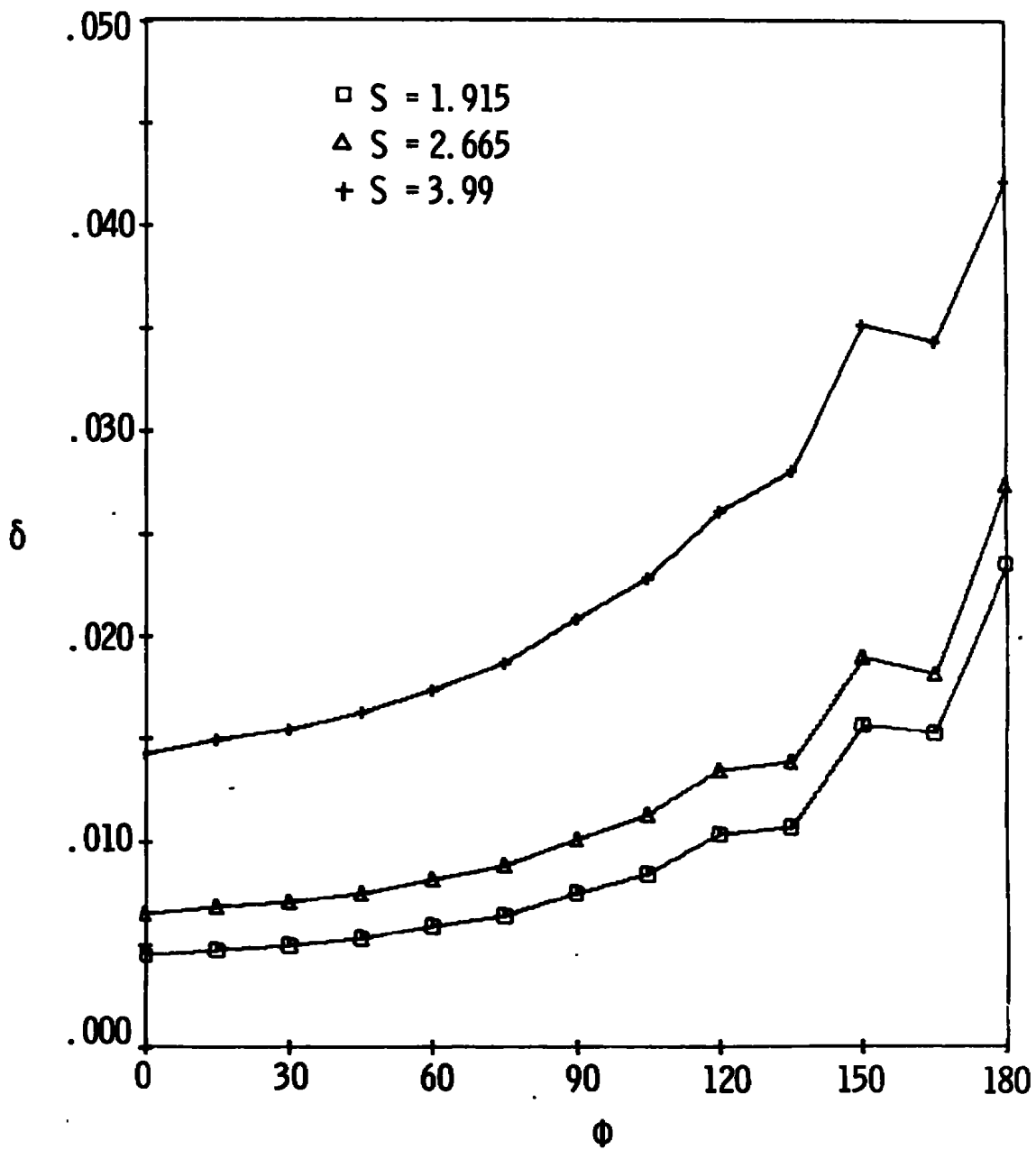


Figure 7. Cont'd.
f) Boundary-Layer Thickness vs. ϕ

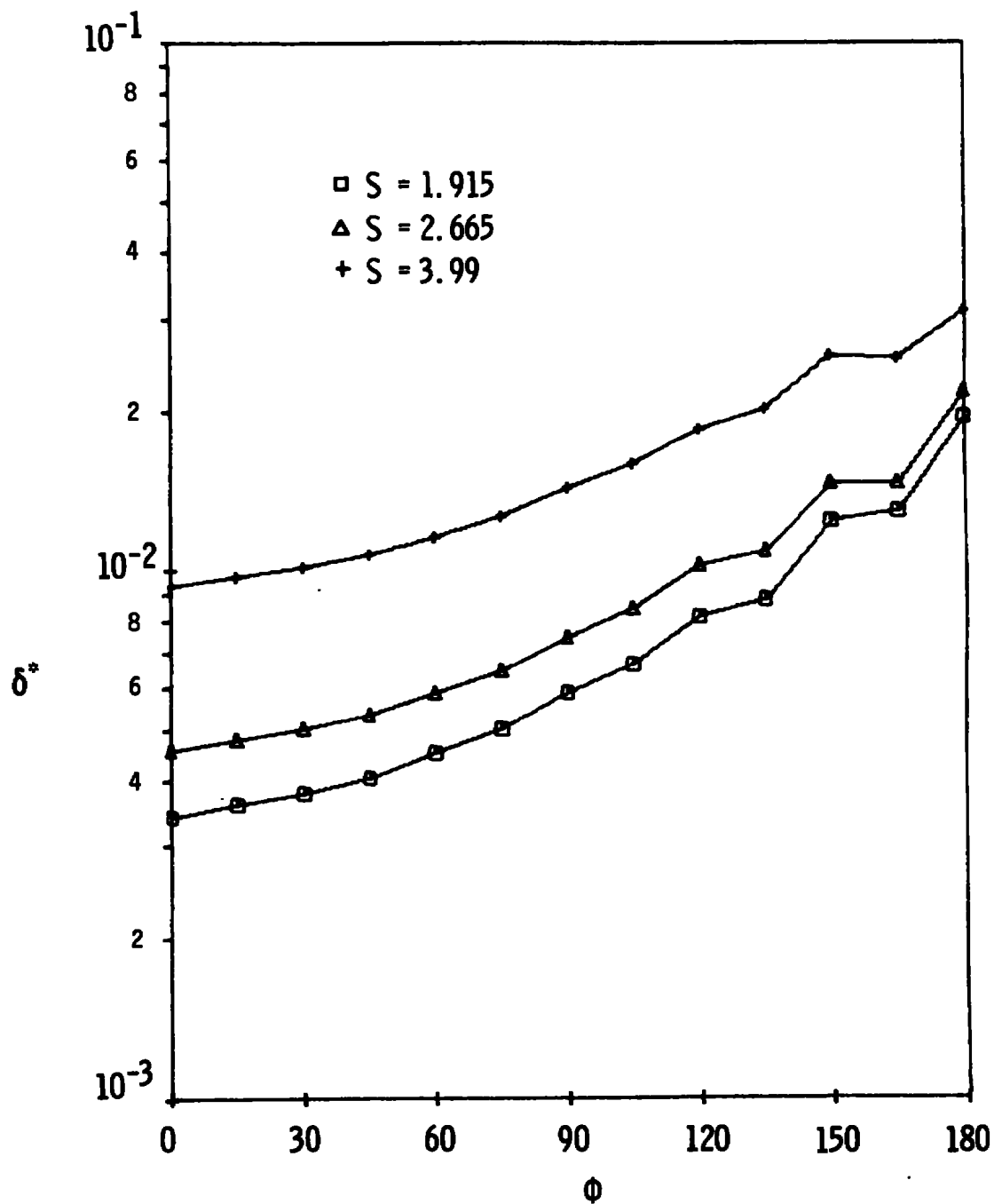


Figure 7. Cont'd.
g) Displacement Thickness vs. ϕ

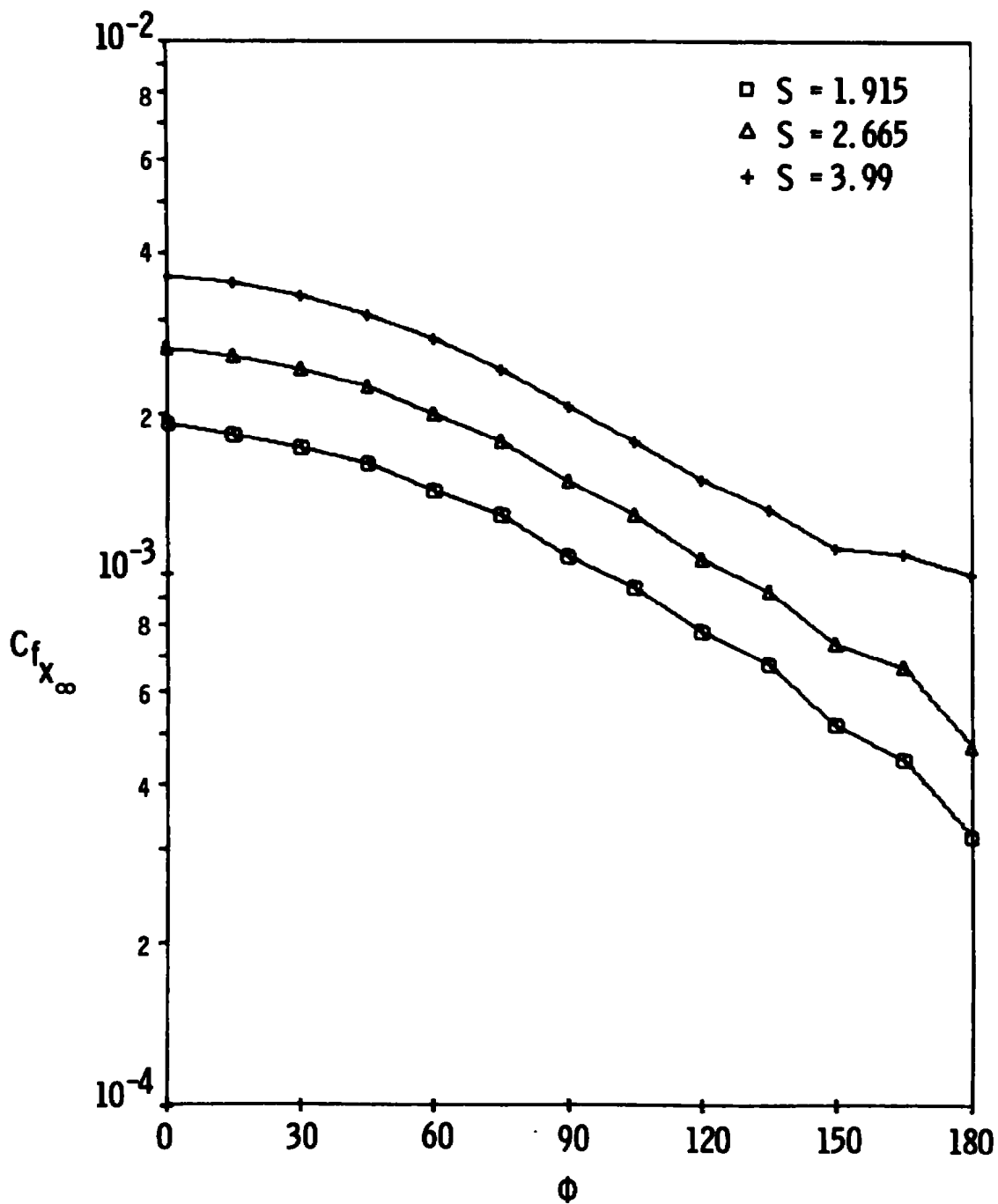


Figure 7. Cont'd.
h) Longitudinal Skin Friction Coefficient vs. ϕ

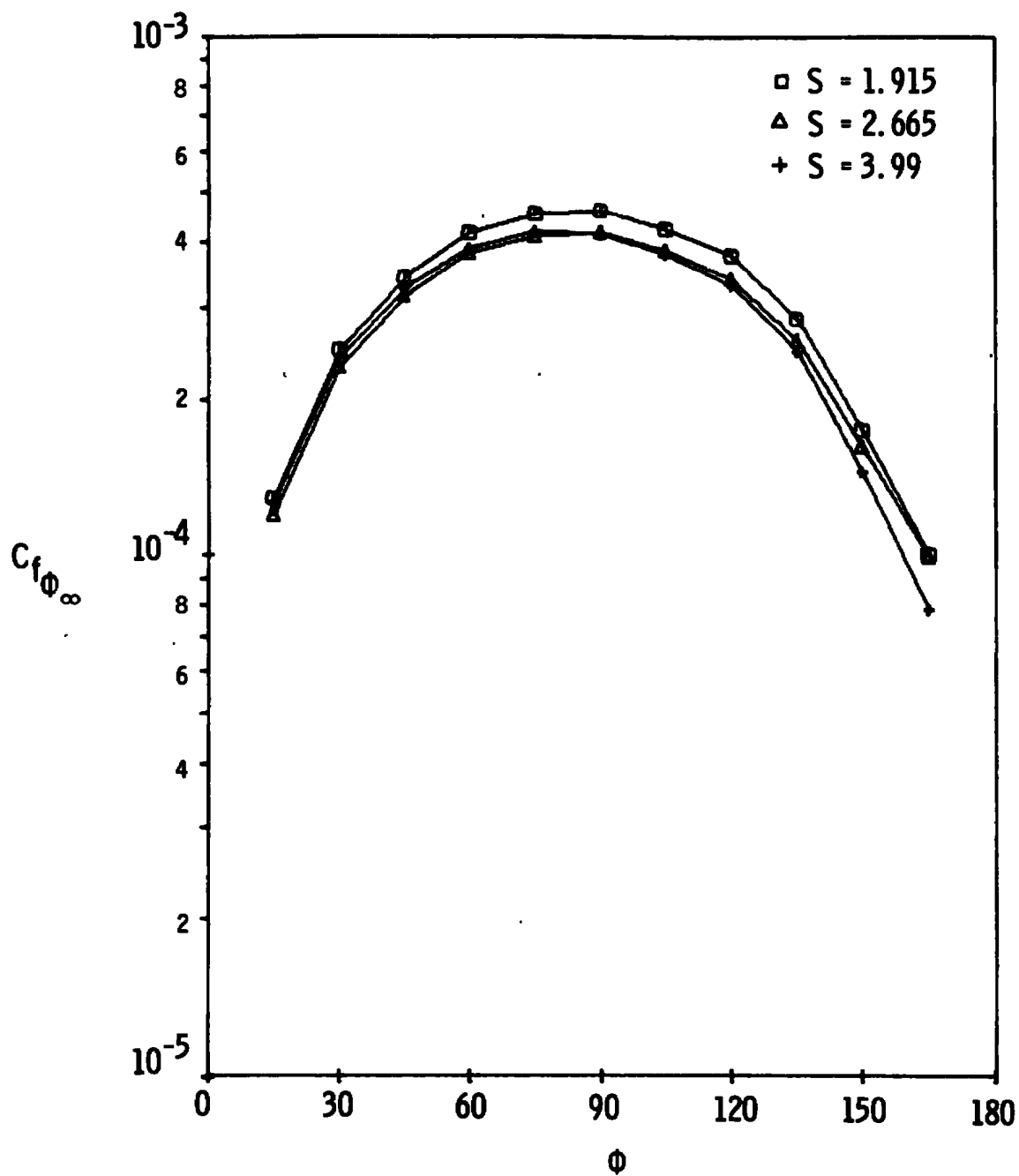


Figure 7. Cont'd.

1) Transverse Skin Friction Coefficient vs. ϕ

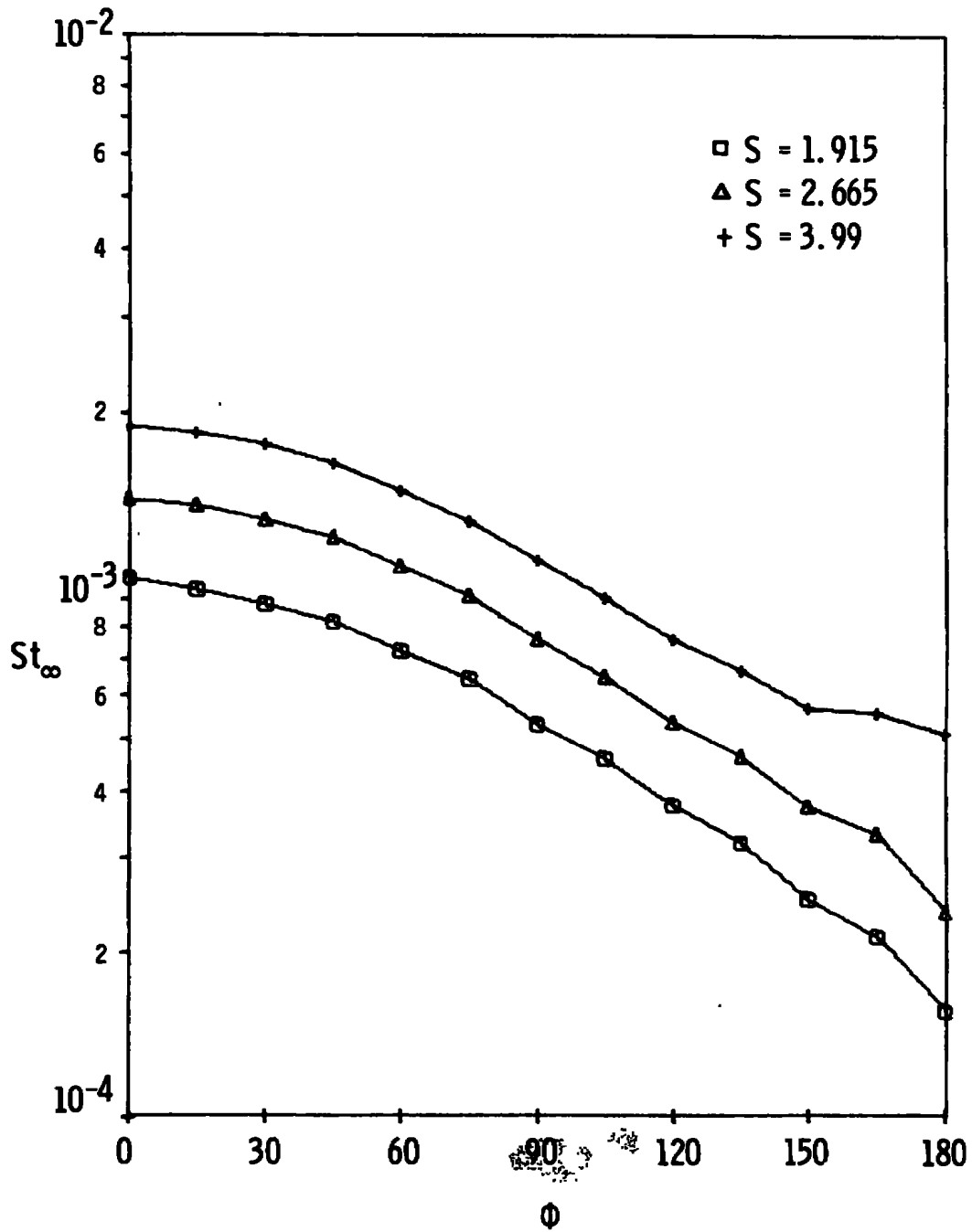


Figure 7. Cont'd.
j) Stanton Number vs. ϕ

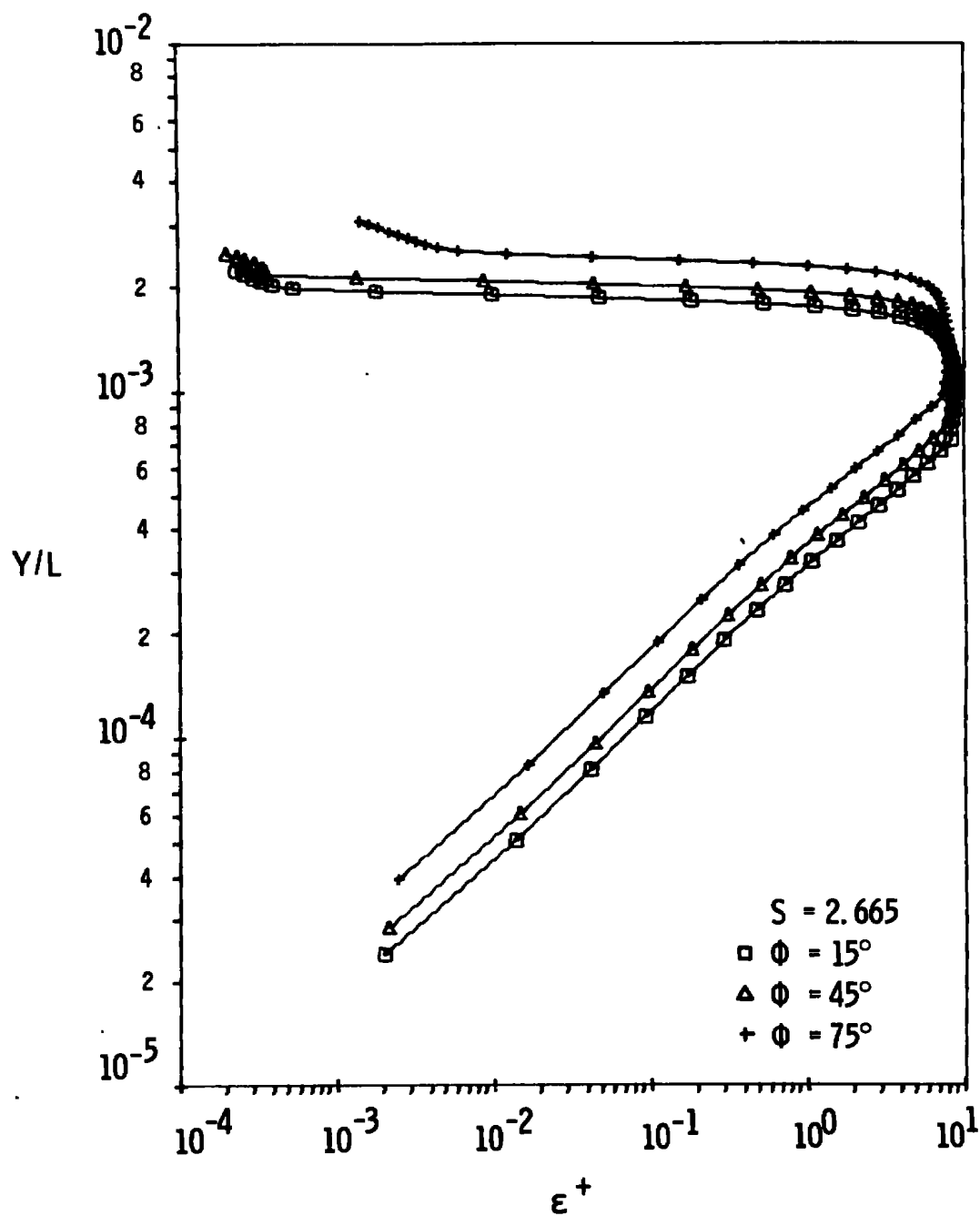


Figure 7. Cont'd.
k) Relative Eddy Viscosity vs. Y/L at Constant S .

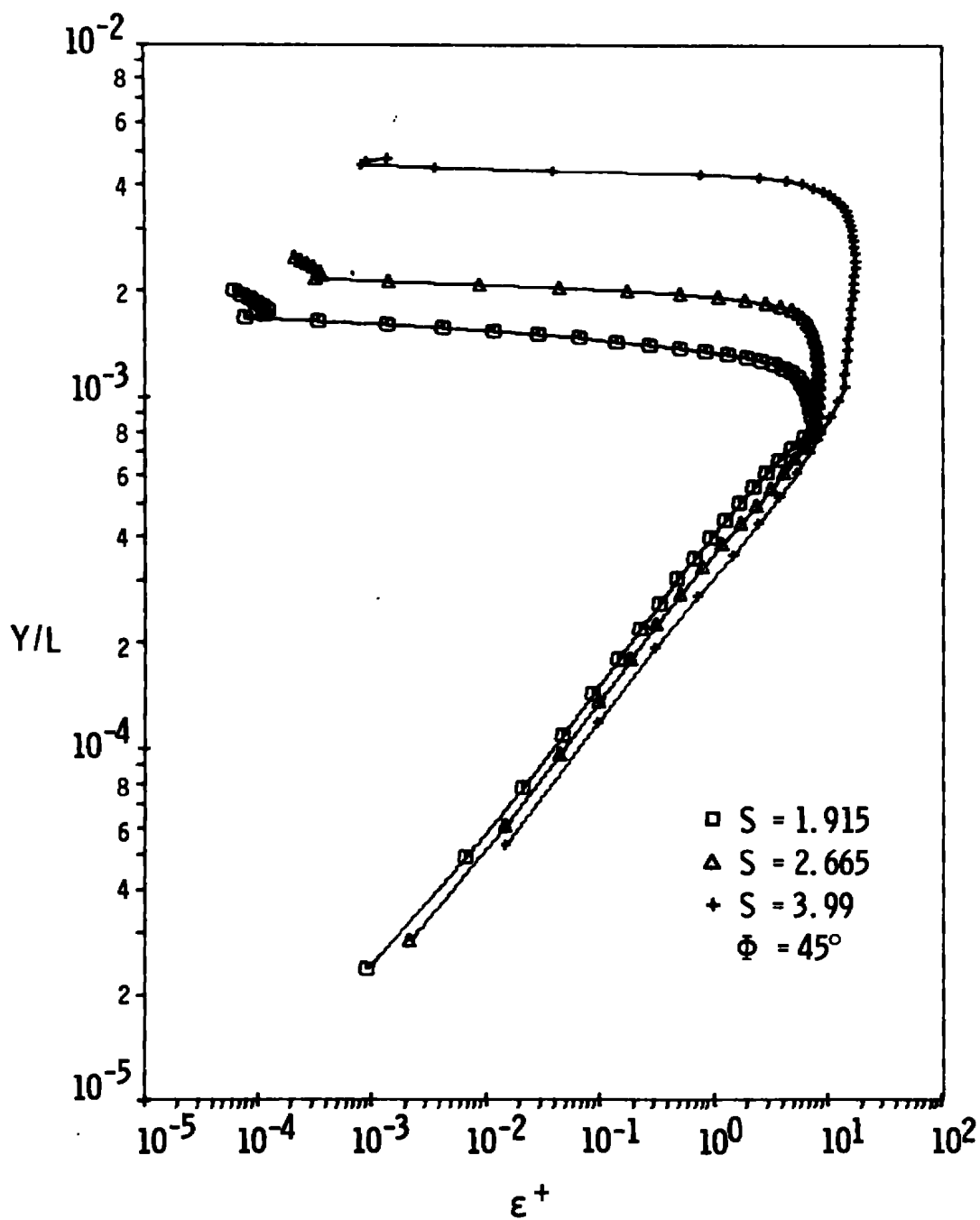


Figure 7. Concluded.
 1. Relative Eddy Viscosity vs. Y/L at Constant ϕ .

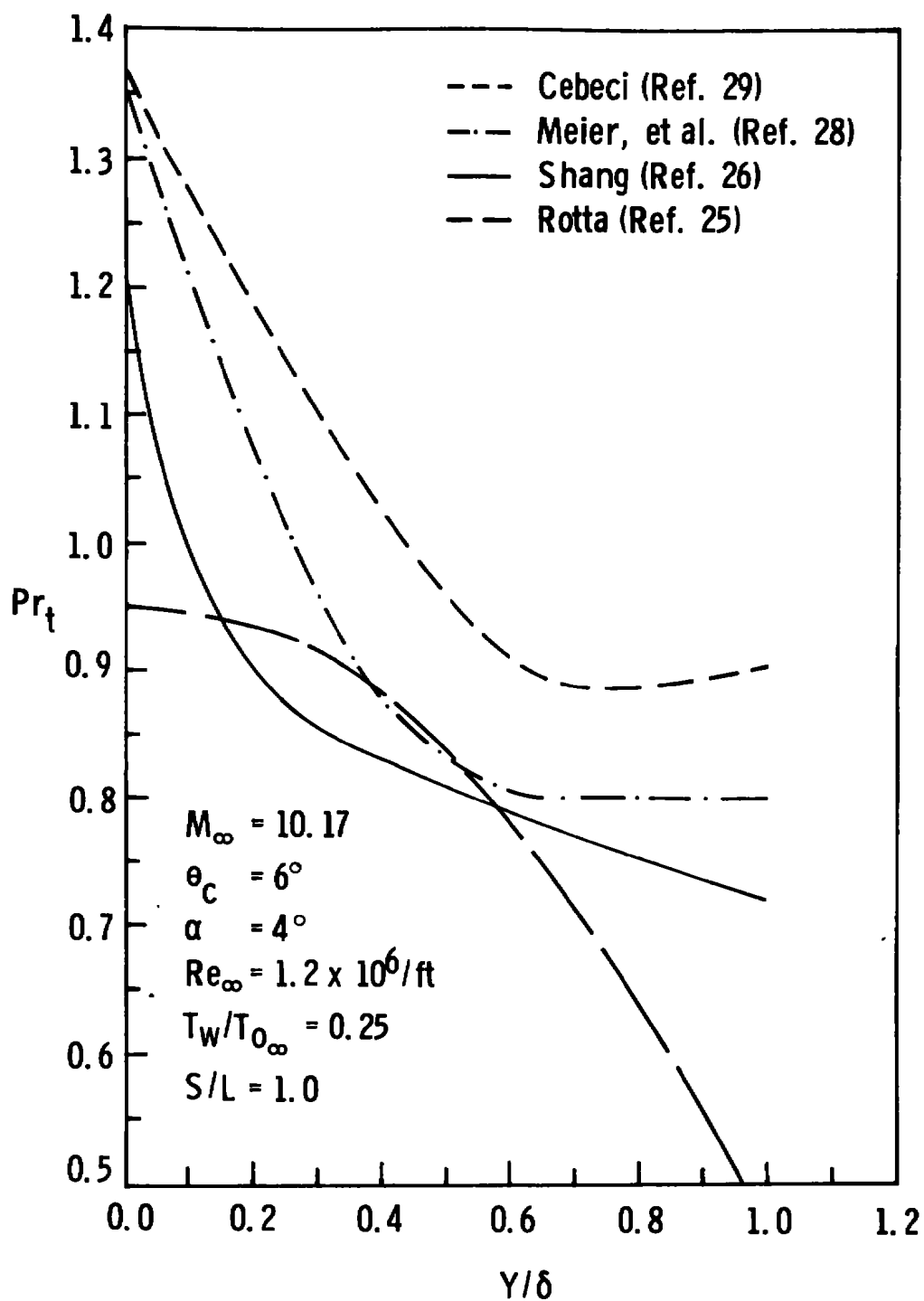


Figure 8. Comparison of Turbulent Prandtl Number Profiles from Laws Provided in the Program.

a) Pr_t Profiles for a Sharp Cone at Angle of Attack

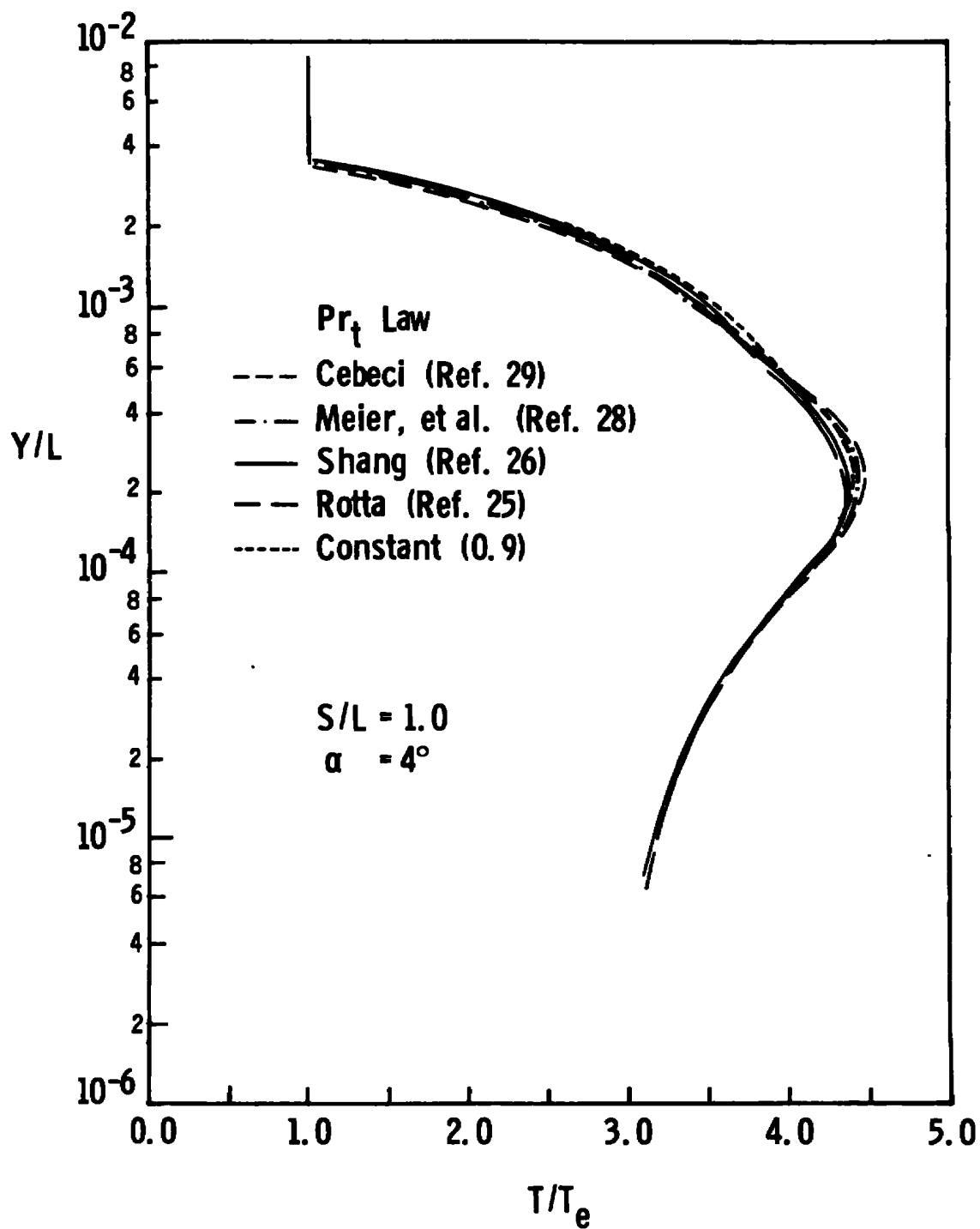


Figure 8. Concluded.
b) Corresponding Temperature Profiles

Table I
Polynomial Coefficients for the Specific Heat at
Constant Pressure for Air and Carbon Dioxide

Gas	Temperature Range °R	A	B	C	D	E	F
AIR	0 - 2,000	6.0351797 $\times 10^3$	-9.4509125 $\times 10^{-4}$	-7.3022675 $\times 10^{-4}$	1.73022675 $\times 10^{-6}$	-9.7657438 $\times 10^{-10}$	1.7465179 $\times 10^{-13}$
	2,000 - 12,600	5.9028 $\times 10^3$	3.77072 $\times 10^{-1}$	9.64649 $\times 10^{-5}$	-3.53769 $\times 10^{-8}$	3.48567 $\times 10^{-12}$	-1.11502 $\times 10^{-16}$
CO ₂	0 - 2,000	2.3317627 $\times 10^2$	7.3287082 $\times 10^1$	-1.342833 $\times 10^{-1}$	1.3090637 $\times 10^{-4}$	-6.0572879 $\times 10^{-8}$	1.0531063 $\times 10^{-11}$
	2,000 - 6,300	1.328997 $\times 10^4$	1.0499195 $\times 10^1$	-3.4760828 $\times 10^{-3}$	6.1489558 $\times 10^{-7}$	-5.568993 $\times 10^{-11}$	2.033227 $\times 10^{15}$

Table II
Polynomial Coefficients for the Viscosity of an Individual Specie

Gas	Temperature Range °R	A	B	C	D	E	F
Air	90 - 12,600	1.48066 $\times 10^{-1}$	6.95936 $\times 10^{-3}$	-1.49079 $\times 10^{-6}$	2.3759 $\times 10^{-10}$	-1.78242 $\times 10^{-14}$	5.0725 $\times 10^{-19}$
He	90 - 12,600	7.2044 $\times 10^{-1}$	7.06794 $\times 10^{-3}$	-1.5363 $\times 10^{-6}$	2.80513 $\times 10^{-10}$	-2.28363 $\times 10^{-14}$	6.74097 $\times 10^{-19}$
Ar	90 - 12,600.	2.63154 $\times 10^{-1}$	8.61381 $\times 10^{-3}$	-1.8422 $\times 10^{-6}$	3.16427 $\times 10^{-10}$	2.47897 $\times 10^{-14}$	7.10697 $\times 10^{-19}$
CO ₂	90 - 6,300	7.81932 $\times 10^{-2}$	6.77326 $\times 10^{-3}$	-1.72869 $\times 10^{-6}$	3.8700139 $\times 10^{-10}$	-5.13048 $\times 10^{-14}$	2.75916 $\times 10^{-18}$

Table III
Polynomial Coefficients for the Binary Diffusion Coefficients of Mixtures

Mixture	Temperature Range °R	A	B	C	D	E	F
He - Air	90 - 12,600	-1.98803 $\times 10^{-1}$	2.31693 $\times 10^{-3}$	2.60637 $\times 10^{-6}$	-4.7411 $\times 10^{-11}$	-1.00312 $\times 10^{-14}$	6.79428 $\times 10^{-19}$
Ar - Air	90 - 12,600	-6.39025 $\times 10^{-2}$	6.67803 $\times 10^{-4}$	1.26081 $\times 10^{-6}$	-1.02832 $\times 10^{-10}$	7.39182 $\times 10^{-15}$	-2.18881 $\times 10^{-19}$
CO ₂ - Air	90 - 6,300	1.30949 $\times 10^{-2}$	-5.62157 $\times 10^{-5}$	1.41785 $\times 10^{-6}$	-3.85557 $\times 10^{-10}$	6.84052 $\times 10^{-14}$	-4.74034 $\times 10^{-18}$

APPENDIX III DESCRIPTION OF COMPUTER PROGRAM

The computer program has been developed to solve a large class of boundary-layer flows. The geometries included in the program are those of a sharp and a spherically blunted cone. For these two geometries the program has full three-dimensional solution capabilities for cases where these cones are at an angle of attack. When either cone is in an axisymmetric flow field (zero angle of attack) the program will solve only the windward streamline of the vehicle.

Solution of each problem by the program employs the use of the iterative tridiagonal matrix method which has been used very successfully by Blottner and Ellis (Ref. 18), Adams (Ref. 15), McGowan and Davis (Ref. 4), and by Anderson and Lewis (Ref. 8). In this method the sets of ordinary differential equations or parabolic partial differential equations are reduced to a linear finite difference form for numerical solution. Subroutines are used to define the coefficients of each equation being solved. To solve a new problem the program only needs to define these coefficients and the boundary conditions, and plug them into the standard solution procedure.

Flexibility has been provided for in the numerical procedure by allowing the user to choose either a fully implicit Krause scheme or a Crank-Nicolson scheme. The Crank-Nicolson scheme is unstable in regions of reverse crossflow, but it does not require information downstream in the cross flow direction. The fully implicit Krause scheme is stable everywhere. The numerical solution procedure is split into four parts: 1) stagnation point solution, 2) windward streamline solution, 3) stagnation line solution, and 4) general solution. The details of each solution are described in the Analysis. The first three solutions are merely specialized cases of the general solution.

Subject to parameters set by the user the program is fully internally adjustable. If the user so specifies the transformed normal coordinate, η , can be automatically increased or decreased to meet a predetermined criteria for asymptoticity of the streamwise velocity profile. The streamwise step size is also fully adjustable based on the number of iterations needed for a converged solution at a previous station. The step size is either unchanged, halved, or doubled when the number of iterations is compared to counters input by the user. If for some reason the program cannot obtain a converged solution at a particular point, it will cut back the step size and try for a solution at a point upstream of the old point. If this procedure fails three consecutive times, execution of the program is terminated.

A flow chart of the program flow is provided in this appendix. It can be seen from the chart that the program is split into four basic parts: 1) input and initialization of data, 2) preparation of edge data, 3) solution of the boundary-layer equations, and 4) plotting the results. The largest part, of course, is the boundary-layer solution which marches

downstream and from the windward to leeward planes solving the governing boundary-layer equations. A separate flow chart of this procedure is also included in the appendix.

There is a special feature of the program for full three-dimensional solutions. If the program cannot obtain a converged solution at some point between the windward and leeward rays it will drop that point from solutions around the body at subsequent streamwise stations. This procedure allows the solution to proceed even after separation or other problems are encountered near the leeward plane of the body.

I. Program Input

Input to the program can be from two different sources: 1) cards or card image data and 2) data sets residing on tape or disk. Card or card image data is designed for easy use on CRT terminals or other telecommunications devices. Each card carries a single variable and bears its name and format. This feature makes it easy to FIND and CHANGE data by hand or by terminal. The user should note that some variables are used only in certain input cases. For instance, RNOSE is used only for blunt cones. A section of edge property data cards are used only when running a sharp cone at zero incidence.

The first card of each card deck is a title card for the case being run. Following variable RNOSE (for blunt cones), or XBAR (for sharp cones) is a section of cards which are read as array XSTA. At this point the user should specify the streamwise locations at which he wants the program to obtain a solution. This is the only method a user has to insure a solution at a particular point due to the internal adjustments the program can make automatically. The XSTA array is also used in specifying where circumferential plots will be drawn by the program. Of course, if a user desires to have plots drawn at a particular point then he must also have a solution there.

Following the input of the XSTA array are the input arrays for wall temperature and injection rate. Input is not required here if wall temperature and injection rate are constants. Each distribution can be read in versus its own table of surface locations in the event that the data are from different sources. However, if the distributions are versus identical tables, either table of surface locations may be left out. The program will automatically set both surface value table equal when either one is left out. A description and list of the input data cards is given in Appendix IV.

The second type of input to the program is in the form of data sets residing on tape or disk. These data sets have to do with edge properties, and they represent two stages of edge properties development. Unit 25 is a data set that is used only when running a particular problem for the first time. This unit holds edge data as it comes from the Black and Lewis (Ref. 36) inviscid program. When the boundary layer program is run the first time

unit 25 is read and subroutines DISKIN, WEDGE, and FORIER digest the data and write the data in its correct form on unit 10 for use by the boundary-layer solution. Subsequent solutions of the same cone in the same inviscid flow field would therefore need only use unit 10 and bypass the extra step needed for a first run. This procedure is identical to the one used by Frieders and Lewis (Ref. 7). A detailed description of the subroutines involved can also be found in Volume II of their report.

The only exception to the edge properties input procedure described above is the case of a sharp cone at zero incidence. In this case the conical flow edge properties are read in on cards along with the normal card input.

II. Program Output

The output of the boundary-layer program is in the form of printed output and machine plots. The printed output contains edge data, surface properties and normal profiles for each solution point. The user can specify output control variables which will automatically control the printing of the output such as printing only every second or third station, or plane that is solved. These variables are described in Appendix IV.

Machine plots are produced at the discretion of the user and at his direction through the use of four integer input arrays which describe where plots are to be made. The plotter package in the program has been written so that it interfaces with a CALCOMP plotter using an IBM 370 system digital computer.

Four types of plots are available to the user by specifying the integer input arrays LPLOT, LPRFL, KPLOT, and KPRFL. The LPLOT array points to particular stations at which surface property plots are desired in the circumferential direction. The integer itself is used as the subscript of the XSTA array so that when $X = XSTA(LPLOT(I))$ the program plots properties such as skin friction versus circumferential angle, from the windward to leeward planes. Therefore through skillful manipulation of the XSTA and LPLOT arrays the user can obtain plots of the surface properties around the cone at up to four streamwise locations of his choice.

The KPLOT array is used similarly to obtain plots of surface properties in the streamwise direction at selected circumferential locations. When the internal counter, K, for circumferential solution planes is equal to $KPLOT(I)$ the program stores data for streamwise surface property plots, such as heat transfer versus X/L at $\phi = 90^\circ$.

The arrays LPRFL and KPRFL are used to obtain plots of normal profiles at selected locations. The program automatically stores the profiles wherever the lines of constant X and constant ϕ specified by LPLOT and KPLOT intersect. The integers of LPRFL and KPRFL become the subscripts of LPLOT and KPLOT, and therefore tell the plotter where profile plots are desired. For instance if $LPRFL(1) = 2$, then profile plots at $X = XSTA(LPLOT(2))$ are

drawn. The resulting plots would show such variables as velocity and temperature profiles at the chosen value of X and for the circumferential positions represented by the KPLLOT array. If 3 planes were chosen for plotting in the KPLLOT array, then at the given value of X the profile plots would show three curves, giving the profiles at each value of ϕ . In similar manner profiles can be compared in the streamwise direction at a constant ϕ by specifying in the KPRFL array the subscript of the KPLLOT array representing the desired ϕ location. The number of curves on each plot would equal the number of X locations chosen by the LPLLOT array.

In short the LPLLOT, KPLLOT, LPRFL, and KPRFL arrays allow the user to have: 1) streamwise plots of surface properties at a constant ϕ , 2) circumferential plots of surface properties at a constant X , 3) normal profiles versus ϕ for a constant value of X , and 4) normal profiles versus X for a constant value of ϕ . Additional information on these arrays is given in Appendix IV.

III. Eddy Viscosity Models

Two inner eddy viscosity models are at the disposal of the user. He may select the Van Driest (Ref. 38) inner law or the Reichardt (Ref. 39) inner law. Both the Reichardt and Van Driest inner laws are corrected for mass transfer. The Reichardt law is recommended for low mass transfer problems only. Higher mass transfer rates are more accurately handled by the corrected Van Driest law. The Reichardt law is more desirable for no mass transfer problems due to the decreased computing time necessary.

The outer eddy viscosity law follows the development of Patankar and Spalding (Ref. 21). The outer law is damped with Klebanoff's (Ref. 23) intermittency factor.

All three eddy viscosity laws have been extended to the three-dimensional case as described in the Analysis.

IV. Transition Models

Two transition models have been provided for in the program. One is an instantaneous model yielding 100% turbulence at the onset of "transition." The other model has been developed from an equation by Dhawan and Narasimha (Ref. 25) and allows a smooth transition from laminar to turbulent flow over a distance specified by the user. This model results in an intermittency factor used as a multiplier on the eddy viscosity. The intermittency factor is a function of empirical constants and streamwise location relative to transition onset distance. No accounting of intermittency factor variation normal to the wall is made in the program.

V. Turbulent Prandtl Number Models

There are 5 different turbulent Prandtl number models in the program. One model gives a constant Prandtl number of 0.9. Each of the other models yields a variable Prandtl number profile normal to the body and each is

described in the Analysis section of this report. The four models have been developed by Cebeci, Rotta, Shang, and Meier.

VI. Mass Transfer Options

The computer program is capable of mass transfer beginning at any point specified by the user. The injected gas and the injection rate are specified by the user. The gases available for injection in the program are air, helium, carbon dioxide, and argon. The program computes the mixture properties, and calculates the thermodynamic and transport properties at each solution point in the mass transfer region.

VII. Other Notes on the Program

Generous use of comment cards has been made in the development of the program. Comment cards are found at most major transfers of control. Common blocks have been named so that the name indicates the function of the variables stored in them. The same is true of subroutine names; for instance, wall boundary conditions are calculated in WALL, the species equation boundary equation is calculated in SPECBC, etc.

The program has been written using an IBM 370/158 digital computer. The organization of the program is such that MAIN serves as a root segment for an overlay structure. The major parts of the program thus become overlay segments, sharply reducing the required core in the machine. Using the plot package in the program alone adds about 44 K of buffers to the core requirements. Appendix VI lists the JCL for running the program on an IBM 370 system. Included in the Appendix are the linkage editor control cards which specify the overlay structure.

The program as listed in Appendix VIII is in double precision for use on an IBM computer. A single precision version would probably be adequate on CDC machines.

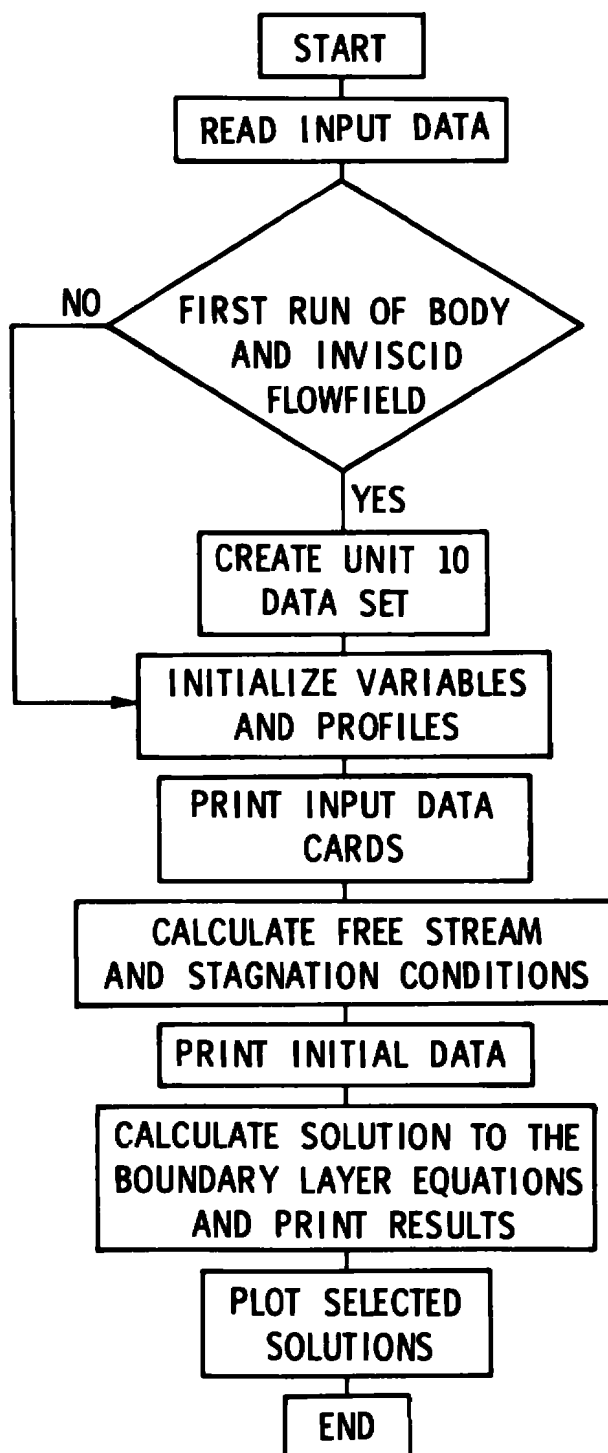


Figure 1. Simplified Flow of Control in the Boundary-Layer Program.

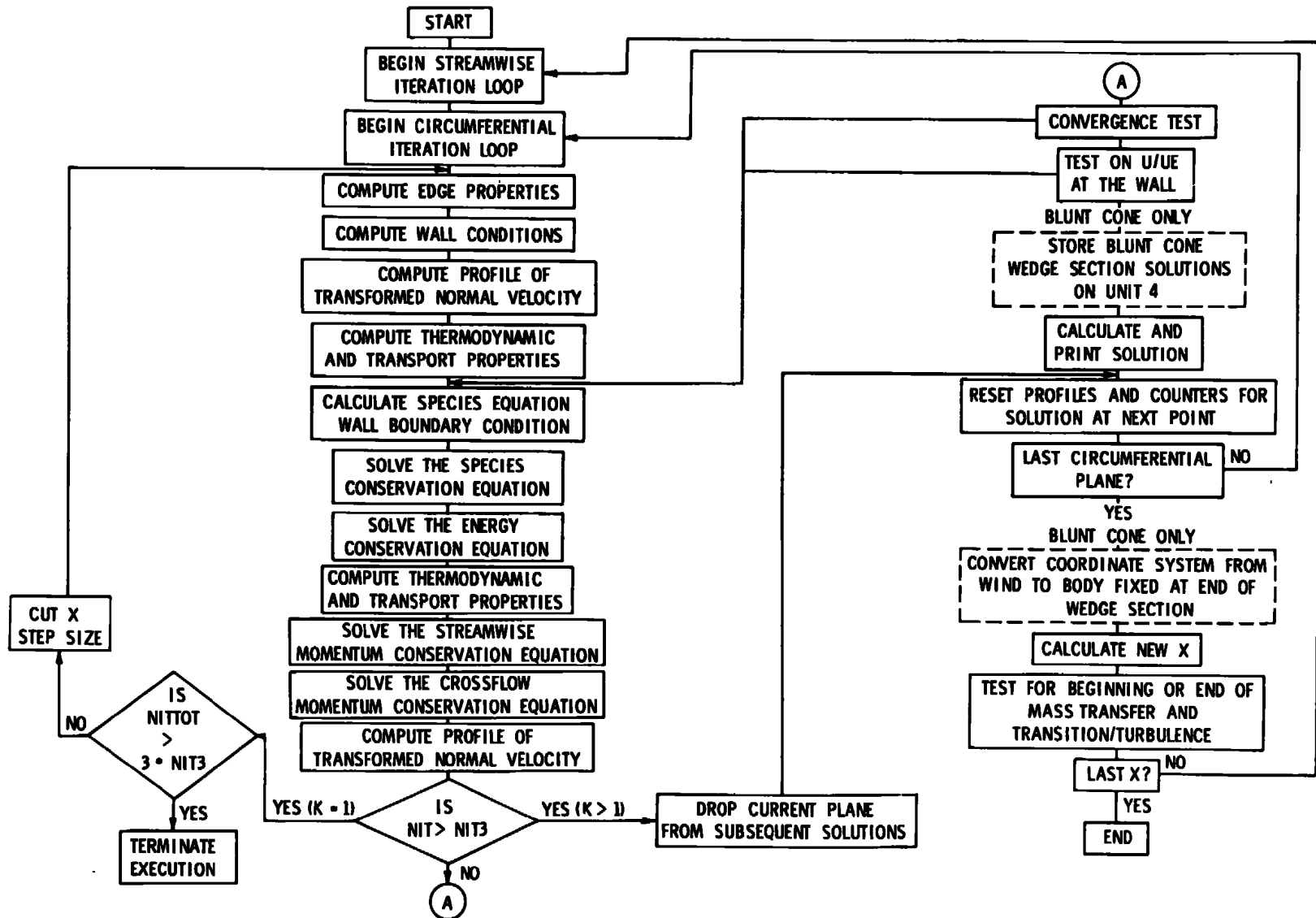


Figure 2. Boundary Layer Solution Procedure.

APPENDIX IV DESCRIPTION OF INPUT DATA

In this description of the input data the number of the card is first, followed by the variable name and the format. Formats may change from card to card; however, all variables are coded starting in column 50. All input data cards are printed automatically by the program so that there will be no question as to the data read in by a particular run.

Following the card number, variable name, and format is a description of the variable, which may include recommended values. Any restrictions on input variables is also noted where necessary.

Three lists of input data cards are also supplied in this appendix for the three different input cases. These cases are: 1) sharp cone at zero angle of attack, 2) sharp cone at angle of attack, and 3) blunt cone.

Card 1. LABEL (20A4)

LABEL is the title of the case and is a single subscripted array. The LABEL is passed to the plotting routines and appears on all machine drawn plots produced by the program.

Card 2. IE (49X,I3)

IE is a number of points taken normal to the body. The program is dimensioned for a maximum of 101 points in the normal profile arrays. 101 is the recommended value; however, savings in execution time can be had for long jobs by decreasing IE to 51 or lower. IE should be an odd number.

Card 3. INJCT (49X,I3)

INJCT is the subscript of the XSTA array giving the surface location at which injection begins. When $X > XSTA(INJCT)$, the internal counter MASTRN is changed from 0 to 1 thereby activating the parts of the program which handle mass transfer. A zero value is reset to NSOLVE.

Card 4. KADETA (49X,I3)

KADETA is an indicator for the adjustment of the transformed normal coordinate η . If KADETA is 0 then the maximum η is held constant. If KADETA is 1 then the maximum η is adjusted when the velocity profile fails to converge at the proper rate at the outer edge as prescribed by the variable ADTEST. The value of η_{max} can be adjusted up or down for windward streamline problems. For full three-dimensional problems η_{max} is only adjusted up, and it can be adjusted at every point. A value of 1 is recommended.

Card 5. KEND2 (49X,I3)

KEND2 specifies the number of circumferential planes to be used in the solution, and thereby also sets the circumferential step size. The program has been coded to accept a maximum of 61 solution planes; however, 61 planes require excessive computing time. Thirteen planes are adequate for most cases being solved. The user should exercise care in choosing this number since the program will drop planes near the leeward streamline. Definition or resolution in the total solution can be lost if the nearest plane is say 30 degrees to the windward when a leeside plane is dropped.

Card 6. KONSET (49X,I3)

KONSET is the subscript of the XSTA array giving the location of the onset of transition. At $X = XSTA(KONSET)$ the variable LAMTRB is reset to 2 and transition to turbulence begins. A zero value is reset to NSOLVE.

Card 7. KPRT (49X,I3)

KPRT is a print control parameter which controls the printing of profiles in the ϕ direction. If set to 1 the program will print profiles at every step in ϕ . If set to 3 the program will print every 3 steps in ϕ , etc. A value of 3 is recommended.

Card 8. KTRANS (49X,I3)

KTRANS is an indicator for the transition model. If KTRANS is set to 0 transition to turbulence will be instantaneous. If set to 1 a smooth transition to turbulence will take place over a distance determined by variable XBAR.

Card 9. LAMTRB (49X,I3)

LAMTRB indicates whether the flow is laminar or turbulent. LAMTRB set to 1 indicates the problem begins with laminar flow. LAMTRB must be set to 2 for fully turbulent flow. A LAMTRB of 1 is reset to 2 at transition onset.

Card 10. LPRT (49X,I3)

LPRT is the print control parameter in the streamwise direction. If set to 1 the program will print solutions at every step in X. If set to 3 the program will print every third step in X, etc.

Card 11. NIT1 (49X,I3)

NIT1 is an iteration counter used to adjust the streamwise step size. If the total number of iterations required to obtain the solution at a point is less than or equal to NIT1 the X step size is doubled.
i.e. $DX = 2*DX$ when $NIT \leq NIT1$.

Card 12. NIT2 (49X,I3)

NIT2 is an iteration counter used to adjust the streamwise step size. If the total number of iterations required to obtain the solution at a point is greater than NIT1 and less than NIT2 the X step size is unchanged. i.e. $DX = DX$ when $NIT1 < NIT < NIT2$.

Card 13. NIT3 (49X,I3)

NIT3 is an iteration counter affecting X step size and convergence of the solution. If the total number of iterations required for a solution at a particular point is greater than NIT3 the program halves the X step size and cuts back the value of X by the new step size. A solution at the smaller value of X is then tried for. If this procedure fails three consecutive times execution is terminated. i.e. $X = X - DX/2$ when $NIT > NIT3$.

NOTE: The X step size is adjusted only at the windward plane.

Card 14. NOINJ (49X,I3)

NOINJ is the subscript of the XSTA giving the surface location at which injection ends. At $X = XSTA(NOINJ)$ the counter MASTRN is reset to 0 ending all mass transfer. A value of 0 is reset to NSOLVE.

Card 15. NOSE (49X,A5)

NOSE is a literal variable coded as either SHARP or BLUNT to indicate either a blunt or sharp vehicle. The program will handle only spherically blunted cones.

Card 16. NSOLVE (49X,I3)

NSOLVE is the number of variables in the XSTA array, and is therefore the subscript of the last XSTA value which indicates the end of the body. It is also the default value for INJCT, NOINJ, and KONSET.

Card 17. KPLOT(I), I = 1,4 (49X,4I3)

KPLOT is a plotter control array which indicates up to four circumferential planes at which plots of surface properties such as heat transfer and skin friction are made versus the normalized surface distance X/L or X/R_n . Leading zeros are not allowed; however, the integer values of KPLOT may be entered in any order. Trailing zeros are allowed. i.e. $KPLOT = 1, 5, 7, 0$ will yield surface plots versus X at planes 1, 5, and 7, where the highest plane number is less than or equal to KEND2. No plots will result from $KPLOT = 0, 1, 5, 7$.

Card 18. KPRFL(I), I = 1,4 (49X,4I3)

KPRFL is a plotter control array which indicates the values of KPLOT chosen for the plotting of normal profiles versus X . KPRFL is the subscript of KPLOT in this case. Profiles are generated only at the intersection of constant ϕ lines and constant X lines specified by KPLOT and LPLLOT. Each plot produced by KPRFL can have up to four curves representing profiles at four different X values, all at a constant ϕ . The same rules apply here as above.

i.e. if KPRFL = 1, 2, 0, 0 and KPLOT is as above, the profile plots versus X will be produced at planes 1 and 5.

Card 19. LPLLOT(I), I=1,4 (49X,4I3)

LPLLOT is a plotter control array which indicates up to four streamwise stations at which plots of surface properties such as heat transfer and skin friction are made versus ϕ . The same coding rules apply as on card 17.

i.e. if LPLLOT = 4, 6, 20, 0 plots of surface properties versus ϕ will be generated at $X = XSTA(4)$, $XSTA(6)$, and $XSTA(20)$.

Card 20. LPRFL(I), I=1,4 (49X,4I3)

LPRFL is a plotter control array which indicates the values of LPLLOT chosen for the plotting of normal profiles versus ϕ . LPRFL is the subscript of LPLLOT in this case. Each plot produced by LPRFL can have up to four curves representing four different values of ϕ , all at a constant X . i.e. if LPRFL = 1, 2, 0, 0 and LPLLOT is as above, then profile plots versus ϕ will be produced at $X = XSTA(4)$ and $X = XSTA(6)$.

Card 21. ADTEST (49X,E14.5)

ADTEST is used in conjunction with KADETA. When KADETA is 1 ADTEST provides the convergence criteria for checking the streamwise velocity profile. When $U/UE(IE) - U/UE(IE-4)$ is less than ADTEST/10 the maximum value of η is decreased by 10%. When it is greater than ADTEST the maximum value of η is increased by 10%.

Card 22. AKSTAR (49X,E14.6)

AKSTAR is a numerical constant in the Van Driest inner eddy viscosity law (k^* in the Analysis). The recommended value is 0.435.

Card 23. ALAMDA (49X,E14.6)

ALAMDA is a numerical constant in the outer eddy viscosity law used in the program (λ in the Analysis). The recommended value is 0.09.

Card 24. ALET (49X,E14.6)

ALET is the value of the turbulent Lewis number. The profile of the turbulent Lewis number is filled with this value.

Card 25. ALPHA (49X,E14.6)

ALPHA is the angle of attack of the vehicle, in degrees.

Card 26. ASTAR (49X,E14.6)

ASTAR is a numerical constant used in the damping term of Van Driest's inner eddy viscosity law in the program (A* in the Analysis). The recommended value is 26.0.

Card 27. COOL (49X,A3)

COOL is a literal variable specifying the type of cooling in the circumferential direction. It can be coded as either ABLATION or TRANSPIRATION. The first 3 letters are picked up by the program. If COOL = ABLATION the injection rate in the circumferential direction is given by a cosine squared distribution: $CWALL = CWALL_{k=1} * \cos^2(\phi)$. If COOL = TRANSPIRATION the injection rate in the circumferential direction is given by the rate at the windward plane times the ratio of local pressure to the windward pressure: $CWALL = CWALL_{k=1} * PE/PE_{k=1}$. The two models are designed to show the effects of ablation and transpiration-cooling in the circumferential direction.

Card 28. CWALL (49X,E14.6)

CWALL is the injection rate for mass transfer cases where the rate is a constant. $CWALL = \rho_W V_W / \rho_\infty U_\infty$

Card 29. CRI (49X,F5.3)

CRI is the indicator for the numerical solution method. If CRI = 1.0, then the solution will be a fully implicit Krause method. If CRI = 0.5, the solution method will be a Crank-Nicolson scheme. CRI = 1.0 is the recommended value.

Card 30. CONV (49X,E14.6)

CONV is the solution convergence criterion. The dependent variable arrays of stagnation enthalpy, streamwise and cross flow velocities, and the species concentration are all checked for convergence at all points. When the largest percentage difference between the current and previous iterations is less than or equal to CONV the solution is taken to be converged.

Card 31. DISK (49X,A2)

Disk indicates whether or not a new data set of edge data is to be created on unit 10. When DISK = YES the program calls subroutine DISKIN which reads data from the Black and Lewis program residing on unit 25. If DISK = NO the unit 10 data of edge properties for this vehicle already exists and DISKIN is not called. Therefore DISK will normally be coded YES only in the first run of a vehicle-inviscid field combination.

Card 32. DXINVS (49X,E14.6)

DXINVS is the interval Δz along the axis of the cone between points where edge data is to be obtained from the Black and Lewis program by subroutine DISKIN. It then becomes the controlling factor in how closely spaced the streamwise edge data points are for interpolation by the boundary-layer solution. DXINVS need not be coded if DISK = NO. The recommended value is 0.04.

Card 33. DXMAX (49X,E14.6)

DXMAX is the maximum step size, in feet, to be taken in the streamwise direction.

Card 34. DX1 (49X,E14.6)

DX1 is the initial streamwise step size in feet. Since this value will be adjusted internally it is not critical that the user choose an accurate value. Usually a value of 0.01 is a good initial DX.

Card 35. EDYLAW (49X,A3)

EDYLAW specifies the inner eddy viscosity law to be used in turbulent cases. Two options are available to the user: 1) EDYLAW = VAN DRIEST and 2) EDYLAW = REICHARDT. The program picks up only the first 3 letters of each name. The user should note the comments on these two laws for mass transfer problems stated in Appendix III. In general the REICHARDT law is recommended.

Card 36. ETAFAC (49X,E14.6)

ETAFAC controls the normal grid spacing. A value of 1.0 gives an equally spaced grid for the transformed normal coordinate. A value greater than 1.0 gives a finer grid at the wall than at the outer edge. A value of 1.04 is recommended with IE = 101 and ETAINF = 6.0. A value of 1.09 is recommended with IE = 101 and ETAINF = 100.0.

Card 37. ETAINF (49X,E14.6)

ETAINF is the maximum value of η . A value between 6.0 and 10.0 is recommended for laminar flow. A value between 10.0 and 100.0 is recommended

for turbulent flow. This value can be adjusted internally by specifying KADETA and ADTEST to do so.

Card 38. GAS2 (49X,A3)

GAS2 is the name of the injected gas in mass transfer problems. It can be coded as AIR, HELIUM, ARGON, or CO2. Only the first three letters are picked up by the program.

Card 39. PLOT (49X,A2)

PLOT is the indicator for machine plot generation. If PLOT = NO, no machine plots will be made. If PLOT = YES, the machine plots built into the program will be generated. The user is cautioned that specifying PLOT = YES and defining the four plotter data sets adds approximately 44K to the program's core requirements.

Card 40. PRL (49X,E14.6)

PRL is the initial value given to the entire laminar Prandtl number profile. This profile is updated from curve fit data after the initial iteration.

Card 41. PRT (49X,A5)

PRT specifies the turbulent Prandtl number model to be used in the turbulent region. It should be coded as ROTTA, SHANG, CEBECI, MEIER, or CONSTANT, where each name is the name of the person who developed the particular model. If PRT = CONSTANT the turbulent Prandtl number profile will be given the value of 0.9 throughout. The four different models are described in the Analysis.

Card 42. PROP (49X,A4)

PROP and VALUE are used together to read either P_∞ , ρ_∞ , or P_0 into the program. If the user has any one of the three quantities the program will calculate the remaining freestream and stagnation quantities in subroutine AERO. PROP should be coded as PINF, PSTAG, or RHOINF. Only the first four letters are read by the program.

Card 43. RTW (49X,E14.6)

RTW is the ratio of the wall temperature to stagnation temperature. It is used to calculate the wall temperature when the wall temperature is a constant.

Card 44. TFS (49X,E14.6)

TFS is the free-stream temperature in degrees Rankine. If TFS is coded as 0.0, TFS will be calculated internally from TSTAG and the Mach number.

Card 45. TSTAG (49X,E14.6)

TSTAG is the stagnation temperature in degrees Rankine. If both TFS and TSTAG are input, the program will calculate an effective specific heat ratio to be used in calculating other free-stream and stagnation properties. If TSTAG is coded as 0.0, TSTAG will be calculated internally from TFS and the Mach number.

Card 46. VALUE (49X,E14.6)

VALUE and PROP are used together to read either P_∞ , ρ_∞ , or P_0 into the program. If PROP = PINF then VALUE is P_∞ in psia. If PROP = PSTAG then VALUE = P_0 in psia. If PROP = RHOINF then VALUE = ρ_∞ in slugs per cubic foot.

Card 47. XBAR (49X,E14.6)

XBAR is the relative length of the transition regime in turbulent cases. It is the ratio of the transition end point location to the transition onset distance.

Card 48. RNOSE (49X,E14.6)

RNOSE is the nose radius of a blunt cone in feet. RNOSE is included in the input deck for blunt cones only.

NOTE: The following eight cards are included in the input deck only for the case of a sharp cone at zero incidence. DISK should be coded as NO in this case.

Card 49. Q (49X,E14.6)

Q is the ratio of specific heats, γ , usually 1.4.

Card 50. R (49X,E14.6)

R is the universal gas constant for air, usually coded as 1716.0.

Card 51. THET1 (49X,E14.6)

THET1 is the half angle of the cone, θ_c , in degrees.

Card 52. XMA (49X,E14.6)

XMA is the free-stream Mach number, M_∞ .

Card 53. PEDG (49X,E14.6)

PEDG is the edge pressure in psf. It is normally taken to be equal to the surface pressure of the inviscid solution.

Card 54. UEDG (49X,E14.6)

UEDG is the streamwise edge velocity in feet per second, normally the surface value of the inviscid solution.

Card 55. TEDG (49X,E14.6)

TEDG is the edge temperature in degrees Rankine, normally the surface value of the inviscid solution.

Card 56. RHOEDG (49X,E14.6)

RHOEDG is the edge density in slugs per cubic foot, normally the surface value of the inviscid solution.

Card 57. XSTA(I), I=1, NSOLVE (F12.6)

XSTA is an important input array. It is an array of surface distances in feet, where the user wishes to have solutions calculated. The program will always obtain solutions at these points regardless of internal adjustments to the streamwise step size. Both the value 0.0 and the end point of the cone must be included in the array as well as any distances describing the beginning or end of injection and transition. In addition, for sharp cones XSTA(2) should be some small value near the sharp tip such as 0.0001 or 0.00025. In blunt cone cases the XSTA array is expanded by subroutine BLUNT1 to include a number of points equal to KEND2. These points are points along the spherical wedge section of the cone which correspond to solutions along the 3-D starting line which terminates the wedge section. When XSTA is expanded all counters such as KONSET and INJCT are reset automatically.

Card 58. XTW(I), TWX(I), XCI(I), CIX(I) (4E12.6)

TWX(I) is the wall temperature in degrees Rankine at XTW(I) which is a surface distance in feet.

CIX(I) is the injection rate $\rho_w v_w / \rho_\infty u_\infty$ at XCI(I) which is a surface distance in feet.

These arrays are dimensioned for a maximum of 500 values each. If none of these cards appear in the input deck the program will automatically assume constant wall temperature and injection rate values based on RTW and CWALL. This input allows the wall temperature distribution and injection rate distribution to be read in versus their own surface distance tables. If both distributions are to be read in versus the same distance table, then either one of the two distance tables may be left blank. Another important feature is the fact that the distributions need not cover the same surface distance. For instance, the wall temperature distribution might be defined over the entire cone while the injection rate distribution might only be defined over a short distance.

TABLE IV-1
INPUT DATA DECK FOR A SHARP CONE AT ANGLE OF ATTACK

	HYPERSONIC SHARP	CCNE	AEDC TR-72-66	TURBULENT
CARD 001	IE	I3	COL 50-52	051
CARD 002	INJCT	I3	CCL 50-52	000
CARD 003	KADETA	I3	COL 50-52	001
CARD 004	KEND2	I3	CCL 50-52	013
CARD 005	KUNSET	I3	COL 50-52	000
CARD 006	KPRT	I3	COL 50-52	003
CARD 007	KTPANS	I3	CCL 50-52	000
CARD 008	LAMTRB	I3	COL 50-52	002
CARD 009	LPRT	I3	CCL 50-52	001
CARD 010	NIT1	I3	CCL 50-52	005
CARD 011	NIT2	I3	CCL 50-52	010
CARD 012	NIT3	I3	CCL 50-52	020
CARD 013	NOINJ	I3	COL 50-52	000
CARD 014	NOSE	A5	COL 50-54	SHARP
CARD 015	NSOLVE	I3	CCL 50-52	004
CARD 016	KPLGT	4I3	COL 50-61	004007010013
CARD 017	KPRFL	4I3	COL 50-61	001002003004
CARD 018	LPLOT	4I3	COL 50-61	003003003000
CARD 019	LPRFL	4I3	COL 50-61	001000000000
CARD 020	ADTEST	E14.6	CCL 50-63	0.001
CARD 021	AKSTAR	E14.6	COL 50-63	0.435
CARD 022	ALAMDA	E14.6	CCL 50-63	0.09
CARD 023	ALET	E14.6	COL 50-63	1.0
CARD 024	ALPHA	E14.6	CCL 50-63	4.0
CARD 025	ASTAR	E14.6	CCL 50-63	26.0
CARD 026	COOL	A3	COL 50-52	ABLATION
CARD 027	CWALL	F14.6	CCL 50-63	0.0
CARD 028	CRI	F5.3	CCL 50-54	1.0
CARD 029	CONV	E14.6	COL 50-63	0.001
CARD 030	DISK	A2	CCL 50-51	NO
CARD 031	DXINVS	E14.6	CCL 50-63	0.04
CARD 032	DXMAX	E14.6	CCL 50-63	0.1
CARD 033	DX1	F5.3	CCL 50-54	0.01
CARD 034	EDYLAW	A3	COL 50-52	REICHARDT
CARD 035	ETAFAC	E14.6	CCL 50-63	1.05
CARD 036	ETAINF	F14.6	CCL 50-63	10.0
CARD 037	GAS2	A3	CCL 50-52	AIR
CARD 038	PLOT	A2	COL 50-51	YES
CARD 039	PRL	E14.6	CCL 50-63	0.71
CARD 040	PRT	A5	CCL 50-54	CONST
CARD 041	PROP	A4	COL 50-53	PSTAG
CARD 042	RTW	E14.6	CCL 50-63	0.39925
CARD 043	TFS	E14.6	CCL 50-63	96.84
CARD 044	TSTAG	E14.6	CCL 50-63	1340.0
CARD 045	VALUE	E14.6	CCL 50-63	860.0
CARD 046	XBAR	E14.6	COL 50-63	2.0
0.0				
0.0001				
3.226				
4.0325				

TABLE IV-2
INPUT DATA DECK FOR A SHARP CONE AT ZERO INCIDENCE

CARD	REF(10)	SHARP CONE, LAMINAR, HELIUM INJECTION, ALPHA=0		
CARD 001	IE	I3	COL 50-52	051
CARD 002	INJCT	I3	CCL 50-52	003
CARD 003	KADETA	I3	CCL 50-52	003
CARD 004	KEND2	I3	CGL 50-52	001
CARD 005	KURSET	I3	CCL 50-52	000
CARD 006	KPKT	I3	CCL 50-52	003
CARD 007	KTRANS	I3	CCL 50-52	001
CARD 008	LAMTRB	I3	CCL 50-52	001
CARD 009	LPRT	I3	CCL 50-52	001
CARD 010	NIT1	I3	CCL 50-52	005
CARD 011	NIT2	I3	CCL 50-52	010
CARD 012	NIT3	I3	CCL 50-52	020
CARD 013	NOINJ	I3	CCL 50-52	000
CARD 014	NOSE	A5	CCL 50-54	SHARP
CARD 015	NSCLVE	I3	CCL 50-52	004
CARD 016	KPLOT	413	CCL 50-61	001000000003
CARD 017	KPRFL	413	CCL 50-61	001000000000
CARD 018	LPLOT	413	CCL 50-61	002003004000
CARD 019	LPRFL	413	CCL 50-61	001002003000
CARD 020	ADTEST	E14.6	CCL 50-63	0.001
CARD 021	AKSTAR	E14.6	CCL 50-63	0.435
CARD 022	ALAMCA	E14.6	CCL 50-63	0.09
CARD 023	ALET	E14.6	CCL 50-63	1.0
CARD 024	ALPHA	E14.6	CCL 50-63	0.0
CARD 025	ASTAR	E14.6	CCL 50-63	26.0
CARD 026	COGL	A3	CCL 50-52	ABLATION
CARD 027	CHALL	F14.6	CCL 50-63	0.33179
CARD 028	CRI	F5.3	CCL 50-54	1.0
CARD 029	CDNV	E14.6	CCL 50-63	0.001
CARD 030	DISK	A2	CCL 50-51	NO
CARD 031	DXINVS	E14.6	CCL 50-63	0.0
CARD 032	DXMAX	E14.6	CCL 50-63	0.10
CARD 033	DX1	F5.3	CCL 50-54	0.01
CARD 034	EDYLAW	A3	CCL 50-52	REICHARDT
CARD 035	ETAFAC	E14.6	CCL 50-63	1.04
CARD 036	ETAINF	E14.6	CCL 50-63	6.0
CARD 037	GAS2	A3	CCL 50-52	HELIUM
CARD 038	PLOT	A2	CCL 50-51	YES
CARD 039	PRL	E14.6	CCL 50-63	0.71
CARD 040	PRT	A5	CCL 50-54	ROTTA
CARD 041	PRCP	A4	CCL 50-53	PSTA
CARD 042	RTW	E14.6	CCL 50-63	0.197446
CARD 043	TFS	E14.6	CCL 50-63	269.2964
CARD 044	TSTAG	E14.6	CCL 50-63	0.0
CARD 045	VALUE	E14.6	CCL 50-63	16.9362
CARD 046	XBAR	E14.6	CCL 50-63	2.0
CARD 047	G	E14.6	CCL 50-63	1.4
CARD 048	R	E14.6	CCL 50-63	1716.0
CARD 049	THET1	E14.6	CCL 50-63	9.0
CARD 050	XMA	E14.6	CCL 50-63	10.0
CARD 051	PEDG	E14.6	CCL 50-63	0.2749
CARD 052	UEDG	E14.6	CCL 50-63	7897.0
CARD 053	TEDG	E14.6	CCL 50-63	460.09
CARD 054	XHOEDG	F14.6	CCL 50-63	3.4850-07
				0.0
				0.0001
				0.08425
				0.19575

TABLE IV-3
INPUT DATA DECK FOR A BLUNT CONE

REF(11)	BLUNT CONE LAMINAR	ARGCN INJECTION
CARD 001	IE 13	CCL 50-52 051
CARD 002	INJCT 13	CCL 50-52 001
CARD 003	KADETA 13	COL 50-52 000
CARD 004	KEND2 13	COL 50-52 001
CARD 005	KCNSET 13	CCL 50-52 000
CARD 006	KPRT 13	CCL 50-52 003
CARD 007	KTRANS 13	CCL 50-52 000
CARD 008	LAMTRd 13	COL 50-52 001
CARD 009	LPRT 13	COL 50-52 001
CARD 010	NIT1 13	CCL 50-52 005
CARD 011	NIT2 13	COL 50-52 010
CARD 012	NIT3 13	COL 50-52 020
CARD 013	NOINJ 13	COL 50-52 000
CARD 014	NUSE A5	CCL 50-54 BLUNT
CARD 015	NSOLVE 13	CCL 50-52 003
CARD 016	KPLOT 413	COL 50-61 00100000000
CARD 017	KPRFL 413	CCL 50-61 00100000000
CARD 018	LPLOT 413	COL 50-61 00300000000
CARD 019	LPRFL 413	COL 50-61 00100000000
CARD 020	ADTEST E14.6	COL 50-63 0.001
CARD 021	AKSTAR E14.6	COL 50-63 0.435
CARD 022	ALAMDA E14.6	COL 50-63 0.09
CARD 023	LEWTRB E14.6	COL 50-63 1.0
CARD 024	ALPHA E14.6	COL 50-63 0.0
CARD 025	ASTAR E14.6	COL 50-63 26.0
CARD 026	COOL A3	COL 50-52 ABLATION
CARD 027	CWALL F14.6	COL 50-63 0.0284
CARD 028	CRI F5.3	COL 50-54 1.0
CARD 029	CONV E14.6	CCL 50-63 0.01
CARD 030	DISK A2	COL 50-51 NO
CARD 031	DXINVS E14.6	CCL 50-63 0.04
CARD 032	DXMAX E14.6	COL 50-63 0.10
CARD 033	DX1 F5.3	COL 50-54 0.02
CARD 034	EDYLAH A3	COL 50-52 REICHARDT
CARD 035	ETAFAC E14.6	COL 50-63 1.04
CARD 036	ETAINF E14.6	COL 50-63 12.0
CARD 037	GAS2 A3	CCL 50-52 ARGON
CARD 038	PLOT A2	CCL 50-51 YES
CARD 039	PRL E14.6	COL 50-63 0.7
CARD 040	PRT A5	CCL 50-54 ROTTA
CARD 041	PROP A4	COL 50-53 PINF
CARD 042	RTW E14.6	CCL 50-63 0.06582
CARD 043	TFS E14.6	CCL 50-63 290.0
CARD 044	TSTAG E14.6	CCL 50-63 8204.0
CARD 045	VALUE E14.6	CCL 50-63 0.00135
CARD 046	XBAR E14.6	COL 50-63 2.0
CARD 047	RNOSE E14.6	COL 50-63 0.083333
	0.0	
	0.01	
	0.42514	

APPENDIX V DESCRIPTION OF OUTPUT DATA

As explained in Appendix III there are two major types of output from the program. The first type is printed output, which is presented in two forms, station data and profile data. The second type is machine drawn plots, also presented in two forms, surface data and profile data.

In addition to solution results and plots, the program prints all of the input data cards as they are read in. Following the input data cards are the thermodynamic, free-stream, stagnation, and vehicle data calculated in the program or obtained from on-line data sets. Unit 3 is a summary of data on the windward streamline. Definitions of the variables in unit 3 are identical to those of the same variables in the station data.

This appendix will attempt to define the output by listing the variable name as it appears in the output, along with a definition of the variable. Printed output will be covered first, followed by the plotted output.

The program also prints miscellaneous messages, which are described following the section on plots. The final section of this appendix deals with output printed by the edge property subroutines.

SECTION I: PRINTED OUTPUT

1.1 Station Data

Station data includes quantities such as geometry, edge quantities, and surface properties which do not vary with distance from the body. In blunt cone cases all distances are initially in a wind-fixed coordinate system. At the end of the spherical wedge section (the sonic line) the coordinates are converted to a body-fixed system.

Line 1

- | | |
|-------|---|
| S | X, distance from the stagnation point along the body surface, in feet. |
| S/REF | nondimensional surface distance. For a sharp cone REF is the total slant length or XSTA(NSOLVE). For a blunt cone REF is the nose radius. |
| Z | axial distance from the stagnation point, in feet. |
| Z/REF | nondimensional axial distance where REF is as defined for S/REF. |

Line 2

- | | |
|---|-----------------------------|
| R | local body radius, in feet. |
|---|-----------------------------|

R/REF nondimensional local body radius.
 DX ΔX , streamwise step size, in feet.
 NIT number of iterations to obtain the solution.

Line 3

XI ξ , transformed streamwise coordinate.
 DXI $\Delta \xi$, streamwise step size in the transformed coordinate, ξ .
 DXDXI $\partial x / \partial \xi$.
 CWALL local injection rate, described in Appendix IV.

Line 4

PE P_e , edge pressure in PSF.
 TE t_e , edge temperature in $^{\circ}R$.
 UE u_e , streamwise edge velocity in FPS.
 VE v_e , cross flow edge velocity in FPS.
 MACHE M_e , edge Mach number.

Line 5

DPEDX $\partial P_e / \partial \xi$.
 DTEDX $\partial t_e / \partial \xi$.
 DUEDX $\partial u_e / \partial \xi$.
 DVEDX $\partial v_e / \partial \xi$.
 RHOE ρ_e , edge density in slugs per cubic foot.

Line 6

DPEDW $\partial P_e / \partial \phi$.
 DTEDW $\partial t_e / \partial \phi$.
 DUEDW $\partial u_e / \partial \phi$.
 DVEDW $\partial v_e / \partial \phi$.
 ROEMUE $\rho_e \mu_e$, density viscosity product at the edge.

Line 7

$$\text{LOCAL EDGE REYNOLDS NUMBER} = \frac{\rho_e u_e x}{\mu_e}$$

Line 8

$$\text{CFXINF} \quad C_{f_{x_\infty}} = \frac{2\tau_{wx}}{\rho_\infty u_\infty^2}, \text{ streamwise skin friction coefficient}$$

$$\text{CFXEDG} \quad C_{f_{x_e}} = \frac{2\tau_{wx}}{\rho_e u_e^2}, \text{ streamwise skin friction coefficient based on edge conditions.}$$

$$\text{CFWINF} \quad C_{f_{\phi_\infty}} = \frac{2\tau_{w\phi}}{\rho_\infty u_\infty^2}, \text{ transverse skin friction coefficient based on free-conditions.}$$

$$\text{CFWEDG} \quad C_{f_{\phi_e}} = \frac{2\tau_{w\phi}}{\rho_e u_e^2}, \text{ transverse skin friction coefficient based on edge conditions.}$$

LINE 9

$$\text{CHEDGE} \quad C_{h_e} = \frac{q_w}{\rho_e u_e (H_w - H_{aw})}, \text{ heat transfer coefficient based on edge properties.}$$

$$\text{CHINF} \quad C_{h_\infty} = \frac{q_w}{\rho_\infty u_\infty (H_w - H_{aw})}, \text{ heat transfer coefficient based on free-stream conditions.}$$

$$\text{STEDGE} \quad St_e = \frac{q_w}{\rho_e u_e (H_w - H_0)}, \text{ local Stanton number based on edge conditions.}$$

$$\text{STINF} \quad St_\infty = \frac{q_w}{\rho_\infty u_\infty (H_w - H_0)}, \text{ local Stanton number based on free-stream conditions.}$$

Line 10

$$\text{QW} \quad \frac{q_w}{\rho_\infty u_\infty^3}, \text{ wall heat transfer coefficient}$$

CHIMAX $\psi_{\max}$, maximum vorticity Reynolds number, where $\psi = \frac{y^2}{\nu} \frac{\partial u}{\partial y}$.

Line 11

LONGITUDINAL SKIN FRICTION τ_{wx} , in PSF.

DELTA*(X) δ_x^* , streamwise boundary-layer displacement thickness in feet.

THETA(X) δ_x , streamwise boundary-layer momentum thickness in feet.

Line 12

TRANSVERSE SKIN FRICTION $\tau_{w\phi}$, in PSF.

DELTA*(PHI) δ_ϕ^* , transverse boundary-layer displacement thickness in feet.

THETA(PHI) θ_ϕ , transverse boundary-layer momentum thickness in feet.

Line 13

WALL HEAT TRANSFER RATE q_w , in BTU/ft²/sec.

DELTA (Ft) δ , the boundary-layer thickness in feet.

Line 14

TRANSITION INTERMITTENCY FACTOR I_f , percentage of full turbulent achieved.

1.2 Profile Data

Three groups of profile data are printed by the program. Every other point is printed in the profile arrays.

Group I

ETA η , the transformed normal coordinate.

Y y , the physical normal distance in feet.

F u/u_e , the nondimensional streamwise velocity profile.

FN $\partial F / \partial \eta$.

G	w/u_e , the nondimensional crossflow velocity profile.
GN	$\partial G/\partial \eta$.
H	H/H_e , the nondimensional stagnation enthalpy profile.
HN	$\partial H/\partial \eta$.
C	$\rho\mu/\rho_e\mu_e$, the nondimensional density-viscosity product profile.
CN	$\partial C/\partial \eta$.
V	transformed normal velocity profile.

Group II

ETA	η , transformed normal coordinate.
Y/L	$y/XSTA(NSOLVE)$, nondimensional physical normal distance profile.
ROROE	ρ/ρ_e , the nondimensional density profile.
XMU	μ , viscosity profile.
E+	ϵ^+ , ratio of eddy viscosity to the laminar viscosity.
CHI	ψ , profile of the vorticity Reynolds number.
LEL	Le , laminar Lewis number profile.
LET	Le_t , turbulent Lewis number profile.
PRL	Pr , laminar Prandtl number profile.
PRT	Pr_t , turbulent Prandtl number profile.
SPHT	C_p , specific heat at constant pressure.

Group III

ETA	η , transformed normal coordinate.
Y/L	$y/XSTA(NSOLVE)$, nondimensional physical normal distance profile.
Z	C_f/C_{f_e} , free-stream mass fraction profile.
ZN	$\partial Z/\partial \eta$.
TEMP	t , the dimensional temperature profile in $^{\circ}R$.
T/TE	t/t_e , the nondimensional temperature profile.

TN $\partial T / \partial \eta$.

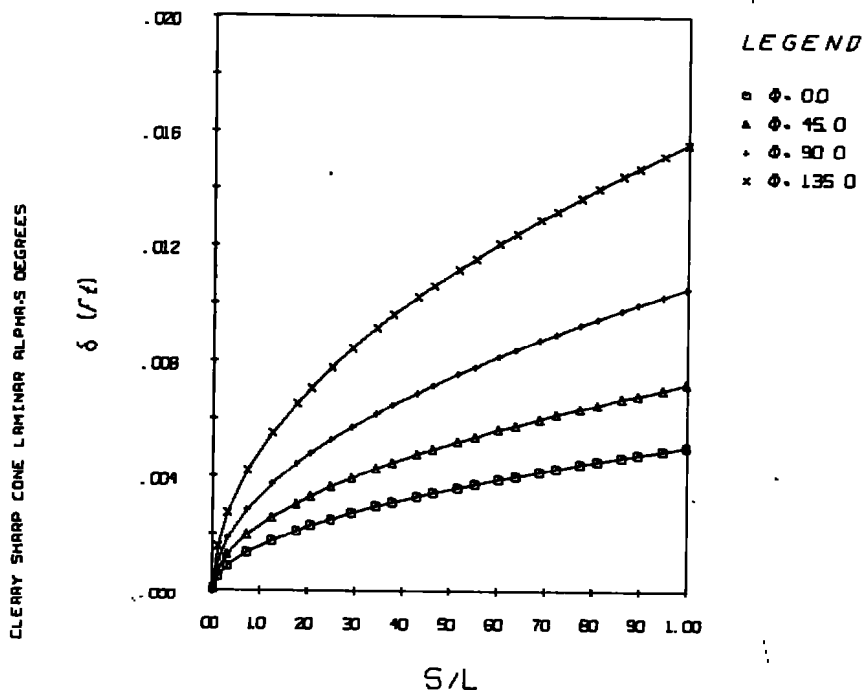
CP/CV C_p / C_v , ratio of specific heats.

RHO ρ , the dimensional density profile in slugs per cubic foot.

SECTION II: PLOTTER OUTPUT

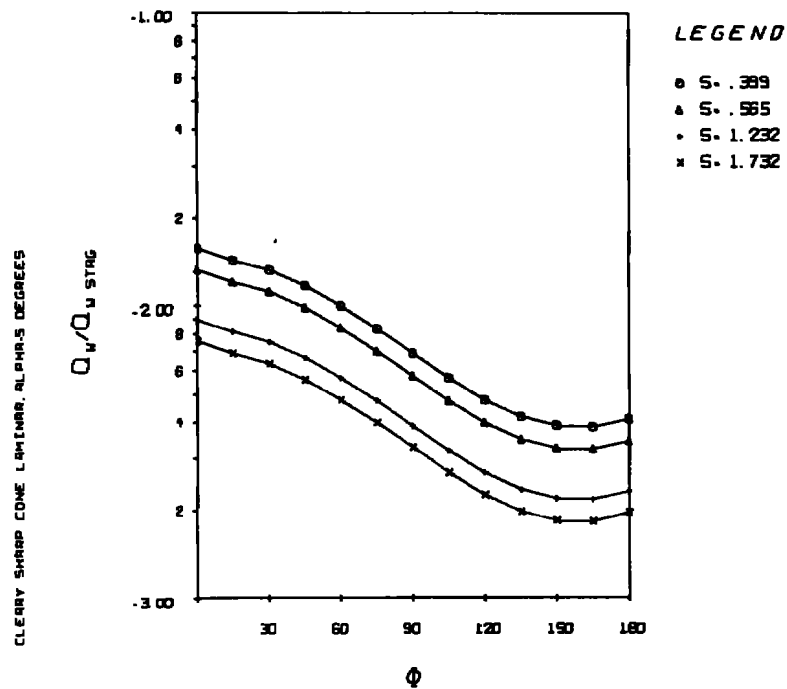
As was described in appendices I and II the program generates four types of machine plots. Each type of plot will be described below by presenting an example of the machine drawn plot.

Streamwise Surface Plots at a constant ϕ

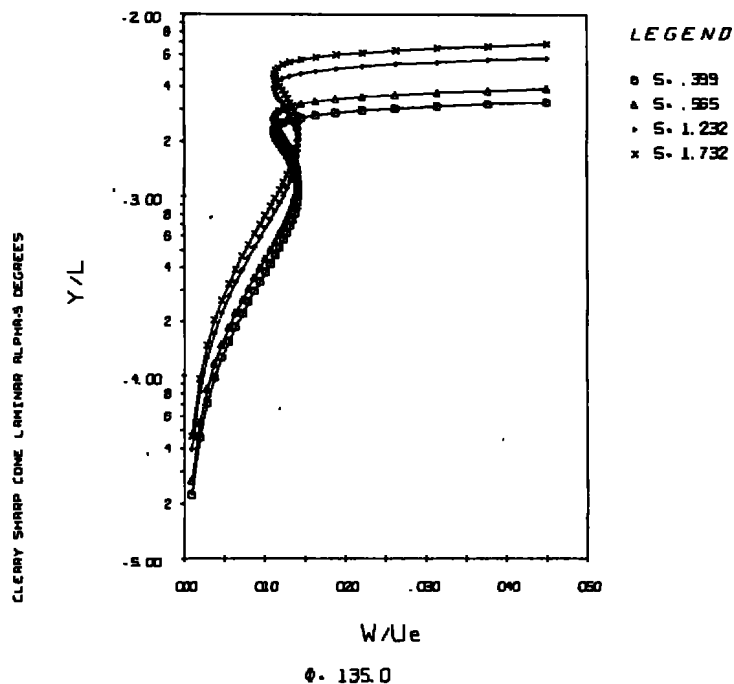


For sharp cones the abscissa is S/L . For blunt cones the abscissa is S/R and is a log scale. The ordinate in either case may be linear or logarithmic depending on the particular variable being plotted.

Transverse Surface Plots at a Constant S

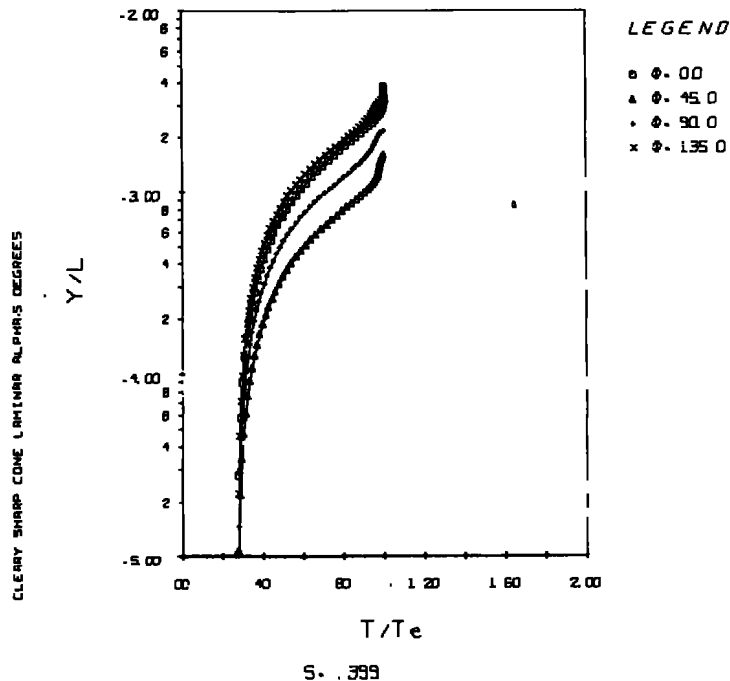


In these plots, ϕ is the circumferential angle with $\phi = 0.0$ being the windward plane. Again the ordinate may be either linear or logarithmic depending on the data being plotted.

Profile Plots versus S at a Constant ϕ 

In cases where either axis of a plot is logarithmic the numbers printed along the scale are the logarithms of the numbers being plotted. Therefore a -4.00 on the above Y/L scale represents a $Y/L = 0.0001$.

Profile Plots versus ϕ at a Constant S



As many as four curves may appear on each plot, as specified by the user. The maximum number of plots drawn is 56. This number of plots would only be drawn for a full 3-D problem having both turbulence and mass transfer. The plots which are built into the program are as follows:

Eight surface plots, P_e , M_e , δ , $C_{f_{x_{\infty}}}$, St_{∞} , q_w/q_{w0} , $C_{f_{\phi_{\infty}}}$, and δ^* in each direction for a total of 16 plots.

Five profile plots, u/u_e , w/u_e , t/t_e , C_f/C_{f_e} , and ϵ^+ at each of four constant x and four constant ϕ locations; for a maximum of 40 plots.

SECTION III: MISCELLANEOUS MESSAGES

The program has a few internal messages which are written to indicate problems with the solution, or coordinate adjustments. A message is printed by subroutine ADDETA whenever η_{∞} is adjusted up or down. The direction of adjustment is given along with χ , the old η_{∞} and the new η_{∞} .

A message is printed by subroutine CHANGX indicating the beginning of transition or mass transfer. Included in the messages are the values of X and the particular integer counter involved. A similar message is also printed by CHANGX when mass transfer ends.

Whenever the program fails to obtain a converged solution within NIT3 iterations, a message is printed by subroutine CONTRL to that effect which includes the values of the transverse and streamwise solution counters and NIT. If this should occur three consecutive times, a message will be printed indicating that execution is terminating.

If a particular boundary-layer problem drops all of its circumferential solution planes due to convergence problems, a message will be printed by CONTRL indicating that execution is terminating.

A normal termination of the program is indicated by the message "THE END" printed out after the last station results.

SECTION IV: PRINTOUT BY EDGE DATA SUBROUTINES

When DISK = YES and unit 30 is defined as a printer in the job control language, subroutines DISKIN and WEDGE generate printed output showing the fourier coefficient data being stored on unit 10 for use in the boundary layer solution. A complete description of this output can be found in Frieders and Lewis (Ref. 7) in their descriptions of the DISKIN and WEDGE subroutines.

Printout is also generated on unit 6 when DISK = YES and NOSE = BLUNT. This printout appears just before the first station data and is printed by BLUNT1. It lists the geometry and edge data over the sphere cap and wedge sections of the blunt cone. The program interpolates in these tables to find the edge properties for solution points in these two regions. The variables printed by BLUNT1 are defined as follows:

NOTE: distances are in wind-fixed coordinates.

ZB	axial distance from the stagnation point, in feet.
XB	surface distance from the stagnation point, in feet.
RB	local body radius, in feet.
PEB	P_e , edge pressure in PSF.
UEB	u_e , edge velocity in FPS.
TEB	t_e , edge temperature in °R.
XMB	M_e , edge Mach number.

APPENDIX VI
JOB CONTROL LANGUAGE

The job control language in this appendix is intended only as a guide for the user. This JCL was used on an IBM 370/158 machine, and therefore includes items pertaining only to that machine. The user will find the DCB parameters useful in writing his own JCL.

The computer program should be overlayed to avoid excessive core requirements. The JCL presented in Table I assumes an overlayed program, and includes the linkage editor control cards for the overlay structure.

Following is a description of the output and input data sets by unit number.

FT06F001	printer output unit for station and profile data.
FT03F001	printer output unit for the summary of windward plane surface data.
FT04F001	direct access unit for storing the solutions of a blunt cone's spherical wedge section for later use as starting data for the afterbody solution.
FT08F001	direct access unit for storing current solutions.
FT10F001	tape or disk unit for storing the edge data for a vehicle-inviscid flow field combination.
FT13F001	plotter data set; tape or disk unit for storing streamwise surface data versus x at a constant ϕ .
FT14F001	plotter data set; tape or disk unit for storing profiles versus ϕ at a constant x .
FT15F001	plotter data set; tape or disk unit for storing profiles versus x at a constant ϕ .
FT16F001	plotter data set; tape or disk unit for storing streamwise data versus ϕ at a constant x .
FT25F001	tape or disk unit corresponding to unit 30 in the Black and Lewis inviscid program; used for first run of a problem to establish edge data on unit 10.
FT30F001	printer output unit from subroutines DISKIN and WEDGE showing edge data coefficients.
FT69F001	tape or disk unit for storing the input data cards in card image format.

The user should note that units 10, 13, 14, 15, 16, 25, and 69 in Table I are coded as on-line disk data sets. Any one or all of them can be used as tape or off-line disk data sets with the appropriate changes in the JCL.

TABLE VI-1

JOB CONTROL LANGUAGE

```

/*PRIORITY IDLE
/*MAIN TIME=100,LINES=50,REGION=3000
/*FORMAT PL,PEN=XFINE,COLOR=BLACK,CENAME=CALCOMP
// EXEC FORTGCLG,PARM=LKED='LIST,OVL',LIB1=PLTLIB,
// PARM.GO='DEST=PLT1,PAPER=40,PTIME=119'
//FORT.SYSIN DD *

```

FORTRAN SOURCE STATEMENTS

```

/*
//LKED.SYSIN DD *
  INSERT DERIV3,FC3,DERIV
  INSERT ASSVAR,BLUNT,CCNVRG,DEPVAR,FINDIF,FRSTRM,GEOM,INTEGR,PDECOF, X
    STAG,IMPSTR,UNIT10,XSOLVE,XICORD,XSOLVE,ZCOORD,POLY
  INSERT INJECT,SURFAS
  INSERT TRBLNT,TRANSL,PLOTS
  OVERLAY ONE
  INSERT AERO,INIT,INPUT,CUT1
  INSERT REF,THERMO
  OVERLAY ONE
  INSERT DISKIN,FORIER,WEDGE
  INSERT FLOODAT
  OVERLAY ONE
  INSERT CNTRL,GNTRY,MIXTUR,INTER3
  INSERT CONICL,EDGE,EDG2,IECCF,CLD,GLDECG,OUTPUT,SOLPNT,GASPRP
  INSERT EDG4
  OVERLAY TWO
  INSERT EDYVIS,TRBPRL
  OVERLAY TWO
  INSERT ABCOE,SOLVE,XMCP,ENERGY
  OVERLAY TWO
  INSERT PHIMOM
  OVERLAY TWO
  INSERT SPECIE,SPECBC
  OVERLAY TWO
  INSERT CHANGX
  OVERLAY TWO
  INSERT VCALC,WALL
  OVERLAY TWO
  INSERT EGPROP
  OVERLAY THREE
  INSERT SHA4PI
  OVERLAY THREE
  INSERT EDGCCF
  OVERLAY THREE
  INSERT PLUNT1,BLUNT2,INTER5,FD5
  OVERLAY TWO
  INSERT PROPTY,OUT2
  OVERLAY TWO
  INSERT ADCETA
  OVERLAY ONE
  INSERT PLOTET,AEHGPT,MAX,MIN,LEGEND,SUBLBL
/*
//GO.FTC6FCG1 DD SYSCUT=A,DCP=BLKSIZE=133
//GO.FTC3FCG1 DD SYSOUT=A,CCR=(RECFM=FA,BLKSIZE=133)
//GO.FT04FCG1 DD UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(6464,(61,10))

```

```

//GO,FT08F001 DD UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(6464,(61,101)
//GO,FT10F001 DD DSN=SHARP.ADAMS.A505F3,UNIT=SYSCA,
//      VCL=SER=USERPK,
//      DISP=(OLD,KEEP),DCB=(RECFM=VBS,LRECL=492,BLKSIZE=12796)
//GO,FT13F001 DD UNIT=SYSDA,DCB=(RECFM=FB,LRECL=120,BLKSIZE=3000),
//      SPACE=(TRK,20)
//GO,FT141C01 DD UNIT=SYSDA,DCB=(RECFM=FB,LRECL=7224,BLKSIZE=7224),
//      SPACE=(TRK,20)
//GO,FT15F001 DD UNIT=SYSDA,DCB=(RECFM=FB,LRECL=7224,BLKSIZE=7224),
//      SPACE=(TRK,20)
//GO,FT16F001 DD UNIT=SYSDA,DCB=(RECFM=FB,LRECL=120,BLKSIZE=3000),
//      SPACE=(TRK,20)
//GO,FT25F001 DD DUMMY
//GO,FT30F001 DD DUMMY
//GO,FT69FG01 DD UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,3),
//      DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600)
//GO.SYSIN DD *

```

INPUT DATA CARDS

```

/*
//

```

APPENDIX VII SAMPLE RUNS OF THE COMPUTER PROGRAM

This appendix presents samples of some printed output from various runs of the computer program. The cases presented are the following (in order of presentation):

- 1) Full three-dimensional solution of Cleary's blunt cone (Ref. 40) at 5 degrees angle of attack, and with $Re_\infty = 1.2 \times 10^6/\text{ft.}$ and $r_{\text{nose}} = 1.1$ inches.
- 2) Full three-dimensional solution of Cleary's sharp cone (Ref. 40) at 5 degrees angle of attack and with $Re_\infty = 1.2 \times 10^6/\text{ft.}$
- 3) A sharp cone at zero angle of attack with injection of carbon dioxide; a windward streamline solution only. See Ref. 10.
- 4) A blunt cone at zero angle of attack with injection of argon beginning at the stagnation point; a windward streamline solution only. See Ref. 11.

Output from unit 6 is presented first for each case. This output includes a complete list of the input data, and for blunt cones it also contains the updated XSTA array. Following the input data is a station by station listing of the results including profiles where called for by the user.

Output from unit 3 is presented after unit 6 for each case. Unit 3 presents the tabulated results for some boundary-layer parameters along the windward streamline ($\phi = 0^\circ$).

Due to space limitations complete solutions to each case can not be provided in this volume; therefore, only selected portions of each solution are presented in this appendix. Those selected portions should aid a user in checking his copy of the computer program after conversion at another machine installation.

Each unit's output is preceded by the header page for that unit as printed by the computer.

I. Full Three-Dimensional Solution of a Blunt Cone at Angle of Attack.

```

*****
RRRRRRRRRR      000000      000000      3333333333      3311333333      RRRRRRRRRRR      CCCCCCCCCC      LL
RRRRRRRRRRRRRR      000000000      000000000      333333333333      333333333333      RRRRRRRRRRRRR      CCCCCCCCCCCC      LL
BB      RR      00      00      00      00      33      33      33      33      BB      RR      CC      CC      LL
BB      RR      00      00      00      00      33      33      33      33      BB      RR      CC      CC      LL
BB      RR      00      00      00      00      33      33      33      33      BB      RR      CC      CC      LL
RRRRRRRRRRRRRR      00      00      00      00      33      33      33      33      RRRRRRRRRRRRR      CC      LL
RRRRRRRRRRRRRR      00      00      00      00      33      33      33      33      RRRRRRRRRRRRR      CC      LL
RR      RR      00      00      00      00      33      33      33      33      RR      RR      CC      CC      LL
RR      RR      00      00      00      00      33      33      33      33      RR      RR      CC      CC      LL
RR      RR      00      00      00      00      33      33      33      33      RR      RR      CC      CC      LL
RRRRRRRRRRRRRR      000000000      000000000      3333333333      3333333333      RRRRRRRRRRRRR      CCCCCCCCCCCC      LLLLLLLLLLLLLL
RRRRRRRRRRRRRR      0000000      0000000      3333333333      3333333333      RRRRRRRRRRRRR      CCCCCCCCCC      LLLLLLLLLLLLLL

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800338CL
JJ      JJ      0000000000      RRRRRRRRRRR      777777777777      11      0000000      2222222222
JJ      JJ      000000000000      RRRRRRRRRRRRR      777777777777      111      000000000      222222222222
JJ      JJ      00      00      RR      RR      77      77      1111      00      00      22      22
JJ      JJ      00      00      RR      RR      77      77      11      00      00      22      22
JJ      JJ      00      00      RR      RR      77      77      11      00      00      22      22
JJ      JJ      00      00      RRRRRRRRRRRRR      77      77      11      00      00      22      22
JJ      JJ      00      00      RRRRRRRRRRRRR      77      77      11      00      00      22      22
JJ      JJ      00      00      RR      RR      77      77      11      00      00      22      22
JJ      JJ      00      00      RR      RR      77      77      11      00      00      22      22
JJ      JJ      00      00      RR      RR      77      77      11      00      00      22      22
JJJJJJJJJJJJ      000000000000      RRRRRRRRRRRRR      77      77      11      000000000      222222222222
JJJJJJJJJJJJ      00000000000      RRRRRRRRRRRRR      77      77      11      0000000      222222222222

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FFFFFFFFFFFFFF      TTTTTTTTTTTT      0000000      666666666666      FFFFFFFFFFFFFFF      0000000      0000000      11
FFFFFFFFFFFFFF      TTTTTTTTTTTT      000000000      666666666666      FFFFFFFFFFFFFFF      000000000      000000000      111
FF      TT      00      00      66      FF      00      00      00      00      1111
FF      TT      00      00      66      FF      00      00      00      00      11
FF      TT      00      00      66      FF      00      00      00      00      11
FFFFFFFF      TT      00      00      666666666666      FFFFFFFF      00      00      00      00      11
FFFFFFFF      TT      00      00      666666666666      FFFFFFFF      00      00      00      00      11
FF      TT      00      00      66      66      FF      00      00      00      00      11
FF      TT      00      00      66      66      FF      00      00      00      00      11
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FF      TT      00      00      66      66      FF      00      00      00      00      11
FF      TT      000000000      666666666666      FF      000000000      000000000      11
FF      TT      0000000      666666666666      FF      0000000      0000000      11

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THREE-DIMENSIONAL BOUNDARY LAYER PROGRAM
FOR
LAMINAR OR TURBULENT FLOW
WITH
BINARY GAS INJECTION
DEVELOPED BY
M.C. FRIEDERS
AEROSPACE ENGINEERING DEPARTMENT
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
BLACKSBURG, VA. 24060

INPUT DATA CARDS ARE AS FOLLOWS:

	BLUNT CONE	LAMINAR	ALPHA=5	REINF=1.2006/FT	NASA TN D-5450
CARD 001	IF	I3	COL 50-52	101	
CARD 002	INJCT	I3	COL 50-52	000	
CARD 003	KADETA	I3	COL 50-52	001	
CARD 004	KFND2	I3	COL 50-52	013	
CARD 005	KONSET	I3	COL 50-52	000	
CARD 006	KPRT	I3	COL 50-52	003	
CARD 007	KTRANS	I3	COL 50-52	000	
CARD 008	LAMTRB	I3	COL 50-52	001	
CARD 009	LPRT	I3	COL 50-52	001	
CARD 010	NIT1	I3	COL 50-52	005	
CARD 011	NIT2	I3	COL 50-52	010	
CARD 012	NIT3	I3	COL 50-52	020	
CARD 013	NOINJ	I3	COL 50-52	000	
CARD 014	NOSE	A5	COL 50-54	BLUNT	
CARD 015	NSOLVE	I3	COL 50-52	013	
CARD 016	KPLOT	4I3	COL 50-61	001004007000	
CARD 017	KPRFL	4I3	COL 50-61	001003000000	
CARD 018	LPLOT	4I3	COL 50-61	004006012000	
CARD 019	LPRFL	4I3	COL 50-61	001003000000	
CARD 020	ADTEST	E14.6	COL 50-63	0.001	
CARD 021	AKSTAR	E14.6	COL 50-63	0.435	
CARD 022	ALAMDA	E14.6	COL 50-63	0.09	
CARD 023	ALET	E14.6	COL 50-63	1.0	
CARD 024	ALPHA	E14.6	COL 50-63	5.0	
CARD 025	ASTAR	E14.6	COL 50-63	26.0	
CARD 026	CNOL	A3	COL 50-52	ABLATION	
CARD 027	CWALL	F14.6	COL 50-63	0.0	
CARD 028	CRI	F5.3	COL 50-54	1.0	
CARD 029	CONV	E14.6	COL 50-63	0.001	
CARD 030	DISK	A2	COL 50-51	NO	
CARD 031	DXINVS	E14.6	COL 50-63	0.04	
CARD 032	DXMAX	E14.6	COL 50-63	0.1	
CARD 033	DX1	F5.3	COL 50-54	0.01	
CARD 034	EDYLAH	A3	COL 50-52	REICHARDT	
CARD 035	ETAFAC	E14.6	COL 50-63	1.04	
CARD 036	ETAINF	E14.6	COL 50-63	6.0	
CARD 037	GAS2	A3	COL 50-52	AIR	
CARD 038	PLQT	A2	COL 50-51	NO	
CARD 039	PRL	E14.6	COL 50-63	0.71	

CARD	Q40	PRY	A5	COL 50-54	ROTTA
CARD	C41	PROP	A4	COL 50-53	PSTAG
CARD	Q42	RTW	E14.6	COL 50-63	0.27
CARD	Q43	TFS	E14.6	COL 50-63	0.0
CARD	Q44	TSTAG	E14.6	COL 50-63	2000.0
CARD	Q45	VALUE	E14.6	COL 50-63	1200.0
CARD	Q46	XRAR	E14.6	COL 50-63	2.0
CARD	Q47	RNOSE	E14.6	COL 50-63	0.09166
					0.0
					C.01
					0.177745
					0.260806
					0.343867
					0.511921
					0.678043
					0.786215
					1.010287
					1.176409
					1.344463
					1.510583
					1.7998

FREE STREAM, STAGNATION, AND VEHICLE DATA:

PSTAG = 0.120000D 04 PSIA
 TSTAG = 0.200000D 04 DEG.R
 HSTAG = 0.120237D 08 FT**2/SEC**2
 PINF = 0.191538D-01 PSIA
 PHOINF = 0.188451D-04 SLUGS/FT**3
 TINF = 0.852079D 02 DEG.R
 UINF = 0.479822D 04 FT/SEC
 MINF = 0.106900D 02
 CP/CV = 0.140900D 01
 R = 0.171767D 04 FT**2/SEC**2/DEG.R
 TW/TO = 0.270000D 00
 ALPHA = 0.500000D 01 DEG.
 THETAC = 0.150000D 02 DEG.

POINTS AT WHICH A SOLUTION IS TO BE OBTAINED:

I	XSTA(I)
1	0.0
2	0.010000
3	0.068364
4	0.068661
5	0.069524
6	0.070879
7	0.072615
8	0.074597
9	0.076680
10	0.078720
11	0.080587

12	0.082166
13	0.083363
14	0.084109
15	0.084362
16	0.177745
17	0.260806
18	0.343867
19	0.511921
20	0.678043
21	0.786215
22	1.010287
23	1.176409
24	1.344463
25	1.510583
26	1.790800

BLUNT CONE EDGE DATA

I	ZB(I)	XB(I)	RB(I)	PEB(I)	UEB(I)	TEB(I)	XMB(I)
1	0.0	0.0	0.0	0.4003460 03	0.0	0.2000000 04	0.0
2	0.5238740-04	0.3099130-02	0.3098530-02	0.3998300 03	0.9411290 02	0.1999260 04	0.4292200-01
3	0.1994510-03	0.6047860-02	0.6043470-02	0.3982830 03	0.1883300 03	0.1997050 04	0.8593930-01
4	0.4452580-03	0.9038300-02	0.9023660-02	0.3957060 03	0.2827740 03	0.1993350 04	0.1291560 00
5	0.7908150-03	0.1204910-01	0.1201440-01	0.3921020 03	0.3775410 03	0.1988150 04	0.1726660 00
6	0.1238430-02	0.1508450-01	0.1501650-01	0.3875170 03	0.4719560 03	0.1981470 04	0.2162090 00
7	0.1786770-02	0.1812790-01	0.1801000-01	0.3818290 03	0.5684830 03	0.1973120 04	0.2609800 00
8	0.2442900-02	0.2120930-01	0.2102060-01	0.3752070 03	0.6644290 03	0.1963280 04	0.3057900 00
9	0.3206090-02	0.2431460-01	0.2403040-01	0.3676090 03	0.7609520 03	0.1951840 04	0.3512380 00
10	0.4077230-02	0.2744170-01	0.2703360-01	0.3597360 03	0.8581360 03	0.1938730 04	0.3975260 00
11	0.5061510-02	0.3067300-01	0.3003760-01	0.3495040 03	0.9566900 03	0.1923880 04	0.4447830 00
12	0.6164700-02	0.3380850-01	0.3304710-01	0.3391540 03	0.1055950 04	0.1907260 04	0.4930640 00
13	0.7390850-02	0.3706080-01	0.3605920-01	0.3277380 03	0.1156010 04	0.1888860 04	0.5424100 00
14	0.8743170-02	0.4036020-01	0.3906860-01	0.3155690 03	0.1257200 04	0.1868550 04	0.5930870 00
15	0.1023000-01	0.4371880-01	0.4207990-01	0.3026130 03	0.1359430 04	0.1846300 04	0.6451670 00
16	0.1185890-01	0.4714390-01	0.4509260-01	0.2890210 03	0.1462070 04	0.1822210 04	0.6984460 00
17	0.1363740-01	0.5064170-01	0.4810430-01	0.2746590 03	0.1566450 04	0.1795870 04	0.7538770 00
18	0.1557260-01	0.5421700-01	0.5111040-01	0.2595280 03	0.1673660 04	0.1767030 04	0.8119190 00
19	0.1768170-01	0.5789080-01	0.5411810-01	0.2440220 03	0.1780970 04	0.1736200 04	0.8716120 00
20	0.1997490-01	0.6166940-01	0.5712100-01	0.2278070 03	0.1891560 04	0.1702420 04	0.9348700 00
21	0.2247470-01	0.6557740-01	0.6012450-01	0.2112180 03	0.2003850 04	0.1666040 04	0.1001130 01
22	0.2433450-01	0.6836430-01	0.6219990-01	0.1993180 03	0.2084370 04	0.1639660 04	0.1050010 01
23	0.2453590-01	0.6866060-01	0.6241720-01	0.1976920 03	0.2095380 04	0.1634840 04	0.1056800 01
24	0.2512650-01	0.6952350-01	0.6304640-01	0.1936500 03	0.2122810 04	0.1625210 04	0.1073790 01
25	0.2606600-01	0.7087890-01	0.6402330-01	0.1880740 03	0.2160730 04	0.1611700 04	0.1097550 01
26	0.2729040-01	0.7261510-01	0.6525420-01	0.1809390 03	0.2209460 04	0.1593990 04	0.1128520 01
27	0.2871620-01	0.7459690-01	0.6663060-01	0.1727540 03	0.2265730 04	0.1573050 04	0.1164940 01
28	0.3024630-01	0.7667960-01	0.6804350-01	0.1644260 03	0.2323500 04	0.1551000 04	0.1203100 01
29	0.3177640-01	0.7872050-01	0.6939390-01	0.1564050 03	0.2379750 04	0.1529000 04	0.1241070 01
30	0.3320220-01	0.8058750-01	0.7059920-01	0.1491850 03	0.2431010 04	0.1508490 04	0.1276390 01
31	0.3442660-01	0.8216600-01	0.7159540-01	0.1432810 03	0.2473430 04	0.1491180 04	0.1306170 01
32	0.3536610-01	0.8336260-01	0.7233640-01	0.1388710 03	0.2505450 04	0.1477920 04	0.1329000 01
33	0.3595670-01	0.8410860-01	0.7279220-01	0.1361330 03	0.2525490 04	0.1469540 04	0.1343450 01
34	0.3615820-01	0.8436200-01	0.7294590-01	0.1352190 03	0.2532210 04	0.1466710 04	0.1348320 01

S = 0.0
R = 0.0
XI = 0.0

S/REF= 0.0
R/REF= 0.0
DXI = 0.0

Z = 0.0
DX = 0.100000-01
DXDXI= 0.0

Z/REF= 0.0
NIT = 4
CHALL= 0.0

PHI = 0.0 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.400346D 03
DPEOX= 0.0
DPEOW= 0.0

TE = 0.200000D 04
DTEDX= 0.0
DTEDW= 0.0

UE = 0.0
DUEDX= 0.0
DUEDW= 0.0

VE = 0.0
DVEDX= 0.0
DVEDW= 0.0

MACHE = 0.0
RHOE = 0.116538D-03
RHOEMUE= 0.113454D-09

LOCAL EDGE REYNOLDS NUMBER =0.0

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.0
CHEDGE= 0.0
QW =-0.768619D-02

CFXEDG= 0.0
CHINF = 0.247440D-01
CHIMAX= 0.0

CFWINF= 0.0
STEEDG= 0.0

CFWEDG= 0.0
STINF = 0.188140D-01

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION= 0.0
TRANSVERSE SKIN FRICTION = 0.0
WALL HEAT TRANSFER RATE =-0.205774D 02 BTU

DELTA*(X) = 0.424945D-04
DELTA*(PHI)= 0.186914D-02
DELTA (FT) = 0.976163D-03

THETA(X) = 0.166479D-03
THETA(PHI)= 0.0

ETA	Y	F	FN	G	GN	H	MN	C	CN	V
0.0	0.0	0.0	0.545815	0.0	0.0	0.256579	0.267124	1.334317	-0.202861	0.0
0.039890	0.130D-05	0.005397	0.545625	0.0	0.0	0.259223	0.267537	1.332316	-0.201683	-0.267D-04
0.020587	0.209D-05	0.011233	0.545405	0.0	0.0	0.262087	0.267983	1.330166	-0.200436	-0.116D-03
0.032157	0.329D-05	0.017541	0.545145	0.0	0.0	0.265190	0.268464	1.327854	-0.199124	-0.282D-03
0.044671	0.460D-05	0.024361	0.544841	0.0	0.0	0.268553	0.268983	1.325371	-0.197745	-0.544D-03
0.058206	0.603D-05	0.031733	0.544484	0.0	0.0	0.272198	0.269544	1.322705	-0.196297	-0.924D-03
0.072845	0.761D-05	0.039701	0.544065	0.0	0.0	0.276148	0.270148	1.319842	-0.194781	-0.145D-02
0.088679	0.933D-05	0.048312	0.543573	0.0	0.0	0.280431	0.270799	1.316770	-0.193194	-0.214D-02
0.105805	0.112D-04	0.057617	0.542997	0.0	0.0	0.285075	0.271501	1.313476	-0.191538	-0.305D-02
0.124329	0.133D-04	0.067669	0.542322	0.0	0.0	0.290111	0.272256	1.309944	-0.189811	-0.421D-02
0.144364	0.156D-04	0.078527	0.541531	0.0	0.0	0.295574	0.273068	1.306160	-0.188013	-0.568D-02
0.166034	0.182D-04	0.090252	0.540603	0.0	0.0	0.301500	0.273940	1.302106	-0.186145	-0.750D-02
0.189472	0.213D-04	0.102910	0.539517	0.0	0.0	0.307932	0.274975	1.297766	-0.184205	-0.977D-02
0.214823	0.240D-04	0.116572	0.538245	0.0	0.0	0.314913	0.275875	1.293122	-0.182194	-0.126D-01
0.242243	0.275D-04	0.131310	0.536754	0.0	0.0	0.322492	0.276944	1.288155	-0.180111	-0.159D-01
0.271903	0.313D-04	0.147203	0.535007	0.0	0.0	0.330723	0.278082	1.282846	-0.177953	-0.201D-01
0.303977	0.355D-04	0.164332	0.532961	0.0	0.0	0.339662	0.279299	1.277174	-0.175718	-0.251D-01
0.338671	0.402D-04	0.182782	0.530563	0.0	0.0	0.349374	0.280565	1.271118	-0.173403	-0.311D-01
0.376197	0.454D-04	0.202640	0.527752	0.0	0.0	0.359928	0.281904	1.264657	-0.171001	-0.383D-01
0.416784	0.512D-04	0.223995	0.524457	0.0	0.0	0.371398	0.283298	1.257767	-0.168504	-0.470D-01
0.460684	0.577D-04	0.246935	0.520594	0.0	0.0	0.383867	0.284735	1.250428	-0.165902	-0.573D-01
0.508165	0.649D-04	0.271548	0.516063	0.0	0.0	0.397422	0.286196	1.242615	-0.163180	-0.696D-01
0.559522	0.730D-04	0.297918	0.510749	0.0	0.0	0.412158	0.287653	1.234309	-0.160320	-0.843D-01
0.615069	0.822D-04	0.326119	0.504517	0.0	0.0	0.428177	0.289064	1.225488	-0.157299	-0.102D 00
0.675148	0.924D-04	0.356215	0.497208	0.0	0.0	0.445585	0.290376	1.216134	-0.154087	-0.122D 00

0.740130	0.1040-03	0.388252	0.488640	0.0	0.0	0.464493	0.291511	1.206234	-0.150649	-0.1460	00
0.810415	0.1170-03	0.422250	0.478603	0.0	0.0	0.485016	0.292365	1.195775	-0.146942	-0.1750	00
0.886434	0.1320-03	0.458195	0.466859	0.0	0.0	0.507263	0.292803	1.184758	-0.142915	-0.2080	00
0.968657	0.1480-03	0.496029	0.453143	0.0	0.0	0.531339	0.292642	1.173187	-0.138509	-0.2470	00
1.057590	0.1670-03	0.535630	0.437168	0.0	0.0	0.557330	0.291650	1.161084	-0.133658	-0.2930	00
1.153779	0.1880-03	0.576805	0.418633	0.0	0.0	0.585295	0.289533	1.148484	-0.128288	-0.3470	00
1.257917	0.2120-03	0.619263	0.397242	0.0	0.0	0.615248	0.285928	1.135446	-0.122322	-0.4090	00
1.370345	0.2400-03	0.662603	0.372736	0.0	0.0	0.647136	0.280401	1.122052	-0.115684	-0.4810	00
1.492055	0.2710-03	0.706295	0.344936	0.0	0.0	0.690812	0.272461	1.108418	-0.108233	-0.5650	00
1.623697	0.3060-03	0.749667	0.313806	0.0	0.0	0.716002	0.261585	1.094696	-0.100129	-0.6600	00
1.766080	0.3460-03	0.791913	0.279537	0.0	0.0	0.752274	0.247277	1.081077	-0.091143	-0.7700	00
1.920082	0.3910-03	0.832109	0.242632	0.0	0.0	0.789008	0.229157	1.067793	-0.081382	-0.8950	00
2.086651	0.4420-03	0.869766	0.203987	0.0	0.0	0.825386	0.207092	1.055111	-0.070956	-0.1040	01
2.266812	0.4990-03	0.902420	0.164929	0.0	0.0	0.863408	0.181345	1.043320	-0.060074	-0.1200	01
2.461673	0.5640-03	0.930752	0.127153	0.0	0.0	0.892956	0.152709	1.032710	-0.049055	-0.1380	01
2.672436	0.6360-03	0.951724	0.092542	0.0	0.0	0.921919	0.122564	1.023538	-0.039323	-0.1570	01
2.900396	0.7150-03	0.971207	0.062845	0.0	0.0	0.946358	0.092790	1.015988	-0.029366	-0.1790	01
3.146959	0.8040-03	0.983540	0.039289	0.0	0.0	0.965696	0.065476	1.010134	-0.019662	-0.2030	01
3.413640	0.9000-03	0.991490	0.022265	0.0	0.0	0.979861	0.042473	1.005910	-0.012589	-0.2300	01
3.702083	0.1010-02	0.996093	0.011234	0.0	0.0	0.989325	0.024924	1.003119	-0.007323	-0.2580	01
4.014063	0.1120-02	0.998442	0.004942	0.0	0.0	0.994993	0.012984	1.001459	-0.003794	-0.2900	01
4.351501	0.1250-02	0.999475	0.001849	0.0	0.0	0.997973	0.005870	1.000090	-0.001710	-0.3230	01
4.716473	0.1380-02	0.999856	0.000571	0.0	0.0	0.999315	0.002240	1.000200	-0.000651	-0.3600	01
5.111227	0.1530-02	0.999969	0.000140	0.0	0.0	0.999817	0.000697	1.000054	-0.000203	-0.3990	01
5.538193	0.1690-02	0.999996	0.000026	0.0	0.0	0.999966	0.000169	1.000010	-0.000049	-0.4420	01
6.000000	0.1860-02	1.000000	-0.000000	0.0	0.0	1.000000	0.000012	1.000000	-0.000006	-0.4980	01

ETA	Y/L	ROROE	XMU	E+	CHI	LEL	LET	PRL	PPT	SP HY
0.0	0.0	3.70370	0.35070-06	0.0	0.0	1.000000	1.000000	0.737088	0.900000	0.60190 04
0.009893	0.5580-06	3.66595	0.35340-06	0.0	0.0	1.000000	1.000000	0.737122	0.900000	0.60210 04
0.020587	0.1170-05	3.62591	0.35710-06	0.0	0.0	1.000000	1.000000	0.737160	0.900000	0.60220 04
0.032157	0.1840-05	3.58352	0.36070-06	0.0	0.0	1.000000	1.000000	0.737203	0.900000	0.60230 04
0.044671	0.2570-05	3.53870	0.36460-06	0.0	0.0	1.000000	1.000000	0.737251	0.900000	0.60250 04
0.058206	0.3370-05	3.49138	0.36880-06	0.0	0.0	1.000000	1.000000	0.737306	0.900000	0.60260 04
0.072845	0.4250-05	3.44152	0.37340-06	0.0	0.0	1.000000	1.000000	0.737368	0.900000	0.60280 04
0.088579	0.5210-05	3.38906	0.37830-06	0.0	0.0	1.000000	1.000000	0.737439	0.900000	0.60300 04
0.105905	0.6270-05	3.33398	0.38350-06	0.0	0.0	1.000000	1.000000	0.737519	0.900000	0.60330 04
0.124329	0.7440-05	3.27626	0.38920-06	0.0	0.0	1.000000	1.000000	0.737611	0.900000	0.60360 04
0.144364	0.8720-05	3.21590	0.39540-06	0.0	0.0	1.000000	1.000000	0.737715	0.900000	0.60390 04
0.166034	0.1010-04	3.15291	0.40210-06	0.0	0.0	1.000000	1.000000	0.737834	0.900000	0.60430 04
0.189472	0.1170-04	3.08734	0.40920-06	0.0	0.0	1.000000	1.000000	0.737971	0.900000	0.60470 04
0.214823	0.1340-04	3.01923	0.41700-06	0.0	0.0	1.000000	1.000000	0.738127	0.900000	0.60520 04
0.242243	0.1530-04	2.94867	0.42530-06	0.0	0.0	1.000000	1.000000	0.738307	0.900000	0.60580 04
0.271900	0.1750-04	2.87576	0.43430-06	0.0	0.0	1.000000	1.000000	0.738513	0.900000	0.60640 04
0.303977	0.1980-04	2.80063	0.44400-06	0.0	0.0	1.000000	1.000000	0.738750	0.900000	0.60710 04
0.338671	0.2240-04	2.72343	0.45440-06	0.0	0.0	1.000000	1.000000	0.739022	0.900000	0.60780 04
0.376197	0.2530-04	2.64435	0.46560-06	0.0	0.0	1.000000	1.000000	0.739335	0.900000	0.60860 04
0.416784	0.2860-04	2.56358	0.47760-06	0.0	0.0	1.000000	1.000000	0.739695	0.900000	0.61010 04
0.460684	0.3220-04	2.48135	0.49060-06	0.0	0.0	1.000000	1.000000	0.740107	0.900000	0.61140 04
0.508165	0.3620-04	2.39794	0.50450-06	0.0	0.0	1.000000	1.000000	0.740590	0.900000	0.61290 04
0.559522	0.4080-04	2.31360	0.51940-06	0.0	0.0	1.000000	1.000000	0.741120	0.900000	0.61470 04
0.615069	0.4590-04	2.22866	0.53530-06	0.0	0.0	1.000000	1.000000	0.741737	0.900000	0.61660 04
0.675148	0.5160-04	2.14343	0.55240-06	0.0	0.0	1.000000	1.000000	0.742437	0.900000	0.61890 04
0.740130	0.5800-04	2.05826	0.57050-06	0.0	0.0	1.000000	1.000000	0.743229	0.900000	0.62150 04

0.810415	0.6530-04	1.97353	0.58990-06	0.0	0.0	1.000000	1.000000	0.744118	0.900000	0.62440 04
0.886434	0.7350-04	1.88962	0.61040-06	0.0	0.0	1.000000	1.000000	0.745111	0.900000	0.62770 04
0.968657	0.8270-04	1.80693	0.63210-06	0.0	0.0	1.000000	1.000000	0.746207	0.900000	0.63130 04
1.057590	0.9320-04	1.72589	0.65490-06	0.0	0.0	1.000000	1.000000	0.747406	0.900000	0.63530 04
1.153779	0.1050-03	1.64694	0.67890-06	0.0	0.0	1.000000	1.000000	0.748700	0.900000	0.63970 04
1.257817	0.1190-03	1.57054	0.70390-06	0.0	0.0	1.000000	1.000000	0.750075	0.900000	0.64440 04
1.370345	0.1340-03	1.49715	0.72960-06	0.0	0.0	1.000000	1.000000	0.751509	0.900000	0.64930 04
1.492055	0.1510-03	1.42726	0.75610-06	0.0	0.0	1.000000	1.000000	0.752975	0.900000	0.65450 04
1.623647	0.1710-03	1.36137	0.78280-06	0.0	0.0	1.000000	1.000000	0.754439	0.900000	0.65970 04
1.766080	0.1930-03	1.30000	0.80960-06	0.0	0.0	1.000000	1.000000	0.755866	0.900000	0.66480 04
1.922082	0.2180-03	1.24364	0.83590-06	0.0	0.0	1.000000	1.000000	0.757218	0.900000	0.66970 04
2.086651	0.2470-03	1.19279	0.86120-06	0.0	0.0	1.000000	1.000000	0.758466	0.900000	0.67420 04
2.266812	0.2790-03	1.14790	0.88480-06	0.0	0.0	1.000000	1.000000	0.759588	0.900000	0.67840 04
2.461673	0.3150-03	1.10932	0.90630-06	0.0	0.0	1.000000	1.000000	0.760569	0.900000	0.68300 04
2.672436	0.3550-03	1.07726	0.92500-06	0.0	0.0	1.000000	1.000000	0.761404	0.900000	0.68520 04
2.900396	0.3990-03	1.05173	0.94050-06	0.0	0.0	1.000000	1.000000	0.762088	0.900000	0.68780 04
3.146959	0.4490-03	1.03242	0.95250-06	0.0	0.0	1.000000	1.000000	0.762623	0.900000	0.68980 04
3.413640	0.5030-03	1.01876	0.96130-06	0.0	0.0	1.000000	1.000000	0.763013	0.900000	0.69130 04
3.702083	0.5620-03	1.00985	0.96700-06	0.0	0.0	1.000000	1.000000	0.763275	0.900000	0.69230 04
4.014063	0.6260-03	1.00459	0.97050-06	0.0	0.0	1.000000	1.000000	0.763433	0.900000	0.69290 04
4.351501	0.6960-03	1.00185	0.97230-06	0.0	0.0	1.000000	1.000000	0.763516	0.900000	0.69320 04
4.716473	0.7720-03	1.00063	0.97310-06	0.0	0.0	1.000000	1.000000	0.763553	0.900000	0.69340 04
5.111227	0.8540-03	1.00017	0.97340-06	0.0	0.0	1.000000	1.000000	0.763567	0.900000	0.69340 04
5.538193	0.9430-03	1.00003	0.97350-06	0.0	0.0	1.000000	1.000000	0.763571	0.900000	0.69340 04
6.000000	0.1040-02	1.00000	0.97350-06	0.0	0.0	1.000000	1.000000	0.763572	0.900000	0.69340 04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	1.000000	0.0	0.5400000 03	0.2700000 00	0.2809740 00	1.399289	0.4316200-03
0.009890	0.5580-06	1.000000	0.0	0.54555610 03	0.2727810 00	0.2813590 00	1.399192	0.4272210-03
0.020587	0.1170-05	1.000000	0.0	0.5515850 03	0.2757930 00	0.2817730 00	1.399083	0.4225550-03
0.032157	0.1840-05	1.000000	0.0	0.5581100 03	0.2790550 00	0.2822170 00	1.398959	0.4176150-03
0.044671	0.2570-05	1.000000	0.0	0.5651800 03	0.2825900 00	0.2826920 00	1.398820	0.4123910-03
0.058206	0.3370-05	1.000000	0.0	0.5728390 03	0.2864200 00	0.2832010 00	1.398662	0.4068770-03
0.072845	0.4250-05	1.000000	0.0	0.5811390 03	0.2905600 00	0.2837450 00	1.398483	0.4010660-03
0.088679	0.5210-05	1.000000	0.0	0.5901340 03	0.2950670 00	0.2843250 00	1.398280	0.3949530-03
0.105805	0.6270-05	1.000000	0.0	0.5998830 03	0.2999420 00	0.2849430 00	1.398049	0.3885340-03
0.124329	0.7440-05	1.000000	0.0	0.6104520 03	0.3052260 00	0.2856010 00	1.397786	0.3818070-03
0.144364	0.8720-05	1.000000	0.0	0.6219100 03	0.3109550 00	0.2862980 00	1.397487	0.3747730-03
0.166034	0.1010-04	1.000000	0.0	0.6343340 03	0.3171670 00	0.2870350 00	1.397144	0.3674330-03
0.189472	0.1170-04	1.000000	0.0	0.6478080 03	0.3239040 00	0.2878110 00	1.396752	0.3597900-03
0.214823	0.1340-04	1.000000	0.0	0.6624210 03	0.3312110 00	0.2886250 00	1.396304	0.3518530-03
0.242243	0.1530-04	1.000000	0.0	0.6782730 03	0.3391360 00	0.2894740 00	1.395790	0.3436300-03
0.271903	0.1750-04	1.000000	0.0	0.6954690 03	0.3477340 00	0.2903530 00	1.395201	0.3351340-03
0.303977	0.1980-04	1.000000	0.0	0.7141250 03	0.3570630 00	0.2912560 00	1.394525	0.3263780-03
0.338671	0.2240-04	1.000000	0.0	0.7343680 03	0.3671840 00	0.2921740 00	1.393750	0.3173820-03
0.376197	0.2530-04	1.000000	0.0	0.7563310 03	0.3781650 00	0.2930910 00	1.392861	0.3081650-03
0.416784	0.2860-04	1.000000	0.0	0.7801600 03	0.3900800 00	0.2939920 00	1.391842	0.2987530-03
0.460684	0.3220-04	1.000000	0.0	0.8060110 03	0.4030060 00	0.2948510 00	1.390675	0.2891710-03
0.508165	0.3620-04	1.000000	0.0	0.8340510 03	0.4170250 00	0.2956350 00	1.389342	0.2794500-03
0.559522	0.4080-04	1.000000	0.0	0.8644530 03	0.4322260 00	0.2963040 00	1.387823	0.2696220-03
0.615069	0.4590-04	1.000000	0.0	0.8974010 03	0.4487010 00	0.2968030 00	1.386097	0.2597220-03
0.675148	0.5160-04	1.000000	0.0	0.9330850 03	0.4665420 00	0.2970630 00	1.384146	0.2497900-03
0.740130	0.5870-04	1.000000	0.0	0.9716930 03	0.4858470 00	0.2969880 00	1.381950	0.2398650-03
0.810415	0.6530-04	1.000000	0.0	0.1013410 04	0.5067060 00	0.2964720 00	1.379497	0.2299900-03

0.886434	0.7350-04	1.000000	0.0	0.105842D 04	0.529208D 00	0.295371D 00	1.376778	0.220211D-03
0.968657	0.8270-04	1.000000	0.0	0.110685D 04	0.553425D 00	0.293507D 00	1.373793	0.210575D-03
1.057590	0.9320-04	1.000000	0.0	0.115882D 04	0.579410D 00	0.290665D 00	1.370554	0.201131D-03
1.153779	0.1050-03	1.000000	0.0	0.121437D 04	0.607186D 00	0.286583D 00	1.367089	0.191931D-03
1.257817	0.1190-03	1.000000	0.0	0.127345D 04	0.636725D 00	0.280954D 00	1.363439	0.183026D-03
1.370345	0.1340-03	1.000000	0.0	0.133588D 04	0.667938D 00	0.273423D 00	1.359665	0.174474D-03
1.492755	0.1510-03	1.000000	0.0	0.140129D 04	0.700645D 00	0.263603D 00	1.355845	0.166329D-03
1.623657	0.1710-03	1.000000	0.0	0.146911D 04	0.734554D 00	0.251096D 00	1.352064	0.158651D-03
1.766080	0.1930-03	1.000000	0.0	0.153847D 04	0.769234D 00	0.235542D 00	1.348416	0.151498D-03
1.920082	0.2130-03	1.000000	0.0	0.160818D 04	0.807402D 00	0.216689D 00	1.344988	0.144931D-03
2.086651	0.2470-03	1.000000	0.0	0.167674D 04	0.838369D 00	0.194499D 00	1.341850	0.139005D-03
2.266812	0.2790-03	1.000000	0.0	0.174231D 04	0.871156D 00	0.169278D 00	1.339051	0.133773D-03
2.461673	0.3150-03	1.000000	0.0	0.180790D 04	0.901452D 00	0.141783D 00	1.336619	0.129278D-03
2.672436	0.3550-03	1.000000	0.0	0.185656D 04	0.928278D 00	0.113275D 00	1.334562	0.125542D-03
2.900396	0.3990-03	1.000000	0.0	0.190164D 04	0.950819D 00	0.854345D-01	1.332884	0.122565D-03
3.146959	0.4490-03	1.000000	0.0	0.193719D 04	0.968595D 00	0.601077D-01	1.331578	0.120316D-03
3.413640	0.5030-03	1.000000	0.0	0.196317D 04	0.981583D 00	0.389057D-01	1.330626	0.118724D-03
3.702183	0.5620-03	1.000000	0.0	0.198049D 04	0.990245D 00	0.227974D-01	1.329990	0.117686D-03
4.014063	0.6260-03	1.000000	0.0	0.199085D 04	0.995426D 00	0.118654D-01	1.329608	0.117073D-03
4.351501	0.6960-03	1.000000	0.0	0.199630D 04	0.998149D 00	0.536154D-02	1.329407	0.115754D-03
4.716473	0.7720-03	1.000000	0.0	0.199875D 04	0.999375D 00	0.204540D-02	1.329316	0.116610D-03
5.111227	0.8540-03	1.000000	0.0	0.199966D 04	0.999832D 00	0.636260D-03	1.329282	0.116557D-03
5.538193	0.9430-03	1.000000	0.0	0.199974D 04	0.999969D 00	0.154367D-03	1.329272	0.116541D-03
6.000000	0.1040-02	1.000000	0.0	0.200000D 04	0.100000D 01	0.112090D-04	1.329270	0.116538D-03

S = 0.100000D-01	S/REF= 0.109099D 00	Z = 0.544953D-03	Z/REF= 0.594538D-02	
R = 0.998017D-02	R/REF= 0.108883D 00	DX = 0.100000D-01	NIT = 6	PHI = 0.0 DEG.
XI = 0.872444D-14	DXI = 0.872444D-14	DXDXI= 0.286197D 12	CHALL= 0.0	

DIMENSIONAL EDGE PROPERTIES

PE = 0.394658D 03	TE = 0.199184D 04	UE = 0.313249D 03	VE = 0.0	MACHE = 0.143129D 00
DPEDX=-0.326481D 15	DTEDX=-0.471135D 15	DUEDX= 0.903529D 16	DVEDX= 0.0	RHOE = 0.115352D-03
DPEDW= 0.0	DTEDW= 0.0	DUEDW= 0.0	DVEDW= 0.0	RHOEMUE= 0.111987D-09

LOCAL EDGE REYNOLDS NUMBER =0.372198D 03

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.536694D-02	CFXEDG= 0.205721D 00	CFWINF= 0.0	CFWEDG= 0.0
CHEDGE= 0.728024D-01	CHINF = 0.290927D-01	STEDGE= 0.553550D-01	STINF = 0.221205D-01
QW =-0.9C3702D-02	CHIMAX= 0.398700D 01		

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION= 0.116427D 01 PSF	DELTA*(X) =-0.286064D-04	THETA(X) = 0.139779D-03
TRANSVERSE SKIN FRICTION = 0.0 PSF	DELTA*(PHI)= 0.187774D-02	THETA*(PHI)= 0.0
WALL HEAT TRANSFER RATE =-0.241938D 02 BTU	DELTA (FT) = 0.916414D-03	

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	1.051773	0.0	0.0	0.256579	0.310050	1.333307	-0.235281	0.0
0.009890	0.9870-06	0.010371	1.045401	0.0	0.0	0.259648	0.310629	1.330988	-0.233653	-0.1010-03
0.020587	0.2070-05	0.021516	1.038385	0.0	0.0	0.262974	0.311254	1.328498	-0.231938	-0.4340-03
0.032157	0.3250-05	0.033485	1.036640	0.0	0.0	0.266579	0.311926	1.325825	-0.230140	-0.1060-02
0.044671	0.4550-05	0.046329	1.022090	0.0	0.0	0.270487	0.312651	1.322957	-0.228259	-0.2030-02
0.058206	0.5980-05	0.060100	1.012654	0.0	0.0	0.274724	0.313430	1.319881	-0.226293	-0.3430-02
0.072845	0.7550-05	0.074849	1.002244	0.0	0.0	0.279319	0.314267	1.316583	-0.224244	-0.5350-02
0.098679	0.9270-05	0.090628	0.997766	0.0	0.0	0.284302	0.315166	1.313050	-0.222110	-0.7890-02
0.105805	0.1120-04	0.107488	0.978123	0.0	0.0	0.289708	0.316129	1.309265	-0.219893	-0.1120-01
0.124329	0.1330-04	0.125478	0.964210	0.0	0.0	0.295574	0.317159	1.305213	-0.217591	-0.1530-01
0.144364	0.1560-04	0.144644	0.948920	0.0	0.0	0.301939	0.318257	1.300878	-0.215206	-0.2050-01
0.166034	0.1810-04	0.165026	0.932146	0.0	0.0	0.308848	0.319425	1.296241	-0.212735	-0.2690-01
0.187472	0.2100-04	0.186659	0.913782	0.0	0.0	0.316350	0.320663	1.291286	-0.210178	-0.3480-01
0.214823	0.2410-04	0.209570	0.893724	0.0	0.0	0.324495	0.321968	1.285991	-0.207534	-0.4430-01
0.242243	0.2760-04	0.233777	0.871881	0.0	0.0	0.333343	0.323336	1.280339	-0.204767	-0.5570-01
0.271900	0.3150-04	0.259283	0.848171	0.0	0.0	0.342953	0.324760	1.274308	-0.201962	-0.6940-01
0.303977	0.3580-04	0.286678	0.822534	0.0	0.0	0.353394	0.326229	1.267877	-0.199022	-0.8560-01
0.338671	0.4060-04	0.314136	0.794934	0.0	0.0	0.364739	0.327724	1.261025	-0.195965	-0.1050 00
0.376157	0.4600-04	0.343410	0.765369	0.0	0.0	0.377066	0.329222	1.253732	-0.192776	-0.1270 00
0.4151784	0.5200-04	0.373632	0.733878	0.0	0.0	0.390459	0.330688	1.245976	-0.189436	-0.1540 00
0.460684	0.5370-04	0.405313	0.700544	0.0	0.0	0.405007	0.332077	1.237738	-0.185971	-0.1840 00
0.508165	0.6620-04	0.437737	0.665508	0.0	0.0	0.420806	0.333327	1.228998	-0.182108	-0.2200 00
0.559522	0.7470-04	0.470967	0.628966	0.0	0.0	0.437953	0.334359	1.219744	-0.178273	-0.2610 00
0.615169	0.8420-04	0.504842	0.591177	0.0	0.0	0.456549	0.335068	1.209962	-0.173979	-0.3070 00
0.675148	0.9500-04	0.539179	0.552454	0.0	0.0	0.476691	0.335321	1.199647	-0.169307	-0.3600 00
0.7403130	0.1070-03	0.573780	0.513160	0.0	0.0	0.498474	0.334951	1.188802	-0.164799	-0.4210 00
0.810415	0.1210-03	0.608433	0.473697	0.0	0.0	0.521982	0.333750	1.177438	-0.158952	-0.4880 00
0.896434	0.1360-03	0.642919	0.434477	0.0	0.0	0.547276	0.331468	1.165580	-0.152983	-0.5640 00
0.963657	0.1540-03	0.677017	0.395906	0.0	0.0	0.574393	0.327807	1.153270	-0.146425	-0.6480 00
1.057590	0.1740-03	0.710510	0.358349	0.0	0.0	0.603323	0.322423	1.140567	-0.139220	-0.7470 00
1.153779	0.1960-03	0.743185	0.327102	0.0	0.0	0.633997	0.314938	1.127555	-0.131320	-0.8490 00
1.257817	0.2270-03	0.774933	0.287369	0.0	0.0	0.666268	0.304957	1.114341	-0.122694	-0.9570 00
1.370345	0.2510-03	0.805247	0.254251	0.0	0.0	0.699890	0.292099	1.101060	-0.113347	-0.1080 01
1.492055	0.2840-03	0.834214	0.222752	0.0	0.0	0.734496	0.276047	1.087878	-0.103308	-0.1210 01
1.623697	0.3210-03	0.861503	0.192810	0.0	0.0	0.769587	0.256606	1.074983	-0.092662	-0.1360 01
1.764280	0.3630-03	0.886864	0.164349	0.0	0.0	0.804525	0.233783	1.062590	-0.081544	-0.1510 01
1.920082	0.4100-03	0.910025	0.137346	0.0	0.0	0.838548	0.207861	1.050923	-0.070152	-0.1670 01
2.086651	0.4430-03	0.930707	0.111897	0.0	0.0	0.870802	0.179464	1.040210	-0.058742	-0.1850 01
2.266312	0.5270-03	0.948651	0.088258	0.0	0.0	0.900409	0.149578	1.030658	-0.047625	-0.2040 01
2.461673	0.5870-03	0.963661	0.066838	0.0	0.0	0.926556	0.119520	1.022439	-0.037148	-0.2240 01
2.572436	0.6600-03	0.975660	0.048134	0.0	0.0	0.948606	0.090812	1.015659	-0.027563	-0.2460 01
2.900396	0.7410-03	0.984732	0.032599	0.0	0.0	0.966203	0.064983	1.010345	-0.019481	-0.2690 01
3.146759	0.8290-03	0.991142	0.020499	0.0	0.0	0.979357	0.043296	1.006428	-0.012826	-0.2940 01
3.413640	0.9250-03	0.995316	0.011794	0.0	0.0	0.989451	0.026499	1.003746	-0.007786	-0.3210 01
3.702283	0.1030-02	0.997783	0.006102	0.0	0.0	0.994181	0.014659	1.002067	-0.004285	-0.3490 01
4.014063	0.1140-02	0.999081	0.002782	0.0	0.0	0.997414	0.007189	1.001124	-0.002095	-0.3810 01
4.351501	0.1270-02	0.999675	0.001690	0.0	0.0	0.999013	0.003052	1.000658	-0.000888	-0.4140 01
4.716473	0.1400-02	0.999906	0.000656	0.0	0.0	0.999687	0.001089	1.000462	-0.000317	-0.4510 01
5.111227	0.1550-02	0.999979	0.000043	0.0	0.0	0.999922	0.000314	1.000394	-0.000091	-0.4900 01
5.538193	0.1700-02	0.999997	0.000018	0.0	0.0	0.999987	0.000069	1.000375	-0.000020	-0.5330 01
6.000000	0.1870-02	1.000000	-0.000000	0.0	0.0	1.000000	0.000002	1.000000	-0.002380	-0.5790 01

ETA Y/L ROROF XMU E+ CHI LEL LET PRL PRT SP HT

0.0	0.0	3.69060	0.35070-06	0.0	0.0	1.000000	1.000000	0.737088	0.900000	0.60190 04
0.009999	0.5510-06	3.64700	0.35430-06	0.0	0.37750-02	1.000000	1.000000	0.737128	0.900000	0.69210 04
0.020587	0.1160-05	3.60093	0.35820-06	0.0	0.15870-01	1.000000	1.000000	0.737172	0.900000	0.60220 04
0.032157	0.1820-05	3.55231	0.36230-06	0.0	0.37480-01	1.000000	1.000000	0.737223	0.900000	0.69240 04
0.044671	0.2540-05	3.50110	0.36680-06	0.0	0.69850-01	1.000000	1.000000	0.737280	0.900000	0.60250 04
0.058206	0.3340-05	3.44726	0.37170-06	0.0	0.11420 00	1.000000	1.000000	0.737345	0.900000	0.69270 04
0.072845	0.4220-05	3.39075	0.37700-06	0.0	0.17180 00	1.000000	1.000000	0.737420	0.900000	0.69300 04
0.089679	0.5180-05	3.33156	0.38260-06	0.0	0.24390 00	1.000000	1.000000	0.737505	0.900000	0.60320 04
0.105805	0.6240-05	3.26970	0.38870-06	0.0	0.33140 00	1.000000	1.000000	0.737602	0.900000	0.69350 04
0.124329	0.7410-05	3.20518	0.39530-06	0.0	0.43530 00	1.000000	1.000000	0.737714	0.900000	0.69390 04
0.144364	0.8700-05	3.13805	0.40250-06	0.0	0.55640 00	1.000000	1.000000	0.737842	0.900000	0.69430 04
0.166034	0.1010-04	3.06837	0.41010-06	0.0	0.69490 00	1.000000	1.000000	0.737989	0.900000	0.69490 04
0.183472	0.1170-04	2.97623	0.41840-06	0.0	0.85100 00	1.000000	1.000000	0.738158	0.900000	0.69530 04
0.214823	0.1350-04	2.92173	0.42730-06	0.0	0.10240 01	1.000000	1.000000	0.738352	0.900000	0.60590 04
0.242243	0.1540-04	2.84501	0.43670-06	0.0	0.12140 01	1.000000	1.000000	0.738576	0.900000	0.60660 04
0.271700	0.1760-04	2.76624	0.44720-06	0.0	0.14180 01	1.000000	1.000000	0.738833	0.900000	0.69740 04
0.303977	0.2000-04	2.68560	0.45830-06	0.0	0.16350 01	1.000000	1.000000	0.739130	0.900000	0.60830 04
0.333671	0.2270-04	2.60330	0.47030-06	0.0	0.18620 01	1.000000	1.000000	0.739472	0.900000	0.60940 04
0.376197	0.2570-04	2.51959	0.48310-06	0.0	0.20960 01	1.000000	1.000000	0.739864	0.900000	0.61070 04
0.416784	0.2900-04	2.43474	0.49680-06	0.0	0.23320 01	1.000000	1.000000	0.740315	0.900000	0.61210 04
0.460684	0.3290-04	2.34904	0.51150-06	0.0	0.25670 01	1.000000	1.000000	0.740831	0.900000	0.61370 04
0.508165	0.3700-04	2.26281	0.52730-06	0.0	0.27960 01	1.000000	1.000000	0.741421	0.900000	0.61560 04
0.559522	0.4170-04	2.17640	0.54410-06	0.0	0.30150 01	1.000000	1.000000	0.742092	0.900000	0.61780 04
0.615069	0.4700-04	2.09017	0.56200-06	0.0	0.32190 01	1.000000	1.000000	0.742851	0.900000	0.62020 04
0.675148	0.5310-04	2.00450	0.58100-06	0.0	0.34020 01	1.000000	1.000000	0.743705	0.900000	0.62300 04
0.740130	0.5980-04	1.91980	0.60120-06	0.0	0.35630 01	1.000000	1.000000	0.744659	0.900000	0.62620 04
0.814415	0.6750-04	1.83650	0.62240-06	0.0	0.36980 01	1.000000	1.000000	0.745713	0.900000	0.62960 04
0.886434	0.7620-04	1.75502	0.64480-06	0.0	0.38080 01	1.000000	1.000000	0.746868	0.900000	0.63350 04
0.968557	0.8600-04	1.67580	0.66810-06	0.0	0.38900 01	1.000000	1.000000	0.748114	0.900000	0.63770 04
1.057590	0.9710-04	1.59930	0.69240-06	0.0	0.39470 01	1.000000	1.000000	0.749440	0.900000	0.64220 04
1.153779	0.1100-03	1.52595	0.71740-06	0.0	0.39780 01	1.000000	1.000000	0.750826	0.900000	0.64700 04
1.257117	0.1240-03	1.45619	0.74290-06	0.0	0.39870 01	1.000000	1.000000	0.752248	0.900000	0.65190 04
1.370345	0.1400-03	1.39046	0.76880-06	0.0	0.39730 01	1.000000	1.000000	0.753674	0.900000	0.65690 04
1.492055	0.1580-03	1.32016	0.79460-06	0.0	0.39340 01	1.000000	1.000000	0.755071	0.900000	0.66190 04
1.623697	0.1790-03	1.27268	0.82000-06	0.0	0.38680 01	1.000000	1.000000	0.756408	0.900000	0.66670 04
1.766080	0.2030-03	1.22135	0.84460-06	0.0	0.37670 01	1.000000	1.000000	0.757656	0.900000	0.67130 04
1.920082	0.2290-03	1.17548	0.86800-06	0.0	0.36220 01	1.000000	1.000000	0.758793	0.900000	0.67540 04
2.086651	0.2580-03	1.13528	0.88950-06	0.0	0.34230 01	1.000000	1.000000	0.759805	0.900000	0.67920 04
2.266812	0.2910-03	1.10090	0.90890-06	0.0	0.31600 01	1.000000	1.000000	0.760686	0.900000	0.68250 04
2.461673	0.3280-03	1.07234	0.92560-06	0.0	0.28260 01	1.000000	1.000000	0.761433	0.900000	0.68530 04
2.672436	0.3690-03	1.04947	0.93960-06	0.0	0.24260 01	1.000000	1.000000	0.762048	0.900000	0.68760 04
2.900396	0.4140-03	1.03195	0.95050-06	0.0	0.19760 01	1.000000	1.000000	0.762533	0.900000	0.68950 04
3.146959	0.4630-03	1.01926	0.95860-06	0.0	0.15350 01	1.000000	1.000000	0.762895	0.900000	0.69080 04
3.413543	0.5150-03	1.01068	0.96420-06	0.0	0.10540 01	1.000000	1.000000	0.763145	0.900000	0.69180 04
3.702083	0.5750-03	1.00535	0.96770-06	0.0	0.06670 00	1.000000	1.000000	0.763303	0.900000	0.69240 04
4.014063	0.6390-03	1.00237	0.96960-06	0.0	0.37190 00	1.000000	1.000000	0.763392	0.900000	0.69270 04
4.351501	0.7070-03	1.00090	0.97060-06	0.0	0.17820 00	1.000000	1.000000	0.763437	0.900000	0.69290 04
4.716473	0.7820-03	1.00029	0.97100-06	0.0	0.71070-01	1.000000	1.000000	0.763455	0.900000	0.69300 04
5.111227	0.8630-03	1.00007	0.97110-06	0.0	0.22570-01	1.000000	1.000000	0.763462	0.900000	0.69300 04
5.538193	0.9500-03	1.00001	0.97120-06	0.0	0.53280-02	1.000000	1.000000	0.763464	0.900000	0.69300 04
6.000000	0.1040-02	1.00000	0.97080-06	0.0	-0.68920-04	1.000000	1.000000	0.763448	0.900000	0.69290 04

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TEMP

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CP/CV

RHO

AEDC-TR-75-55

0.0	0.0	1.000000	0.0	0.5400000 03	0.2711060 00	0.3274630 00	1.399289	0.4254880-03
0.009890	0.5510-06	1.000000	0.0	0.5464550 03	0.2743470 00	0.3279190 00	1.399176	0.4204610-03
0.020587	0.1160-05	1.000000	0.0	0.5534470 03	0.2778570 00	0.3284090 00	1.399048	0.4151490-03
0.032157	0.1820-05	1.000000	0.0	0.5610220 03	0.2816600 00	0.3289330 00	1.398902	0.4095440-03
0.044671	0.2540-05	1.000000	0.0	0.5692270 03	0.2857800 00	0.3294950 00	1.398737	0.4036610-03
0.058206	0.3340-05	1.000000	0.0	0.5781190 03	0.2902440 00	0.3300060 00	1.398549	0.3974330-03
0.072345	0.4220-05	1.000000	0.0	0.5877530 03	0.2950810 00	0.3307360 00	1.398335	0.3909180-03
0.088679	0.5180-05	1.000000	0.0	0.5981950 03	0.3003230 00	0.3314170 00	1.398090	0.3840940-03
0.105905	0.6240-05	1.000000	0.0	0.6095130 03	0.3060950 00	0.3321400 00	1.397810	0.3769620-03
0.124329	0.7410-05	1.000000	0.0	0.6217820 03	0.3121650 00	0.3329030 00	1.397490	0.3695240-03
0.144364	0.8790-05	1.000000	0.0	0.6359830 03	0.3188430 00	0.3337060 00	1.397173	0.3617650-03
0.166034	0.1010-04	1.000000	0.0	0.6495050 03	0.3260830 00	0.3345450 00	1.396702	0.3537510-03
0.189472	0.1170-04	1.000000	0.0	0.6651440 03	0.3339350 00	0.3354160 00	1.396218	0.3454340-03
0.214823	0.1350-04	1.000000	0.0	0.68271040 03	0.3424400 00	0.3363120 00	1.395662	0.3368450-03
0.242243	0.1540-04	1.000000	0.0	0.7004970 03	0.3516840 00	0.3372230 00	1.395023	0.3280000-03
0.271900	0.1760-04	1.000000	0.0	0.7204450 03	0.3616980 00	0.3381330 00	1.394288	0.3189190-03
0.303977	0.2030-04	1.000000	0.0	0.7420780 03	0.3725590 00	0.3390230 00	1.393443	0.3096210-03
0.338671	0.2270-04	1.000000	0.0	0.7655370 03	0.3843370 00	0.3398660 00	1.392474	0.3013400-03
0.376197	0.2570-04	1.000000	0.0	0.7909700 03	0.3971050 00	0.3406270 00	1.391361	0.2904830-03
0.416784	0.2930-04	1.000000	0.0	0.8185350 03	0.4109440 00	0.3412600 00	1.390088	0.2807010-03
0.463684	0.3280-04	1.000000	0.0	0.8483980 03	0.4259370 00	0.3417060 00	1.388634	0.2709200-03
0.508165	0.3700-04	1.000000	0.0	0.8807270 03	0.4421680 00	0.3418900 00	1.386980	0.2608790-03
0.559522	0.4170-04	1.000000	0.0	0.9156960 03	0.4597240 00	0.3417170 00	1.385107	0.2509160-03
0.615069	0.4700-04	1.000000	0.0	0.9534750 03	0.4786910 00	0.3410720 00	1.382996	0.2409750-03
0.675148	0.5310-04	1.000000	0.0	0.9942240 03	0.4991490 00	0.3398120 00	1.380635	0.2310950-03
0.740130	0.5980-04	1.000000	0.0	0.1038090 04	0.5211730 00	0.3377660 00	1.378014	0.2213330-03
0.810415	0.6750-04	1.000000	0.0	0.1085180 04	0.5448110 00	0.3347330 00	1.375134	0.2117250-03
0.886434	0.7620-04	1.000000	0.0	0.1135560 04	0.5701050 00	0.3304790 00	1.372006	0.2023350-03
0.968657	0.8630-04	1.000000	0.0	0.1189240 04	0.5970540 00	0.3247430 00	1.368655	0.1932020-03
1.057590	0.9710-04	1.000000	0.0	0.1246130 04	0.6256150 00	0.3172380 00	1.365120	0.1843820-03
1.153779	0.1100-03	1.000000	0.0	0.1376020 04	0.6556870 00	0.3076650 00	1.361457	0.1750200-03
1.257317	0.1240-03	1.000000	0.0	0.1368580 04	0.6870960 00	0.2957280 00	1.357735	0.1678840-03
1.370345	0.1430-03	1.000000	0.0	0.1433280 04	0.7195770 00	0.2811650 00	1.354036	0.1603060-03
1.492055	0.1580-03	1.000000	0.0	0.1499380 04	0.7527620 00	0.2637770 00	1.350444	0.1532370-03
1.623697	0.1790-03	1.000000	0.0	0.1565930 04	0.7861720 00	0.2434830 00	1.347037	0.1467270-03
1.766780	0.2030-03	1.000000	0.0	0.1631740 04	0.8192110 00	0.2203710 00	1.343884	0.1408090-03
1.920082	0.2290-03	1.000000	0.0	0.1695420 04	0.8511810 00	0.1947610 00	1.341033	0.1355700-03
2.086651	0.2580-03	1.000000	0.0	0.1755440 04	0.8813170 00	0.1672530 00	1.338512	0.1308850-03
2.265812	0.2910-03	1.000000	0.0	0.1810270 04	0.9088420 00	0.1387510 00	1.336332	0.1269220-03
2.461673	0.3280-03	1.000000	0.0	0.1858480 04	0.9330450 00	0.1104310 00	1.334490	0.1236300-03
2.672436	0.3690-03	1.000000	0.0	0.1878990 04	0.9533830 00	0.8363600-01	1.332982	0.1200930-03
2.900396	0.4140-03	1.000000	0.0	0.1931220 04	0.9695680 00	0.5969850-01	1.331797	0.1189730-03
3.146499	0.4630-03	1.000000	0.0	0.1955270 04	0.9816390 00	0.3973310-01	1.330916	0.1175100-03
3.413640	0.5160-03	1.000000	0.0	0.1971870 04	0.9899730 00	0.2427050-01	1.330307	0.1165210-03
3.702083	0.5750-03	1.000000	0.0	0.1982320 04	0.9952190 00	0.1341730-01	1.329923	0.1159060-03
4.014063	0.6390-03	1.000000	0.0	0.1988210 04	0.9981780 00	0.6577820-02	1.329706	0.1155630-03
4.351501	0.7070-03	1.000000	0.0	0.1991120 04	0.9996410 00	0.2792350-02	1.329598	0.1153040-03
4.716473	0.7820-03	1.000000	0.0	0.1992350 04	0.1000260 01	0.9964790-03	1.329553	0.1153230-03
5.111227	0.8630-03	1.000000	0.0	0.1992780 04	0.1000470 01	0.2877070-03	1.329537	0.1152980-03
5.538193	0.9530-03	1.000000	0.0	0.1992900 04	0.1000530 01	0.6351720-04	1.329533	0.1152910-03
6.000000	0.1040-02	1.000000	0.0	0.1991840 04	0.1000000 01	-0.3486210-02	1.329572	0.1152900-03

R = 0.294672D-01 R/REF= 0.321484D 00
 XI = 0.648152D-12 DXI = 0.639427D-12

DX = 0.20000D-01 NIT = 5
 DXDXI= 0.121861D 11 CHALL= 0.0

PHI = 0.0 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.351385D 03 TE = 0.192683D 04
 DPEDX=-0.377159D 14 DTEDX=-0.590884D 14
 DPEDW= 0.0 DTEDW= 0.0

UE = 0.937958D 03 VE = 0.0
 DUEDX= 0.378741D 15 DVEDX= 0.0
 DUEDW= 0.0 DVEDW= 0.0

MACHE = 0.435740D 00
 RHOE = 0.106169D-03
 RHOEMUE= 0.100757D-09

LOCAL EDGE REYNOLDS NUMBER =0.314796D 04

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.110880D-01 CFXEDG= 0.515047D-01
 CHINF = 0.242398D-01
 QW =-0.752957D-02 CHIMAX= 0.151828D 02

CFWINF= 0.0 CFMEDG= 0.0
 STEDGE= 0.167354D-01 STINF = 0.184306D-01

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION= 0.240538D 01 PSF
 TRANSVERSE SKIN FRICTION = 0.0 PSF
 WALL HEAT TRANSFER RATE =-0.201581D 02 BTU

DELTA*(X) =-0.763924D-05 THETA(X) = 0.155293D-03
 DELTA*(PHI)= 0.197235D-02 THETA(PHI)= 0.0
 DELTA (FT) = 0.981965D-03

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	0.791140	0.0	0.0	0.256579	0.282872	1.325264	-0.213362	0.0
0.009890	0.108D-05	0.007814	0.788986	0.0	0.0	0.259379	0.283447	1.323161	-0.211816	-0.130D-04
0.020587	0.225D-05	0.016241	0.786604	0.0	0.0	0.262415	0.284067	1.320904	-0.210185	-0.567D-04
0.032157	0.354D-05	0.025326	0.783961	0.0	0.0	0.265705	0.284735	1.318483	-0.208471	-0.140D-03
0.044671	0.495D-05	0.035119	0.781024	0.0	0.0	0.269273	0.285454	1.315885	-0.206673	-0.272D-03
0.058236	0.650D-05	0.045668	0.777758	0.0	0.0	0.273142	0.286226	1.313101	-0.204792	-0.467D-03
0.072845	0.820D-05	0.057027	0.774125	0.0	0.0	0.277338	0.287057	1.310117	-0.202827	-0.740D-03
0.088679	0.101D-04	0.069253	0.770078	0.0	0.0	0.281890	0.287948	1.306922	-0.200777	-0.111D-02
0.105805	0.121D-04	0.082403	0.765569	0.0	0.0	0.286830	0.288904	1.303502	-0.198645	-0.160D-02
0.124329	0.144D-04	0.096538	0.760541	0.0	0.0	0.292191	0.289928	1.299843	-0.196431	-0.224D-02
0.144364	0.169D-04	0.111720	0.754933	0.0	0.0	0.298011	0.291024	1.295931	-0.194136	-0.307D-02
0.166034	0.196D-04	0.128012	0.748676	0.0	0.0	0.304330	0.292193	1.291750	-0.191762	-0.414D-02
0.187472	0.226D-04	0.145479	0.741693	0.0	0.0	0.311193	0.293440	1.287284	-0.189311	-0.548D-02
0.214823	0.263D-04	0.164183	0.733900	0.0	0.0	0.318649	0.294764	1.282517	-0.186785	-0.718D-02
0.242243	0.297D-04	0.184188	0.725207	0.0	0.0	0.326751	0.296167	1.277432	-0.184185	-0.932D-02
0.271900	0.338D-04	0.205553	0.715512	0.0	0.0	0.335556	0.297647	1.272010	-0.181512	-0.120D-01
0.303977	0.394D-04	0.229332	0.704709	0.0	0.0	0.345129	0.299200	1.266212	-0.178768	-0.153D-01
0.338671	0.435D-04	0.252575	0.692684	0.0	0.0	0.355538	0.300820	1.260079	-0.175952	-0.195D-01
0.376197	0.492D-04	0.278319	0.679319	0.0	0.0	0.366858	0.302495	1.253532	-0.173060	-0.246D-01
0.415784	0.555D-04	0.305592	0.664490	0.0	0.0	0.379171	0.304209	1.246549	-0.170090	-0.310D-01
0.460684	0.626D-04	0.334404	0.648075	0.0	0.0	0.392564	0.305936	1.239170	-0.167031	-0.388D-01
0.508165	0.715D-04	0.364748	0.629955	0.0	0.0	0.407132	0.307642	1.231314	-0.163874	-0.445D-01
0.559522	0.793D-04	0.396590	0.610020	0.0	0.0	0.422975	0.309279	1.222983	-0.160601	-0.604D-01
0.615069	0.892D-04	0.429369	0.588176	0.0	0.0	0.440198	0.310781	1.214158	-0.157188	-0.749D-01
0.675148	0.100D-03	0.464492	0.564354	0.0	0.0	0.458411	0.312061	1.204823	-0.153604	-0.927D-01
0.742133	0.113D-03	0.503325	0.538515	0.0	0.0	0.479224	0.313001	1.194965	-0.149809	-0.114D 00
0.812415	0.127D-03	0.537194	0.510664	0.0	0.0	0.501244	0.313449	1.184579	-0.145753	-0.140D 00

0.242243	0.340D-04	1.000000	0.0	0.667642D 03	0.455196D 00	0.337457D 00	1.396138	0.117911D-03
0.271903	0.387D-04	1.000000	0.0	0.682212D 03	0.465135D 00	0.332476D 00	1.395658	0.115393D-03
0.303977	0.438D-04	1.000000	0.0	0.697730D 03	0.475710D 00	0.327230D 00	1.395121	0.112827D-03
0.338671	0.495D-04	1.000000	0.0	0.714241D 03	0.486967D 00	0.321725D 00	1.394521	0.110218D-03
0.376197	0.558D-04	1.000000	0.0	0.731788D 03	0.498931D 00	0.315975D 00	1.393851	0.107575D-03
0.416784	0.628D-04	1.000000	0.0	0.750419D 03	0.511633D 00	0.309996D 00	1.393105	0.104905D-03
0.460684	0.705D-04	1.000000	0.0	0.770177D 03	0.525104D 00	0.303813D 00	1.392275	0.102213D-03
0.508165	0.791D-04	1.000000	0.0	0.791111D 03	0.539377D 00	0.297455D 00	1.391355	0.099527D-04
0.559522	0.897D-04	1.000000	0.0	0.813269D 03	0.554486D 00	0.290959D 00	1.390337	0.096797D-04
0.615069	0.993D-04	1.000000	0.0	0.836700D 03	0.570459D 00	0.284367D 00	1.389213	0.094086D-04
0.675148	0.111D-03	1.000000	0.0	0.861460D 03	0.587361D 00	0.277724D 00	1.387976	0.091382D-04
0.740133	0.124D-03	1.000000	0.0	0.887607D 03	0.605167D 00	0.271074D 00	1.386619	0.088690D-04
0.810415	0.139D-03	1.000000	0.0	0.915703D 03	0.623982D 00	0.264458D 00	1.385134	0.0850164D-04
0.886434	0.155D-03	1.000000	0.0	0.944316D 03	0.643832D 00	0.257903D 00	1.383515	0.0833645D-04
0.968557	0.174D-03	1.000000	0.0	0.975019D 03	0.664764D 00	0.251414D 00	1.381758	0.0807394D-04
1.057593	0.194D-03	1.000000	0.0	0.100738D 04	0.686831D 00	0.244958D 00	1.379856	0.0781455D-04
1.153779	0.217D-03	1.000000	0.0	0.104148D 04	0.710075D 00	0.238449D 00	1.377809	0.0755974D-04
1.257817	0.243D-03	1.000000	0.0	0.107735D 04	0.734531D 00	0.231723D 00	1.375617	0.0730728D-04
1.370345	0.271D-03	1.000000	0.0	0.111500D 04	0.760202D 00	0.224521D 00	1.373286	0.0706032D-04
1.490055	0.303D-03	1.000000	0.0	0.115437D 04	0.787045D 00	0.216470D 00	1.370832	0.0681952D-04
1.623597	0.339D-03	1.000000	0.0	0.119528D 04	0.814938D 00	0.207086D 00	1.368278	0.0658611D-04
1.766380	0.379D-03	1.000000	0.0	0.123738D 04	0.843644D 00	0.195803D 00	1.365660	0.0636201D-04
1.920082	0.424D-03	1.000000	0.0	0.128010D 04	0.872770D 00	0.182039D 00	1.363032	0.0614970D-04
2.086651	0.475D-03	1.000000	0.0	0.132259D 04	0.901713D 00	0.165359D 00	1.360459	0.0595212D-04
2.266812	0.531D-03	1.000000	0.0	0.136373D 04	0.929785D 00	0.145631D 00	1.358020	0.0577259D-04
2.461673	0.594D-03	1.000000	0.0	0.140217D 04	0.955994D 00	0.123236D 00	1.355794	0.0561434D-04
2.672436	0.663D-03	1.000000	0.0	0.143651D 04	0.979408D 00	0.091834D-01	1.353856	0.0548012D-04
2.900396	0.740D-03	1.000000	0.0	0.146552D 04	0.999189D 00	0.0750543D-01	1.352259	0.0537163D-04
3.146959	0.824D-03	1.000000	0.0	0.148843D 04	0.101480D 01	0.0527233D-01	1.351025	0.0528099D-04
3.413540	0.917D-03	1.000000	0.0	0.150509D 04	0.102616D 01	0.0338924D-01	1.350143	0.0520442D-04
3.702083	0.102D-02	1.000000	0.0	0.151609D 04	0.103367D 01	0.0196145D-01	1.349569	0.0519245D-04
4.014063	0.113D-02	1.000000	0.0	0.152258D 04	0.103809D 01	0.000262D-01	1.349232	0.0517034D-04
4.351501	0.125D-02	1.000000	0.0	0.152591D 04	0.104036D 01	0.042358D-02	1.349059	0.0515054D-04
4.716473	0.138D-02	1.000000	0.0	0.152737D 04	0.104136D 01	0.0163650D-02	1.348984	0.0515410D-04
5.111227	0.152D-02	1.000000	0.0	0.152790D 04	0.104172D 01	0.0487367D-03	1.348957	0.0515237D-04
5.538193	0.167D-02	1.000000	0.0	0.152805D 04	0.104182D 01	0.0106968D-03	1.348949	0.0515183D-04
6.000000	0.183D-02	1.000000	0.0	0.146671D 04	0.100000D 01	-0.268301D 00	1.352194	0.0515102D-04

S = 0.963631D-01
R = 0.795677D-01
XI = 0.322518D-10

S/REF= 0.105131D 01
R/REF= 0.868074D 00
DXI = 0.124199D-10

Z = 0.461569D-01
DX = 0.200000D-01
DXDXI= 0.157400D 10

Z/REF= 0.503566D 00
NIT = 3
CWALL= 0.0

PHI = 0.0 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.121875D 03
DPEOX=-0.565725D 13
DPEOW= 0.0

TE = 0.142439D 04
DTEOX=-0.168633D 14
DTEOW= 0.0

UE = 0.263253D 04
DUEOX= 0.431407D 14
DUEOW= 0.0

VE = 0.0
DVEDX= 0.0
DVEDW= 0.281282D 03

MACHE = 0.142241D 01
RHOE = 0.498133D-04
RHOEMUE= 0.381196D-10

LOCAL EDGE REYNOLDS NUMBER =0.165130D 05

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.119588D-01
 CMEDGE= 0.606729D-02
 QW --0.27324D-02

CFXEDG= 0.150298D-01
 CHINF = 0.879905D-02
 CHIMAX= 0.562547D 02

CFWINF= 0.0
 STEEDGE= 0.461324D-02

CFWEDG= 0.541733D-03
 STINF = 0.669032D-02

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION= 0.259428D 01 PSF
 TRANSVERSE SKIN FRICTION = 0.0 PSF
 WALL HEAT TRANSFER RATE --0.731739D 01 BTU

DELTA*(X) = 0.818847D-04
 DELTA*(PHI)= 0.280447D-02
 DELTA (FT) = 0.200869D-02

THETA(X) = 0.305268D-03
 THETA(PHI)= 0.661015D-03

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	0.784221	0.0	0.028266	0.256579	0.275560	1.263972	-0.198230	0.0
0.009893	0.277D-05	0.007746	0.782247	0.000278	0.027987	0.259311	0.276869	1.262026	-0.195310	-0.320D-04
0.020587	0.581D-05	0.016102	0.780054	0.000576	0.027680	0.262289	0.278272	1.259953	-0.192229	-0.139D-03
0.032157	0.913D-05	0.025113	0.777610	0.000894	0.027343	0.265508	0.279775	1.257748	-0.188995	-0.338D-03
0.044671	0.128D-04	0.034827	0.774883	0.001234	0.026971	0.269019	0.281381	1.255405	-0.186607	-0.653D-03
0.058206	0.167D-04	0.045295	0.771837	0.001596	0.026563	0.272840	0.283096	1.252917	-0.182066	-0.111D-02
0.072845	0.211D-04	0.056569	0.768433	0.001982	0.026114	0.276997	0.284924	1.250279	-0.178372	-0.174D-02
0.088679	0.259D-04	0.068707	0.764628	0.002392	0.025622	0.281524	0.286A68	1.247445	-0.174528	-0.257D-02
0.105905	0.312D-04	0.081766	0.760372	0.002826	0.025081	0.286455	0.288931	1.244530	-0.170538	-0.367D-02
0.124329	0.369D-04	0.095807	0.755609	0.003285	0.024489	0.291877	0.291115	1.241410	-0.166408	-0.506D-02
0.144364	0.433D-04	0.110893	0.750279	0.003769	0.023841	0.297683	0.293420	1.238119	-0.162145	-0.683D-02
0.166034	0.503D-04	0.127087	0.744314	0.004278	0.023134	0.304068	0.295844	1.234654	-0.157759	-0.903D-02
0.189472	0.580D-04	0.144455	0.737638	0.004811	0.022365	0.311032	0.298383	1.231010	-0.153261	-0.118D-01
0.214823	0.665D-04	0.163061	0.730169	0.005368	0.021530	0.318630	0.301030	1.227183	-0.148667	-0.151D-01
0.242243	0.759D-04	0.182969	0.721818	0.005946	0.020626	0.326922	0.303771	1.223172	-0.143993	-0.192D-01
0.271909	0.862D-04	0.204238	0.712487	0.006543	0.019654	0.335974	0.306592	1.218973	-0.139259	-0.242D-01
0.303977	0.977D-04	0.226927	0.702072	0.007157	0.018611	0.345855	0.309469	1.214584	-0.134499	-0.303D-01
0.338671	0.110D-03	0.251085	0.690461	0.007783	0.017500	0.356643	0.312372	1.210003	-0.129708	-0.375D-01
0.376197	0.124D-03	0.276754	0.677539	0.008417	0.016324	0.368421	0.315263	1.205227	-0.124946	-0.463D-01
0.415784	0.140D-03	0.303964	0.663187	0.009055	0.015088	0.381275	0.318090	1.200235	-0.120235	-0.568D-01
0.460684	0.157D-03	0.332731	0.647283	0.009688	0.013802	0.395301	0.320793	1.195079	-0.115609	-0.693D-01
0.508165	0.176D-03	0.363050	0.629710	0.010312	0.012476	0.410595	0.323295	1.189649	-0.111104	-0.842D-01
0.559522	0.197D-03	0.394894	0.610358	0.010917	0.011126	0.427258	0.325501	1.184109	-0.106756	-0.102D 00
0.615069	0.221D-03	0.428210	0.589127	0.011497	0.009770	0.445393	0.327299	1.178298	-0.102596	-0.123D 00
0.675148	0.247D-03	0.462909	0.565938	0.012043	0.008429	0.465099	0.328550	1.172256	-0.098655	-0.147D 00
0.740133	0.276D-03	0.498867	0.540739	0.012547	0.007127	0.486474	0.329097	1.165970	-0.094950	-0.177D 00
0.810415	0.308D-03	0.535914	0.513512	0.013003	0.005899	0.509601	0.328749	1.159423	-0.091487	-0.211D 00
0.886434	0.344D-03	0.573837	0.484284	0.013405	0.004746	0.534547	0.327289	1.152595	-0.088254	-0.251D 00
0.968557	0.384D-03	0.612370	0.453137	0.013751	0.003717	0.561355	0.324463	1.145468	-0.085215	-0.297D 00
1.057590	0.429D-03	0.651195	0.420215	0.014040	0.002828	0.590027	0.319987	1.138023	-0.082304	-0.351D 00
1.153779	0.479D-03	0.689941	0.385730	0.014274	0.002094	0.620516	0.313546	1.130247	-0.079426	-0.414D 00
1.257317	0.535D-03	0.729190	0.349975	0.014459	0.001524	0.652705	0.304797	1.122139	-0.076451	-0.486D 00
1.370345	0.598D-03	0.765478	0.313317	0.014605	0.001117	0.686389	0.293399	1.113717	-0.073224	-0.569D 00
1.492055	0.669D-03	0.801313	0.276209	0.014723	0.000865	0.721251	0.278986	1.105023	-0.069573	-0.664D 00
1.623697	0.747D-03	0.835192	0.239177	0.014827	0.000748	0.756847	0.261309	1.096138	-0.065330	-0.771D 00
1.766087	0.835D-03	0.866580	0.202872	0.014931	0.000741	0.792583	0.240299	1.087183	-0.060358	-0.903D 00
1.920082	0.934D-03	0.895033	0.167804	0.015050	0.000816	0.827717	0.215747	1.078326	-0.054581	-0.103D 01
2.086651	0.104D-02	0.920134	0.134876	0.015196	0.000950	0.861379	0.188306	1.069776	-0.049026	-0.118D 01
2.266812	0.117D-02	0.941578	0.104604	0.015383	0.001131	0.892620	0.158674	1.061772	-0.040840	-0.135D 01
2.461673	0.130D-02	0.959209	0.077814	0.015625	0.001370	0.920506	0.128086	1.054558	-0.033306	-0.154D 01
2.672436	0.146D-02	0.973049	0.055075	0.015947	0.001707	0.944244	0.098154	1.048353	-0.025818	-0.175D 01

2.900396	0.1620-02	0.983324	0.036602	0.016389	0.002223	0.963330	0.073656	1.043298	-0.018828	-0.1980	01
3.146959	0.1810-02	0.990456	0.022616	0.017030	0.003055	0.977657	0.047198	1.039452	-0.012764	-0.2230	01
3.413640	0.2010-02	0.995021	0.012786	0.018007	0.004416	0.987569	0.028848	1.036749	-0.007931	-0.2500	01
3.732383	0.2230-02	0.997671	0.006497	0.019568	0.006634	0.993793	0.015868	1.035023	-0.004442	-0.2790	01
4.014063	0.2470-02	0.999039	0.002904	0.022143	0.012228	0.997276	0.007702	1.034038	-0.002198	-0.3110	01
4.351501	0.2730-02	0.999653	0.001115	0.026475	0.016023	0.998977	0.003221	1.033548	-0.000937	-0.3460	01
4.716473	0.3010-02	0.999887	0.000360	0.033857	0.025363	0.999682	0.001127	1.033341	-0.000333	-0.3840	01
5.111227	0.3310-02	0.999962	0.000102	0.046548	0.040441	0.999923	0.000318	1.033269	-0.000094	-0.4250	01
5.538193	0.3640-02	0.999986	0.000036	0.068499	0.064838	0.999987	0.000069	1.033251	-0.000018	-0.4710	01
6.000000	0.4000-02	1.000000	0.000029	0.106848	0.103479	1.000000	0.000003	1.000000	-0.213220	-0.5220	01

ETA	Y/L	ROPOE	XMU	E+	CHI	LEL	LET	PRL	PRT	SP HT
0.0	0.0	2.75781	0.35070-06	0.0	0.0	1.000000	1.000000	0.737098	0.900000	0.60190 04
0.009890	0.1550-05	2.72894	0.35390-06	0.0	0.21600-01	1.000000	1.000000	0.737123	0.900000	0.60210 04
0.020587	0.3240-05	2.69863	0.35730-06	0.0	0.91410-01	1.000000	1.000000	0.737162	0.900000	0.60220 04
0.032157	0.5100-05	2.66686	0.36090-06	0.0	0.21760 00	1.000000	1.000000	0.737205	0.900000	0.60230 04
0.044671	0.7130-05	2.62363	0.36480-06	0.0	0.40890 00	1.000000	1.000000	0.737253	0.900000	0.60250 04
0.058206	0.9350-05	2.59835	0.36890-06	0.0	0.67510 00	1.000000	1.000000	0.737307	0.900000	0.60260 04
0.072845	0.1180-04	2.56283	0.37330-06	0.0	0.10270 01	1.000000	1.000000	0.737368	0.900000	0.60280 04
0.098479	0.1450-04	2.52531	0.37800-06	0.0	0.14740 01	1.000000	1.000000	0.737435	0.900000	0.60300 04
0.105805	0.1740-04	2.48642	0.38300-06	0.0	0.20310 01	1.000000	1.000000	0.737511	0.900000	0.60330 04
0.124329	0.2060-04	2.44622	0.38830-06	0.0	0.27080 01	1.000000	1.000000	0.737596	0.900000	0.60350 04
0.144364	0.2420-04	2.40477	0.39400-06	0.0	0.35180 01	1.000000	1.000000	0.737691	0.900000	0.60390 04
0.166034	0.2810-04	2.36214	0.40000-06	0.0	0.44760 01	1.000000	1.000000	0.737796	0.900000	0.60420 04
0.189472	0.3240-04	2.31842	0.40630-06	0.0	0.55950 01	1.000000	1.000000	0.737915	0.900000	0.60450 04
0.214823	0.3710-04	2.27371	0.41300-06	0.0	0.68980 01	1.000000	1.000000	0.738047	0.900000	0.60490 04
0.242243	0.4240-04	2.22810	0.42010-06	0.0	0.83690 01	1.000000	1.000000	0.738194	0.900000	0.60540 04
0.271900	0.4820-04	2.18170	0.42760-06	0.0	0.10050 02	1.000000	1.000000	0.738358	0.900000	0.60590 04
0.303977	0.5450-04	2.13464	0.43540-06	0.0	0.11940 02	1.000000	1.000000	0.738540	0.900000	0.60650 04
0.338671	0.6160-04	2.08702	0.44370-06	0.0	0.14060 02	1.000000	1.000000	0.738743	0.900000	0.60710 04
0.376197	0.6940-04	2.03895	0.45230-06	0.0	0.16400 02	1.000000	1.000000	0.738968	0.900000	0.60780 04
0.416784	0.7810-04	1.99054	0.46140-06	0.0	0.18980 02	1.000000	1.000000	0.739217	0.900000	0.60860 04
0.460684	0.8770-04	1.94190	0.47090-06	0.0	0.21780 02	1.000000	1.000000	0.739492	0.900000	0.60950 04
0.509165	0.9830-04	1.89310	0.48090-06	0.0	0.24790 02	1.000000	1.000000	0.739796	0.900000	0.61040 04
0.559522	0.1100-03	1.84423	0.49130-06	0.0	0.28010 02	1.000000	1.000000	0.740131	0.900000	0.61150 04
0.615069	0.1230-03	1.79533	0.50220-06	0.0	0.31390 02	1.000000	1.000000	0.740501	0.900000	0.61270 04
0.675149	0.1380-03	1.74644	0.51370-06	0.0	0.34900 02	1.000000	1.000000	0.740908	0.900000	0.61400 04
0.742130	0.1540-03	1.69759	0.52560-06	0.0	0.38460 02	1.000000	1.000000	0.741356	0.900000	0.61540 04
0.810415	0.1720-03	1.64879	0.53810-06	0.0	0.42070 02	1.000000	1.000000	0.741849	0.900000	0.61700 04
0.886434	0.1920-03	1.60003	0.55130-06	0.0	0.45420 02	1.000000	1.000000	0.742390	0.900000	0.61880 04
0.968557	0.2150-03	1.55132	0.56500-06	0.0	0.48610 02	1.000000	1.000000	0.742985	0.900000	0.62070 04
1.057590	0.2400-03	1.50271	0.57950-06	0.0	0.51420 02	1.000000	1.000000	0.743637	0.900000	0.62280 04
1.153779	0.2680-03	1.45425	0.59480-06	0.0	0.53710 02	1.000000	1.000000	0.744350	0.900000	0.62510 04
1.257817	0.2990-03	1.40610	0.61070-06	0.0	0.55340 02	1.000000	1.000000	0.745126	0.900000	0.62770 04
1.370345	0.3340-03	1.35849	0.62740-06	0.0	0.56170 02	1.000000	1.000000	0.745955	0.900000	0.63050 04
1.492055	0.3730-03	1.31173	0.64470-06	0.0	0.56100 02	1.000000	1.000000	0.746862	0.900000	0.63350 04
1.623697	0.4170-03	1.26630	0.66240-06	0.0	0.55030 02	1.000000	1.000000	0.747807	0.900000	0.63670 04
1.766080	0.4660-03	1.22275	0.68040-06	0.0	0.52950 02	1.000000	1.000000	0.748783	0.900000	0.64000 04
1.920082	0.5210-03	1.18173	0.69830-06	0.0	0.49840 02	1.000000	1.000000	0.749767	0.900000	0.64330 04
2.086651	0.5830-03	1.14396	0.71560-06	0.0	0.45780 02	1.000000	1.000000	0.750730	0.900000	0.64660 04
2.266812	0.6520-03	1.11011	0.73190-06	0.0	0.40870 02	1.000000	1.000000	0.751637	0.900000	0.64980 04
2.461673	0.7290-03	1.08079	0.74670-06	0.0	0.35270 02	1.000000	1.000000	0.752456	0.900000	0.65260 04
2.672436	0.8130-03	1.05541	0.75940-06	0.0	0.29200 02	1.000000	1.000000	0.753160	0.900000	0.65510 04
2.900396	0.9070-03	1.03712	0.76980-06	0.0	0.22970 02	1.000000	1.000000	0.753731	0.900000	0.65710 04

3.146959	0.1010-02	1.02276	0.77770-06	0.0	0.16940 02	1.000000	1.000000	0.754163	0.900000	0.65870 04
3.413649	0.1120-02	1.01289	0.78330-06	0.0	0.11520 02	1.000000	1.000000	0.754466	0.900000	0.65970 04
3.702083	0.1250-02	1.00655	0.78690-06	0.0	0.70850 01	1.000000	1.000000	0.754658	0.900000	0.66040 04
4.014063	0.1380-02	1.00300	0.78890-06	0.0	0.38450 01	1.000000	1.000000	0.754768	0.900000	0.66080 04
4.351501	0.1520-02	1.00124	0.78990-06	0.0	0.17930 01	1.000000	1.000000	0.754822	0.900000	0.66100 04
4.716473	0.1680-02	1.00049	0.79040-06	0.0	0.70330 00	1.000000	1.000000	0.754846	0.900000	0.66110 04
5.111227	0.1850-02	1.00024	0.79050-06	0.0	0.24060 00	1.000000	1.000000	0.754853	0.900000	0.66110 04
5.538193	0.2030-02	1.00017	0.79060-06	0.0	0.10370 00	1.000000	1.000000	0.754855	0.900000	0.66110 04
6.007000	0.2230-02	1.00000	0.76520-06	0.0	0.19240 00	1.000000	1.000000	0.753481	0.900000	0.65630 04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	1.000000	0.0	0.5400000 03	0.3791090 00	0.4069750 00	1.399289	0.1313960-03
0.009890	0.1550-05	1.000000	0.0	0.5457120 03	0.3831190 00	0.4039420 00	1.399189	0.1300200-03
0.070587	0.3240-05	1.000000	0.0	0.5518420 03	0.3874230 00	0.4006810 00	1.399078	0.1285760-03
0.032157	0.5100-05	1.000000	0.0	0.5584160 03	0.3920380 00	0.3971820 00	1.398953	0.1270620-03
0.044671	0.7130-05	1.000000	0.0	0.5654620 03	0.3965850 00	0.3934370 00	1.398814	0.1254790-03
0.058206	0.9350-05	1.000000	0.0	0.5730080 03	0.4022810 00	0.3894130 00	1.398658	0.1238260-03
0.072345	0.1180-04	1.000000	0.0	0.5810830 03	0.4079520 00	0.3851190 00	1.398484	0.1221060-03
0.088679	0.1450-04	1.000000	0.0	0.5897180 03	0.4140140 00	0.3805370 00	1.398290	0.1203180-03
0.105905	0.1740-04	1.000000	0.0	0.5989410 03	0.4204890 00	0.3756580 00	1.398072	0.1184650-03
0.124329	0.2060-04	1.000000	0.0	0.6087840 03	0.4273990 00	0.3704730 00	1.397829	0.1165550-03
0.144364	0.2420-04	1.000000	0.0	0.6192770 03	0.4347660 00	0.3649780 00	1.397557	0.1145750-03
0.166034	0.2810-04	1.000000	0.0	0.6304530 03	0.4426120 00	0.3591730 00	1.397253	0.1125440-03
0.189472	0.3240-04	1.000000	0.0	0.6423410 03	0.4509580 00	0.3530620 00	1.396914	0.1104610-03
0.214823	0.3710-04	1.000000	0.0	0.6549730 03	0.4596270 00	0.3466540 00	1.396536	0.1083300-03
0.242243	0.4240-04	1.000000	0.0	0.6683810 03	0.4692400 00	0.3399660 00	1.396114	0.1061570-03
0.271900	0.4820-04	1.000000	0.0	0.6825940 03	0.4792190 00	0.3330220 00	1.395645	0.1039470-03
0.303977	0.5450-04	1.000000	0.0	0.6976440 03	0.4897840 00	0.3258570 00	1.395124	0.1017050-03
0.338671	0.6160-04	1.000000	0.0	0.7135630 03	0.5009600 00	0.3185150 00	1.394546	0.9943570-04
0.376197	0.6940-04	1.000000	0.0	0.7303850 03	0.5127700 00	0.3110530 00	1.393906	0.9714550-04
0.416784	0.7810-04	1.000000	0.0	0.7481460 03	0.5252390 00	0.3035380 00	1.393198	0.9483920-04
0.460384	0.8770-04	1.000000	0.0	0.7668870 03	0.5383970 00	0.2960490 00	1.392416	0.9252150-04
0.508165	0.9830-04	1.000000	0.0	0.7866540 03	0.5522740 00	0.2886760 00	1.391554	0.9019670-04
0.559522	0.1110-03	1.000000	0.0	0.8075020 03	0.5669100 00	0.2815150 00	1.390606	0.8786800-04
0.615069	0.1230-03	1.000000	0.0	0.8294960 03	0.5823510 00	0.2746620 00	1.389563	0.8553820-04
0.675148	0.1380-03	1.000000	0.0	0.8527140 03	0.5986520 00	0.2682110 00	1.388418	0.8320910-04
0.740130	0.1540-03	1.000000	0.0	0.8772520 03	0.6158780 00	0.2622370 00	1.387162	0.8088170-04
0.810415	0.1720-03	1.000000	0.0	0.9032200 03	0.6341100 00	0.2567820 00	1.385785	0.7855630-04
0.886434	0.1920-03	1.000000	0.0	0.9307450 03	0.6534340 00	0.2518420 00	1.384276	0.7623310-04
0.968657	0.2150-03	1.000000	0.0	0.9599670 03	0.6739490 00	0.2473440 00	1.382626	0.7391260-04
1.057590	0.2430-03	1.000000	0.0	0.9910240 03	0.6957520 00	0.2431230 00	1.380823	0.7150610-04
1.153779	0.2680-03	1.000000	0.0	0.1024040 04	0.7189330 00	0.2389040 00	1.378861	0.6928770-04
1.257317	0.2990-03	1.000000	0.0	0.1059110 04	0.7435520 00	0.2342870 00	1.376735	0.6699370-04
1.370345	0.3340-03	1.000000	0.0	0.1096230 04	0.7696150 00	0.2287510 00	1.374451	0.6472400-04
1.492055	0.3730-03	1.000000	0.0	0.1135300 04	0.7970460 00	0.2216660 00	1.372022	0.6249740-04
1.623657	0.4170-03	1.000000	0.0	0.1176040 04	0.8256440 00	0.2123560 00	1.369479	0.6033270-04
1.766080	0.4660-03	1.000000	0.0	0.1217930 04	0.8550520 00	0.2001790 00	1.366867	0.5825760-04
1.920182	0.5210-03	1.000000	0.0	0.1260200 04	0.8847280 00	0.1846560 00	1.364252	0.5630350-04
2.086651	0.5830-03	1.000000	0.0	0.1301810 04	0.9139420 00	0.1656300 00	1.361712	0.5450370-04
2.266812	0.6520-03	1.000000	0.0	0.1341500 04	0.9418060 00	0.1434130 00	1.359331	0.5289120-04
2.461673	0.7280-03	1.000000	0.0	0.1377890 04	0.9673560 00	0.1188840 00	1.357193	0.5149420-04
2.672436	0.8130-03	1.000000	0.0	0.1409690 04	0.9896820 00	0.9346950-01	1.355365	0.5033260-04
2.900396	0.9070-03	1.000000	0.0	0.1435910 04	0.1008090 01	0.6896200-01	1.353889	0.4941360-04
3.146959	0.1010-02	1.000000	0.0	0.1456070 04	0.1022240 01	0.4717010-01	1.352775	0.4872940-04

3.413640	0.1120-02	1.000000	0.0	0.1470350 04	0.1032270 01	0.2949570-01	1.351997	0.4825620-04
3.702083	0.1250-02	1.000000	0.0	0.1479520 04	0.1038700 01	0.1658710-01	1.351502	0.4795720-04
4.014063	0.1380-02	1.000000	0.0	0.1484760 04	0.1042380 01	0.8226140-02	1.351221	0.4778780-04
4.351501	0.1520-02	1.000000	0.0	0.1487380 04	0.1044220 01	0.3512040-02	1.351081	0.4770380-04
4.716473	0.1680-02	1.000000	0.0	0.1488480 04	0.1045000 01	0.1250400-02	1.351022	0.4766830-04
5.111227	0.1850-02	1.000000	0.0	0.1488870 04	0.1045260 01	0.3522950-03	1.351001	0.4765610-04
5.538193	0.2030-02	1.000000	0.0	0.1488960 04	0.1045330 01	0.6571070-04	1.350996	0.4765300-04
6.000000	0.2230-02	1.000000	0.0	0.1424390 04	0.1007000 01	-0.2907880 00	1.354534	0.4764490-04

S	= 0.9636310-01	S/REF= 0.1051310 01	Z	= 0.4615690-01	Z/REF= 0.5035660 00		
R	= 0.7956770-01	R/REF= 0.8680740 00	DX	= 0.200000-01	NIT = 4	PHI = 15.00 DEG.	
XI	= 0.3225130-10	DXI = 0.1241990-10	DXDXI= 0.1574000 10	CWALL= 0.0			

DIMENSIONAL EDGE PROPERTIES

PE	= 0.1208830 03	TE	= 0.1421070 04	UE	= 0.2639110 04	VE	= 0.7281020 02	MACHE	= 0.1427630 01
DPEDX=-	0.5592670 13	DTENX=-	0.1682320 14	DUEDX=	0.4279130 14	DVEDX=	0.5730160 13	RHCE	= 0.4952310-04
DPEDW=-	0.7515390 01	DTEDW=-	0.2520730 02	DUEDW=	0.5001440 02	DVEDW=	0.2718360 03	RHOEMUE=	0.3783230-10

LOCAL EDGE REYNOLDS NUMBER =0.1648620 05

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF=	0.1193750-01	CFXEDG=	0.1501590-01	CFWINF=	0.6474750-03	CFWEDG=	0.8144400-03
CHEDGE=	0.6097000-02	CHINF =	0.8812570-02	STEDGE=	0.4635830-02	STINF =	0.6700600-02
QW	=-0.2737440-02	CHIMAX=	0.5623110 02				

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION=	0.2589660 01 PSF	DELTA*(X) =	0.8445870-04	THETA(X) =	0.3044180-03
TRANSVERSE SKIN FRICTION =	0.1404600 C PSF	DELTA*(PHI)=	0.3252690-03	THETA(PHI)=	0.6252910-03
WALL HEAT TRANSFER RATE	=-0.7328640 01 BTU	DELTA (FT) =	0.2006400-02		

S	= 0.9636310-01	S/REF= 0.1051310 01	Z	= 0.4615690-01	Z/REF= 0.5035660 00		
R	= 0.7956770-01	R/REF= 0.8680740 00	DX	= 0.200000-01	NIT = 3	PHI = 30.00 DEG.	
XI	= 0.3225180-10	DXI = 0.1241990-10	DXDXI= 0.1574000 10	CWALL= 0.0			

DIMENSIONAL EDGE PROPERTIES

PE	= 0.1180090 03	TE	= 0.1411350 04	UE	= 0.2658470 04	VE	= 0.1407980 03	MACHE	= 0.1443050 01
DPEDX=-	0.5455580 13	DTFDX=-	0.1683130 14	DUEDX=	0.4215710 14	DVEDX=	0.1108080 14	RHOE	= 0.4867850-04
DPEDW=-	0.1425230 02	DTEDW=-	0.4863520 02	DUFOW=	0.9719290 02	DVEDW=	0.2448250 03	RHOEMUE=	0.3699900-10

LOCAL EDGE REYNOLDS NUMBER =0.1640700 05

AAABBBB	000000	000000	3333333333	3333333333	AAAAAAAAA	CCCCCCCCC	LL
ABBBB	000000	000000	3333333333	3333333333	ABBBB	CCCCCCCCC	LL
BA	00	00	33	33	BA	CC	LL
BB	00	00	33	33	BB	CC	LL
BA	00	00	33	33	BA	CC	LL
AAAAABBBB	00	00	333	333	AAAAABBBB	CC	LL
BBBBAABBB	00	00	333	333	BBBBAABBB	CC	LL
BA	00	00	33	33	BA	CC	LL
BA	00	00	33	33	BA	CC	LL
BA	00	00	33	33	BA	CC	LL
AAAAABBBB	000000	000000	3333333333	3333333333	AAAAABBBB	CCCCCCCCC	LLLLLLLLLLLL
BBBBAABBB	000000	000000	3333333333	3333333333	BBBBAABBB	CCCCCCCCC	LLLLLLLLLLLL

	JJ	0000000000	000000000000	777777777777	11	44	777777777777
	JJ	000000000000	000000000000	777777777777	111	444	777777777777
	JJ	00	00	77	1111	4444	77
	JJ	00	00	77	11	44	77
	JJ	00	00	77	11	44	77
	JJ	00	00	77	11	44	77
	JJ	00	00	77	11	44	77
	JJ	00	00	77	11	44	77
	JJ	00	00	77	11	44	77
	JJ	00	00	77	11	44	77
	JJ	00	00	77	11	44	77
JJ	JJ	00	00	77	11	4444444444	77
JJ	JJ	00	00	77	11	4444444444	77
JJ	JJ	00	00	77	11	44	77
JJJJJJJJJJJJ	JJJJJJJJJJJJ	000000000000	000000000000	77	11	44	77
JJJJJJJJJJJJ	JJJJJJJJJJJJ	000000000000	000000000000	77	11	44	77

[illegible]

PROPERTIES AT THE WINDWARD STREAMLINE

S/REF	S	CFXINF	STINF	QW(DIM)	QW/QWSTAG	ZWALL
0.0	0.0	0.0	0.1881400-01	-0.2057740 02	0.1000000 01	1.000000
0.1090990 00	0.1000000-01	0.5366940-02	0.2212050-01	-0.2419380 02	0.1175750 01	1.000000
0.3272970 00	0.3000000-01	0.1108800-01	0.1843060-01	-0.2015810 02	0.9796230 00	1.000000
0.7459460 00	0.6036430-01	0.1656310-01	0.1169330-01	-0.1278930 02	0.6215230 00	1.000000
0.7490790 00	0.6866060-01	0.1547900-01	0.1138270-01	-0.1244950 02	0.6050110 00	1.000000
0.7584940 00	0.6952350-01	0.1451480-01	0.1098560-01	-0.1201530 02	0.5839070 00	1.000000
0.7732810 00	0.7087890-01	0.1386760-01	0.1059560-01	-0.1158870 02	0.5631750 00	1.000000
0.7922220 00	0.7261510-01	0.1354930-01	0.1022560-01	-0.1118410 02	0.5435130 00	1.000000
0.8138440 00	0.7459690-01	0.1329650-01	0.9828290-02	-0.1074950 02	0.5223930 00	1.000000
0.8365660 00	0.7667960-01	0.1317260-01	0.9432920-02	-0.1031710 02	0.5013780 00	1.000000
0.8589310 00	0.7972050-01	0.1290910-01	0.9063410-02	-0.9912910 01	0.4917380 00	1.000000
0.8792000 00	0.8058750-01	0.1274310-01	0.8726880-02	-0.9544830 01	0.4638510 00	1.000000
0.8964210 00	0.8216600-01	0.1260040-01	0.8448400-02	-0.9240260 01	0.4490490 00	1.000000
0.9094760 00	0.8336260-01	0.1251610-01	0.8243050-02	-0.9015650 01	0.4381340 00	1.000000
0.9176150 00	0.8410860-01	0.1244770-01	0.8113880-02	-0.8874380 01	0.4312690 00	1.000000
0.9203790 00	0.8436200-01	0.1241550-01	0.8069430-02	-0.8825770 01	0.4289060 00	1.000000
0.1051310 01	0.9636310-01	0.1195880-01	0.6903200-02	-0.7317390 01	0.3556040 00	1.000000
0.1487710 01	0.1363630 00	0.0000330-02	0.3370960-02	-0.3686910 01	0.1791730 00	1.000000

II. Full Three-Dimensional Solution of a Sharp Cone at Angle of Attack.

[illegible][illegible][illegible]

THREE-DIMENSIONAL BOUNDARY LAYER PROGRAM
FOR
LAMINAR OR TURBULENT FLOW
WITH
BINARY GAS INJECTION
DEVELOPED BY
M.C. FRIEDERS
AEROSPACE ENGINEERING DEPARTMENT
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
BLACKSBURG, VA. 24060

INPUT DATA CARDS ARE AS FOLLOWS:

	SHARP CONE	LAMINAR	ALPHA=5	REINF=1.2006/FT	NASA TN D-5450	
CARD 001	IE	13	COL 50-52	101		00000280
CARD 002	INJCT	13	COL 50-52	000		00000290
CARD 003	KADETA	13	COL 50-52	001		00000300
CARD 004	KEND2	13	COL 50-52	013		00000310
CARD 005	KONSET	13	COL 50-52	000		00000320
CARD 006	KPRT	13	COL 50-52	003		00000330
CARD 007	KTRANS	13	COL 50-52	000		00000340
CARD 008	LAHTR9	13	COL 50-52	001		00000350
CARD 009	LPKT	13	COL 50-52	001		00000360
CARD 010	NIT1	13	COL 50-52	005		00000370
CARD 011	NIT2	13	COL 50-52	010		00000380
CARD 012	NIT3	13	COL 50-52	020		00000390
CARD 013	NCINJ	13	COL 50-52	000		00000400
CARD 014	NOSE	A5	COL 50-54	SHARP		00000410
CARD 015	NSOLVE	13	COL 50-52	013		00000420
CARD 016	KPLUT	413	COL 50-61	001004007010		00000430
CARD 017	KPRFL	413	COL 50-61	001004000000		00000440
CARD 018	LPLDT	413	COL 50-61	003005009012		00000450
CARD 019	LPKFL	413	COL 50-61	001004000000		00000460
CARD 020	ADTEST	E14.6	COL 50-63	0.001		00000470
CARD 021	AKSTAR	E14.6	COL 50-63	0.435		00000480
CARD 022	ALAMDA	E14.6	COL 50-63	0.09		00000490
CARD 023	ALET	E14.6	COL 50-63	1.0		00000500
CARD 024	ALPHA	E14.6	COL 50-63	5.09		00000510
CARD 025	ASTAR	E14.6	COL 50-63	26.0		00000520
CARD 026	COUL	A3	COL 50-52	ABLATION		00000530
CARD 027	CWALL	F14.6	COL 50-63	0.0		00000540
CARD 028	CRI	F5.3	COL 50-54	1.0		00000550
CARD 029	CONV	E14.6	COL 50-63	0.001		00000560
CARD 030	DISK	A2	COL 50-51	NU		00000570
CARD 031	DXINVS	E14.6	COL 50-63	0.04		00000580
CARD 032	DXMAX	E14.6	COL 50-63	0.1		00000590
CARD 033	DX1	F5.3	COL 50-54	0.01		00000600
CARD 034	EDYLAW	A3	COL 50-52	REICHARDT		00000610
CARD 035	ETAFAC	E14.6	COL 50-63	1.04		00000620
CARD 036	ETAINF	E14.6	COL 50-63	6.0		00000630
CARD 037	GAS2	A3	COL 50-52	AIR		00000640
CARD 038	PLOT	A2	COL 50-51	NU		00000650
CARD 039	PKL	E14.6	COL 50-63	0.71		00000660

CARD	040	PRT	A5	COL	50-54	ROTTA	00000670
CARD	C41	PROP	A4	COL	50-53	PSTAG	00000680
CARD	C42	RTW	E14.6	COL	50-63	0.27	00000690
CARD	C43	TFS	E14.6	COL	50-63	0.0	00000710
CARD	C44	TSTAG	E14.6	COL	50-63	2000.0	00000712
CARD	C45	VALUE	E14.6	COL	50-63	1200.0	00000720
CARD	C46	XBAR	E14.6	COL	50-63	2.0	00000730
	0.0						00000740
	0.01						00000750
	C.3498						00000760
	0.4629						00000770
	C.5660						00000780
	C.7340						00000790
	C.9001						00000800
	1.0663						00000810
	1.2324						00000820
	1.3985						00000830
	1.5666						00000840
	1.7327						00000850
	1.9316						00000860

FREE STREAM, STAGNATION, AND VEHICLE DATA:

PSTAG = 0.120000D 04 PSIA
 TSTAG = 0.200000D 04 DEG.R
 MSTAG = 0.120237D 08 FT**2/SEC**2
 PINF = 0.191538D-01 PSIA
 RHUINF = 0.188451D-04 SLUGS/FT**3
 TINF = 0.852079D 02 DEG.R
 UINF = 0.479822D 04 FT/SEC
 MINF = 0.106000D 02
 CP/CV = 0.140000D 01
 R = 0.171767D 04 FT**2/SEC**2/DEG.R
 TW/TO = 0.270000D 00
 ALPHA = 0.500000D 01 DEG.
 THETAC = 0.150000D 02 DEG.

POINTS AT WHICH A SOLUTION IS TO BE OBTAINED:

I	XSTA(I)
1	0.0
2	C.010000
3	C.399800
4	0.482900
5	0.566000
6	0.734000
7	C.900100
8	1.066300
9	1.232400
10	1.398500
11	1.566600
12	1.732700

13 1.931600

S = 0.0
R = 0.0
XI = 0.0

S/REF= 0.0
R/REF= 0.0
DXI = 0.0

Z = 0.0
DX = 0.100000-01
DXOXI= 0.0

Z/REF= 0.0
NIT = 5
CHALL= 0.0

PHI = 0.0 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.555805D 02
DPEDX= 0.0
DPEDW= 0.0

TE = 0.355768D 03
DTEDX= 0.0
DTEDW= 0.0

UE = 0.444632D 04
DUEDX= 0.0
DUEDW= 0.0

VE = 0.0
DVEDX= 0.0
DVEDW= 0.214067D 03

MACHE = 0.480710D 01
RHOE = 0.909527D-04
RHOEUE= 0.222444D-10

LCCAL EDGE REYNOLDS NUMBER =0.0

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	0.542647	0.0	0.100383	0.270155	0.298667	0.944810	-0.152531	0.0
0.009890	0.0	0.005371	0.543505	0.000991	0.099931	0.273117	0.300415	0.943315	-0.149838	-0.3920-04
0.020587	0.0	0.011190	0.544420	0.002057	0.099432	0.276341	0.302305	0.941728	-0.146015	-0.1700-03
0.032157	0.0	0.017494	0.545393	0.003204	0.098878	0.279850	0.304347	0.940046	-0.143851	-0.4140-03
0.044671	0.0	0.024326	0.546423	0.004438	0.098262	0.283672	0.306552	0.938266	-0.140609	-0.7990-03
0.058206	0.0	0.031729	0.547511	0.005763	0.097578	0.287838	0.308935	0.936387	-0.137182	-0.1360-02
0.072845	0.0	0.039753	0.548658	0.007186	0.096817	0.292379	0.311506	0.934405	-0.133560	-0.2120-02
0.088679	0.0	0.048450	0.549860	0.008712	0.095968	0.297334	0.314279	0.932321	-0.129735	-0.3150-02
0.105805	0.0	0.057878	0.551115	0.010348	0.095023	0.302742	0.317269	0.930134	-0.125697	-0.4480-02
0.124329	0.0	0.068098	0.552416	0.012098	0.093968	0.308648	0.320489	0.927845	-0.121438	-0.6180-02
0.144364	0.0	0.079180	0.553755	0.013969	0.092750	0.315104	0.323952	0.925457	-0.116945	-0.8330-02
0.166034	0.0	0.091195	0.555119	0.015966	0.091475	0.322165	0.327672	0.922975	-0.112208	-0.1100-01
0.189472	0.0	0.104222	0.556492	0.018093	0.090006	0.329892	0.331660	0.920403	-0.107214	-0.1430-01
0.214823	0.0	0.118347	0.557848	0.020354	0.088363	0.338354	0.335926	0.917753	-0.101948	-0.1840-01
0.242243	0.0	0.133662	0.559157	0.022752	0.086528	0.347627	0.340474	0.915034	-0.096395	-0.2340-01
0.271900	0.0	0.150264	0.560377	0.025288	0.084477	0.357797	0.345305	0.912263	-0.090540	-0.2940-01
0.303377	0.0	0.168257	0.561453	0.027961	0.082187	0.368955	0.350411	0.909458	-0.084365	-0.3670-01
0.338671	0.0	0.187753	0.562313	0.030769	0.079632	0.381207	0.355774	0.906645	-0.077852	-0.4550-01
0.376197	0.0	0.208866	0.562866	0.033704	0.076785	0.394663	0.361359	0.903853	-0.070982	-0.5610-01
0.416784	0.0	0.231717	0.562995	0.036756	0.073617	0.409448	0.367113	0.901123	-0.063735	-0.6870-01
0.460684	0.0	0.256425	0.562551	0.039492	0.070102	0.425695	0.372954	0.898491	-0.056096	-0.8380-01
0.508165	0.0	0.283112	0.561348	0.043148	0.066214	0.443544	0.376761	0.896020	-0.048049	-0.1020 00
0.559522	0.0	0.311891	0.559153	0.046439	0.061929	0.463145	0.384370	0.893771	-0.039587	-0.1230 00
0.615069	0.0	0.342862	0.555685	0.049749	0.057232	0.484646	0.389552	0.891820	-0.030709	-0.1480 00
0.675148	0.0	0.376105	0.550599	0.053034	0.052115	0.508194	0.394005	0.890257	-0.021429	-0.1770 00
0.740130	0.0	0.411667	0.543489	0.056241	0.046586	0.533918	0.397332	0.889181	-0.011780	-0.2120 00
0.810415	0.0	0.444546	0.533888	0.059306	0.040670	0.561922	0.399032	0.888708	-0.001825	-0.2530 00
0.886434	0.0	0.489674	0.521272	0.062158	0.034418	0.592260	0.398488	0.888961	0.000336	-0.3010 00
0.968657	0.0	0.531895	0.505085	0.064718	0.027914	0.624912	0.394968	0.890075	0.018556	-0.3560 00
1.057590	0.0	0.575942	0.484777	0.066930	0.021275	0.659753	0.387649	0.892185	0.028626	-0.4200 00
1.153779	0.0	0.621408	0.459858	0.068621	0.014660	0.696514	0.375669	0.895419	0.038265	-0.4950 00
1.257917	0.0	0.667732	0.429985	0.069802	0.008265	0.734748	0.358221	0.899882	0.047125	-0.5600 00
1.370345	0.0	0.714184	0.395063	0.070383	0.002319	0.773747	0.334697	0.905645	0.054787	-0.6790 00
1.492055	0.0	0.759873	0.355358	0.070327	-0.002937	0.812777	0.304869	0.912714	0.060797	-0.7900 00
1.623657	0.0	0.803774	0.311596	0.069633	-0.007266	0.850601	0.269096	0.921018	0.064703	-0.9170 00
1.766380	0.0	0.844755	0.265020	0.068344	-0.010678	0.886040	0.228492	0.930391	0.066122	-0.1060 01
1.920382	0.0	0.881869	0.217373	0.066551	-0.012435	0.917845	0.184986	0.940514	0.064812	-0.1220 01
2.086651	0.0	0.914073	0.170772	0.064389	-0.013186	0.944915	0.141206	0.951021	0.060742	-0.1400 01

2.266812	0.0	0.940763	0.127473	0.062027	-0.012786	0.966487	0.100141	0.961410	0.054151	-0.1590 01
2.461673	0.0	0.961682	0.089542	0.059646	-0.011488	0.982307	0.064610	0.971151	0.045589	-0.1810 01
2.672436	0.0	0.977024	0.058505	0.057416	-0.009614	0.992704	0.036668	0.979735	0.035907	-0.2050 01
2.900396	0.0	0.987418	0.035054	0.055466	-0.007523	0.993554	0.017137	0.986774	0.026165	-0.2300 01
3.146959	0.0	0.993821	0.018927	0.053868	-0.005545	1.001090	0.005448	0.992081	0.017424	-0.2580 01
3.413640	0.0	0.997340	0.009014	0.052624	-0.003918	1.001621	-0.000100	0.995713	0.016461	-0.2820 01
3.702083	0.0	0.999023	0.003689	0.051683	-0.002749	1.001251	-0.001737	0.997938	0.005577	-0.3210 01
4.014063	0.0	0.999705	0.001255	0.050957	-0.002017	1.000704	-0.001524	0.999137	0.002592	-0.3560 01
4.351501	0.0	0.999930	0.000341	0.050356	-0.001618	1.000305	-0.000852	0.999695	0.001025	-0.3950 01
4.716473	0.0	0.999988	0.000070	0.049809	-0.001421	1.000101	-0.000345	0.999912	0.000335	-0.4360 01
5.111227	0.0	0.999998	0.000010	0.049270	-0.001325	1.000025	-0.000102	0.999980	0.000067	-0.4800 01
5.538193	0.0	1.000000	0.000001	0.048719	-0.001267	1.000004	-0.000022	0.999997	0.000017	-0.5280 01
6.000000	0.0	1.000000	-0.000000	0.048145	-0.001220	1.000000	-0.000001	1.000000	0.000000	-0.5800 01

ETA	Y/L	RURDE	XMU	E+	CHI	LEL	LET	PRL	PRT	SP NT
0.0	0.0	0.65883	0.35070-06	0.0	0.0	1.000000	1.000000	0.737088	0.900000	0.60190 04
0.009890	0.0	0.65174	0.35400-06	0.0	0.0	1.000000	1.000000	0.737124	0.900000	0.60210 04
0.020587	0.0	0.64433	0.35750-06	0.0	0.0	1.000000	1.000000	0.737164	0.900000	0.60220 04
0.032157	0.0	0.63659	0.36120-06	0.0	0.0	1.000000	1.000000	0.737208	0.900000	0.60230 04
0.044671	0.0	0.62854	0.36510-06	0.0	0.0	1.000000	1.000000	0.737257	0.900000	0.60250 04
0.058206	0.0	0.62017	0.36930-06	0.0	0.0	1.000000	1.000000	0.737312	0.900000	0.60260 04
0.072845	0.0	0.61152	0.37370-06	0.0	0.0	1.000000	1.000000	0.737373	0.900000	0.60280 04
0.088679	0.0	0.60258	0.37840-06	0.0	0.0	1.000000	1.000000	0.737441	0.900000	0.60300 04
0.105305	0.0	0.59340	0.38340-06	0.0	0.0	1.000000	1.000000	0.737516	0.900000	0.60330 04
0.124329	0.0	0.58398	0.38860-06	0.0	0.0	1.000000	1.000000	0.737630	0.900000	0.60350 04
0.144364	0.0	0.57438	0.39410-06	0.0	0.0	1.000000	1.000000	0.737692	0.900000	0.60380 04
0.166034	0.0	0.56462	0.39980-06	0.0	0.0	1.000000	1.000000	0.737793	0.900000	0.60410 04
0.189472	0.0	0.55474	0.40580-06	0.0	0.0	1.000000	1.000000	0.737904	0.900000	0.60450 04
0.214823	0.0	0.54481	0.41200-06	0.0	0.0	1.000000	1.000000	0.738026	0.900000	0.60490 04
0.242243	0.0	0.53488	0.41840-06	0.0	0.0	1.000000	1.000000	0.738158	0.900000	0.60530 04
0.271900	0.0	0.52501	0.42500-06	0.0	0.0	1.000000	1.000000	0.738300	0.900000	0.60570 04
0.303977	0.0	0.51528	0.43170-06	0.0	0.0	1.000000	1.000000	0.738452	0.900000	0.60620 04
0.338671	0.0	0.50577	0.43840-06	0.0	0.0	1.000000	1.000000	0.738613	0.900000	0.60670 04
0.376157	0.0	0.49657	0.44520-06	0.0	0.0	1.000000	1.000000	0.738781	0.900000	0.60720 04
0.416784	0.0	0.48779	0.45180-06	0.0	0.0	1.000000	1.000000	0.738953	0.900000	0.60780 04
0.460684	0.0	0.47956	0.45820-06	0.0	0.0	1.000000	1.000000	0.739127	0.900000	0.60830 04
0.508165	0.0	0.47199	0.46430-06	0.0	0.0	1.000000	1.000000	0.739298	0.900000	0.60890 04
0.559522	0.0	0.46526	0.46980-06	0.0	0.0	1.000000	1.000000	0.739459	0.900000	0.60940 04
0.615069	0.0	0.45953	0.47460-06	0.0	0.0	1.000000	1.000000	0.739603	0.900000	0.60990 04
0.675148	0.0	0.45500	0.47850-06	0.0	0.0	1.000000	1.000000	0.739722	0.900000	0.61020 04
0.740130	0.0	0.45193	0.48120-06	0.0	0.0	1.000000	1.000000	0.739805	0.900000	0.61050 04
0.810415	0.0	0.45059	0.48240-06	0.0	0.0	1.000000	1.000000	0.739842	0.900000	0.61060 04
0.886434	0.0	0.45131	0.48170-06	0.0	0.0	1.000000	1.000000	0.739822	0.900000	0.61050 04
0.968657	0.0	0.45448	0.47900-06	0.0	0.0	1.000000	1.000000	0.739736	0.900000	0.61030 04
1.057590	0.0	0.46059	0.47370-06	0.0	0.0	1.000000	1.000000	0.739576	0.900000	0.60970 04
1.153779	0.0	0.47018	0.46580-06	0.0	0.0	1.000000	1.000000	0.739340	0.900000	0.60900 04
1.257817	0.0	0.48389	0.45480-06	0.0	0.0	1.000000	1.000000	0.739034	0.900000	0.60800 04
1.370345	0.0	0.50244	0.44080-06	0.0	0.0	1.000000	1.000000	0.738672	0.900000	0.60690 04
1.492055	0.0	0.52660	0.42390-06	0.0	0.0	1.000000	1.000000	0.738276	0.900000	0.60570 04
1.623697	0.0	0.55708	0.40430-06	0.0	0.0	1.000000	1.000000	0.737977	0.900000	0.60440 04
1.766080	0.0	0.59443	0.38280-06	0.0	0.0	1.000000	1.000000	0.737508	0.900000	0.60330 04
1.920082	0.0	0.63874	0.36010-06	0.0	0.0	1.000000	1.000000	0.737195	0.900000	0.60230 04
2.086651	0.0	0.68935	0.33740-06	0.0	0.0	1.000000	1.000000	0.736958	0.900000	0.60150 04
2.266812	0.0	0.74451	0.31580-06	0.0	0.0	1.000000	1.000000	0.736797	0.900000	0.60100 04

2.461673	0.0	0.80119	0.29650-06	0.0	0.0	1.000000	1.000000	0.736702	0.900000	0.60070	04
2.672436	0.0	0.85537	0.28010-06	0.0	0.0	1.000000	1.000000	0.736655	0.900000	0.60060	04
2.900396	0.0	0.90289	0.26730-06	0.0	0.0	1.000000	1.000000	0.736638	0.900000	0.60060	04
3.146959	0.0	0.94062	0.25800-06	0.0	0.0	1.000000	1.000000	0.736636	0.900000	0.60050	04
3.413640	0.0	0.96739	0.25170-06	0.0	0.0	1.000000	1.000000	0.736639	0.900000	0.60060	04
3.702383	0.0	0.98418	0.24800-06	0.0	0.0	1.000000	1.000000	0.736642	0.900000	0.60060	04
4.014563	0.0	0.99335	0.24600-06	0.0	0.0	1.000000	1.000000	0.736644	0.900000	0.60060	04
4.351501	0.0	0.99764	0.24510-06	0.0	0.0	1.000000	1.000000	0.736645	0.900000	0.60060	04
4.716473	0.0	0.99932	0.24470-06	0.0	0.0	1.000000	1.000000	0.736646	0.900000	0.60060	04
5.111227	0.0	0.99985	0.24460-06	0.0	0.0	1.000000	1.000000	0.736646	0.900000	0.60060	04
5.538193	0.0	0.99998	0.24460-06	0.0	0.0	1.000000	1.000000	0.736646	0.900000	0.60060	04
6.000000	0.0	1.00000	0.24460-06	0.0	0.0	1.000000	1.000000	0.736646	0.900000	0.60060	04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	1.000000	0.0	0.5400000 03	0.1517840 01	0.1677320 01	1.399289	0.5992240-04
0.009890	0.0	1.000000	0.0	0.5458710 03	0.1534340 01	0.1659860 01	1.399187	0.5927790-04
0.020587	0.0	1.000000	0.0	0.5521520 03	0.1552000 01	0.1640850 01	1.399072	0.5860360-04
0.032157	0.0	1.000000	0.0	0.5588630 03	0.1570860 01	0.1620110 01	1.398945	0.5789940-04
0.044671	0.0	1.000000	0.0	0.5660260 03	0.1591000 01	0.1597480 01	1.398803	0.5716720-04
0.058206	0.0	1.000000	0.0	0.5736590 03	0.1612450 01	0.1572770 01	1.398645	0.5640650-04
0.072845	0.0	1.000000	0.0	0.5817800 03	0.1635280 01	0.1545780 01	1.398469	0.5561910-04
0.088079	0.0	1.000000	0.0	0.5904450 03	0.1659520 01	0.1516280 01	1.398274	0.5480660-04
0.105805	0.0	1.000000	0.0	0.5995460 03	0.1685210 01	0.1484020 01	1.398058	0.5397100-04
0.124329	0.0	1.000000	0.0	0.6092100 03	0.1712380 01	0.1448730 01	1.397818	0.5311490-04
0.144364	0.0	1.000000	0.0	0.6193990 03	0.1741020 01	0.1410120 01	1.397554	0.5224110-04
0.166034	0.0	1.000000	0.0	0.6301080 03	0.1771120 01	0.1367860 01	1.397263	0.5135330-04
0.189472	0.0	1.000000	0.0	0.6413210 03	0.1802640 01	0.1321580 01	1.396944	0.5045540-04
0.214823	0.0	1.000000	0.0	0.6530130 03	0.1835500 01	0.1270900 01	1.396596	0.4955200-04
0.242243	0.0	1.000000	0.0	0.6651410 03	0.1869590 01	0.1215390 01	1.396218	0.4864850-04
0.271900	0.0	1.000000	0.0	0.6776450 03	0.1903470 01	0.1154620 01	1.395811	0.4775080-04
0.303377	0.0	1.000000	0.0	0.6904430 03	0.1940710 01	0.1088100 01	1.395377	0.4686570-04
0.338671	0.0	1.000000	0.0	0.7034250 03	0.1977260 01	0.1015350 01	1.394918	0.4600080-04
0.376157	0.0	1.000000	0.0	0.7164510 03	0.2013810 01	0.09358650 00	1.394438	0.4516440-04
0.416784	0.0	1.000000	0.0	0.7293400 03	0.2050040 01	0.08491790 00	1.393947	0.4436630-04
0.463084	0.0	1.000000	0.0	0.7418670 03	0.2085250 01	0.07548580 00	1.393452	0.4361710-04
0.508165	0.0	1.000000	0.0	0.7537550 03	0.2118670 01	0.06525600 00	1.392968	0.4292920-04
0.559522	0.0	1.000000	0.0	0.7646670 03	0.2149340 01	0.05420980 00	1.392510	0.4231660-04
0.615369	0.0	1.000000	0.0	0.7742050 03	0.2176150 01	0.04235150 00	1.392101	0.4175520-04
0.675148	0.0	1.000000	0.0	0.7819010 03	0.2197780 01	0.02971980 00	1.391765	0.4138390-04
0.740130	0.0	1.000000	0.0	0.7872200 03	0.2212730 01	0.01640110 00	1.391529	0.4110430-04
0.810415	0.0	1.000000	0.0	0.7895680 03	0.2219330 01	0.00254550-01	1.391424	0.4098200-04
0.886434	0.0	1.000000	0.0	0.7888310 03	0.2215800 01	-0.1161490 00	1.391480	0.4104740-04
0.968657	0.0	1.000000	0.0	0.7827960 03	0.2200300 01	-0.2574990 00	1.391725	0.4133660-04
1.057590	0.0	1.000000	0.0	0.7724150 03	0.2171120 01	-0.3941910 00	1.392179	0.4189210-04
1.153779	0.0	1.000000	0.0	0.7566620 03	0.2126840 01	-0.5207140 00	1.392847	0.4276430-04
1.257817	0.0	1.000000	0.0	0.7352210 03	0.2066570 01	-0.6306460 00	1.393716	0.4401140-04
1.370345	0.0	1.000000	0.0	0.7080740 03	0.1990270 01	-0.7171310 00	1.394749	0.4569870-04
1.492055	0.0	1.000000	0.0	0.6755960 03	0.1898980 01	-0.7736920 00	1.395879	0.4789560-04
1.623657	0.0	1.000000	0.0	0.6386300 03	0.1795070 01	-0.7953310 00	1.397022	0.5066800-04
1.766080	0.0	1.000000	0.0	0.5985390 03	0.1682300 01	-0.7797620 00	1.398083	0.5406460-04
1.920082	0.0	1.000000	0.0	0.5569890 03	0.1565590 01	-0.7284230 00	1.398981	0.5809470-04
2.086651	0.0	1.000000	0.0	0.5160920 03	0.1450640 01	-0.6468840 00	1.399666	0.6269830-04
2.266812	0.0	1.000000	0.0	0.4778560 03	0.1343170 01	-0.5443500 00	1.400131	0.6771510-04
2.461673	0.0	1.000000	0.0	0.4440510 03	0.1248150 01	-0.4322190 00	1.400406	0.7287020-04

2.672436	0.0	1.000000	0.0	0.4159220	03	0.1169080	01	-.3220650	00	1.400540	0.7779840-04
2.900396	0.0	1.000000	0.0	0.3940310	03	0.1107550	01	-.2236180	00	1.400590	0.8212060-04
3.146959	0.0	1.000000	0.0	0.3782280	03	0.1063130	01	-.1433160	00	1.400596	0.8555180-04
3.413640	0.0	1.000000	0.0	0.3677600	03	0.1033710	01	-.8372870-01		1.400588	0.8798710-04
3.702383	0.0	1.000000	0.0	0.3614870	03	0.1016370	01	-.4387140-01		1.400578	0.8951380-04
4.014363	0.0	1.000000	0.0	0.3581500	03	0.1006690	01	-.2019250-01		1.400572	0.9034790-04
4.351501	0.0	1.000000	0.0	0.3566100	03	0.1002370	01	-.7952580-02		1.400568	0.9073810-04
4.716473	0.0	1.000000	0.0	0.3560110	03	0.1000680	01	-.2592720-02		1.400567	0.9089070-04
5.111227	0.0	1.000000	0.0	0.3558220	03	0.1000150	01	-.6707180-03		1.400567	0.9093890-04
5.538193	0.0	1.000000	0.0	0.3557760	03	0.1000020	01	-.1302440-03		1.400567	0.9095060-04
6.000000	0.0	1.000000	0.0	0.3557680	03	0.1000000	01	-.2558060-05		1.400566	0.9095270-04

S = 0.0
R = 0.0
XI = 0.0

S/REF= 0.0
R/REF= 0.0
DXI = 0.0

Z = 0.0
DX = 0.100000-01
DXDXI= 0.0

Z/REF= 0.0
NIT = 6
CHALL= 0.0

PHI = 15.00 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.5467910 02
DPEOX= 0.0
DPEOW=-0.6812760 01

TE = 0.3541010 03
DTEOX= 0.0
DTEOW=-0.1265280 02

UE = 0.4448220 04
DUEOX= 0.0
DUEOW= 0.1447780 02'

VE = 0.5565440 02
DVEDX= 0.0
DVEDW= 0.2095960 03

MACHE = 0.4820470 01
RHCE = 0.8989890-04
RHOEMUE = 0.2189690-10

LOCAL EDGE REYNOLDS NUMBER =0.0

S = 0.0
R = 0.0
XI = 0.0

S/REF= 0.0
R/REF= 0.0
CXI = 0.0

Z = 0.0
DX = 0.100000-01
DXDXI= 0.0

Z/REF= 0.0
NIT = 7
CHALL= 0.0

PHI = 30.00 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.5208860 02
DPEOX= 0.0
DPEOW=-0.1276940 02

TE = 0.3492220 03
DTEOX= 0.0
DTEOW=-0.2442020 02

UE = 0.4453830 04
DUEOX= 0.0
DUEOW= 0.2816870 02

VE = 0.1089310 03
DVEDX= 0.0
DVEDW= 0.1958380 03

MACHE = 0.4860140 01
RHCE = 0.8683630-04
RHOEMUE = 0.2089690-10

LOCAL EDGE REYNOLDS NUMBER =0.0

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	0.549969	0.0	0.049160	0.270155	0.301813	0.942531	-0.153766	0.0
0.009890	0.0	0.005444	0.550848	0.000485	0.048937	0.273148	0.303621	0.941024	-0.150961	-0.3880-04
0.020587	0.0	0.011341	0.551784	0.001007	0.048628	0.276407	0.305576	0.939425	-0.147982	-0.1680-03
0.032157	0.0	0.017731	0.552779	0.001567	0.048318	0.279954	0.307687	0.937731	-0.144829	-0.4100-03
0.044671	0.0	0.024655	0.553833	0.002170	0.047974	0.283819	0.309969	0.935940	-0.141493	-0.7910-03
0.058206	0.0	0.032159	0.554945	0.002817	0.047592	0.288031	0.312432	0.934049	-0.137967	-0.1340-02
0.072845	0.0	0.040291	0.556116	0.003510	0.047167	0.292624	0.315090	0.932056	-0.134242	-0.2100-02
0.088679	0.0	0.049107	0.557343	0.004253	0.046695	0.297636	0.317958	0.929962	-0.130310	-0.3110-02
0.105805	0.0	0.058663	0.558621	0.005049	0.046169	0.303108	0.321048	0.927766	-0.126162	-0.4430-02

2.900396	0.0	1.000000	0.0	0.2640870	03	0.1021590	01	-0.8495390-01	1.400043	0.4008050-04
3.146959	0.0	1.000000	0.0	0.2605420	03	0.1007880	01	-0.3544060-01	1.400013	0.4062570-04
3.413640	0.0	1.000000	0.0	0.2590860	03	0.1002250	01	-0.1217420-01	1.400000	0.4085400-04
3.702083	0.0	1.000000	0.0	0.2586040	03	0.1000380	01	-0.3300490-02	1.399996	0.4093020-04
4.014063	0.0	1.000000	0.0	0.2584810	03	0.9999060	00	-0.6773320-03	1.399994	0.4094970-04
4.351501	0.0	1.000000	0.0	0.2584570	03	0.9998140	00	-0.1103600-03	1.399994	0.4095340-04
4.716473	0.0	1.000000	0.0	0.2584530	03	0.9997970	00	-0.2590870-04	1.399994	0.4095410-04
5.111227	0.0	1.000000	0.0	0.2584510	03	0.9997890	00	-0.1609190-04	1.399994	0.4095450-04
5.538193	0.0	1.000000	0.0	0.2584490	03	0.9997830	00	-0.1339880-04	1.399994	0.4095470-04
6.000000	0.0	1.000000	0.0	0.2584500	03	0.1000000	01	0.1416800-02	1.399995	0.4095490-04

FAILED TO GET A CONVERGED SOLUTION AT K= 13

S = 0.1000000-01 S/REF= 0.5177060-02

R = 0.2588190-02 R/REF= 0.1339920-02

XI = 0.2208470-14 DXI = 0.2208470-14

L= 1 NIT= 21

Z = 0.9659260-02

DX = 0.1000000-01

DXDXI= 0.1509340 13

Z/REF= 0.5000650-02

NIT = 7

CHALL= 0.0

PHI = 0.0 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.5558050 02

DPEDX= 0.0

DPEDW= 0.0

TE = 0.3557680 03

DTEDX= 0.0

CTEDW= 0.0

UE = 0.4446320 04

DUEDX= 0.0

DUEDW= 0.0

VE = 0.0

DVEDX= 0.0

DVEDW= 0.2140670 03

MACHE = 0.4807100 01

RHOE = 0.9095270-04

RHOEMUE= 0.2224440-10

LOCAL EDGE REYNOLDS NUMBER =0.1653530 05

NCNDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.4046810-01

CHEDGE= 0.6130450-02

QM =-0.8516700-02

CFXEDG= 0.9764600-02

CHINF = 0.2741760-01

CHIMAX= 0.1054550 03

CFWINF= 0.0

STEDGE= 0.4999170-02

CFWEDG= 0.1806700-02

STINF = 0.2235820-01

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION= 0.8778920 01 PSF

TRANSVERSE SKIN FRICTION = 0.0 PSF

WALL HEAT TRANSFER RATE =-0.2280080 02 BTU

DELTA*(X) = 0.2041440-03

DELTA*(PHI) = 0.9757750-04

DELTA (FT) = 0.3427180-03

THETA(X) = 0.2506790-04

THETA(PHI)=-0.6823600-04

ETA	Y	F	FN	G	GN	H	MN	C	CN	V
0.0	0.0	0.0	0.542550	0.0	0.100386	0.270155	0.298591	0.944810	-0.152492	0.0
0.009890	0.9580-06	0.005370	0.543408	0.000991	0.099934	0.273116	0.300337	0.943315	-0.149770	-0.3920-04
0.020587	0.2010-05	0.011188	0.544323	0.002057	0.099435	0.276339	0.302225	0.941729	-0.146877	-0.1700-03
0.032157	0.3150-05	0.017491	0.545295	0.003204	0.098880	0.279848	0.304266	0.940047	-0.143815	-0.4140-03
0.044671	0.4410-05	0.024321	0.546325	0.004438	0.098265	0.283669	0.306470	0.938268	-0.140574	-0.7990-03
0.058206	0.5790-05	0.031723	0.547413	0.005763	0.097581	0.287833	0.308850	0.936389	-0.137147	-0.1360-02
0.072845	0.7300-05	0.039746	0.548559	0.007186	0.096819	0.292373	0.311419	0.934408	-0.133526	-0.2120-02
0.088679	0.8950-05	0.048441	0.549761	0.008713	0.095971	0.297326	0.314191	0.932324	-0.129702	-0.3140-02
0.105805	0.1080-04	0.057867	0.551015	0.010348	0.095025	0.302733	0.317179	0.930137	-0.125666	-0.4480-02
0.124329	0.1280-04	0.068086	0.552316	0.012099	0.093970	0.308638	0.320397	0.927849	-0.121408	-0.6180-02
0.144364	0.1500-04	0.079166	0.553654	0.013970	0.092793	0.315072	0.323858	0.925462	-0.116916	-0.8320-02

0.166034	0.1740-04	0.091178	0.555018	0.015966	0.091478	0.322150	0.327576	0.922980	-0.112181	-0.1100-01
0.189472	0.2000-04	0.104203	0.556390	0.018093	0.090008	0.329875	0.331562	0.920410	-0.107187	-0.1430-01
0.214823	0.2300-04	0.118326	0.557747	0.020354	0.088366	0.338334	0.335825	0.917759	-0.101923	-0.1840-01
0.242243	0.2620-04	0.133638	0.559056	0.022752	0.086531	0.347605	0.340371	0.915041	-0.096373	-0.2340-01
0.271900	0.2970-04	0.150236	0.560276	0.025289	0.084480	0.357771	0.345200	0.912271	-0.090520	-0.2940-01
0.303977	0.3370-04	0.168227	0.561352	0.027962	0.082191	0.368927	0.350305	0.909467	-0.084347	-0.3670-01
0.338671	0.3800-04	0.187719	0.562213	0.030770	0.079636	0.381174	0.355667	0.906654	-0.077836	-0.4550-01
0.376197	0.4270-04	0.208828	0.562767	0.033705	0.076788	0.394627	0.361252	0.903863	-0.070968	-0.5610-01
0.416784	0.4800-04	0.231675	0.562897	0.036758	0.073621	0.409407	0.367006	0.901130	-0.063725	-0.6870-01
0.460084	0.5370-04	0.256380	0.562455	0.039913	0.070106	0.425649	0.372848	0.898501	-0.056089	-0.8370-01
0.508165	0.6010-04	0.283062	0.561255	0.043150	0.066218	0.443494	0.378659	0.896030	-0.048046	-0.1020 00
0.559522	0.6700-04	0.311836	0.559764	0.046441	0.061934	0.463090	0.384272	0.893782	-0.039588	-0.1230 00
0.615069	0.7470-04	0.342802	0.555600	0.049751	0.057236	0.484585	0.389461	0.891831	-0.030715	-0.1460 00
0.675148	0.8300-04	0.376040	0.550520	0.053036	0.052120	0.508128	0.393923	0.890267	-0.021439	-0.1770 00
0.740130	0.9210-04	0.411597	0.543418	0.056243	0.046590	0.533847	0.397262	0.889191	-0.011796	-0.2120 00
0.810415	0.1020-03	0.449471	0.533826	0.059309	0.040675	0.561847	0.396977	0.888716	-0.001847	-0.2530 00
0.866434	0.1130-03	0.463595	0.521221	0.062162	0.034423	0.592181	0.398450	0.888967	0.008309	-0.3000 00
0.968657	0.1240-03	0.531813	0.505048	0.064722	0.027918	0.624831	0.394949	0.890079	0.018524	-0.3560 00
1.057590	0.1370-03	0.575857	0.484753	0.066904	0.021279	0.659671	0.387652	0.892186	0.026588	-0.4200 00
1.153779	0.1500-03	0.671322	0.459849	0.068625	0.014663	0.696433	0.375693	0.894415	0.038275	-0.4950 00
1.257017	0.1640-03	0.667646	0.429592	0.069807	0.008267	0.734671	0.358265	0.895875	0.047083	-0.5800 00
1.370345	0.1780-03	0.714100	0.395086	0.070388	0.002319	0.773726	0.334756	0.905633	0.054747	-0.6780 00
1.492055	0.1930-03	0.754791	0.355395	0.070332	-0.002937	0.812714	0.304938	0.912698	0.060761	-0.7900 00
1.623657	0.2090-03	0.803698	0.311644	0.065638	-0.007268	0.850547	0.269169	0.920997	0.064675	-0.9170 00
1.766080	0.2240-03	0.844727	0.265077	0.068348	-0.010481	0.885996	0.228562	0.930356	0.066105	-0.1060 01
1.920382	0.2430-03	0.881810	0.217434	0.066555	-0.012458	0.917811	0.185047	0.940488	0.064807	-0.1220 01
2.086651	0.2560-03	0.914025	0.170833	0.064392	-0.013190	0.944890	0.141255	0.950995	0.060748	-0.1400 01
2.266812	0.2720-03	0.940726	0.127529	0.062029	-0.012789	0.966471	0.100178	0.961387	0.054167	-0.1590 01
2.461673	0.2880-03	0.961655	0.089590	0.059648	-0.011491	0.982296	0.064635	0.971131	0.045611	-0.1810 01
2.672436	0.3040-03	0.977005	0.058542	0.057417	-0.009616	0.992698	0.036685	0.979720	0.035929	-0.2050 01
2.900356	0.3210-03	0.987407	0.035080	0.055467	-0.007525	0.998551	0.017147	0.986763	0.026184	-0.2300 01
3.146959	0.3380-03	0.993815	0.018943	0.053868	-0.005547	1.001089	0.005453	0.992075	0.017438	-0.2580 01
3.413640	0.3550-03	0.997337	0.009023	0.052625	-0.003919	1.001620	-0.000098	0.995710	0.010470	-0.2860 01
3.702083	0.3740-03	0.999022	0.003693	0.051683	-0.002749	1.001251	-0.001737	0.997937	0.005581	-0.3210 01
4.014063	0.3940-03	0.999704	0.001257	0.050557	-0.002017	1.000704	-0.001524	0.999137	0.002594	-0.3560 01
4.351501	0.4160-03	0.999930	0.000342	0.050357	-0.001618	1.000305	-0.000852	0.999694	0.001026	-0.3940 01
4.716473	0.4390-03	0.999988	0.000070	0.049809	-0.001422	1.000101	-0.000345	0.999912	0.000335	-0.4360 01
5.111227	0.4640-03	0.999998	0.000010	0.049271	-0.001325	1.000025	-0.000102	0.999980	0.000087	-0.4800 01
5.538193	0.4910-03	1.000000	0.000001	0.048719	-0.001267	1.000004	-0.000022	0.999997	0.000017	-0.5280 01
6.000000	0.5200-03	1.000000	-0.000000	0.048145	-0.001220	1.000000	-0.000001	1.000000	0.000000	-0.5800 01

ETA	Y/L	RORGE	XMU	E+	CHI	LEL	LET	PRL	PRT	SP HT
0.0	0.0	0.65883	0.35070-06	0.0	0.0	1.000000	1.000000	0.737088	0.900000	0.60190 04
0.009890	0.4960-06	0.65175	0.35400-06	0.0	0.38140-02	1.000000	1.000000	0.737124	0.900000	0.60210 04
0.020587	0.1040-05	0.64433	0.35750-06	0.0	0.16210-01	1.000000	1.000000	0.737164	0.900000	0.60220 04
0.032157	0.1630-05	0.63660	0.36120-06	0.0	0.38760-01	1.000000	1.000000	0.737208	0.900000	0.60230 04
0.044671	0.2280-05	0.62854	0.36510-06	0.0	0.73220-01	1.000000	1.000000	0.737257	0.900000	0.60250 04
0.058206	0.3030-05	0.62018	0.36930-06	0.0	0.12160 00	1.000000	1.000000	0.737312	0.900000	0.60260 04
0.072845	0.3730-05	0.61153	0.37370-06	0.0	0.18610 00	1.000000	1.000000	0.737373	0.900000	0.60280 04
0.088679	0.4630-05	0.60260	0.37840-06	0.0	0.26930 00	1.000000	1.000000	0.737441	0.900000	0.60300 04
0.105905	0.5580-05	0.59341	0.38340-06	0.0	0.37400 00	1.000000	1.000000	0.737516	0.900000	0.60330 04
0.124329	0.6610-05	0.58400	0.38860-06	0.0	0.50340 00	1.000000	1.000000	0.737599	0.900000	0.60350 04
0.144364	0.7750-05	0.57440	0.39410-06	0.0	0.66120 00	1.000000	1.000000	0.737691	0.900000	0.60380 04
0.166034	0.9000-05	0.56464	0.39980-06	0.0	0.85170 00	1.000000	1.000000	0.737793	0.900000	0.60410 04

0.189472	0.1040-04	0.55477	0.40580-06	0.0	0.10800 01	1.000000	1.000000	0.737904	0.900000	0.60450 04
0.214823	0.1190-04	0.54484	0.41200-06	0.0	0.13500 01	1.000000	1.000000	0.738025	0.900000	0.60490 04
0.242243	0.1360-04	0.53490	0.41840-06	0.0	0.16710 01	1.000000	1.000000	0.738157	0.900000	0.60530 04
0.271900	0.1540-04	0.52504	0.42500-06	0.0	0.20480 01	1.000000	1.000000	0.738299	0.900000	0.60570 04
0.303977	0.1740-04	0.51531	0.43160-06	0.0	0.24930 01	1.000000	1.000000	0.738451	0.900000	0.60620 04
0.333671	0.1970-04	0.50580	0.43840-06	0.0	0.30140 01	1.000000	1.000000	0.738612	0.900000	0.60670 04
0.376197	0.2210-04	0.49660	0.44510-06	0.0	0.36260 01	1.000000	1.000000	0.738780	0.900000	0.60720 04
0.416784	0.2480-04	0.48783	0.45180-06	0.0	0.43460 01	1.000000	1.000000	0.738953	0.900000	0.60780 04
0.460684	0.2760-04	0.47959	0.45820-06	0.0	0.51920 01	1.000000	1.000000	0.739126	0.900000	0.60830 04
0.508165	0.3110-04	0.47203	0.46430-06	0.0	0.61910 01	1.000000	1.000000	0.739297	0.900000	0.60890 04
0.559522	0.3470-04	0.46529	0.46980-06	0.0	0.73730 01	1.000000	1.000000	0.739458	0.900000	0.60940 04
0.615069	0.3970-04	0.45956	0.47460-06	0.0	0.87770 01	1.000000	1.000000	0.739602	0.900000	0.60990 04
0.675148	0.4300-04	0.45503	0.47850-06	0.0	1.0450 02	1.000000	1.000000	0.739721	0.900000	0.61020 04
0.740130	0.4770-04	0.45156	0.48140-06	0.0	0.12460 02	1.000000	1.000000	0.739834	0.900000	0.61050 04
0.810415	0.5280-04	0.45061	0.48740-06	0.0	0.14890 02	1.000000	1.000000	0.739941	0.900000	0.61060 04
0.886434	0.5830-04	0.45132	0.48170-06	0.0	0.17830 02	1.000000	1.000000	0.739622	0.900000	0.61050 04
0.968557	0.6430-04	0.45449	0.47900-06	0.0	0.21410 02	1.000000	1.000000	0.739735	0.900000	0.61030 04
1.057593	0.7070-04	0.46055	0.47370-06	0.0	0.25790 02	1.000000	1.000000	0.739576	0.900000	0.60970 04
1.153779	0.7750-04	0.47017	0.46580-06	0.0	0.31160 02	1.000000	1.000000	0.739340	0.900000	0.60900 04
1.257317	0.8470-04	0.48387	0.45480-06	0.0	0.37720 02	1.000000	1.000000	0.739035	0.900000	0.60800 04
1.370345	0.9220-04	0.50240	0.44090-06	0.0	0.45680 02	1.000000	1.000000	0.738673	0.900000	0.60650 04
1.492355	1.0300-03	0.52654	0.42390-06	0.0	0.55200 02	1.000000	1.000000	0.738277	0.900000	0.60570 04
1.623597	0.1080-03	0.55700	0.40440-06	0.0	0.66230 02	1.000000	1.000000	0.737878	0.900000	0.60440 04
1.766760	0.1160-03	0.59432	0.38290-06	0.0	0.78340 02	1.000000	1.000000	0.737509	0.900000	0.60330 04
1.920382	0.1240-03	0.63862	0.36020-06	0.0	0.90430 02	1.000000	1.000000	0.737196	0.900000	0.60230 04
2.086651	0.1330-03	0.68922	0.33750-06	0.0	0.10040 03	1.000000	1.000000	0.736959	0.900000	0.60150 04
2.266812	0.1410-03	0.74438	0.31590-06	0.0	0.10550 03	1.000000	1.000000	0.736797	0.900000	0.60100 04
2.461573	0.1490-03	0.80107	0.29650-06	0.0	0.10250 03	1.000000	1.000000	0.736702	0.900000	0.60070 04
2.672436	0.1530-03	0.85527	0.28020-06	0.0	0.90100 02	1.000000	1.000000	0.736655	0.900000	0.60060 04
2.902396	0.1660-03	0.92282	0.26730-06	0.0	0.70060 02	1.000000	1.000000	0.736639	0.900000	0.60030 04
3.146959	0.1750-03	0.94057	0.25800-06	0.0	0.47180 02	1.000000	1.000000	0.736636	0.900000	0.60030 04
3.413540	0.1840-03	0.96737	0.25170-06	0.0	0.28980 02	1.000000	1.000000	0.736639	0.900000	0.60030 04
3.702383	0.1940-03	0.98417	0.24860-06	0.0	0.12860 02	1.000000	1.000000	0.736642	0.900000	0.60030 04
4.014063	0.2040-03	0.99334	0.24600-06	0.0	0.49900 01	1.000000	1.000000	0.736644	0.900000	0.60030 04
4.351501	0.2150-03	0.99764	0.24510-06	0.0	0.15280 01	1.000000	1.000000	0.736645	0.900000	0.60030 04
4.716473	0.2270-03	0.99932	0.24470-06	0.0	0.35290 00	1.000000	1.000000	0.736646	0.900000	0.60030 04
5.111227	0.2400-03	0.99985	0.24460-06	0.0	0.57620-01	1.000000	1.000000	0.736646	0.900000	0.60030 04
5.538193	0.2540-03	0.99998	0.24460-06	0.0	0.60340-02	1.000000	1.000000	0.736646	0.900000	0.60030 04
6.000000	0.2690-03	1.00000	0.24460-06	0.0	-0.50850-03	1.000000	1.000000	0.736646	0.900000	0.60030 04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	1.000000	0.0	0.5400000 03	0.1517840 01	0.1676890 01	1.399289	0.5992240-04
0.009890	0.4960-06	1.000000	0.0	0.5458690 03	0.1534340 01	0.1659440 01	1.399187	0.5927810-04
0.020567	0.1040-05	1.000000	0.0	0.5521490 03	0.1551990 01	0.1640430 01	1.399072	0.5860400-04
0.032157	0.1630-05	1.000000	0.0	0.5588580 03	0.1570850 01	0.1619690 01	1.398945	0.5790040-04
0.044671	0.2280-05	1.000000	0.0	0.5660190 03	0.1597980 01	0.1597060 01	1.398803	0.5716790-04
0.058206	0.3000-05	1.000000	0.0	0.5736500 03	0.1612430 01	0.1572360 01	1.398645	0.5640740-04
0.072645	0.3780-05	1.000000	0.0	0.5817690 03	0.1635250 01	0.1545370 01	1.398469	0.5562020-04
0.088579	0.4630-05	1.000000	0.0	0.5903520 03	0.1659480 01	0.1515870 01	1.398274	0.5480780-04
0.105805	0.5580-05	1.000000	0.0	0.5995300 03	0.1685170 01	0.1483620 01	1.398058	0.5397240-04
0.124329	0.6610-05	1.000000	0.0	0.6091910 03	0.1712330 01	0.1440340 01	1.397819	0.5311650-04
0.144364	0.7750-05	1.000000	0.0	0.6193780 03	0.1740960 01	0.1409740 01	1.397554	0.5224290-04
0.166034	0.9000-05	1.000000	0.0	0.6300840 03	0.1771050 01	0.1367490 01	1.397263	0.5135520-04
0.189472	0.1040-04	1.000000	0.0	0.6412940 03	0.1802560 01	0.1321220 01	1.396944	0.5045750-04

0.214823	0.119D-04	1.000000	0.0	0.6529830	03	0.1835420	01	0.1270550	01	1.396596	0.4955430-04
0.242243	0.136D-04	1.000000	0.0	0.6651070	03	0.1869500	01	0.1215070	01	1.396219	0.4865100-04
0.271900	0.154D-04	1.000000	0.0	0.6776080	03	0.1904630	01	0.1154320	01	1.395812	0.4775340-04
0.303977	0.174D-04	1.000000	0.0	0.6904030	03	0.1940600	01	0.1087820	01	1.395378	0.4686850-04
0.338671	0.197D-04	1.000000	0.0	0.7033820	03	0.1977080	01	0.1015100	01	1.394919	0.4600360-04
0.376197	0.221D-04	1.000000	0.0	0.7164050	03	0.2013680	01	0.9356540	00	1.394440	0.4516730-04
0.416784	0.248D-04	1.000000	0.0	0.7292910	03	0.2049900	01	0.8490090	00	1.393948	0.4436920-04
0.460684	0.278D-04	1.000000	0.0	0.7418160	03	0.2085110	01	0.7547350	00	1.393454	0.4362010-04
0.508165	0.311D-04	1.000000	0.0	0.7537020	03	0.2118520	01	0.6524920	00	1.392970	0.4293220-04
0.559522	0.347D-04	1.000000	0.0	0.7646140	03	0.2149190	01	0.5420920	00	1.392513	0.4231950-04
0.615069	0.387D-04	1.000000	0.0	0.7741520	03	0.2176000	01	0.4235790	00	1.392104	0.4179810-04
0.675148	0.430D-04	1.000000	0.0	0.7818500	03	0.2197640	01	0.2973380	00	1.391767	0.4138660-04
0.740130	0.477D-04	1.000000	0.0	0.7871730	03	0.2212600	01	0.1642310	00	1.391531	0.4110670-04
0.810415	0.528D-04	1.000000	0.0	0.7895280	03	0.2219220	01	0.2575970-01		1.391426	0.4098410-04
0.886434	0.583D-04	1.000000	0.0	0.7882790	03	0.2215710	01	-0.1157630	00	1.391482	0.4104900-04
0.968057	0.643D-04	1.000000	0.0	0.7827780	03	0.2200250	01	-0.2570410	00	1.391726	0.4133750-04
1.057590	0.707D-04	1.000000	0.0	0.7724130	03	0.2171110	01	-0.3936760	00	1.392179	0.4189220-04
1.153779	0.775D-04	1.000000	0.0	0.7566770	03	0.2126880	01	-0.5201690	00	1.392846	0.4276340-04
1.257817	0.847D-04	1.000000	0.0	0.7352570	03	0.2066670	01	-0.6301060	00	1.393715	0.4400920-04
1.370345	0.922D-04	1.000000	0.0	0.7081310	03	0.1990430	01	-0.7166390	00	1.394747	0.4569510-04
1.492355	0.109D-03	1.000000	0.0	0.6756720	03	0.1899190	01	-0.7732910	00	1.395877	0.4789020-04
1.623697	0.108D-03	1.000000	0.0	0.6387210	03	0.1795330	01	-0.7950610	00	1.397019	0.5066070-04
1.766080	0.116D-03	1.000000	0.0	0.5986100	03	0.1682580	01	-0.7796450	00	1.398080	0.5405540-04
1.920082	0.124D-03	1.000000	0.0	0.5570920	03	0.1565890	01	-0.7284570	00	1.398979	0.5808390-04
2.086651	0.133D-03	1.000000	0.0	0.5161900	03	0.1450920	01	-0.6470430	00	1.399665	0.6268640-04
2.266812	0.141D-03	1.000000	0.0	0.4779410	03	0.1343410	01	-0.5445860	00	1.400131	0.6770310-04
2.461673	0.149D-03	1.000000	0.0	0.4441180	03	0.1248330	01	-0.4324760	00	1.400405	0.7285920-04
2.672436	0.158D-03	1.000000	0.0	0.4159710	03	0.1169220	01	-0.3222970	00	1.400540	0.7778940-04
2.900396	0.166D-03	1.000000	0.0	0.3940630	03	0.1107640	01	-0.2237970	00	1.400589	0.8211400-04
3.146959	0.175D-03	1.000000	0.0	0.3782470	03	0.1063180	01	-0.1434360	00	1.400566	0.8554760-04
3.413640	0.184D-03	1.000000	0.0	0.3677690	03	0.1033730	01	-0.8379880-01		1.400588	0.8798480-04
3.762083	0.194D-03	1.000000	0.0	0.3614920	03	0.1016090	01	-0.4390710-01		1.400578	0.8951270-04
4.014063	0.204D-03	1.000000	0.0	0.3581520	03	0.1006700	01	-0.2020830-01		1.400572	0.9034740-04
4.351501	0.215D-03	1.000000	0.0	0.3566110	03	0.1002370	01	-0.7958620-02		1.400568	0.9073790-04
4.716473	0.227D-03	1.000000	0.0	0.3560110	03	0.1000680	01	-0.2594710-02		1.400567	0.9089060-04
5.111227	0.240D-03	1.000000	0.0	0.3558230	03	0.1000150	01	-0.6712710-03		1.400567	0.9093890-04
5.538193	0.254D-03	1.000000	0.0	0.3557760	03	0.1000020	01	-0.1303690-03		1.400567	0.9095060-04
6.000000	0.269D-03	1.000000	0.0	0.3557680	03	0.1000000	01	-0.2566210-05		1.400566	0.9095270-04

S = 0.100000D-01
R = 0.258819D-02
XI = 0.220847D-14

S/REF= 0.517706D-02
R/REF= 0.133992D-02
DXI = 0.220847D-14

Z = 0.965926D-02
DX = 0.100000D-01
DXDXI = 0.150934D 13

Z/REF= 0.500065D-02
NIT = 4
CHALL= 0.0

PHI = 15.00 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.546791D 02
DPEDX= 0.0
DPEDW=-0.681276D 01

TE = 0.354101D 03
DTEDX= 0.0
DTEDW=-0.126528D 02

UE = 0.444822D 04
DUEDX= 0.0
DUEW= 0.144778D 02

VE = 0.556544D 02
DVEDX= 0.0
DVEDW= 0.209596D 03

MACHE = 0.482047D 01
RHOE = 0.898989D-04
RHOEMUE= 0.218969D-10

LOCAL EDGE REYNOLDS NUMBER = 0.164177D 05

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.396998D-01 CFXEDG= 0.968321D-02 CFWINF= 0.179728D-02 CFWEDG= 0.438374D-03
 CHEDGE= 0.6C7449D-02 CHINF = 0.268641D-01 STEDEG= 0.495354D-02 STINF = 0.219068D-01
 QW =-0.834476D-02 CHIMAX= 0.106616D 03

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LCNGITUDINAL SKIN FRICTION= 0.861226D 01 PSF DELTA*(X) = 0.208233D-03 THETA(X) = 0.254513D-04
 TRANSVERSE SKIN FRICTION = 0.389891D 00 PSF DELTA*(PHI)= 0.131304D-03 THETA(PHI)=-0.263909D-04
 WALL HEAT TRANSFER RATE =-0.223405D 02 BTU DELTA (FT) = 0.348808D-03

S = 0.100000D-01 S/REF= 0.517706D-02 Z = 0.965926D-02 Z/REF= 0.500065D-02 PHI = 30.00 DEG.
 R = 0.258819D-02 R/REF= 0.133992D-02 DX = 0.10900D-01 NIT = 3
 XI = 0.220847D-14 DXI = 0.220847D-14 DXDXI= 0.150934D 13 CWALL= 0.0

DIMENSIONAL EDGE PROPERTIES

PE = 0.52C886D 02 TE = 0.349222D 03 UE = 0.445383D 04 VE = 0.108931D 03 MACHE = 0.486014D 01
 DPEDX= 0.0 DTEDX= 0.0 DUEDX= 0.0 DYEDX= 0.0 RHOE = 0.868363D-04
 DPEDW=-0.127694D 02 DTEDW=-0.244202D 02 DUEDW= 0.281687D 02 DYEDW= 0.195838D 03 RHOEMUE= 0.208969D-10

LOCAL EDGE REYNOLDS NUMBER =0.160714D 03

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.385021C-01 CFXEDG= 0.969783D-02 CFWINF= 0.345190D-02 CFWEDG= 0.869458D-03
 CHEDGE= 0.607127D-02 CHINF = 0.259678D-01 STEDEG= 0.495092D-02 STINF = 0.211759D-01
 QW =-0.806635D-02 CHIMAX= 0.107349D 03

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTICN= 0.835242D 01 PSF DELTA*(X) = 0.214983D-03 THETA(X) = 0.2591C8D-04
 TRANSVERSE SKIN FRICTION = 0.748835D 00 PSF DELTA*(PHI)= 0.135521D-03 THETA(PHI)=-0.281714D-04
 WALL HEAT TRANSFER RATE =-0.215951D 02 BTU DELTA (FT) = 0.357933D-03

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	0.548950	0.0	0.049216	0.270155	0.301251	0.942531	-0.153479	0.0
0.009890	0.102D-05	0.0C5433	0.549826	0.000485	0.048963	0.273143	0.303053	0.941026	-0.15C685	-0.387D-04
0.020587	0.214D-05	0.011320	0.550759	0.001008	0.048683	0.276395	0.304999	0.939431	-0.147717	-0.168D-03
0.032157	0.336D-05	0.017698	0.551750	0.001569	0.048373	0.279936	0.307103	0.937740	-0.144574	-0.409D-03
0.044671	0.47C0-05	0.024609	0.552800	0.002172	0.048029	0.283793	0.309375	0.935952	-0.141250	-0.789D-03
0.058206	0.617D-05	0.032C99	0.553909	0.002820	0.047647	0.287997	0.311829	0.934064	-0.137736	-0.134D-02
0.072845	0.777D-05	0.040216	0.555075	0.003514	0.047223	0.292592	0.314477	0.932075	-0.134025	-0.210D-02
0.088679	0.554D-C5	0.049015	0.556298	0.004258	0.046750	0.297584	0.317334	0.929984	-0.130106	-0.311D-02

0.105805	0.1150-04	0.058553	0.557572	0.005055	0.046225	0.303045	0.320413	0.927791	-0.125971	-0.4420-02
0.124329	0.1360-04	0.068894	0.558893	0.005905	0.045640	0.309011	0.323728	0.925498	-0.121610	-0.6100-02
0.144364	0.1600-04	0.080105	0.560249	0.006813	0.044988	0.315533	0.327294	0.923108	-0.117012	-0.8220-02
0.166034	0.1850-04	0.092261	0.561629	0.007780	0.044262	0.322667	0.331123	0.920625	-0.112165	-0.1090-01
0.189472	0.2140-04	0.105441	0.563913	0.008608	0.043452	0.330476	0.335227	0.918057	-0.107057	-0.1410-01
0.214923	0.2450-04	0.119732	0.564378	0.009899	0.042549	0.339030	0.339614	0.915411	-0.101673	-0.1820-01
0.242243	0.2790-04	0.135725	0.565688	0.011052	0.041544	0.348406	0.344291	0.912702	-0.095998	-0.2310-01
0.271900	0.3170-04	0.152021	0.566901	0.012267	0.040424	0.358691	0.349255	0.909944	-0.090016	-0.2900-01
0.303977	0.3590-04	0.170223	0.567959	0.013544	0.039178	0.369797	0.354530	0.907158	-0.083711	-0.3620-01
0.338671	0.4050-04	0.189944	0.568787	0.014879	0.037793	0.382374	0.360303	0.904370	-0.077063	-0.4400-01
0.376197	0.4560-04	0.211300	0.569290	0.016269	0.036256	0.395992	0.365728	0.901611	-0.070053	-0.5520-01
0.415764	0.5110-04	0.234409	0.569744	0.017706	0.034555	0.410957	0.371617	0.898918	-0.062665	-0.6760-01
0.460684	0.5730-04	0.259395	0.568796	0.019182	0.032678	0.427404	0.377583	0.896339	-0.054861	-0.8240-01
0.508165	0.6400-04	0.286375	0.567451	0.020685	0.030615	0.445477	0.383500	0.893979	-0.046687	-0.1000 00
0.555522	0.7140-04	0.315462	0.565069	0.022199	0.028357	0.465323	0.389192	0.891755	-0.038077	-0.1210 00
0.615069	0.7960-04	0.346755	0.561355	0.023706	0.025902	0.487094	0.394419	0.889892	-0.029052	-0.1450 00
0.675148	0.8940-04	0.380330	0.555957	0.025183	0.023251	0.510933	0.398864	0.886433	-0.019628	-0.1740 00
0.740130	0.9810-04	0.416228	0.548455	0.026601	0.020417	0.536972	0.402111	0.887479	-0.009844	-0.2080 00
0.810415	0.1090-03	0.454439	0.538369	0.027930	0.017422	0.565306	0.403638	0.887146	0.000236	-0.2400 00
0.885434	0.1200-03	0.494487	0.525165	0.029135	0.014302	0.595984	0.402904	0.887560	0.010505	-0.2940 00
0.963657	0.1320-03	0.537400	0.508281	0.030177	0.011110	0.628975	0.398853	0.881857	0.020008	-0.3480 00
1.057590	0.1450-03	0.581635	0.487144	0.031020	0.007919	0.664136	0.390941	0.891169	0.030926	-0.4110 00
1.153779	0.1590-03	0.627340	0.461334	0.031628	0.004818	0.701178	0.373193	0.894625	0.040571	-0.4930 00
1.257817	0.1740-03	0.673174	0.430469	0.031972	0.001914	0.739628	0.359807	0.895327	0.049381	-0.5660 00
1.370345	0.1890-03	0.720221	0.344512	0.032033	-0.000677	0.778794	0.335199	0.905337	0.056932	-0.6610 00
1.492255	0.2050-03	0.765778	0.353764	0.031810	-0.002839	0.817764	0.304702	0.912658	0.042761	-0.7690 00
1.623597	0.2210-03	0.809407	0.300080	0.031317	-0.004472	0.855421	0.267265	0.921205	0.066418	-0.8920 00
1.766380	0.2370-03	0.850009	0.261720	0.030594	-0.005510	0.890520	0.225621	0.930790	0.067526	-0.1030 01
1.920002	0.2540-03	0.886527	0.213524	0.029700	-0.005935	0.921815	0.181329	0.941112	0.065955	-0.1100 01
2.086551	0.2710-03	0.918062	0.166667	0.028713	-0.005791	0.948231	0.137132	0.951757	0.061394	-0.1360 01
2.266312	0.2870-03	0.944011	0.123433	0.027717	-0.005182	0.969062	0.096081	0.962230	0.054407	-0.1550 01
2.461673	0.3040-03	0.964173	0.085871	0.026793	-0.004263	0.984123	0.060981	0.971932	0.045477	-0.1760 01
2.672436	0.3210-03	0.978801	0.055441	0.026007	-0.003211	0.993830	0.033787	0.980509	0.035499	-0.1990 01
2.900395	0.3360-03	0.991530	0.032729	0.025395	-0.002197	0.999126	0.015151	0.987430	0.025577	-0.2240 01
3.146959	0.3560-03	0.994506	0.017346	0.024967	-0.001348	1.0001283	0.004314	0.992582	0.016791	-0.2510 01
3.413640	0.3740-03	0.997694	0.008071	0.024700	-0.000728	1.001609	-0.000578	0.990553	0.009905	-0.2810 01
3.702083	0.3940-03	0.999180	0.003206	0.024555	-0.000338	1.001168	-0.001824	0.998137	0.005166	-0.3130 01
4.014063	0.4140-03	0.999762	0.001051	0.024488	-0.000129	1.000627	-0.001452	0.999234	0.002337	-0.3470 01
4.351501	0.4370-03	0.999946	0.000273	0.024464	-0.000037	1.000259	-0.000764	0.999728	0.000694	-0.3850 01
4.716473	0.4610-03	0.999991	0.000003	0.024458	-0.000006	1.000081	-0.000292	0.999914	0.000200	-0.4250 01
5.111227	0.4870-03	0.999999	0.000000	0.024458	-0.000001	1.000009	-0.000001	0.999970	0.000069	-0.4690 01
5.538153	0.5160-03	1.000000	0.000001	0.024458	-0.000000	1.000000	-0.000000	0.999993	0.000012	-0.5170 01
6.000000	0.5460-03	1.000000	-0.000000	0.024458	-0.000003	1.000000	-0.000000	1.000000	0.000096	-0.5680 01

ETA	Y/L	RURGE	XMU	E+	CHI	LEL	LET	PRL	PRT	SP HT
0.0	0.0	0.64670	0.35070-06	0.0	0.0	1.000000	1.000000	0.737088	0.900000	0.60190 04
0.309890	0.5290-06	0.63968	0.35400-06	0.0	0.38590-02	1.000000	1.000000	0.737124	0.900000	0.60210 04
0.020587	0.1110-05	0.63235	0.35750-06	0.0	0.16400-01	1.000000	1.000000	0.737164	0.900000	0.60220 04
0.032157	0.1740-05	0.62470	0.36120-06	0.0	0.39200-01	1.000000	1.000000	0.737209	0.900000	0.60230 04
0.044571	0.2430-05	0.61674	0.36520-06	0.0	0.74040-01	1.000000	1.000000	0.737259	0.900000	0.60250 04
0.058206	0.3190-05	0.60848	0.36940-06	0.0	0.12290 00	1.000000	1.000000	0.737314	0.900000	0.60270 04
0.072845	0.4020-05	0.59993	0.37390-06	0.0	0.18810 00	1.000000	1.000000	0.737376	0.900000	0.60280 04
0.088679	0.4940-05	0.59112	0.37860-06	0.0	0.27220 00	1.000000	1.000000	0.737444	0.900000	0.60310 04
0.105305	0.5940-05	0.58207	0.38360-06	0.0	0.37800 00	1.000000	1.000000	0.737520	0.900000	0.60330 04

0.124329	0.7050-05	0.57280	0.38880-06	0.0	0.50870 00	1.000000	1.000000	0.737604	0.900000	0.60360 04
0.144364	0.8260-05	0.56334	0.39430-06	0.0	0.66820 00	1.000000	1.000000	0.737696	0.900000	0.60380 04
0.166034	0.9590-05	0.55375	0.40010-06	0.0	0.86060 00	1.000000	1.000000	0.737798	0.900000	0.60420 04
0.189472	0.1110-04	0.54406	0.40610-06	0.0	0.10910 01	1.000000	1.000000	0.737910	0.900000	0.60450 04
0.214823	0.1270-04	0.53431	0.41230-06	0.0	0.13650 01	1.000000	1.000000	0.738032	0.900000	0.60490 04
0.242243	0.1450-04	0.52458	0.41870-06	0.0	0.16890 01	1.000000	1.000000	0.738164	0.900000	0.60530 04
0.271900	0.1640-04	0.51493	0.42530-06	0.0	0.20710 01	1.000000	1.000000	0.738306	0.900000	0.60570 04
0.303777	0.1860-04	0.50543	0.43190-06	0.0	0.25200 01	1.000000	1.000000	0.738458	0.900000	0.60620 04
0.338671	0.2100-04	0.49617	0.43860-06	0.0	0.30430 01	1.000000	1.000000	0.738618	0.900000	0.60670 04
0.376197	0.2360-04	0.48723	0.44530-06	0.0	0.36690 01	1.000000	1.000000	0.738784	0.900000	0.60730 04
0.416784	0.2650-04	0.47873	0.45190-06	0.0	0.43980 01	1.000000	1.000000	0.738955	0.900000	0.60780 04
0.460684	0.2970-04	0.47078	0.45820-06	0.0	0.52580 01	1.000000	1.000000	0.739126	0.900000	0.60830 04
0.508165	0.3310-04	0.46352	0.46410-06	0.0	0.62730 01	1.000000	1.000000	0.739293	0.900000	0.60890 04
0.559522	0.3760-04	0.45710	0.46950-06	0.0	0.74750 01	1.000000	1.000000	0.739448	0.900000	0.60930 04
0.615369	0.4120-04	0.45171	0.47410-06	0.0	0.89070 01	1.000000	1.000000	0.739536	0.900000	0.60980 04
0.675148	0.4500-04	0.44754	0.47770-06	0.0	0.10620 02	1.000000	1.000000	0.739797	0.900000	0.61010 04
0.743130	0.5080-04	0.44485	0.48010-06	0.0	0.12670 02	1.000000	1.000000	0.739770	0.900000	0.61040 04
0.810415	0.5620-04	0.44391	0.48090-06	0.0	0.15160 02	1.000000	1.000000	0.739796	0.900000	0.61040 04
0.886434	0.6210-04	0.44508	0.47990-06	0.0	0.18170 02	1.000000	1.000000	0.739764	0.900000	0.61030 04
0.968657	0.6840-04	0.44675	0.47670-06	0.0	0.21850 02	1.000000	1.000000	0.739664	0.900000	0.61000 04
1.057593	0.7520-04	0.45539	0.47090-06	0.0	0.26360 02	1.000000	1.000000	0.739491	0.900000	0.60950 04
1.153779	0.8240-04	0.46555	0.46240-06	0.0	0.31900 02	1.000000	1.000000	0.739244	0.900000	0.60870 04
1.257817	0.8990-04	0.48000	0.45050-06	0.0	0.38680 02	1.000000	1.000000	0.738929	0.900000	0.60770 04
1.370345	0.9790-04	0.49935	0.43630-06	0.0	0.46920 02	1.000000	1.000000	0.738561	0.900000	0.60650 04
1.492055	0.1060-03	0.52443	0.41880-06	0.0	0.56770 02	1.000000	1.000000	0.738166	0.900000	0.60530 04
1.623697	0.1140-03	0.55597	0.39870-06	0.0	0.68170 02	1.000000	1.000000	0.737774	0.900000	0.60410 04
1.766360	0.1230-03	0.59450	0.37680-06	0.0	0.80630 02	1.000000	1.000000	0.737417	0.900000	0.60300 04
1.920082	0.1320-03	0.64008	0.35380-06	0.0	0.92960 02	1.000000	1.000000	0.737122	0.900000	0.60210 04
2.086651	0.1400-03	0.69197	0.33100-06	0.0	0.10290 03	1.000000	1.000000	0.736903	0.900000	0.60140 04
2.266812	0.1490-03	0.74824	0.30950-06	0.0	0.10730 03	1.000000	1.000000	0.736760	0.900000	0.60090 04
2.461673	0.1570-03	0.80569	0.29030-06	0.0	0.10330 03	1.000000	1.000000	0.736681	0.900000	0.60070 04
2.672436	0.1650-03	0.86012	0.27430-06	0.0	0.89590 02	1.000000	1.000000	0.736645	0.900000	0.60060 04
2.900356	0.1750-03	0.90731	0.26190-06	0.0	0.69430 02	1.000000	1.000000	0.736636	0.900000	0.60050 04
3.146959	0.1840-03	0.94423	0.25300-06	0.0	0.45010 02	1.000000	1.000000	0.736638	0.900000	0.60060 04
3.413540	0.1940-03	0.96958	0.24710-06	0.0	0.25040 02	1.000000	1.000000	0.736643	0.900000	0.60060 04
3.702083	0.2040-03	0.98578	0.24370-06	0.0	0.11540 02	1.000000	1.000000	0.736647	0.900000	0.60060 04
4.014063	0.2150-03	0.99419	0.24190-06	0.0	0.43000 01	1.000000	1.000000	0.736650	0.900000	0.60060 04
4.351501	0.2260-03	0.99601	0.24110-06	0.0	0.12520 01	1.000000	1.000000	0.736651	0.900000	0.60060 04
4.716473	0.2390-03	0.99945	0.24060-06	0.0	0.27170 00	1.000000	1.000000	0.736652	0.900000	0.60060 04
5.111227	0.2520-03	0.99988	0.24070-06	0.0	0.40940-01	1.000000	1.000000	0.736652	0.900000	0.60060 04
5.538193	0.2670-03	0.99998	0.24060-06	0.0	0.38630-02	1.000000	1.000000	0.736652	0.900000	0.60060 04
6.000000	0.2830-03	1.00000	0.24060-06	0.0	-0.35510-03	1.000000	1.000000	0.736652	0.900000	0.60060 04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	1.000000	0.0	0.5400000 03	0.1546290 01	0.1723540 01	1.399289	0.5615770-04
0.009890	0.5290-06	1.000000	0.0	0.5459210 03	0.1563250 01	0.1705100 01	1.399186	0.5554860-04
0.020587	0.1110-05	1.000000	0.0	0.5522530 03	0.1581380 01	0.1685010 01	1.399070	0.5491170-04
0.032157	0.1740-05	1.000000	0.0	0.5590170 03	0.1600750 01	0.1663110 01	1.398942	0.5424730-04
0.044671	0.2430-05	1.000000	0.0	0.5662330 03	0.1621410 01	0.1639200 01	1.398798	0.5355660-04
0.058206	0.3190-05	1.000000	0.0	0.5739200 03	0.1643420 01	0.1613120 01	1.398639	0.5283870-04
0.072845	0.4020-05	1.000000	0.0	0.5820940 03	0.1666830 01	0.1584620 01	1.398462	0.5209670-04
0.088679	0.4940-05	1.000000	0.0	0.5907700 03	0.1691670 01	0.1553530 01	1.398265	0.5133150-04
0.105805	0.5940-05	1.000000	0.0	0.5999600 03	0.1717990 01	0.1519490 01	1.398047	0.5054530-04
0.124329	0.7050-05	1.000000	0.0	0.6096690 03	0.1745790 01	0.1482280 01	1.397806	0.4974030-04

0.144364	0.826D-05	1.000000	0.0	0.619899D 03	0.177508D 01	0.144159D 01	1.397540	0.489195D-04
0.166034	0.959D-05	1.000000	0.0	0.630640D 03	0.180584D 01	0.139708D 01	1.397249	0.480863D-04
0.189472	0.111D-04	1.000000	0.0	0.641877D 03	0.183802D 01	0.134836D 01	1.396927	0.472445D-04
0.214823	0.127D-04	1.000000	0.0	0.653579D 03	0.187153D 01	0.129504D 01	1.396578	0.463986D-04
0.242243	0.145D-04	1.000000	0.0	0.665701D 03	0.190624D 01	0.123669D 01	1.396200	0.455537D-04
0.271900	0.164D-04	1.000000	0.0	0.678179D 03	0.194197D 01	0.117284D 01	1.395793	0.447156D-04
0.303477	0.186D-04	1.000000	0.0	0.690427D 03	0.197647D 01	0.110302D 01	1.395360	0.438905D-04
0.338671	0.210D-04	1.000000	0.0	0.703830D 03	0.201542D 01	0.102671D 01	1.394903	0.430854D-04
0.376157	0.236D-04	1.000000	0.0	0.716741D 03	0.205239D 01	0.094343D 00	1.394428	0.423058D-04
0.416784	0.265D-04	1.000000	0.0	0.729471D 03	0.208984D 01	0.0852712D 00	1.393941	0.415714D-04
0.460664	0.297D-04	1.000000	0.0	0.741788D 03	0.212412D 01	0.0754115D 00	1.393455	0.408911D-04
0.508165	0.331D-04	1.000000	0.0	0.753407D 03	0.215739D 01	0.0647328D 00	1.392982	0.402507D-04
0.559522	0.370D-04	1.000000	0.0	0.763983D 03	0.218767D 01	0.0532197D 00	1.392539	0.396935D-04
0.615069	0.412D-04	1.000000	0.0	0.773106D 03	0.221379D 01	0.0408824D 00	1.392149	0.392251D-04
0.675148	0.458D-04	1.000000	0.0	0.780301D 03	0.223439D 01	0.0277676D 00	1.391835	0.388634D-04
0.740130	0.508D-04	1.000000	0.0	0.785023D 03	0.224792D 01	0.0139731D 00	1.391627	0.385625D-04
0.810415	0.562D-04	1.000000	0.0	0.786675D 03	0.225765D 01	-0.335550D-02	1.391553	0.385485D-04
0.885434	0.621D-04	1.000000	0.0	0.784617D 03	0.224676D 01	-0.149073D 00	1.391645	0.384495D-04
0.968657	0.684D-04	1.000000	0.0	0.778206D 03	0.222640D 01	-0.293873D 00	1.391927	0.385680D-04
1.057590	0.752D-04	1.000000	0.0	0.766843D 03	0.219586D 01	-0.433091D 00	1.392418	0.395455D-04
1.153779	0.824D-04	1.000000	0.0	0.750044D 03	0.214776D 01	-0.560931D 00	1.393120	0.404312D-04
1.257817	0.899D-04	1.000000	0.0	0.727532D 03	0.208329D 01	-0.670713D 00	1.394017	0.416822D-04
1.370345	0.979D-04	1.000000	0.0	0.699338D 03	0.200256D 01	-0.755398D 00	1.395064	0.433626D-04
1.492355	0.106D-03	1.000000	0.0	0.665898D 03	0.190687D 01	-0.808460D 00	1.396194	0.455402D-04
1.623657	0.114D-03	1.000000	0.0	0.628124D 03	0.179864D 01	-0.825050D 00	1.397318	0.432700D-04
1.766080	0.123D-03	1.000000	0.0	0.587415D 03	0.168207D 01	-0.803251D 00	1.398343	0.516248D-04
1.920382	0.132D-03	1.000000	0.0	0.545582D 03	0.156228D 01	-0.745075D 00	1.399192	0.555832D-04
2.086351	0.140D-03	1.000000	0.0	0.504673D 03	0.144513D 01	-0.656751D 00	1.399823	0.600888D-04
2.266312	0.149D-03	1.000000	0.0	0.466717D 03	0.133645D 01	-0.548291D 00	1.400236	0.643755D-04
2.461673	0.157D-03	1.000000	0.0	0.433439D 03	0.124116D 01	-0.431513D 00	1.400466	0.659640D-04
2.672436	0.166D-03	1.000000	0.0	0.406009D 03	0.116261D 01	-0.318320D 00	1.400569	0.746090D-04
2.900396	0.175D-03	1.000000	0.0	0.384893D 03	0.110214D 01	-0.218440D 00	1.400596	0.787886D-04
3.146959	0.184D-03	1.000000	0.0	0.369842D 03	0.105905D 01	-0.138047D 00	1.400590	0.815448D-04
3.413540	0.194D-03	1.000000	0.0	0.360026D 03	0.103094D 01	-0.792850D-01	1.400576	0.842305D-04
3.702383	0.204D-03	1.000000	0.0	0.354755D 03	0.101441D 01	-0.406760D-01	1.400563	0.856027D-04
4.014063	0.215D-03	1.000000	0.0	0.351256D 03	0.100582D 01	-0.182365D-01	1.400555	0.863376D-04
4.351501	0.226D-03	1.000000	0.0	0.349912D 03	0.100197D 01	-0.695008D-02	1.400552	0.866652D-04
4.716473	0.237D-03	1.000000	0.0	0.349408D 03	0.100053D 01	-0.217415D-02	1.400550	0.867900D-04
5.111227	0.252D-03	1.000000	0.0	0.349257D 03	0.100010D 01	-0.533754D-03	1.400550	0.868277D-04
5.536153	0.267D-03	1.000000	0.0	0.349222D 03	0.999999D 00	-0.966915D-04	1.400550	0.868364D-04
6.000000	0.283D-03	1.000000	0.0	0.349222D 03	0.100000D 01	0.110849D-03	1.400550	0.868378D-04

S = 0.100000D-01	S/REF= 0.517706D-02	Z = 0.965926D-02	Z/REF= 0.500065D-02
R = 0.258819D-02	R/REF= 0.133992D-02	DX = 0.100020D-01	NIT = 3
XI = 0.220847D-14	DXI = 0.220847D-14	DXDXI= 0.150934D 13	CWALL= 0.0

PHI = 45.00 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.481284D 02	TE = 0.341436D 03	UE = 0.446288D 04	VE = 0.157401D 03	MACHE = 0.492523D 01
OPEDX= 0.0	CTEDX= 0.0	DUECX= 0.0	DVEDX= 0.0	RHOE = 0.820640D-04
OPEDW=-0.171845D 02	DTEDW=-0.347811D 02	DUEDW= 0.407604D 02	DVEDW= 0.172999D 03	RHOEUE= 0.193644D-10

RRRRRRRRRR	0000000	0000000	3333333333	3333333333	SSSSSSSSSS	CCCCCCCCCC	LL
RRRRRRRRRR	0000000	0000000	3333333333	3333333333	SSSSSSSSSS	CCCCCCCCCC	LL
RR	00	00	33	33	SS	CC	LL
RR	00	00	33	33	SS	CC	LL
RR	00	00	33	33	SS	CC	LL
RRRRRRRRRR	00	00	333	333	SSSSSSSSSS	CC	LL
RRRRRRRRRR	00	00	333	333	SSSSSSSSSS	CC	LL
RR	00	00	33	33	SS	CC	LL
RR	00	00	33	33	SS	CC	LL
RR	00	00	33	33	SS	CC	LL
RRRRRRRRRR	0000000	0000000	3333333333	3333333333	SSSSSSSSSS	CCCCCCCCCC	LLLLLLLLLLLL
RRRRRRRRRR	0000000	0000000	3333333333	3333333333	SSSSSSSSSS	CCCCCCCCCC	LLLLLLLLLLLL

RRRRRRRRRR

JJ	0000000000	RRRRRRRRRR	7777777777	11	3333333333	9999999999
JJ	0000000000	RRRRRRRRRR	7777777777	111	3333333333	9999999999
JJ	00	RR	77	111	33	99
JJ	00	RR	77	11	33	99
JJ	00	RR	77	11	33	99
JJ	00	RRRRRRRRRR	77	11	333	9999999999
JJ	00	RRRRRRRRRR	77	11	333	9999999999
JJ	00	RR	77	11	33	99
JJ	00	RR	77	11	33	99
JJ	00	RR	77	11	33	99
JJ	00	RR	77	11	33	99
JJJJJJJJJJJ	0000000000	RRRRRRRRRR	77	11	3333333333	9999999999
JJJJJJJJJJJ	0000000000	RRRRRRRRRR	77	11	3333333333	9999999999

FFFFFFFFFFFF	TTTTTTTTTTTT	0000000	3333333333	FFFFFFFFFFFF	0000000	0000000	11
FFFFFFFFFFFF	TTTTTTTTTTTT	00000000	3333333333	FFFFFFFFFFFF	00000000	00000000	111
FF	TT	00	33	FF	00	00	1111
FF	TT	00	33	FF	00	00	11
FF	TT	00	33	FF	00	00	11
FFFFFFFFFFFF	TT	00	333	FFFFFFFFFFFF	00	00	11
FFFFFFFFFFFF	TT	00	333	FFFFFFFFFFFF	00	00	11
FF	TT	00	33	FF	00	00	11
FF	TT	00	33	FF	00	00	11
FF	TT	00	33	FF	00	00	11
FF	TT	00	33	FF	00	00	11
FF	TT	00000000	3333333333	FF	00000000	00000000	11
FF	TT	0000000	3333333333	FF	0000000	0000000	11

PROPERTIES AT THE WINDWARD STREAMLINE

S/REF	S	CFXINF	STINF	QW(DIM)	QW/QWSTAG	ZWALL
0.0	0.0	0.0	0.0	0.0	0.0	1.000000
0.517706D-02	0.100000D-01	0.404681D-01	0.223582D-01	-0.228008D 02	0.100000D 01	1.000000
0.155312D-01	0.300000D-01	0.233654D-01	0.129088D-01	-0.131644D 02	0.577366D 00	1.000000

III. Solution of a Sharp Cone at Zero Incidence and with Mass Transfer.

888888888888	0000000	0000000	3333333333	3333333333	CCCCCCCCCCC	0000000000	2222222222
888888888888	000000000	000000000	333333333333	333333333333	CCCCCCCCCCCCC	000000000000	222222222222
88	00	00	33	33	CC	00	22
88	00	00	33	33	CC	00	22
88	00	00	33	33	CC	00	22
888888888888	00	00	333	333	CC	00	22
888888888888	00	00	333	333	CC	00	22
88	00	00	33	33	CC	00	22
88	00	00	33	33	CC	00	22
88	00	00	33	33	CC	00	22
888888888888	000000000	000000000	333333333333	333333333333	CCCCCCCCCCCCC	000000000000	222222222222
888888888888	0000000	0000000	3333333333	3333333333	CCCCCCCCCCCCC	00000000000	222222222222

80033C02	JJ	00000000000	88888888888	777777777777	777777777777	88888888888	33333333333
	JJ	00000000000	888888888888	777777777777	777777777777	888888888888	333333333333
	JJ	00	88	77	77	88	33
	JJ	00	88	77	77	88	33
	JJ	00	88	77	77	88	33
	JJ	00	88888888888	77	77	88888888888	333
	JJ	00	888888888888	77	77	888888888888	333
	JJ	00	88	77	77	88	33
	JJ	00	88	77	77	88	33
JJ	JJ	00	88	77	77	88	33
JJ	JJ	00	88	77	77	88	33
JJJJJJJJJJJ	JJJJJJJJJJJ	000000000000	888888888888	77	77	888888888888	333333333333
JJJJJJJJJJJ	JJJJJJJJJJJ	00000000000	888888888888	77	77	888888888888	333333333333

FFFFFFFFFFFFF	TTTTTTTTTTTT	0000000	666666666666	FFFFFFFFFFFFF	0000000	0000000	11
FFFFFFFFFFFFF	TTTTTTTTTTTT	000000000	666666666666	FFFFFFFFFFFFF	000000000	000000000	111
FF	TT	00	66	FF	00	00	1111
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FFFFFFFFFFFF	TT	00	666666666666	FFFFFFFFFFFF	00	00	11
FFFFFFFFFFFF	TT	00	666666666666	FFFFFFFFFFFF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	000000000	666666666666	FF	000000000	000000000	11
FF	TT	0000000	666666666666	FF	0000000	0000000	11

THREE-DIMENSIONAL BOUNDARY LAYER PROGRAM
FOR
LAMINAR OR TURBULENT FLOW
WITH
BINARY GAS INJECTION
DEVELOPED BY
M.C. FRIEDERS
AEROSPACE ENGINEERING DEPARTMENT
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
BLACKSBURG, VA. 24060

INPUT DATA CARDS ARE AS FOLLOWS:

JLS SHARP CONE, LAMINAR, CO2 INJECTION, ALPHA=0				
CARD 001	IE	I3	COL 50-52	051
CARD 002	INJCT	I3	COL 50-52	003
CARD 003	KADFT	I3	COL 50-52	030
CARD 004	KEND2	I3	COL 50-52	001
CARD 005	KCNSET	I3	COL 50-52	000
CARD 006	KPRT	I3	COL 50-52	003
CARD 007	KTRANS	I3	COL 50-52	001
CARD 008	LAMTRM	I3	COL 50-52	001
CARD 009	LPRT	I3	COL 50-52	001
CARD 010	NIT1	I3	COL 50-52	003
CARD 011	NIT2	I3	COL 50-52	010
CARD 012	NIT3	I3	COL 50-52	020
CARD 013	NOINJ	I3	COL 50-52	004
CARD 014	NOSE	A5	COL 50-54	SHARP
CARD 015	NSOLVE	I3	COL 50-52	004
CARD 016	KPLOT	4I3	COL 50-61	001000000000
CARD 017	KPPFL	4I3	COL 50-61	001000000000
CARD 018	LPLT	4I3	COL 50-61	002003004000
CARD 019	LPPFL	4I3	COL 50-61	001002003000
CARD 020	ADTEST	F14.6	COL 50-63	0.001
CARD 021	AKSTAR	F14.6	COL 50-63	0.435
CARD 022	ALAMDA	F14.6	COL 50-63	0.09
CARD 023	ALET	F14.6	COL 50-63	1.0
CARD 024	ALPHA	F14.6	COL 50-63	0.0
CARD 025	ASTAP	F14.6	COL 50-63	26.0
CARD 026	CNCL	A3	COL 50-52	ABLATION
CARD 027	CWALL	F14.6	COL 50-63	0.03974
CARD 028	CRI	F5.3	COL 50-54	1.0
CARD 029	CCNV	F14.6	COL 50-63	0.001
CARD 030	DISK	A2	COL 50-51	NO
CARD 031	DXINVS	F14.6	COL 50-63	0.0
CARD 032	DXMAX	F14.6	COL 50-63	0.01
CARD 033	DX1	F5.3	COL 50-54	0.01
CARD 034	ENDLAW	A3	COL 50-52	REICHARDT
CARD 035	ETAFA	F14.6	COL 50-63	1.04
CARD 036	ETAINF	F14.6	COL 50-63	6.0
CARD 037	GAS2	A3	COL 50-52	CO2
CARD 038	PLT	A2	COL 50-51	YES
CARD 039	PPL	F14.6	COL 50-63	0.71

CARD 040	PRT	A5	COL 50-54	ROTTA
CARD 041	PRDP	A4	COL 50-53	PSTA
CARD 042	PTW	F14.6	COL 50-63	0.197446
CARD 043	TFS	F14.6	COL 50-63	269.2964
CARD 044	TSTAG	F14.6	COL 50-63	0.0
CARD 045	VALUF	F14.6	COL 50-63	16.9362
CARD 046	XRAR	F14.6	COL 50-63	2.0
CARD 047	G	F14.6	COL 50-63	1.4
CARD 048	R	F14.6	COL 50-63	1716.0
CARD 049	THETAC	F14.6	COL 50-63	9.0
CARD 050	XPA	F14.6	COL 50-63	10.7
CARD 051	PEOG	F14.6	COL 50-63	0.2749
CARD 052	UFNG	F14.6	COL 50-63	7897.0
CARD 053	TEOG	F14.6	COL 50-63	460.09
CARD 054	RHCFDG	F14.6	COL 50-63	3.4850-07
0.0				
0.0001				
0.08425				
0.19975				

FREE STREAM, STAGNATION, AND VEHICLE DATA:

PSTAG = 0.169362D 02 PSIA
 TSTAG = 0.565522D 04 DEG.R
 MSTAG = 0.339983D 08 FT**2/SEC**2
 PINF = 0.399069D-03 PSIA
 RHUINF = 0.124234D-06 SLUGS/FT**3
 TINF = 0.269296D 03 DEG.R
 UINF = 0.804728D 04 FT/SEC
 MINF = 0.100000D 02
 CP/CV = 0.140000D 01
 R = 0.171767D 04 FT**2/SEC**2/DEG.R
 TW/TO = 0.197446D 00
 ALPHA = 0.0 DEG.
 THETAC = 0.900000D 01 DEG.

POINTS AT WHICH A SOLUTION IS TO BE OBTAINED:

I	XSTA(I)
1	0.0
2	0.000100
3	0.084250
4	0.199750

S = 0.0
 R = 0.0
 XI = 0.0

S/REF = 0.0
 R/REF = 0.0
 DXI = 0.0

Z = 0.0
 DX = 0.100000-01
 DXDXI = 0.0

Z/REF = 0.0
 NIT = 6
 CWALL = 0.0

PHI = 0.0 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.274900D 00
 DPEDX= 0.0
 DPEDW= 0.0

TE = 0.460900D 03
 NTEOX= 0.0
 NTEOW= 0.0

UE = 0.789700D 04
 DUEOX= 0.0
 DUEOW= 0.0

VE = 0.0
 DVEDX= 0.0
 DVEDW= 0.0

MACHE = 0.750770D 01
 RHOE = 0.348500D-06
 RHOEMUE= 0.106529D-12

LOCAL EDGE REYNOLDS NUMBER =0.0

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	0.487041	0.0	0.0	0.200002	0.295166	0.857866	-0.272372	0.0
0.080174	0.0	0.039524	0.498749	0.0	0.0	0.224366	0.312559	0.837460	-0.237151	-0.1580-02
0.156891	0.0	0.083284	0.510126	0.0	0.0	0.252273	0.330938	0.818443	-0.202297	-0.6900-02
0.260684	0.0	0.131641	0.527454	0.0	0.0	0.294217	0.349937	0.801114	-0.167986	-0.1700-01
0.362130	0.0	0.184906	0.528295	0.0	0.0	0.320707	0.369011	0.785835	-0.133967	-0.3300-01
0.471854	0.0	0.243292	0.534289	0.0	0.0	0.362238	0.387293	0.773033	-0.100037	-0.5650-01
0.590532	0.0	0.306831	0.535122	0.0	0.0	0.409222	0.403454	0.763215	-0.066071	-0.8920-01
0.718994	0.0	0.375274	0.529540	0.0	0.0	0.461887	0.415576	0.756959	-0.032078	-0.1330 00
0.857733	0.0	0.447964	0.515492	0.0	0.0	0.520116	0.421124	0.754904	0.001716	-0.1000 00
1.007896	0.0	0.523712	0.491039	0.0	0.0	0.583256	0.417126	0.757713	0.034742	-0.2630 00
1.170314	0.0	0.600716	0.454868	0.0	0.0	0.649923	0.400691	0.765990	0.065910	-0.3540 00
1.345986	0.0	0.676578	0.406942	0.0	0.0	0.717879	0.369890	0.780140	0.093484	-0.4470 00
1.535993	0.0	0.748491	0.349032	0.0	0.0	0.784112	0.324801	0.800173	0.115162	-0.6020 00
1.741505	0.0	0.813594	0.284829	0.0	0.0	0.845170	0.269221	0.825479	0.128475	-0.7630 00
1.963786	0.0	0.869449	0.219402	0.0	0.0	0.897764	0.205548	0.854682	0.131508	-0.9500 00
2.204206	0.0	0.914486	0.158121	0.0	0.0	0.939469	0.143716	0.885667	0.123827	-0.1160 01
2.464243	0.0	0.948286	0.105463	0.0	0.0	0.969310	0.089497	0.915892	0.107063	-0.1410 01
2.745503	0.0	0.971602	0.064171	0.0	0.0	0.988001	0.047714	0.942907	0.084539	-0.1680 01
3.049737	0.0	0.986142	0.034938	0.0	0.0	0.997699	0.020075	0.964847	0.060242	-0.1980 01
3.378738	0.0	0.994157	0.016587	0.0	0.0	1.001338	0.005110	0.980780	0.037985	-0.2300 01
3.734617	0.0	0.997947	0.006638	0.0	0.0	1.001777	-0.000804	0.990895	0.020681	-0.2660 01
4.119536	0.0	0.999427	0.002143	0.0	0.0	1.001125	-0.001817	0.996369	0.009471	-0.3040 01
4.535865	0.0	0.999880	0.000528	0.0	0.0	1.000481	-0.001150	0.998823	0.003544	-0.3460 01
4.986166	0.0	0.999983	0.000092	0.0	0.0	1.000142	-0.000451	0.999707	0.001043	-0.3910 01
5.473211	0.0	0.999999	0.000010	0.0	0.0	1.000026	-0.000117	0.999951	0.000028	-0.4390 01
6.000000	0.0	1.000000	-0.000001	0.0	0.0	1.000000	-0.000007	1.000000	0.000009	-0.4970 01

ETA	Y/L	RHOE	XMU	E+	CHI	LEL	LET	PRL	PRY	SP HT
0.0	0.0	0.41204	0.63640-06	0.0	0.0	1.000000	1.000000	0.746431	0.900000	0.63200 04
0.080174	0.0	0.37139	0.68930-06	0.0	0.0	1.000000	1.000000	0.749271	0.900000	0.64160 04
0.156891	0.0	0.33843	0.73920-06	0.0	0.0	1.000000	1.000000	0.752043	0.900000	0.65120 04
0.260684	0.0	0.31183	0.78530-06	0.0	0.0	1.000000	1.000000	0.754573	0.900000	0.66010 04
0.362130	0.0	0.29067	0.82640-06	0.0	0.0	1.000000	1.000000	0.756736	0.900000	0.66790 04
0.471854	0.0	0.27439	0.86120-06	0.0	0.0	1.000000	1.000000	0.758467	0.900000	0.67420 04
0.590532	0.0	0.26269	0.88810-06	0.0	0.0	1.000000	1.000000	0.759739	0.900000	0.67890 04
0.718994	0.0	0.25557	0.90540-06	0.0	0.0	1.000000	1.000000	0.760528	0.900000	0.68190 04
0.857733	0.0	0.25328	0.91110-06	0.0	0.0	1.000000	1.000000	0.760784	0.900000	0.68280 04
1.007896	0.0	0.25641	0.90330-06	0.0	0.0	1.000000	1.000000	0.760433	0.900000	0.68150 04
1.170314	0.0	0.26593	0.88050-06	0.0	0.0	1.000000	1.000000	0.759384	0.900000	0.67760 04
1.345986	0.0	0.28328	0.84180-06	0.0	0.0	1.000000	1.000000	0.757516	0.900000	0.67070 04
1.535993	0.0	0.31047	0.78780-06	0.0	0.0	1.000000	1.000000	0.754709	0.900000	0.66060 04
1.741505	0.0	0.35013	0.72070-06	0.0	0.0	1.000000	1.000000	0.751011	0.900000	0.64760 04
1.963786	0.0	0.40529	0.64460-06	0.0	0.0	1.000000	1.000000	0.746859	0.900000	0.63350 04
2.204206	0.0	0.47853	0.56570-06	0.0	0.0	1.000000	1.000000	0.743015	0.900000	0.62080 04
2.464243	0.0	0.56998	0.49120-06	0.0	0.0	1.000000	1.000000	0.740127	0.900000	0.61150 04
2.745503	0.0	0.67451	0.42730-06	0.0	0.0	1.000000	1.000000	0.738352	0.900000	0.60590 04

3.049707	0.0	0.78018	0.37800-06	0.0	0.0	1.000000	1.000000	0.737436	0.900000	0.60300 04
3.375738	0.0	0.87126	0.34410-06	0.0	0.0	1.000000	1.000000	0.737020	0.900000	0.60170 04
3.734617	0.0	0.93627	0.32350-06	0.0	0.0	1.000000	1.000000	0.736847	0.900000	0.60120 04
4.119536	0.0	0.97396	0.31270-06	0.0	0.0	1.000000	1.000000	0.736778	0.900000	0.60100 04
4.535365	0.0	0.99147	0.30790-06	0.0	0.0	1.000000	1.000000	0.736753	0.900000	0.60090 04
4.986166	0.0	0.99787	0.30620-06	0.0	0.0	1.000000	1.000000	0.736744	0.900000	0.60090 04
5.473211	0.0	0.99965	0.30580-06	0.0	0.0	1.000000	1.000000	0.736742	0.900000	0.60090 04
6.000000	0.0	1.00000	0.30570-06	0.0	0.0	1.000000	1.000000	0.736741	0.900000	0.60090 04

AEDC-TR-75-55

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	1.000000	0.0	0.1116600 04	0.2426920 01	0.3447660 01	1.373187	0.1433300-06
0.0380174	0.0	1.000000	0.0	0.1238840 04	0.2692610 01	0.3177360 01	1.365570	0.1291870-06
0.166891	0.0	1.000000	0.0	0.1359490 04	0.2954830 01	0.2864990 01	1.358268	0.1177270-06
0.260684	0.0	1.000000	0.0	0.1475460 04	0.3206890 01	0.2504290 01	1.351721	0.1084700-06
0.362130	0.0	1.000000	0.0	0.1592840 04	0.3440280 01	0.2091770 01	1.346206	0.1011110-06
0.471854	0.0	1.000000	0.0	0.1676780 04	0.3644450 01	0.1625430 01	1.341848	0.0954460-07
0.590532	0.0	1.000000	0.0	0.1751440 04	0.3806740 01	0.1107670 01	1.338676	0.0913770-07
0.718894	0.0	1.000000	0.0	0.1800270 04	0.3912870 01	0.05498110 00	1.336722	0.0889990-07
0.857730	0.0	1.000000	0.0	0.1816530 04	0.3948210 01	-0.2955470-01	1.336089	0.0810330-07
1.017396	0.0	1.000000	0.0	0.1794330 04	0.3899070 01	-0.5927770 00	1.336955	0.0919310-07
1.170314	0.0	1.000000	0.0	0.1730100 04	0.3760360 01	-0.1094770 01	1.339558	0.0250450-07
1.345986	0.0	1.000000	0.0	0.1624160 04	0.3530100 01	-0.1485160 01	1.344236	0.0853840-07
1.535993	0.0	1.000000	0.0	0.1481930 04	0.3270960 01	-0.1721770 01	1.351372	0.1070060-06
1.741505	0.0	1.000000	0.0	0.1314070 04	0.2856110 01	-0.1783540 01	1.360971	0.1217920-06
1.963786	0.0	1.000000	0.0	0.1135200 04	0.2467350 01	-0.1678060 01	1.372028	0.1409820-06
2.204206	0.0	1.000000	0.0	0.09614590 03	0.2089720 01	-0.1441900 01	1.392540	0.1664580-06
2.464243	0.0	1.000000	0.0	0.07072090 03	0.1754460 01	-0.1132460 01	1.390620	0.1982660-06
2.745500	0.0	1.000000	0.0	0.06821090 03	0.1482550 01	-0.08115350 00	1.395662	0.2346700-06
3.049707	0.0	1.000000	0.0	0.05877260 03	0.1281760 01	-0.05279310 00	1.398200	0.2713040-06
3.375738	0.0	1.000000	0.0	0.05230740 03	0.1147760 01	-0.03085300 00	1.399486	0.3030690-06
3.734617	0.0	1.000000	0.0	0.04914070 03	0.1068070 01	-0.01591500 00	1.399986	0.3256820-06
4.119536	0.0	1.000000	0.0	0.04723900 03	0.10026730 01	-0.0060810-01	1.400184	0.3387990-06
4.535365	0.0	1.000000	0.0	0.04640470 03	0.1008600 01	-0.0020210-01	1.400259	0.3448840-06
4.986166	0.0	1.000000	0.0	0.04610720 03	0.1007130 01	-0.0011430-02	1.400283	0.3471100-06
5.473211	0.0	1.000000	0.0	0.04602530 03	0.1000350 01	-0.0004850-02	1.400290	0.3477270-06
6.000000	0.0	1.000000	0.0	0.04600900 03	0.1000000 01	-0.0003820-04	1.400291	0.3478500-06

S = 0.1000000-03	S/REF= 0.5006260-03	Z = 0.0876880-04	Z/REF= 0.4944620-03
R = 0.1564340-04	P/REF= 0.7831510-04	DX = 0.1000000-03	NIT = 2
XI = 0.6862340-23	DXI = 0.6862340-23	DXDXI= 0.4857430 19	CHALL= 0.0

PHI = 0.0 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.2749000 00	TE = 0.4600900 03	UE = 0.7897000 04	VE = 0.0	MACHE = 0.7507700 01
DPEOX= 0.0	DEOX= 0.0	DUEOX= 0.0	DVEDX= 0.0	RHNE = 0.3485000-06
DPEDW= 0.0	DEEDW= 0.0	DUEW= 0.0	DVEDW= 0.0	RHOEUE= 0.1065290-12

LOCAL EDGE REYNOLDS NUMMER =0.9003300 00

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.291326D 01 CFXEDG= 0.107843D 01
CHEDGE= 0.617256D 00 CHINF = 0.169918D 01
QW =-0.630696D 00 CHIMAX= 0.107760D 01

CFWINF= 0.0 CFWEEDG= 0.0
STEDGE= 0.546691D 00 STINF = 0.150493D 01

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION= 0.117189D 02 PSF
TRANSVERSE SKIN FRICTION = 0.0 PSF
WALL HEAT TRANSFER RATE =-0.525034D 02 BTU

DELTA*(X) = 0.580340D-03 THETA(X) = 0.357204D-04
DELTA*(PHI) = 0.991834D-03 THETA(PHI) = 0.0
DELTA (FT) = 0.778884D-03

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	0.496963	0.0	0.0	0.200002	0.295107	0.857866	-0.272317	0.0
0.080174	0.177D-04	0.039517	0.498667	0.0	0.0	0.224360	0.312479	0.837464	-0.237097	-0.158D-02
0.166891	0.388D-04	0.083271	0.510041	0.0	0.0	0.252260	0.330839	0.818452	-0.202245	-0.690D-02
0.260684	0.636D-04	0.131619	0.520370	0.0	0.0	0.284193	0.349823	0.801128	-0.167940	-0.170D-01
0.362133	0.927D-04	0.184876	0.528915	0.0	0.0	0.323671	0.368898	0.785853	-0.133929	-0.330D-01
0.471854	0.126D-03	0.243254	0.534217	0.0	0.0	0.362188	0.387170	0.773055	-0.100010	-0.565D-01
0.597532	0.164D-03	0.306785	0.535062	0.0	0.0	0.409159	0.403344	0.763239	-0.066057	-0.991D-01
0.718394	0.207D-03	0.375222	0.529499	0.0	0.0	0.461812	0.415493	0.756994	-0.032079	-0.133D 00
0.857733	0.254D-03	0.447907	0.515473	0.0	0.0	0.520032	0.421082	0.754928	0.001699	-0.190D 00
1.007496	0.305D-03	0.523654	0.491043	0.0	0.0	0.583169	0.417134	0.757733	0.034709	-0.263D 00
1.170314	0.359D-03	0.600660	0.454894	0.0	0.0	0.649841	0.400750	0.766003	0.065863	-0.354D 00
1.345986	0.413D-03	0.676528	0.406983	0.0	0.0	0.717812	0.369984	0.780145	0.093430	-0.467D 00
1.535993	0.469D-03	0.748450	0.349078	0.0	0.0	0.784064	0.324905	0.800167	0.115109	-0.602D 00
1.741505	0.522D-03	0.813563	0.284972	0.0	0.0	0.845142	0.268312	0.825463	0.128432	-0.763D 00
1.963786	0.573D-03	0.869427	0.219437	0.0	0.0	0.897754	0.205611	0.854658	0.131491	-0.950D 00
2.204206	0.620D-03	0.914471	0.158146	0.0	0.0	0.939470	0.143750	0.895639	0.123918	-0.116D 01
2.454243	0.663D-03	0.948275	0.105489	0.0	0.0	0.969317	0.089509	0.915864	0.107069	-0.141D 01
2.745503	0.702D-03	0.971596	0.064182	0.0	0.0	0.989009	0.047713	0.942492	0.084554	-0.168D 01
3.049707	0.739D-03	0.986138	0.034945	0.0	0.0	0.997707	0.023070	0.964929	0.060261	-0.198D 01
3.378738	0.773D-03	0.994155	0.016591	0.0	0.0	1.001343	0.005105	0.980767	0.038003	-0.230D 01
3.734517	0.806D-03	0.997946	0.006640	0.0	0.0	1.001780	-0.000809	0.990989	0.020693	-0.266D 01
4.119536	0.841D-03	0.999427	0.002144	0.0	0.0	1.001126	-0.001821	0.996364	0.009479	-0.304D 01
4.535365	0.878D-03	0.999980	0.000528	0.0	0.0	1.000482	-0.001152	0.998822	0.003548	-0.346D 01
4.986166	0.916D-03	0.999983	0.000092	0.0	0.0	1.000143	-0.000452	0.999707	0.001044	-0.391D 01
5.473211	0.954D-03	0.999999	0.000010	0.0	0.0	1.000026	-0.000117	0.999951	0.000229	-0.439D 01
6.000000	0.100D-02	1.000000	-0.000001	0.0	0.0	1.000000	-0.000007	1.000000	0.000009	-0.492D 01

ETA	Y/L	RCRNF	XMU	E+	CHI	LEL	LET	PRL	PRT	SP HT
0.0	0.0	0.41204	0.6364D-06	0.0	0.0	1.000000	1.000000	0.746431	0.900000	0.6320D 04
0.080174	0.285D-04	0.37140	0.6893D-06	0.0	0.9964D-03	1.000000	1.000000	0.749270	0.900000	0.6416D 04
0.166891	0.194D-03	0.33844	0.7392D-06	0.0	0.3796D-02	1.000000	1.000000	0.752042	0.900000	0.6512D 04
0.260684	0.310D-03	0.31145	0.7853D-06	0.0	0.8345D-02	1.000000	1.000000	0.754571	0.900000	0.6601D 04
0.362133	0.464D-03	0.29079	0.8263D-06	0.0	0.1485D-01	1.000000	1.000000	0.756734	0.900000	0.6679D 04
0.471854	0.631D-03	0.27442	0.8611D-06	0.0	0.2377D-01	1.000000	1.000000	0.758464	0.900000	0.6742D 04
0.597532	0.822D-03	0.26272	0.8880D-06	0.0	0.3587D-01	1.000000	1.000000	0.759736	0.900000	0.6789D 04
0.718394	0.104D-02	0.25559	0.9053D-06	0.0	0.5231D-01	1.000000	1.000000	0.760525	0.900000	0.6819D 04
0.857733	0.127D-02	0.25331	0.9110D-06	0.0	0.7486D-01	1.000000	1.000000	0.760781	0.900000	0.6828D 04
1.007496	0.153D-02	0.25643	0.9032D-06	0.0	0.1061D 00	1.000000	1.000000	0.760431	0.900000	0.6815D 04

1.007896	0.4290-01	0.39858	0.73290-06	0.0	0.29650 01	1.213195	1.000000	0.944435	0.900000	0.14170 05
1.170314	0.5100-01	0.37027	0.75420-06	0.0	0.43240 01	1.186917	1.000000	0.940405	0.900000	0.13740 05
1.345986	0.6730-01	0.35247	0.77580-06	0.0	0.53550 01	1.156284	1.000000	0.934389	0.900000	0.13200 05
1.535993	0.7380-01	0.33612	0.79610-06	0.0	0.70730 01	1.120846	1.000000	0.925689	0.900000	0.12550 05
1.741505	0.8290-01	0.32266	0.81210-06	0.0	0.91290 01	1.080439	1.000000	0.913490	0.900000	0.11780 05
1.963786	0.9620-01	0.31421	0.81930-06	0.0	0.11850 02	1.035399	1.000000	0.896942	0.900000	0.10910 05
2.204206	0.1110 00	0.31388	0.81120-06	0.0	0.15520 02	0.986815	1.000000	0.875365	0.900000	0.99560 04
2.464243	0.1260 00	0.32611	0.78080-06	0.0	0.20720 02	0.936642	1.000000	0.848636	0.900000	0.89680 04
2.745509	0.1420 00	0.35710	0.72320-06	0.0	0.28420 02	0.887621	1.000000	0.817845	0.900000	0.80010 04
3.047707	0.1570 00	0.41456	0.64050-06	0.0	0.30750 02	0.844084	1.000000	0.786991	0.900000	0.71620 04
3.377738	0.1710 00	0.50512	0.54500-06	0.0	0.54320 02	0.811294	1.000000	0.762599	0.900000	0.65700 04
3.734617	0.1930 00	0.62706	0.45530-06	0.0	0.66030 02	0.790590	1.000000	0.747795	0.900000	0.62390 04
4.119536	0.1940 00	0.76183	0.38610-06	0.0	0.62720 02	0.779200	1.000000	0.740671	0.900000	0.67890 04
4.535365	0.2740 00	0.87761	0.34210-06	0.0	0.41360 02	0.773825	1.000000	0.737891	0.900000	0.63320 04
4.986166	0.2130 00	0.95194	0.31930-06	0.0	0.17760 02	0.771751	1.000000	0.737012	0.900000	0.60140 04
5.473211	0.2230 00	0.99722	0.30910-06	0.0	0.49080 01	0.771102	1.000000	0.736788	0.900000	0.60100 04
6.000000	0.2330 00	1.00000	0.30570-06	0.0	0.30850 .00	0.770929	1.000000	0.736741	0.900000	0.60090 04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	0.373106	0.121428	0.1116600 04	0.2426920 01	0.5321280 00	1.095200	0.1824420-06
0.090174	0.2960-02	0.383043	0.126483	0.1136780 04	0.2470700 01	0.5586400 00	1.095962	0.1784110-06
0.156991	0.6230-02	0.394256	0.132210	0.1159420 04	0.2519990 01	0.5762470 00	1.096868	0.1740820-06
0.267684	0.9970-02	0.406958	0.138722	0.1184700 04	0.2574930 01	0.5951870 00	1.097062	0.1694400-06
0.352130	0.1390-01	0.421401	0.146097	0.1212950 04	0.2636330 01	0.6151640 00	1.099297	0.1644750-06
0.471954	0.1840-01	0.437883	0.154403	0.1244530 04	0.2704970 01	0.6355440 00	1.100949	0.1591830-06
0.597532	0.2350-01	0.456754	0.163689	0.1279790 04	0.2781610 01	0.6551310 00	1.103017	0.1535720-06
0.718994	0.2920-01	0.478423	0.173974	0.1319020 04	0.2866860 01	0.6717950 00	1.105640	0.1476610-06
0.857730	0.3550-01	0.503356	0.185211	0.1367330 04	0.2961090 01	0.6818690 00	1.109009	0.1414990-06
1.007896	0.4290-01	0.532077	0.197238	0.1409490 04	0.3063510 01	0.6992110 00	1.113388	0.1351160-06
1.170314	0.5100-01	0.565139	0.209664	0.1459550 04	0.3172320 01	0.6538230 00	1.119135	0.1287970-06
1.345986	0.6030-01	0.603070	0.221690	0.1510260 04	0.3282540 01	0.5901210 00	1.126732	0.1226050-06
1.535993	0.7030-01	0.646245	0.231835	0.1557110 04	0.3384370 01	0.4656830 00	1.136821	0.1169290-06
1.741505	0.8280-01	0.694649	0.237616	0.1592100 04	0.3460410 01	0.2530050 00	1.150240	0.1122380-06
1.963786	0.9620-01	0.747498	0.235417	0.1602590 04	0.3483720 01	-0.7056660-01	1.168089	0.1092990-06
2.204206	0.1110 00	0.802764	0.221119	0.1571810 04	0.3416300 01	-0.4989310 00	1.191738	0.1091820-06
2.464243	0.1260 00	0.856903	0.192149	0.1483390 04	0.3224140 01	-0.9645780 00	1.227738	0.1134380-06
2.745509	0.1420 00	0.905318	0.150530	0.1331500 04	0.2894010 01	-0.1330430 01	1.262208	0.1242170-06
3.047707	0.1570 00	0.943885	0.103994	0.1131530 04	0.2459370 01	-0.1450510 01	1.307608	0.1442050-06
3.378738	0.1710 00	0.970744	0.062376	0.0200550 03	0.1999730 01	-0.1282640 01	1.349724	0.1757060-06
3.734617	0.1930 00	0.988973	0.032020	0.7370290 03	0.1601920 01	-0.9367920 00	1.377527	0.2191240-06
4.119536	0.1940 00	0.995082	0.013761	0.5049460 03	0.1314840 01	-0.5747640 00	1.392030	0.2650070-06
4.535365	0.2740 00	0.998524	0.004783	0.5245160 03	0.1140030 01	-0.2975830 00	1.397834	0.3052780-06
4.986166	0.2130 00	0.999666	0.001281	0.4833760 03	0.1050610 01	-0.1283160 00	1.399698	0.3311310-06
5.473211	0.2230 00	0.999949	0.000251	0.4660530 03	0.1912960 01	-0.4506490-01	1.400185	0.3434060-06
6.000000	0.2330 00	1.000000	0.000009	0.4600900 03	0.1000070 01	-0.9931590-02	1.400291	0.3478500-06

S = 0.1997500 00
R = 0.3124780-01
XI = 0.5469310-13

S/REF = 0.1000000 01
R/REF = 0.1564340 00
DXI = 0.2027960-14

Z = 0.1972910 00
DX = 0.2500000-02
DXDXI = 0.1217400 13

Z/REF = 0.9876880 00
NIT = 12
CHALL = 0.3974000-01

PHI = 0.0 DEG.

DIMENSIONAL EDGE PROPERTIES

PE = 0.274900D 00 TE = 0.460090D 03
 PEDX= 0.0 RTEDX= 0.0
 PEDW= 0.0 RTEDW= 0.0

UF = 0.789700D 04 VE = 0.0
 UEDX= 0.0 VEDX= 0.0
 UEDW= 0.0 VEDW= 0.0

NACHE = 0.750770D 01
 RMCE = 0.348507D 06
 RMCEMUE = 0.106529D 12

LOCAL EDGE REYNOLDS NUMER = 0.179841D 04

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.247860D 01 CFXEDG= 0.917526D 02
 CHFDF= 0.989374D 03 CHINF = 0.272355D 02
 QH = -0.288719D 02 CHIMAX= 0.676640D 02

CFWINF= 0.0 CFWEDG= 0.0
 STEDGE= 0.327137D 02 STINF = 0.900543D 02

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION= 0.997047D 01 PSF
 TRANSVERSE SKIN FRICTION = 0.0 PSF
 WALL HEAT TRANSFER RATE = -0.240384D 00 BTU

DELTA*(X) = 0.311005D 01 THETA(X) = 0.219844D 02
 DELTA*(PHI) = 0.462972D 01 THETA(PHI) = 0.0
 DELTA (FT) = 0.411668D 01

ETA	Y	F	FN	G	GN	H	MN	C	CN	V
0.0	0.0	0.0	0.152884	0.0	0.0	0.387904	0.075944	1.039023	-0.098150	0.5000 00
0.0393174	0.593D-03	0.012547	0.160154	0.0	0.0	0.394161	0.080164	1.031357	-0.094936	0.5000 00
0.166891	0.125D-02	0.026788	0.168404	0.0	0.0	0.401320	0.085041	1.023020	-0.097325	0.4990 00
0.263684	0.193D-02	0.043020	0.177866	0.0	0.0	0.409558	0.090730	1.013774	-0.099823	0.4980 00
0.362133	0.270D-02	0.061607	0.188735	0.0	0.0	0.419092	0.097368	1.003515	-0.102390	0.4960 00
0.471854	0.369D-02	0.082990	0.201222	0.0	0.0	0.430192	0.105104	0.992136	-0.104958	0.4920 00
0.590532	0.470D-02	0.107709	0.215553	0.0	0.0	0.443190	0.114100	0.979528	-0.107410	0.4880 00
0.718994	0.584D-02	0.136415	0.231941	0.0	0.0	0.458494	0.124514	0.965594	-0.109554	0.4810 00
0.857733	0.712D-02	0.169895	0.250544	0.0	0.0	0.476600	0.136476	0.950262	-0.111074	0.4720 00
1.007896	0.857D-02	0.209072	0.271375	0.0	0.0	0.498103	0.150041	0.933525	-0.111471	0.4600 00
1.170314	0.102D-01	0.255000	0.294142	0.0	0.0	0.523692	0.165108	0.915495	-0.109975	0.4420 00
1.345986	0.121D-01	0.308799	0.317979	0.0	0.0	0.554129	0.181301	0.896499	-0.105446	0.4190 00
1.535993	0.142D-01	0.371501	0.341022	0.0	0.0	0.590193	0.197906	0.877218	-0.096295	0.3870 00
1.741505	0.165D-01	0.443728	0.359974	0.0	0.0	0.632499	0.213170	0.858891	-0.090547	0.3440 00
1.963786	0.193D-01	0.525133	0.369193	0.0	0.0	0.681369	0.225073	0.843471	-0.086253	0.2840 00
2.204206	0.222D-01	0.613626	0.362109	0.0	0.0	0.736365	0.230065	0.833802	-0.082581	0.2010 00
2.454243	0.253D-01	0.704661	0.332541	0.0	0.0	0.795778	0.223463	0.833197	0.018798	0.8730-01
2.745503	0.285D-01	0.791339	0.279539	0.0	0.0	0.855962	0.207352	0.844405	0.059322	-0.6670-01
3.049707	0.316D-01	0.866058	0.210717	0.0	0.0	0.911155	0.159176	0.867730	0.089106	-0.2690 00
3.373738	0.344D-01	0.923309	0.140099	0.0	0.0	0.954912	0.106578	0.890484	0.097945	-0.5250 00
3.734617	0.367D-01	0.961699	0.080855	0.0	0.0	0.983330	0.056653	0.932921	0.085850	-0.8350 00
4.119536	0.390D-01	0.983817	0.039600	0.0	0.0	0.997364	0.021454	0.961540	0.061725	-0.1190 01
4.535365	0.410D-01	0.994459	0.015892	0.0	0.0	1.001701	0.003678	0.981651	0.036721	-0.1600 01
4.985166	0.429D-01	0.998557	0.004971	0.0	0.0	1.001628	-0.001730	0.993064	0.016968	-0.2040 01
5.473211	0.448D-01	0.999750	0.001141	0.0	0.0	1.000638	-0.001712	0.998190	0.006740	-0.2530 01
6.000000	0.469D-01	1.000000	0.000065	0.0	0.0	1.000000	-0.000725	1.000000	0.001431	-0.3060 01

ETA	Y/L	ROROE	XMU	E+	CHI	LEL	LET	PRL	PRT	SP HT
0.0	0.0	0.52584	0.60400D-06	0.0	0.0	1.338747	1.000000	0.949821	0.900000	0.15610 05

0.080174	0.2970-02	0.51431	0.61300-06	0.0	0.17390-01	1.330966	1.000000	0.950090	0.900000	0.15560 05
0.156891	0.6250-02	0.50192	0.62300-06	0.0	0.76050-01	1.322454	1.000000	0.950324	0.900000	0.15500 05
0.260684	0.9900-02	0.49861	0.63420-06	0.0	0.18740 00	1.312812	1.000000	0.950493	0.900000	0.15420 05
0.362130	0.1400-01	0.47437	0.64660-06	0.0	0.36540 00	1.301847	1.000000	0.950521	0.900000	0.15320 05
0.471854	0.1850-01	0.45919	0.66050-06	0.0	0.62670 00	1.287322	1.000000	0.950368	0.900000	0.15200 05
0.590532	0.2300-01	0.44309	0.67590-06	0.0	0.99170 00	1.274945	1.000000	0.949922	0.900000	0.15040 05
0.718374	0.2920-01	0.42612	0.69270-06	0.0	0.14940 01	1.258355	1.000000	0.949035	0.900000	0.14830 05
0.857730	0.3560-01	0.40842	0.71120-06	0.0	0.21320 01	1.239117	1.000000	0.947491	0.900000	0.14570 05
1.077396	0.4290-01	0.39021	0.73130-06	0.0	0.29680 01	1.216714	1.000000	0.944993	0.900000	0.14230 05
1.170314	0.5110-01	0.37186	0.75260-06	0.0	0.40330 01	1.190558	1.000000	0.941000	0.900000	0.13810 05
1.345986	0.6040-01	0.35398	0.77420-06	0.0	0.53660 01	1.160077	1.000000	0.935254	0.900000	0.13270 05
1.535993	0.7100-01	0.33748	0.79460-06	0.0	0.70470 01	1.124821	1.000000	0.926776	0.900000	0.12620 05
1.741505	0.8300-01	0.32377	0.81000-06	0.0	0.91510 01	1.084536	1.000000	0.914839	0.900000	0.11860 05
1.963786	0.9640-01	0.31495	0.81870-06	0.0	0.11870 02	1.039529	1.000000	0.898571	0.900000	0.10980 05
2.274206	0.1110 00	0.31407	0.91150-06	0.0	0.15530 02	0.990035	1.000000	0.977252	0.900000	0.10030 05
2.464243	0.1270 00	0.37556	0.78230-06	0.0	0.20700 02	0.940366	1.000000	0.850695	0.900000	0.90370 04
2.745500	0.1430 00	0.35555	0.72670-06	0.0	0.28350 02	0.890928	1.000000	0.819994	0.900000	0.80590 04
3.049707	0.1590 00	0.41140	0.64410-06	0.0	0.39650 02	0.846512	1.000000	0.790676	0.900000	0.72030 04
3.379739	0.1720 00	0.50114	0.54870-06	0.0	0.54300 02	0.812829	1.000000	0.763672	0.900000	0.65940 04
3.734617	0.1850 00	0.62238	0.45820-06	0.0	0.66440 02	0.791416	1.000000	0.748342	0.900000	0.62510 04
4.119536	0.1950 00	0.75750	0.38800-06	0.0	0.63770 02	0.779580	1.000000	0.740895	0.900000	0.60930 04
4.535365	0.2050 00	0.87465	0.34310-06	0.0	0.47560 02	0.773969	1.000000	0.737964	0.900000	0.60340 04
4.986166	0.2150 00	0.95049	0.31040-06	0.0	0.18490 02	0.771794	1.000000	0.737030	0.900000	0.60150 04
5.473211	0.2240 00	0.98677	0.30920-06	0.0	0.51600 01	0.771111	1.000000	0.736791	0.900000	0.60100 04
6.000000	0.2340 00	1.00000	0.30570-06	0.0	0.33630 00	0.770929	1.000000	0.736741	0.900000	0.60090 04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RMC
0.0	0.0	0.367385	0.124168	0.1116600 04	0.2426920 01	0.5148350 00	1.094381	0.1829140-06
0.080174	0.2970-02	0.377545	0.129285	0.1136360 04	0.2469970 01	0.5500860 00	1.095177	0.1789040-06
0.165891	0.6250-02	0.388997	0.134886	0.1158670 04	0.2518350 01	0.5680390 00	1.096114	0.1745070-06
0.260684	0.9900-02	0.401938	0.141104	0.1183600 04	0.2572530 01	0.5873390 00	1.097237	0.1699640-06
0.362130	0.1400-01	0.415602	0.149009	0.1211490 04	0.2633160 01	0.6076710 00	1.098597	0.1650110-06
0.471854	0.1850-01	0.433267	0.155798	0.1242700 04	0.2700990 01	0.6284070 00	1.100265	0.1597300-06
0.590532	0.2360-01	0.452268	0.164490	0.1277580 04	0.2776800 01	0.6483670 00	1.102335	0.1541280-06
0.718994	0.2920-01	0.474001	0.174204	0.1316420 04	0.2861220 01	0.6655150 00	1.104942	0.1482250-06
0.857730	0.3560-01	0.498930	0.184961	0.1359350 04	0.2954530 01	0.6763330 00	1.108272	0.1420680-06
1.077896	0.4290-01	0.527585	0.196656	0.1406170 04	0.3056290 01	0.6749110 00	1.112583	0.1357340-06
1.170314	0.5110-01	0.567537	0.208935	0.1455980 04	0.3164550 01	0.6515730 00	1.118228	0.1293520-06
1.345986	0.6040-01	0.598340	0.221021	0.1504630 04	0.3274630 01	0.5911330 00	1.125686	0.1231020-06
1.535993	0.7100-01	0.641409	0.231444	0.1553760 04	0.3377000 01	0.4715250 00	1.135590	0.1173930-06
1.741505	0.8300-01	0.689780	0.237736	0.1599670 04	0.3454970 01	0.2652600 00	1.148776	0.1126240-06
1.963786	0.9640-01	0.742734	0.236284	0.1601710 04	0.3481300 01	-0.5124990-01	1.166337	0.1095540-06
2.204206	0.1110 00	0.798317	0.222889	0.1573400 04	0.3419780 01	-0.4744700 00	1.189651	0.1092490-06
2.464243	0.1270 00	0.853035	0.194753	0.1488300 04	0.3236140 01	-0.9406600 00	1.220292	0.1132450-06
2.745500	0.1430 00	0.902263	0.152559	0.1338750 04	0.2909760 01	-0.1315150 01	1.250487	0.1236780-06
3.049707	0.1590 00	0.941745	0.106833	0.1139970 04	0.2477720 01	-0.1448840 01	1.304999	0.1432440-06
3.378739	0.1720 00	0.969439	0.064544	0.0927790 03	0.2016520 01	-0.1292050 01	1.347302	0.1743220-06
3.734617	0.1850 00	0.986192	0.033385	0.0727510 03	0.1614360 01	-0.9498660 00	1.376469	0.2164940-06
4.119536	0.1950 00	0.994786	0.014467	0.06084620 03	0.1322480 01	-0.5857200 00	1.391582	0.2634980-06
4.535365	0.2050 00	0.998421	0.005075	0.05263140 03	0.1143040 01	-0.3045650 00	1.397686	0.3042460-06
4.986166	0.2150 00	0.999638	0.001374	0.04841170 03	0.1052220 01	-0.1318950 00	1.399660	0.3306270-06
5.473211	0.2240 00	0.999044	0.000272	0.04662690 03	0.1013430 01	-0.4655120-01	1.400178	0.3432470-06
6.000000	0.2340 00	1.000000	0.000010	0.04600900 03	0.1000000 01	-0.1037360-01	1.400291	0.3478500-06

FFFFFFFFFFFF	TTTTTTTTTTTT	00000000	3333333333	FFFFFFFFFFFF	00000000	00000000	11			
FFFFFFFFFFFF	TTTTTTTTTTTT	00000000	3333333333	FFFFFFFFFFFF	00000000	00000000	11			
FF	TT	00	00	33	33	FF	00	00	00	1111
FF	TT	00	00	33	33	FF	00	00	00	11
FF	TT	00	00	33	33	FF	00	00	00	11
FFFFFFFFFF	TT	00	00	333	FFFFFFFF	00	00	00	00	11
FFFFFFFFFF	TT	00	00	333	FFFFFFFF	00	00	00	00	11
FF	TT	00	00	33	FF	00	00	00	00	11
FF	TT	00	00	33	FF	00	00	00	00	11
FF	TT	00	00	33	FF	00	00	00	00	11
FF	TT	00	00	33	FF	00	00	00	00	11
FF	TT	00000000	3333333333	FF	00000000	00000000	11			
FF	TT	00000000	3333333333	FF	00000000	00000000	11			

PROPERTIES AT THE WINDOW STREAMLINE

S/REF	S	CFXINF	STINF	QW(OIP)	QW/QWSTAG	ZWALL
0.0	0.0	0.0	0.0	0.0	0.0	1.000000
0.5006260-03	0.1000000-03	0.2913260 01	0.1504930 01	-0.5250340 02	0.1000000 01	1.000000
0.5056320-01	0.1010000-01	0.2878610 00	0.1497340 00	-0.5223860 01	0.9949560-01	1.000000
0.1006260 00	0.2010000-01	0.2054670 00	0.1061380 00	-0.3702480 01	0.7052640-01	1.000000
0.1506880 00	0.3010000-01	0.1679070 00	0.8673200-01	-0.3075960 01	0.5763180-01	1.000000
0.2007510 00	0.4010000-01	0.1456670 00	0.7514310-01	-0.2621560 01	0.4493120-01	1.000000
0.2508140 00	0.5010000-01	0.1331420 00	0.6722670-01	-0.2345370 01	0.4467090-01	1.000000
0.3008760 00	0.6010000-01	0.1184230 00	0.6137950-01	-0.2141380 01	0.4078550-01	1.000000
0.3509390 00	0.7010000-01	0.1100210 00	0.5683320-01	-0.1992770 01	0.3776460-01	1.000000
0.4010010 00	0.8010000-01	0.1029250 00	0.5316730-01	-0.1854880 01	0.3532870-01	1.000000
0.4217770 00	0.8425000-01	0.1003580 00	0.5184130-01	-0.1808610 01	0.3444760-01	1.000000
0.4267830 00	0.8525000-01	0.8548190-01	0.3224810-01	-0.1061440 01	0.2021660-01	0.847980
0.4292870 00	0.8575000-01	0.8240530-01	0.3141660-01	-0.1022330 01	0.1967180-01	0.818651
0.4305380 00	0.8600000-01	0.8116650-01	0.3113510-01	-0.1038820 01	0.1921430-01	0.807557
0.4317900 00	0.8625000-01	0.8009950-01	0.3075490-01	-0.9925840 00	0.1800510-01	0.747816
0.4330410 00	0.8650000-01	0.7915300-01	0.3053680-01	-0.9823940 00	0.1871110-01	0.789664
0.4342930 00	0.8675000-01	0.7820610-01	0.3125620-01	-0.1005230 01	0.1914540-01	0.788613
0.4367960 00	0.8725000-01	0.7676040-01	0.2960720-01	-0.9449250 00	0.1769740-01	0.770114
0.4380480 00	0.8750000-01	0.7599970-01	0.3030910-01	-0.9670810 00	0.1841940-01	0.769261
0.4405510 00	0.8800000-01	0.7478640-01	0.2892520-01	-0.9169170 00	0.1746490-01	0.753552
0.4418020 00	0.8825000-01	0.7414120-01	0.2953200-01	-0.9359490 00	0.1782640-01	0.752821
0.4443050 00	0.9875000-01	0.7308340-01	0.2841180-01	-0.8755810 00	0.1705760-01	0.739679
0.4455570 00	0.8930000-01	0.7251450-01	0.2888330-01	-0.9101590 00	0.1733540-01	0.738931
0.4480500 00	0.8950000-01	0.7157010-01	0.2787660-01	-0.8741500 00	0.1664940-01	0.727077
0.4493120 00	0.8975000-01	0.7106060-01	0.2830170-01	-0.8872380 00	0.1689870-01	0.726451
0.4518150 00	0.9025000-01	0.7020230-01	0.2748020-01	-0.8570390 00	0.1634060-01	0.716286
0.4543180 00	0.9075000-01	0.6929620-01	0.2796060-01	-0.8726180 00	0.1662020-01	0.715409
0.4593240 00	0.9175000-01	0.6792430-01	0.2654290-01	-0.8220240 00	0.1565660-01	0.697128
0.4618270 00	0.9225000-01	0.6704220-01	0.2701050-01	-0.8362770 00	0.1592810-01	0.696416
0.4668340 00	0.9325000-01	0.6574150-01	0.2585340-01	-0.7953430 00	0.1514840-01	0.681070
0.4693370 00	0.9375000-01	0.6504790-01	0.2621410-01	-0.8061570 00	0.1535440-01	0.680387
0.4743430 00	0.9475000-01	0.6388070-01	0.2516390-01	-0.7693660 00	0.1465360-01	0.666530
0.4768460 00	0.9525000-01	0.6325730-01	0.2548840-01	-0.7790390 00	0.1483790-01	0.665914
0.4818520 00	0.9625000-01	0.6219490-01	0.2453690-01	-0.7459690 00	0.1420800-01	0.653386
0.4843550 00	0.9675000-01	0.6162780-01	0.2482890-01	-0.7546530 00	0.1437340-01	0.652828
0.4893620 00	0.9775000-01	0.6055770-01	0.2395680-01	-0.7246250 00	0.1380150-01	0.641405
0.4918650 00	0.9825000-01	0.6012960-01	0.2422300-01	-0.7324780 00	0.1395110-01	0.640894
0.4968710 00	0.9925000-01	0.5922380-01	0.2341760-01	-0.7049610 00	0.1342730-01	0.630393
0.4993740 00	0.9975000-01	0.5874120-01	0.2366110-01	-0.7121130 00	0.1356320-01	0.629921
0.5043800 00	0.1007500 00	0.5789480-01	0.2296890-01	-0.6885970 00	0.1311530-01	0.620668
0.5068840 00	0.1012500 00	0.5744170-01	0.2315360-01	-0.6939130 00	0.1321650-01	0.620177
0.5118900 00	0.1022500 00	0.5659600-01	0.2321350-01	-0.6954790 00	0.1324640-01	0.619139
0.5219070 00	0.1042500 00	0.5513300-01	0.2184180-01	-0.6491770 00	0.1236450-01	0.600801
0.5269090 00	0.1052500 00	0.5436380-01	0.2209900-01	-0.6566200 00	0.1250620-01	0.600213
0.5369210 00	0.1072500 00	0.5303630-01	0.2101050-01	-0.6701090 00	0.1181080-01	0.584884
0.5419270 00	0.1082500 00	0.5234370-01	0.2123370-01	-0.6265110 00	0.1193310-01	0.584367
0.5519460 00	0.1102500 00	0.5113250-01	0.2025220-01	-0.5939670 00	0.1131200-01	0.570602
0.5569460 00	0.1112500 00	0.5050170-01	0.2045070-01	-0.5996430 00	0.1142100-01	0.570133
0.5669590 00	0.1132500 00	0.4938700-01	0.1950030-01	-0.5713850 00	0.1088280-01	0.557996
0.5719650 00	0.1142500 00	0.4890690-01	0.1974240-01	-0.5756460 00	0.1096400-01	0.557526
0.5819770 00	0.1162500 00	0.4777780-01	0.1893060-01	-0.5492200 00	0.1046060-01	0.546112

0.5869840 00	0.1172500 00	0.4724080-01	0.1907220-01	-0.5531670 00	0.1053580-01	0.545672
0.5969960 00	0.1192500 00	0.4628280-01	0.1831390-01	-0.5286860 00	0.1006950-01	0.535011
0.6020330 00	0.1202500 00	0.4578450-01	0.1844540-01	-0.5323350 00	0.1013910-01	0.534600
0.6120150 00	0.1222500 00	0.4498910-01	0.1773490-01	-0.5095730 00	0.9705520-02	0.524613
0.6170210 00	0.1237500 00	0.4442370-01	0.1785720-01	-0.5129550 00	0.9769940-02	0.524228
0.6270340 00	0.1252500 00	0.4358320-01	0.1718890-01	-0.4917320 00	0.9365140-02	0.514836
0.6320400 00	0.1262500 00	0.4314680-01	0.1730330-01	-0.4948500 00	0.9425110-02	0.514473
0.6420530 00	0.1282500 00	0.4235500-01	0.1667240-01	-0.4749260 00	0.9045630-02	0.505606
0.6470590 00	0.1292500 00	0.4194420-01	0.1677970-01	-0.4778700 00	0.9101700-02	0.505263
0.6570710 00	0.1312500 00	0.4119600-01	0.1618220-01	-0.4591260 00	0.8744690-02	0.496861
0.6620780 00	0.1322500 00	0.4080810-01	0.1628340-01	-0.4618910 00	0.8797350-02	0.496537
0.6720900 00	0.1342500 00	0.4009770-01	0.1575130-01	-0.4453040 00	0.8481440-02	0.488956
0.6770960 00	0.1352500 00	0.3972990-01	0.1582510-01	-0.4472660 00	0.8518800-02	0.488611
0.6871090 00	0.1372500 00	0.3905510-01	0.1530370-01	-0.4311780 00	0.8211050-02	0.481187
0.6921150 00	0.1382500 00	0.3870690-01	0.1537590-01	-0.4330210 00	0.8247490-02	0.480853
0.7021280 00	0.1402500 00	0.3806570-01	0.1487580-01	-0.4176070 00	0.7953910-02	0.473697
0.7071340 00	0.1412500 00	0.3773340-01	0.1494560-01	-0.4194560 00	0.7989120-02	0.473376
0.7171460 00	0.1432500 00	0.3712180-01	0.1446670-01	-0.4047690 00	0.7709390-02	0.466495
0.7221530 00	0.1442500 00	0.3687590-01	0.1453410-01	-0.4065490 00	0.7743290-02	0.466186
0.7321650 00	0.1462500 00	0.3622050-01	0.1407490-01	-0.3925400 00	0.7476470-02	0.459565
0.7371710 00	0.1472500 00	0.3591790-01	0.1413990-01	-0.3942530 00	0.7509990-02	0.459267
0.7471840 00	0.1492500 00	0.3535840-01	0.1367910-01	-0.3808710 00	0.7254220-02	0.452890
0.7521900 00	0.1502500 00	0.3506890-01	0.1376190-01	-0.3825200 00	0.7285620-02	0.452603
0.7622030 00	0.1522500 00	0.3453240-01	0.1333810-01	-0.3697190 00	0.7041790-02	0.446451
0.7672090 00	0.1532500 00	0.3425490-01	0.1339860-01	-0.3713080 00	0.7072070-02	0.446175
0.7772220 00	0.1552500 00	0.3373980-01	0.1299280-01	-0.3599430 00	0.6838470-02	0.440233
0.7822280 00	0.1562500 00	0.3347360-01	0.1304930-01	-0.3605780 00	0.6867710-02	0.439966
0.7922400 00	0.1582500 00	0.3297830-01	0.1265640-01	-0.3498110 00	0.6643590-02	0.434218
0.7972470 00	0.1592500 00	0.3272250-01	0.1271310-01	-0.3502960 00	0.6671970-02	0.433960
0.8072590 00	0.1612500 00	0.3222910-01	0.1265940-01	-0.3487000 00	0.6641470-02	0.432978
0.8272340 00	0.1652500 00	0.3132310-01	0.1188130-01	-0.3254270 00	0.6198270-02	0.421139
0.8372290 00	0.1672500 00	0.3086250-01	0.1196600-01	-0.3276940 00	0.6241190-02	0.420937
0.8573220 00	0.1712500 00	0.3000960-01	0.1132500-01	-0.3096650 00	0.5878940-02	0.410687
0.8673340 00	0.1732500 00	0.2957880-01	0.1138690-01	-0.3102900 00	0.5909720-02	0.410386
0.8873590 00	0.1772500 00	0.2877790-01	0.1077890-01	-0.2923920 00	0.5568830-02	0.400692
0.8973720 00	0.1792500 00	0.2837640-01	0.1083890-01	-0.2939450 00	0.5598590-02	0.400406
0.9173970 00	0.1832500 00	0.2767620-01	0.1026530-01	-0.2771320 00	0.5279310-02	0.390164
0.9274090 00	0.1852500 00	0.2724750-01	0.1032360-01	-0.2786970 00	0.5308190-02	0.390092
0.9474340 00	0.1892500 00	0.2654130-01	0.9781580-02	-0.2629540 00	0.5008520-02	0.382064
0.9574470 00	0.1912500 00	0.2618440-01	0.9838410-02	-0.2644380 00	0.5036590-02	0.381805
0.9774720 00	0.1952500 00	0.2551880-01	0.9325110-02	-0.2496390 00	0.4754720-02	0.373354
0.9874940 00	0.1972500 00	0.2518260-01	0.9390600-02	-0.2510740 00	0.4782060-02	0.373106
0.1000300 01	0.1997500 00	0.2478500-01	0.9005430-02	-0.2403840 00	0.4578440-02	0.367385

IV. Solution of a Blunt Cone at Zero Incidence and with Mass Transfer.

```

JJ      000000000000  888888888888
JJ      0000000000000  8888888888888
JJ      00      00  88      88
JJ      00      00  88      88
JJ      00      00  88      88
JJ      0C      00  888888888888
JJ      00      00  888888888888
JJ      00      00  88      88
JJ      00      00  88      88
JJ      00      00  88      88
JJJJJJJJJJJJJJ  0000000000000  888888888888888
JJJJJJJJJJJJJJ  000000000000  888888888888

```

[illegible]

FFFFFFFFFFFF	TTTTTTTTTTTT	0000000	666666666666	FFFFFFFFFFFF	0000000	0000000	11
FFFFFFFFFFFF	TTTTTTTTTTTT	00000000	666666666666	FFFFFFFFFFFF	00000000	00000000	111
FF	TT	00	66	FF	00	00	1111
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FFFFFFFFFFFF	TT	00	666666666666	FFFFFFFFFFFF	00	00	11
FFFFFFFFFFFF	TT	00	666666666666	FFFFFFFFFFFF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00	66	FF	00	00	11
FF	TT	00000000	666666666666	FF	00000000	00000000	11
FF	TT	0000000	666666666666	FF	0000000	0000000	11

THREE-DIMENSIONAL BOUNDARY LAYER PROGRAM
FOR
LAMINAR OR TURBULENT FLOW
WITH
BINARY GAS INJECTION
DEVELOPED BY
M.C. FRIEDERS
AEROSPACE ENGINEERING DEPARTMENT
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
BLACKSBURG, VA. 24060

AEDC-TR-75-55

INPUT DATA CARDS ARE AS FOLLOWS:

	LEWIS, ADAMS, GILLEY, BLUNT, LAMINAR	ARGON INJECTION
CARD 001	IE 13 COL 50-52	051
CARD 002	INJCT 13 COL 50-52	001
CARD 003	KADETA 13 COL 50-52	000
CARD 004	KEND2 13 COL 50-52	001
CARD 005	KCNSET 13 COL 50-52	000
CARD 006	KPRT 13 COL 50-52	003
CARD 007	KTRANS 13 COL 50-52	000
CARD 008	LAMTR8 13 COL 50-52	001
CARD 009	LPRT 13 COL 50-52	001
CARD 010	NIT1 13 COL 50-52	005
CARD 011	NIT2 13 COL 50-52	010
CARD 012	NIT3 13 COL 50-52	020
CARD 013	NCINJ 13 COL 50-52	000
CARD 014	NOSE A5 COL 50-54	BLUNT
CARD 015	NSOLVE 13 COL 50-52	003
CARD 016	KPLOT 413 COL 50-61	001000000000
CARD 017	KPRFL 413 COL 50-61	001000000000
CARD 018	LPLUT 413 COL 50-61	003000000000
CARD 019	LPRFL 413 COL 50-61	001000000000
CARD 020	ADTEST E14.6 COL 50-63	0.001
CARD 021	AKSTAR E14.6 COL 50-63	0.435
CARD 022	ALAMDA E14.6 COL 50-63	0.09
CARD 023	LEWTR8 E14.6 COL 50-63	1.0
CARD 024	ALPHA E14.6 COL 50-63	0.0
CARD 025	ASTAR E14.6 COL 50-63	26.0
CARD 026	COOL A3 COL 50-52	ABLATION
CARD 027	CWALL F14.6 COL 50-63	0.0284
CARD 028	CR1 F5.3 COL 50-54	1.0
CARD 029	CONV E14.6 COL 50-63	0.01
CARD 030	DISK A2 COL 50-51	NO
CARD 031	DXINVS E14.6 COL 50-63	0.04
CARD 032	DXMAX E14.6 COL 50-63	0.10
CARD 033	DX1 F5.3 COL 50-54	0.02
CARD 034	EDYLAW A3 COL 50-52	REICHARDT
CARD 035	ETAFAE E14.6 COL 50-63	1.04
CARD 036	ETAINF E14.6 COL 50-63	12.0
CARD 037	GAS2 A3 COL 50-52	ARGON
CARD 038	PLAT A2 COL 50-51	NO
CARD 039	PRL E14.6 COL 50-63	0.7

CARD 040	PAT	A5	COL 50-54	ROTTA
CARD 041	PROP	A4	COL 50-53	PINF
CARD 042	RTW	E14.6	COL 50-63	0.06582
CARD 043	TFS	E14.6	COL 50-63	290.0
CARD 044	TSTAG	E14.6	COL 50-63	8204.0
CARD 045	VALUE	E14.6	COL 50-63	0.00135
CARD 046	XBAR	E14.6	COL 50-63	2.09
CARD 047	RNOSE	E14.6	COL 50-63	0.083333
0.0				
0.01				
0.42514				

FREE STREAM, STAGNATION, AND VEHICLE DATA:

PSTAG = 0.164499D 04 PSIA
 TSTAG = 0.820400D 04 DEG.R
 HSTAG = 0.590786D 08 FT**2/SEC**2
 PINF = 0.135000D-02 PSIA
 RMJINF = 0.390264D-06 SLUGS/FT**3
 TINF = 0.290000D 03 DEG.R
 UINF = 0.106762D 05 FT/SEC
 MINF = 0.132000D 02
 CP/CV = 0.140000D 01
 R = 0.171767D 04 FT**2/SEC**2/DEG.R
 TW/TO = 0.658200D-01
 ALPHA = 0.0 DEG.
 THETAC = 0.750000D 01 DEG.

POINTS AT WHICH A SOLUTION IS TO BE OBTAINED:

I	XSTA(I)
1	0.0
2	0.010000
3	0.061934
4	0.425140

BLUNT CONE EDGE DATA

I	ZB(I)	XB(I)	RB(I)	PEB(I)	UEB(I)	TEB(I)	XMB(I)
1	0.0	0.0	0.0	0.437084D 02	0.0	0.820400D 04	0.0
2	0.479041D-04	0.282573D-02	0.282519D-02	0.436525D 02	0.189959D 03	0.820100D 04	0.427752D-01
3	0.180217D-03	0.548151D-02	0.547755D-02	0.434848D 02	0.380115D 03	0.819198D 04	0.856419D-01
4	0.401342D-03	0.818192D-02	0.816878D-02	0.432054D 02	0.570718D 03	0.817691D 04	0.128704D 00
5	0.712150D-03	0.109023D-01	0.108713D-01	0.428146D 02	0.761963D 03	0.815571D 04	0.172056D 00
6	0.111383D-02	0.136401D-01	0.135793D-01	0.423131D 02	0.954030D 03	0.812830D 04	0.215788D 00
7	0.160914D-02	0.164029D-01	0.162972D-01	0.417065D 02	0.114566D 04	0.809484D 04	0.259667D 00
8	0.219631D-02	0.191747D-01	0.190060D-01	0.409808D 02	0.134144D 04	0.805434D 04	0.304805D 00
9	0.288217D-02	0.219808D-01	0.217268D-01	0.401563D 02	0.153630D 04	0.800770D 04	0.350097D 00
10	0.366694D-02	0.248131D-01	0.244481D-01	0.392277D 02	0.173253D 04	0.795435D 04	0.396137D 00
11	0.455217D-02	0.276710D-01	0.271653D-01	0.381954D 02	0.193070D 04	0.789398D 04	0.443132D 00

12	0.5542410-02	0.3056400-01	0.2988330-01	0.3706200 02	0.2130960 04	0.7826330 04	0.4912060 00
13	0.6643440-02	0.3350030-01	0.3260520-01	0.3583220 02	0.2333230 04	0.7751230 04	0.5404270 00
14	0.7858660-02	0.3648140-01	0.3532720-01	0.3451230 02	0.2537310 04	0.7669560 04	0.5908580 00
15	0.9193850-02	0.3951380-01	0.3804960-01	0.3310190 02	0.2744200 04	0.7577680 04	0.6428560 00
16	0.1065620-01	0.4260540-01	0.4077730-01	0.3162380 02	0.2951630 04	0.7479420 04	0.6959750 00
17	0.1225280-01	0.4576270-01	0.4349700-01	0.3006320 02	0.3162770 04	0.7372050 04	0.7511720 00
18	0.1399020-01	0.4899000-01	0.4621650-01	0.2842040 02	0.3378590 04	0.7254640 04	0.8088980 00
19	0.1588230-01	0.5230370-01	0.4843670-01	0.2672800 02	0.3596060 04	0.7128490 04	0.8685490 00
20	0.1794170-01	0.5571530-01	0.5165620-01	0.2498310 02	0.3816950 04	0.6992300 04	0.9308340 00
21	0.2018050-01	0.5923390-01	0.5437040-01	0.2314420 02	0.4047930 04	0.6941210 04	0.9980040 00
22	0.2197480-01	0.6193390-01	0.5638760-01	0.2175880 02	0.4221810 04	0.6721620 04	0.1050090 01

S	= 0.0	S/REF= 0.0	Z	= 0.0	Z/REF= 0.0	PHI	= 0.0 DEG.
R	= 0.0	R/REF= 0.0	DX	= 0.200000-01	NIT	= 10	
XI	= 0.0	DXI = 0.0	DXDXI	= 0.0	CHALL	= 0.2840000-01	

DIMENSIONAL EDGE PROPERTIES

PE	= 0.4370840 02	TE	= 0.8204000 04	UE	= 0.0	VE	= 0.0	MACHE	= 0.0
DPEOX	= 0.0	DTEOX	= 0.0	DUEOX	= 0.0	DVEDX	= 0.0	RHOE	= 0.3101700-05
DPEDW	= 0.0	DTEDW	= 0.0	DUECW	= 0.0	DVEDW	= 0.0	RHOEMUE	= 0.8127290-11

LOCAL EDGE REYNOLDS NUMBER =0.0

NCDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF	= 0.0	CFXEDG	= 0.0	CFWINF	= 0.0	CFWEDG	= 0.0
CHEDGE	= 0.0	CHINF	= 0.2234660 00	STEDGE	= 0.0	STINF	= 0.1469000 00
QM	= -0.7209230-01	CHIMAX	= 0.0				

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION	= 0.0	PSF	DELTA*(X)	= -0.2409690-03	THETA*(X)	= 0.1301980-02
TRANSVERSE SKIN FRICTION	= 0.0	PSF	DELTA*(PHI)	= 0.2645790-01	THETA*(PHI)	= 0.0
WALL HEAT TRANSFER RATE	= -0.4402850 02 BTU		DELTA (FT)	= 0.6394360-02		

ETA	Y	F	FN	G	GN	H	MN	C	CN	V
0.0	0.0	0.0	0.285576	0.0	0.0	0.051862	0.188734	2.155593	-1.019725	0.1140 00
0.160349	0.3350-04	0.047577	0.307805	0.0	0.0	0.083501	0.206249	1.995716	-0.946780	0.1100 00
0.333782	0.8780-04	0.102991	0.330713	0.0	0.0	0.121043	0.226995	1.844324	-0.812838	0.9710-01
0.521368	0.1690-03	0.167191	0.353089	0.0	0.0	0.165802	0.250266	1.702420	-0.705930	0.7180-01
0.724260	0.2840-03	0.241019	0.373546	0.0	0.0	0.219062	0.274208	1.570068	-0.608266	0.3040-01
0.943709	0.4430-03	0.324980	0.389804	0.0	0.0	0.282005	0.299189	1.446150	-0.514466	-0.3160-01
1.181064	0.6560-03	0.418737	0.397108	0.0	0.0	0.355938	0.322202	1.336638	-0.410168	-0.1200 00
1.437788	0.9390-03	0.520278	0.389691	0.0	0.0	0.441038	0.337844	1.244816	-0.309023	-0.2400 00
1.715461	0.1310-02	0.625383	0.362507	0.0	0.0	0.535707	0.339752	1.172190	-0.219969	-0.4000 00
2.015751	0.1780-02	0.727586	0.313911	0.0	0.0	0.635869	0.322243	1.117600	-0.150265	-0.6030 00
2.340629	0.2360-02	0.819170	0.247901	0.0	0.0	0.734912	0.283002	1.077695	-0.101107	-0.8550 00
2.691973	0.3070-02	0.893129	0.174196	0.0	0.0	0.824646	0.225200	1.048709	-0.067597	-0.1160 01
3.071487	0.3910-02	0.945490	0.105072	0.0	0.0	0.877364	0.158075	1.028026	-0.043481	-0.1510 01

3.483310	0.4870-02	0.976902	0.053239	0.0	0.0	0.948527	0.094760	1.014223	-0.025390	-0.1900	01
3.927572	0.5960-02	0.992235	0.021354	0.0	0.0	0.978711	0.046744	1.006111	-0.012711	-0.2340	01
4.408411	0.7160-02	0.998043	0.006473	0.0	0.0	0.993062	0.018188	1.002127	-0.005190	-0.2820	01
4.928486	0.8460-02	0.999656	0.001392	0.0	0.0	0.998316	0.003309	1.000571	-0.001645	-0.3340	01
5.491000	0.9830-02	0.999962	0.002195	0.0	0.0	0.999716	0.001092	1.000111	-0.000383	-0.3900	01
6.099414	0.1140-01	0.999958	0.000016	0.0	0.0	0.999969	0.000147	1.000015	-0.000061	-0.4510	01
6.757475	0.1310-01	1.000000	0.000001	0.0	0.0	0.999998	0.000012	1.000001	-0.000006	-0.5170	01
7.469234	0.1490-01	1.000000	0.000000	0.0	0.0	1.000000	0.000001	1.000000	-0.000000	-0.5820	01
8.239373	0.1630-01	1.000000	0.000000	0.0	0.0	1.000000	0.000000	1.000000	-0.000000	-0.6650	01
9.071730	0.1890-01	1.000000	0.000000	0.0	0.0	1.000000	0.000000	1.000000	-0.000000	-0.7480	01
9.972332	0.2120-01	1.000000	0.000000	0.0	0.0	1.000000	0.000000	1.000000	-0.000000	-0.8380	01
10.946423	0.2360-01	1.000000	0.000000	0.0	0.0	1.000000	0.000000	1.000000	-0.000000	-0.9360	01
12.000000	0.2630-01	1.000000	0.000000	0.0	0.0	1.000000	0.000000	1.000000	-0.000000	-0.1040	02

ETA	Y/L	ROROE	XMU	E+	CHI	LEL	LET	PRL	PRT	SP HT
0.0	0.0	15.67864	0.36030-06	0.0	0.0	1.463182	1.000000	0.730251	0.900000	0.56510 04
0.160349	0.7880-04	9.77804	0.53480-06	0.0	0.0	1.337113	1.000000	0.734211	0.900000	0.57750 04
0.333782	0.2070-03	6.82766	0.70780-06	0.0	0.0	1.285595	1.000000	0.742135	0.900000	0.60270 04
0.521368	0.3970-03	5.08315	0.87760-06	0.0	0.0	1.273536	1.000000	0.750974	0.900000	0.63250 04
0.724260	0.6660-03	3.94189	0.10440-05	0.0	0.0	1.274224	1.000000	0.755051	0.900000	0.64740 04
0.943709	0.1040-02	3.12509	0.12130-05	0.0	0.0	1.288988	1.000000	0.761171	0.900000	0.67030 04
1.181064	0.1540-02	2.52582	0.13840-05	0.0	0.0	1.305630	1.000000	0.766850	0.900000	0.69270 04
1.437788	0.2210-02	2.08623	0.15630-05	0.0	0.0	1.316463	1.000000	0.771613	0.900000	0.71260 04
1.715461	0.3070-02	1.75283	0.17520-05	0.0	0.0	1.316604	1.000000	0.775093	0.900000	0.72820 04
2.015791	0.4180-02	1.50333	0.19480-05	0.0	0.0	1.305956	1.000000	0.777209	0.900000	0.73980 04
2.340629	0.5550-02	1.31990	0.21390-05	0.0	0.0	1.289044	1.000000	0.778246	0.900000	0.74530 04
2.691973	0.7210-02	1.18957	0.23100-05	0.0	0.0	1.271884	1.000000	0.778707	0.900000	0.74960 04
3.071987	0.9190-02	1.10209	0.24440-05	0.0	0.0	1.258520	1.000000	0.779002	0.900000	0.75300 04
3.483310	0.1150-01	1.04629	0.25350-05	0.0	0.0	1.249992	1.000000	0.779276	0.900000	0.75590 04
3.927572	0.1400-01	1.01921	0.25870-05	0.0	0.0	1.245448	1.000000	0.779503	0.900000	0.75800 04
4.408411	0.1680-01	1.00609	0.26100-05	0.0	0.0	1.243470	1.000000	0.779645	0.900000	0.75930 04
4.928486	0.1990-01	1.00144	0.26180-05	0.0	0.0	1.242807	1.000000	0.779712	0.900000	0.75980 04
5.491000	0.2320-01	1.00023	0.26200-05	0.0	0.0	1.242650	1.000000	0.779736	0.900000	0.76000 04
6.099414	0.2680-01	1.00002	0.26200-05	0.0	0.0	1.242628	1.000000	0.779742	0.900000	0.76010 04
6.757475	0.3070-01	1.00000	0.26200-05	0.0	0.0	1.242626	1.000000	0.779743	0.900000	0.76010 04
7.469234	0.3500-01	1.00000	0.26200-05	0.0	0.0	1.242626	1.000000	0.779743	0.900000	0.76010 04
8.239373	0.3950-01	1.00000	0.26200-05	0.0	0.0	1.242626	1.000000	0.779743	0.900000	0.76010 04
9.071730	0.4450-01	1.00000	0.26200-05	0.0	0.0	1.242626	1.000000	0.779743	0.900000	0.76010 04
9.972332	0.4990-01	1.00000	0.26200-05	0.0	0.0	1.242626	1.000000	0.779743	0.900000	0.76010 04
10.946423	0.5550-01	1.00000	0.26200-05	0.0	0.0	1.242626	1.000000	0.779743	0.900000	0.76010 04
12.000000	0.6180-01	1.00000	0.26200-05	0.0	0.0	1.242626	1.000000	0.779743	0.900000	0.76010 04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	0.873266	0.020380	0.5399870 03	0.6582000-01	0.2451900 00	1.415171	0.4863040-04
0.160349	0.7880-04	0.876850	0.024245	0.8684240 03	0.1058540 00	0.2554830 00	1.403244	0.3032850-04
0.333782	0.2070-03	0.881379	0.027791	0.1242090 04	0.1514000 00	0.2688990 00	1.380688	0.2117740-04
0.521368	0.3970-03	0.886901	0.030952	0.1665750 04	0.2030410 00	0.2817440 00	1.357058	0.1576640-04
0.724260	0.6660-03	0.893488	0.033878	0.2144010 04	0.2613370 00	0.2965580 00	1.346905	0.1222660-04
0.943709	0.1040-02	0.901238	0.036649	0.2698470 04	0.3289210 00	0.3151520 00	1.332090	0.9693100-05
1.181064	0.1540-02	0.910249	0.039136	0.3324950 04	0.4052840 00	0.3267550 00	1.318994	0.7846760-05
1.437788	0.2210-02	0.920572	0.041050	0.4020250 04	0.4900350 00	0.3310100 00	1.308512	0.6470850-05
1.715461	0.3070-02	0.932135	0.041912	0.4769420 04	0.5813530 00	0.3233020 00	1.301186	0.5436740-05

2.015791	0.418D-02	0.944676	0.041084	0.554151D 04	0.675465D 00	0.299485D 00	1.296928	0.466287D-03
2.340629	0.555D-02	0.957606	0.037956	0.628893D 04	0.766569D 00	0.257945D 00	1.294947	0.409392D-03
2.691973	0.721D-02	0.970036	0.032308	0.695387D 04	0.847619D 00	0.201667D 00	1.294103	0.368970D-03
3.071987	0.919D-02	0.980904	0.024688	0.748334D 04	0.912157D 00	0.139066D 00	1.293530	0.341835D-03
3.483310	0.115D-01	0.989315	0.016466	0.794913D 04	0.956744D 00	0.817981D-01	1.292959	0.325148D-03
3.927572	0.140D-01	0.994911	0.009300	0.806364D 04	0.982525D 00	0.394870D-01	1.292474	0.316129D-03
4.4C8411	0.168C-01	0.998013	0.004301	0.815882D 04	0.994492D 00	0.149463D-01	1.292168	0.312058D-03
4.928486	0.199D-01	0.999393	0.001563	0.819359D 04	0.998731D 00	0.418990D-02	1.292022	0.310616C-03
5.491303	0.232D-01	0.999364	0.000423	0.820234D 04	0.999804D 00	0.806767D-03	1.291970	0.310242D-03
6.399414	0.268D-01	0.99998C	0.000179	0.820385D 04	0.999982D 00	0.962758D-04	1.291957	0.310177D-03
6.757475	0.307D-01	0.999999	0.000009	0.820399D 04	0.999999D 00	0.624911D-05	1.291955	0.310171D-03
7.469234	0.359D-01	1.000000	0.000001	0.820400D 04	0.100000D 01	0.213089D-06	1.291955	0.310170D-03
8.239073	0.395D-01	1.000000	0.000000	0.820400D 04	0.100000D 01	0.603293D-08	1.291955	0.310170D-03
9.071733	0.445D-01	1.000000	0.000000	0.820400D 04	0.100000D 01	0.812450D-10	1.291955	0.310170D-03
9.972332	0.498D-01	1.000000	0.000000	0.820400D 04	0.100000D 01	-0.486278D-13	1.291955	0.310170D-03
10.946423	0.556D-01	1.000000	0.000000	0.820400D 04	0.100000D 01	0.277556D-16	1.291955	0.310170D-03
12.000000	0.618D-01	1.000000	0.0	0.820400D 04	0.100000D 01	0.133227D-14	1.291955	0.310170D-03

S = 0.100000D-01	S/REF= 0.120000D 00	Z = 0.599283D-03	Z/REF= 0.719142D-02	PHI = 0.0 DEG.
R = 0.997602D-02	R/REF= 0.119713D 00	DX = 0.100000C-1	NIT = 4	
XI = 0.139030D-14	DXI = 0.139030D-14	DXDXI= 0.179925D 13	CHALL= 0.284000D-01	

DIMENSIONAL EDGE PROPERTIES

PE = 0.429564D 02	TE = 0.816342D 04	UE = 0.698523D 03	VE = 0.0	MACHE = 0.157656D 00
DPEOX=-0.270619D 15	DTEOX=-0.146988D 17	DUEOX= 0.126463D 18	DVEDX= 0.0	RHOE = 0.306349D-05
DPEOW= 0.0	DTEOW= 0.0	DUEOW= 0.0	DVEDW= 0.0	RHOEMUE= 0.799490D-11

LOCAL EDGE REYNOLDS NUMBER =0.819973D 01

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

CFXINF= 0.356451D-01	CFXEDG= 0.106075D 01	CFWINF= 0.0	CFWEDG= 0.0
CHEDGE= 0.508943D 00	CHINF= 0.261392D 00	STEDGE= 0.334407D 00	STINF= 0.171751D 00
QW =-0.843091D-01	CHMAX= 0.644038D 00		

DIMENSIONAL BOUNDARY LAYER PARAMETERS

LONGITUDINAL SKIN FRICTION= 0.792792D 00 PSF	DELTA*(X) =-0.624155D-03	THETA*(X) = 0.115452D-02
TRANSVERSE SKIN FRICTION = 0.0 PSF	DELTA*(PHI)= 0.263174D-01	THETA*(PHI)= 0.0
WALL HEAT TRANSFER RATE =-0.514896D 02 BTU	DELTA (FT) = 0.609684D-02	

ETA	Y	F	FN	G	GN	H	HN	C	CN	V
0.0	0.0	0.0	0.495988	0.0	0.0	0.051622	0.216316	2.165836	-1.343459	0.112D 00
0.160349	0.340D-04	0.081564	0.519049	0.0	0.0	0.088234	0.240506	1.975085	-1.065575	0.100D 00
0.333782	0.914D-04	0.172732	0.528041	0.0	0.0	0.132300	0.267987	1.806207	-0.898725	0.600D-01
0.521368	0.179D-03	0.271452	0.520361	0.0	0.0	0.185404	0.297640	1.650873	-0.760190	-0.145D-01
0.724260	0.305D-03	0.374930	0.496271	0.0	0.0	0.248804	0.326898	1.508846	-0.645421	-0.129D 00

0.943709	0.4810-03	0.479831	0.456789	0.0	0.0	0.323776	0.354486	1.381919	-0.513393	-0.2860 00
1.181064	0.7190-03	0.582204	0.404071	0.0	0.0	0.410545	0.373070	1.275960	-0.384090	-0.4880 00
1.437768	0.1030-02	0.678132	0.342739	0.0	0.0	0.507233	0.375123	1.193007	-0.269716	-0.7330 00
1.715461	0.1440-02	0.764137	0.277952	0.0	0.0	0.609366	0.354985	1.131703	-0.180640	-0.1020 01
2.015791	0.1950-02	0.837719	0.213920	0.0	0.0	0.710187	0.311911	1.087847	-0.119964	-0.1330 01
2.340629	0.2580-02	0.897031	0.153783	0.0	0.0	0.801969	0.250956	1.056578	-0.078554	-0.1680 01
2.691973	0.3320-02	0.941165	0.100093	0.0	0.0	0.877845	0.181679	1.034315	-0.051069	-0.2040 01
3.071987	0.4180-02	0.970609	0.058138	0.0	0.0	0.933664	0.115630	1.019058	-0.031158	-0.2430 01
3.483310	0.5150-02	0.987612	0.028511	0.0	0.0	0.969257	0.062823	1.009507	-0.016933	-0.2850 01
3.927572	0.6230-02	0.995779	0.011383	0.0	0.0	0.988295	0.028110	1.004311	-0.007822	-0.3300 01
4.408411	0.7410-02	0.998898	0.003521	0.0	0.0	0.996508	0.009918	1.001962	-0.002935	-0.3780 01
4.928486	0.8690-02	0.999794	0.000755	0.0	0.0	0.999230	0.002615	1.001120	-0.000852	-0.4300 01
5.491000	0.1010-01	0.999975	0.000121	0.0	0.0	0.999883	0.000482	1.000893	-0.000180	-0.4860 01
6.099414	0.1160-01	0.999998	0.000011	0.0	0.0	0.999989	0.000057	1.000850	-0.000026	-0.5470 01
6.757475	0.1320-01	1.000000	0.000001	0.0	0.0	0.999999	0.000004	1.000844	-0.000002	-0.6130 01
7.469234	0.1500-01	1.000000	0.000000	0.0	0.0	1.000000	0.000000	1.000844	-0.000000	-0.6640 01
8.239373	0.1690-01	1.000000	0.000000	0.0	0.0	1.000000	0.000000	1.000844	-0.000000	-0.7610 01
9.071730	0.1890-01	1.000000	-0.000000	0.0	0.0	1.000000	0.000000	1.000844	-0.000000	-0.8440 01
9.972332	0.2120-01	1.000000	-0.000000	0.0	0.0	1.000000	-0.000000	1.000844	-0.000000	-0.9340 01
10.946423	0.2360-01	1.000000	-0.000000	0.0	0.0	1.000000	-0.000000	1.000844	-0.000000	-0.1030 02
12.000000	0.2620-01	1.000000	-0.000000	0.0	0.0	1.000000	-0.000000	1.000000	-0.002372	-0.1140 02

ETA	Y/L	RUR0E	XMU	E+	CHI	LEL	LET	PRL	PRT	SP HT
0.0	0.0	15.68852	0.36030-06	0.0	0.0	1.469685	1.000000	0.730229	0.900000	0.56300 04
0.160349	0.8000-04	9.22955	0.55840-06	0.0	0.79270-01	1.326576	1.000000	0.735071	0.900000	0.58010 04
0.333782	0.2150-03	6.25632	0.75340-06	0.0	0.19840 00	1.279709	1.000000	0.744542	0.900000	0.61050 04
0.521368	0.4210-03	4.57453	0.94160-06	0.0	0.32070 00	1.274339	1.000000	0.753910	0.900000	0.64290 04
0.724260	0.7180-03	3.49858	0.11260-05	0.0	0.43530 00	1.280597	1.000000	0.758019	0.900000	0.65830 04
0.943709	0.1130-02	2.75245	0.13100-05	0.0	0.52930 00	1.298791	1.000000	0.764480	0.900000	0.69320 04
1.181064	0.1690-02	2.22273	0.14980-05	0.0	0.59720 00	1.313617	1.000000	0.770015	0.900000	0.70580 04
1.437768	0.2430-02	1.83953	0.16930-05	0.0	0.63510 00	1.317808	1.000000	0.774148	0.900000	0.72380 04
1.715461	0.3390-02	1.56125	0.18920-05	0.0	0.64400 00	1.305904	1.000000	0.776730	0.900000	0.73630 04
2.015791	0.4590-02	1.36092	0.20960-05	0.0	0.62660 00	1.294156	1.000000	0.778041	0.900000	0.74390 04
2.340629	0.6060-02	1.21982	0.22600-05	0.0	0.58200 00	1.276923	1.000000	0.778617	0.900000	0.74860 04
2.691973	0.7810-02	1.12420	0.24010-05	0.0	0.50580 00	1.262748	1.000000	0.778933	0.900000	0.75210 04
3.071987	0.9830-02	1.06334	0.25010-05	0.0	0.39770 00	1.253135	1.000000	0.779202	0.900000	0.75500 04
3.483310	0.1210-01	1.02614	0.25620-05	0.0	0.27000 00	1.247570	1.000000	0.779438	0.900000	0.75730 04
3.927572	0.1470-01	1.01041	0.25940-05	0.0	0.15060 00	1.244839	1.000000	0.779604	0.900000	0.75890 04
4.408411	0.1740-01	1.00303	0.26070-05	0.0	0.64650-01	1.243749	1.000000	0.779676	0.900000	0.75970 04
4.928486	0.2040-01	1.00065	0.26110-05	0.0	0.19950-01	1.243420	1.000000	0.779735	0.900000	0.76000 04
5.491000	0.2370-01	1.00009	0.26120-05	0.0	0.40760-02	1.243351	1.000000	0.779747	0.900000	0.76010 04
6.099414	0.2720-01	1.00001	0.26120-05	0.0	0.49730-03	1.243343	1.000000	0.779750	0.900000	0.76010 04
6.757475	0.3110-01	1.00000	0.26120-05	0.0	0.32200-04	1.243342	1.000000	0.779751	0.900000	0.76010 04
7.469234	0.3520-01	1.00000	0.26120-05	0.0	0.11070-05	1.243342	1.000000	0.779751	0.900000	0.76010 04
8.239373	0.3970-01	1.00000	0.26120-05	0.0	0.19960-07	1.243342	1.000000	0.779751	0.900000	0.76010 04
9.071730	0.4450-01	1.00000	0.26120-05	0.0	-0.23960-07	1.243342	1.000000	0.779751	0.900000	0.76010 04
9.972332	0.4980-01	1.00000	0.26120-05	0.0	-0.87100-07	1.243342	1.000000	0.779751	0.900000	0.76010 04
10.946423	0.5540-01	1.00000	0.26120-05	0.0	-0.25590-06	1.243342	1.000000	0.779751	0.900000	0.76010 04
12.000000	0.6150-01	1.00000	0.26100-05	0.0	-0.67020-06	1.242242	1.000000	0.779753	0.900000	0.76010 04

ETA	Y/L	Z	ZN	TEMP	T/TE	TN	CP/CV	RHO
0.0	0.0	0.872871	0.023179	0.5399870 03	0.6614720-01	0.2764050 00	1.415224	0.4801170-04

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C.160349 0.8000-04 0.877C22 0.028411 0.916348D 03 0.112250D 00 0.297440D 00 1.400717 0.282465D-04
0.333782 0.215D-03 0.882361 0.032887 0.134984D 04 0.165352D 00 0.313854D 00 1.374084 0.191463D-04
0.521368 0.421D-03 0.888912 0.036751 0.184267D 04 0.225722D 00 0.327902D 00 1.349549 0.139994D-04
0.724260 0.718D-03 0.896733 0.040191 0.240402D 04 0.294487D 00 0.351490D 00 1.339618 0.107C67D-04
0.943709 0.113D-02 0.905903 0.043166 0.304780D 04 0.373348D 00 0.365282D 00 1.324375 0.842333D-05
1.181064 0.169D-02 0.916441 0.045328 0.376295D 04 0.460953D 00 0.369815D 00 1.311971 0.680224D-05
1.437788 0.243D-02 0.928239 0.046163 0.453179D 04 0.555134D 00 0.359893D 00 1.303143 0.562952D-05
1.715461 0.339D-02 0.940978 0.045560 0.532054D 04 0.651754D 00 0.331838D 00 1.297873 0.477790D-05
2.015751 0.459D-02 0.954069 0.041547 0.608147D 04 0.744966D 00 0.285614D 00 1.295328 0.416484D-05
2.340629 0.606D-02 0.966670 0.035591 0.676123D 04 0.828235D 00 0.225753D 00 1.294261 0.373302D-05
2.691773 0.781D-02 0.977839 0.027813 0.731363D 04 0.895903D 00 0.160686D 00 1.293664 0.344040D-05
3.071787 0.983D-02 0.986777 0.019424 0.771315D 04 0.944843D 00 0.100510D 00 1.293113 0.325415D-05
3.483010 0.121D-01 0.993056 0.011837 0.796337D 04 0.975495D 00 0.535925D-01 1.292613 0.314641D-05
3.927572 0.147D-01 0.995942 0.006120 0.809454D 04 0.991563D 00 0.234497D-01 1.292255 0.309215D-05
4.408411 0.174D-01 0.998854 0.002554 0.814969D 04 0.998318D 00 0.802593D-02 1.292057 0.306958D-05
4.928486 0.234D-01 0.999690 0.000862 0.816730D 04 0.100048D 01 0.201991D-02 1.291972 0.306229D-05
5.491000 0.237D-01 0.999937 0.000212 0.817128D 04 0.100096D 01 0.344166D-03 1.291945 0.306059D-05
6.099414 0.272D-01 0.999992 0.000035 0.817185D 04 0.100103D 01 0.354763D-04 1.291939 0.306033D-05
6.757475 0.311D-01 0.999999 0.000004 0.817190D 04 0.100104D 01 0.194146D-05 1.291938 0.306031D-05
7.469234 0.352D-01 1.000000 0.000000 0.817190D 04 0.100104D 01 0.609661D-07 1.291938 0.306031D-05
8.239373 0.397D-01 1.000000 0.000000 0.817190D 04 0.100104D 01 0.176287D-08 1.291938 0.306031D-05
9.071730 0.445D-01 1.000000 -0.000000 0.817190D 04 0.100104D 01 0.134834D-10 1.291938 0.306031D-05
9.972332 0.493D-01 1.000000 0.000000 0.817190D 04 0.100104D 01 0.458911D-11 1.291938 0.306031D-05
10.946423 0.554D-01 1.000000 0.000000 0.817190D 04 0.100104D 01 0.107759D-10 1.291938 0.306031D-05
12.000000 0.615D-01 1.000000 0.000000 0.816342D 04 0.100000D 01 -0.292167D-02 1.291933 0.306031D-05

```

```

S = 0.360000D-01 S/REF= 0.360001D 00 Z = 0.534195D-02 Z/REF= 0.641037D-01 PHI = 0.0 DEG.
R = 0.293562D-01 R/REF= 0.352276D 00 DX = 0.20000D-01 NIT = 5
XI = 0.100928D-12 DXI = 0.995377D-13 DXDXI = 0.793204D 11 CWALL= 0.284000D-01

```

DIMENSIONAL EDGE PROPERTIES

```

PE = 0.372894D 02 TE = 0.784002D 04 UE = 0.209199D 04 VE = 0.0 MACHE = 0.481800D 00
DPEDX=-0.317718D 14 DTEOX=-0.190850D 16 DUEDX= 0.548471D 16 DVEDX= 0.0 RHOE = 0.276903D-05
DPEDW= 0.0 DTEDW= 0.0 DUEDW= 0.0 DVEDW= 0.0 RHOENUE= 0.699289D-11

```

LOCAL EDGE REYNOLDS NUMBER = 0.688145D 02

NONDIMENSIONAL BOUNDARY LAYERS PARAMETERS

```

CFXINF= 0.756134D-01 CFXEDG= 0.277550D 00 CFWINF= 0.0 CFWEDG= 0.0
CHEDGE= 0.154775D 00 CHINF= 0.215186D 00 STEDGE= 0.101390D 00 STINF= 0.140964D 00
CW = -0.692005D-01 CHIMAX= 0.231281D 01

```

DIMENSIONAL BOUNDARY LAYER PARAMETERS

```

LONGITUDINAL SKIN FRICTION= 0.168174D 01 PSF DELTA*(X) = -0.551458D-03 THETA(X) = 0.128357D-02
TRANSVERSE SKIN FRICTION = 0.0 PSF DELTA*(PHI)= 0.279408D-01 THETA(PHI)= 0.0
WALL HEAT TRANSFER RATE = -0.422624D 02 BTU DELTA (FT) = 0.659511D-02

```

```

*****
888888888888      0000000      0000000      3333333333      3333333333      AAAAAAAAA      RRRRRRRRRRR      GGGGGGGGGGG
9888888888888888  0000000000  0000000000  333333333333  333333333333  AAAAAAAAAAAAA  RRRRRRRRRRRRR  GGGGGGGGGGGGG
88      88      00      00      00      00      33      33      33      33      AA      AA      RR      RR      GG      GG
88      88      00      00      00      00      33      33      33      33      AA      AA      RR      RR      GG      GG
88      88      00      00      00      00      33      33      33      33      AA      AA      RR      RR      GG      GG
8888888888888888  00      00      00      00      33      33      33      33      AA      AA      RR      RR      GG      GG
8888888888888888  00      00      00      00      33      33      33      33      AA      AA      RR      RR      GG      GG
88      88      00      00      00      00      33      33      33      33      AA      AA      RR      RR      GG      GG
88      88      00      00      00      00      33      33      33      33      AA      AA      RR      RR      GG      GG
88      88      00      00      00      00      33      33      33      33      AA      AA      RR      RR      GG      GG
8888888888888888  0000000000  0000000000  333333333333  333333333333  AAAAAAAAAAAAA  RRRRRRRRRRRRR  GGGGGGGGGGGGG
8888888888888888  00000000      00000000      3333333333      3333333333      AA      AA      RR      RR      GG      GG

```

```

80033ARG      JJ      0000000000      9898988888      77777777777777      11      3333333333      666666666666
JJ      000000000000      888888888888      777777777777      111      333333333333      666666666666
JJ      00      00      88      88      77      77      1111      33      33      66      66
JJ      00      00      88      88      77      77      11      33      33      66      66
JJ      00      00      88      88      77      77      11      33      33      66      66
JJ      00      00      888888888888      77      77      11      33      33      666666666666
JJ      00      00      888888888888      77      77      11      33      33      666666666666
JJ      00      00      88      88      77      77      11      33      33      66      66
JJ      00      00      88      88      77      77      11      33      33      66      66
JJJJJJJJJJJJJJ  000000000000      888888888888      77      77      11      333333333333      666666666666
JJJJJJJJJJJJJJ  000000000000      888888888888      77      77      11      3333333333      666666666666

```

```

FFFFFFFFFFFFFF      TTTTTTTTTTT      0000000      3333333333      FFFFFFFFFFFFFFF      0000000      0000000      11
FFFFFFFFFFFFFF      TTTTTTTTTTT      00000000      333333333333      FFFFFFFFFFFFFFF      00000000      00000000      111
FF      TT      00      00      33      33      FF      00      00      00      00      1111
FF      TT      00      00      33      33      FF      00      00      00      00      11
FF      TT      00      00      33      33      FF      00      00      00      00      11
FFFFFFFFFF      TT      00      00      33      33      FFFFFFFFFF      00      00      00      00      11
FFFFFFFFFF      TT      00      00      33      33      FFFFFFFFFF      00      00      00      00      11
FF      TT      00      00      33      33      FF      00      00      00      00      11
FF      TT      00      00      33      33      FF      00      00      00      00      11
FF      TT      00      00      33      33      FF      00      00      00      00      11
FF      TT      00000000      3333333333      FF      00000000      00000000      11
FF      TT      000000      3333333331      FF      000000      000000      11

```

PROPERTIES AT THE WINDWARD STREAMLINE

S/REF	S	CFXINF	STINF	QW(DIM)	QW/QWSTAG	ZWALL
0.0	0.0	0.0	0.146900D 00	-0.440285D 02	0.100000D 01	0.873266
0.120000D 00	0.100000D-01	0.356451D-01	0.171751D 00	-0.514896D 02	0.116946D 01	0.872871
0.360001D 00	0.300000D-01	0.756134D-01	0.140964D 00	-0.422624D 02	0.959888D 00	0.867531
0.743209D 00	0.619339D-01	0.925537D-01	0.864505D-01	-0.259254D 02	0.588831D 00	0.856029
0.122321D 01	0.101934D 00	0.461277D-01	0.263758D-01	-0.794499D 01	0.180451D 00	0.694588
0.146321D 01	0.121934D 00	0.240509D-01	0.107125D-01	-0.323893D 01	0.735643D-01	0.561653
0.158321D 01	0.131934D 00	0.153399D-01	0.829625D-02	-0.251016D 01	0.570121D-01	0.536180
0.170321D 01	0.141934D 00	0.111991D-01	0.690044D-02	-0.208860D 01	0.474374D-01	0.524129
0.194321D 01	0.161934D 00	0.865217D-02	0.546966D-02	-0.166042D 01	0.377124D-01	0.418521
0.206321D 01	0.171934D 00	0.741287D-02	0.471532D-02	-0.143165D 01	0.325164D-01	0.414790
0.230322D 01	0.191934D 00	0.572230D-02	0.365758D-02	-0.111076D 01	0.252282D-01	0.404446
0.242322D 01	0.201934D 00	0.226638D-02	0.228282D-02	-0.696095D 00	0.158101D-01	0.263168
0.248322D 01	0.206934D 00	0.312982D-02	0.236553D-02	-0.721331D 00	0.163833D-01	0.259662
0.254322D 01	0.211934D 00	0.318337D-02	0.227570D-02	-0.693963D 00	0.157617D-01	0.257781
0.266322D 01	0.221934D 00	0.301229D-02	0.205662D-02	-0.627200D 00	0.142453D-01	0.254742
0.290322D 01	0.241934D 00	0.255133D-02	0.165034D-02	-0.503389D 00	0.114332D-01	0.247057

APPENDIX VIII LISTING OF THE COMPUTER PROGRAM

Following is a listing of the computer program described in the last four appendices. The listed program is in double precision for use on an IBM machine.

In each subroutine the cards are labeled with an acronym for the subroutine name, and they are also sequence numbered in the last four columns. Statement numbers are in ascending order in increments of 10. All formats are gathered at the end of each subroutine.

```

C      PROGRAM MAIN                                MAIN 1
      IMPLICIT REAL*8(A-H,O-Z)                    MAIN 2
      REAL*8 NOSE                                  MAIN 3
      COMMON /ASSVAR/ IFL,KRL                      MAIN 4
      COMMON /BLUNT/ ZH(100),XH(100),RH(100),PEB(100),YEB(100),MAIN 5
      1XMB(100),NBLUNT,RWEDGE,NBLPL8,NBLPL1       MAIN 6
      COMMON /CONVAG/ CONV,AIT1,AIT2,AIT3,AIT      MAIN 7
      COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,MAIN 8
      101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YCMAN 9
      2L(101),RORCE(101)                          MAIN 10
      COMMON /FINDIF/ A(101),B(101),R(101),CC(101),DD(101),D(101),E(101)MAIN 11
      1),CK1                                         MAIN 12
      COMMON /FRSTPM/ FMDINF,PINF,TFS,UFS,R,PRL,Q,XMA MAIN 13
      COMMON /GEOM/ ALPHA,THETAC,I,CSE,FNOSE,ALST,X,XX,WX MAIN 14
      COMMON /INJECT/ INJCT,NGINJ,GAS2,CIGL,MASTRN MAIN 15
      COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPK,MAIN 16
      1LPR                                           MAIN 17
      COMMON /PDECCF/ A0(101),A1(101),A2(101),A3(101),A4(101),A5(101) MAIN 18
      COMMON /PLOTS/ PLOT,KPLOT(4),LPLOT(4),KPRFL(4),LPRFL(4),NPTS(4,2) MAIN 19
      COMMON /STAG/ PSTAG,TSTAG,PNC,CWSTAG,HSTAG,ME MAIN 20
      COMMON /SURFAS/ CWALL,CWIND,PWIND,VWALL,TWALL,XTW(500),TWX(500),XMAIN 21
      1CI(500),CIX(500),HWALL,TCONW,KCI,KTW       MAIN 22
      COMMON /TMPKTR/ TEMP(101),TCTE(101),TP(101),RTW,TB MAIN 23
      COMMON /TRANS/ KTRANS,KCNSET,XIF,CHI2(101),CHIMAX,XBAR MAIN 24
      COMMON /TRBLNT/ ASTAR,AKSTAP,ALAMDA,YSURL,EVSCTY(101),PRT,EDYLAW,EMAIN 25
      1PLUS(101),ALET,L4NTRB                       MAIN 26
      COMMON /UNITIO/ DXINVS,DISK                  MAIN 27
      COMMON /WSOLVE/ C=                            MAIN 28
      COMMON /XICORD/ X1,XX1,DX1,XICLD,CXDX1,DXDXX1 MAIN 29
      COMMON /XSOLVE/ XSTA(100),CXMAX,UX,DXCLD,DX1,WSOLVE MAIN 30
      COMMON /ZCCORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA MAIN 31
      DATA AND,YES/2HPC,2HYF/                     MAIN 32
      DEFINE FILE 8(61,6472,L,IFL),4(61,6472,L,KBL) MAIN 33
      CALL INPUT                                     MAIN 34
      IF (DISK.EQ.AND) GO TO 10                      MAIN 35
      KEND=KEND2                                     MAIN 36
      CALL DISKIN                                    MAIN 37
      REWIND 10                                     MAIN 38
      10 CONTINUE                                   MAIN 39
      CALL INIT                                     MAIN 40
      CALL AENO                                      MAIN 41
      CALL OUT1                                      MAIN 42
      CALL CNTRL                                     MAIN 43
      IF (PLTY.EQ.AND) GO TO 20                     MAIN 44
      END FILE 13                                    MAIN 45
      END FILE 14                                    MAIN 46
      END FILE 15                                    MAIN 47
      END FILE 16                                    MAIN 48
      REWIND 13                                     MAIN 49
      REWIND 14                                     MAIN 50
      REWIND 15                                     MAIN 51
      REWIND 16                                     MAIN 52
      CALL PLGTER                                    MAIN 53
      20 STOP                                       MAIN 54
      END                                           MAIN 55

```

```

SUBROUTINE ABCDE (W)                                ABCD 1
      IMPLICIT REAL*8(A-H,O-Z)                    ABCD 2
      REAL*8 NOSE                                  ABCD 3
      COMMON /FINDIF/ A(101),B(101),R(101),CC(101),DD(101),D(101),E(101)ABCD 4
      1),CK1                                         ABCD 5
      COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,KK,LL,NBLNT1,IND,KPRT,LPRT,KPABCD 6
      1R,LPR                                          ABCD 7
      COMMON /PDECCF/ A0(101),A1(101),A2(101),A3(101),A4(101),A5(101) ABCD 8
      COMMON /WSOLVE/ C=                            ABCD 9
      COMMON /XICORD/ X1,XX1,DX1,XICLD,CXDX1,DXDXX1 ABCD 10
      COMMON /ZCCORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA ABCD 11

```

	DIMENSION M(2,101,3)	ARCD 12
C		ABCD 13
C	SUBROUTINE ABCDE CALCULATES THE COEFFICIENTS OF THE GOVERNING	ABCD 14
C	EQUATIONS IN FINITE-DIFFERENCE FORM	ABCD 15
C		ABCD 16
	I=1	ABCD 17
	K=2	ABCD 18
C		ABCD 19
C		ABCD 20
	IF (KK.EQ.1.AND.LL.EQ.1) GC TO 60	ABCD 21
	IF (KK.EQ.1) GO TO 40	ABCD 22
	IF (LL.EQ.1) GO TO 20	ABCD 23
C		ABCD 24
C	COEFFICIENTS FOR THE GENERAL CASE	ABCD 25
C		ABCD 26
	DO 10 J=2,IM	ABCD 27
	DETA1=ETA(J+1)-ETA(J)+ETAFAC**2*(ETA(J)-ETA(J-1))	ABCD 28
	DETA2=(ETA(J+1)-ETA(J))*2+ETAFAC*(ETA(J)-ETA(J-1))*2	ABCD 29
	A(J)=CRI*(2.000*ETAFAC*AO(J)/DETA2-ETAFAC**2*A1(J)/DETA1)	ABCD 30
	CC(J)=CRI*(2.000*AO(J)/DETA2+A1(J)/DETA1)	ABCD 31
	BB(J)=CRI*(-2.000*(1.000+ETAFAC)*AO(J)/DETA2-(1.000-ETAFAC**2)*A1(J)/DETA1+A2(J))	ABCD 32
	B(J)=BB(J)+A4(J)/DXI+A5(J)/2.CGO/DW	ABCD 33
	DD(J)=-((1.000-CRI)/CRI*(A(J)*W(I,J-1,K)+BB(J)*W(I,J,K)+CC(J)*W(I,J+1,K)))	ABCD 34
	C(J)=DD(J)-A3(J)+A4(J)*W(I,J,K)/DXI+A5(J)*(W(I+1,J,K-1)-W(I,J,K+1))/2.000/DW	ABCD 35
10	CONTINUE	ABCD 36
	RETURN	ABCD 37
20	CONTINUE	ABCD 38
C		ABCD 39
C	COEFFICIENTS FOR THE STAGNATION LINE	ABCD 40
C		ABCD 41
	I=2	ABCD 42
	K=1	ABCD 43
	DO 30 J=2,IM	ABCD 44
	DETA1=ETA(J+1)-ETA(J)+ETAFAC**2*(ETA(J)-ETA(J-1))	ABCD 45
	DETA2=(ETA(J+1)-ETA(J))*2+ETAFAC*(ETA(J)-ETA(J-1))*2	ABCD 46
	A(J)=CRI*(2.000*ETAFAC*AO(J)/DETA2-ETAFAC**2*A1(J)/DETA1)	ABCD 47
	CC(J)=CRI*(2.000*AO(J)/DETA2+A1(J)/DETA1)	ABCD 48
	BB(J)=CRI*(-2.000*(1.000+ETAFAC)*AO(J)/DETA2-(1.000-ETAFAC**2)*A1(J)/DETA1+A2(J))	ABCD 49
	B(J)=BB(J)+A5(J)/DW	ABCD 50
	D(J)=-A3(J)+A5(J)*W(I,J,K)/DW-((1.000-CRI)/CRI*(A(J)*W(I,J-1,K)+BB(J)*W(I,J,K)+CC(J)*W(I,J+1,K)))	ABCD 51
	1J)*W(I,J,K)+CC(J)*W(I,J+1,K))	ABCD 52
30	CONTINUE	ABCD 53
	RETURN	ABCD 54
40	CONTINUE	ABCD 55
C		ABCD 56
C	COEFFICIENTS FOR THE WINDWARD STREAMLINE	ABCD 57
C		ABCD 58
	I=1	ABCD 59
	K=2	ABCD 60
	DO 50 J=2,IM	ABCD 61
	DETA1=ETA(J+1)-ETA(J)+ETAFAC**2*(ETA(J)-ETA(J-1))	ABCD 62
	DETA2=(ETA(J+1)-ETA(J))*2+ETAFAC*(ETA(J)-ETA(J-1))*2	ABCD 63
	A(J)=CRI*(2.000*ETAFAC*AO(J)/DETA2-ETAFAC**2*A1(J)/DETA1)	ABCD 64
	CC(J)=CRI*(2.000*AO(J)/DETA2+A1(J)/DETA1)	ABCD 65
	BB(J)=CRI*(-2.000*(1.000+ETAFAC)*AO(J)/DETA2-(1.000-ETAFAC**2)*A1(J)/DETA1+A2(J))	ABCD 66
	B(J)=BB(J)+A4(J)/CXI	ABCD 67
	D(J)=-((1.000-CRI)/CRI*(A(J)*W(I,J-1,K)+BB(J)*W(I,J,K)+CC(J)*W(I,J+1,K)))	ABCD 68
	1J)*W(I,J,K)+CC(J)*W(I,J+1,K))	ABCD 69
50	CONTINUE	ABCD 70
	RETURN	ABCD 71
60	CONTINUE	ABCD 72
C		ABCD 73
C	O.C.E. COEFFICIENTS FOR THE STAGNATION POINT	ABCD 74
C		ABCD 75
	DO 70 J=2,IM	ABCD 76
	DETA1=ETA(J+1)-ETA(J)+ETAFAC**2*(ETA(J)-ETA(J-1))	ABCD 77
		ABCD 78
		ABCD 79
		ABCD 80
		ABCD 81
		ABCD 82

```

      DETA2=(ETA(J+1)-ETA(J))*2+ETAFAC*(ETA(J)-ETA(J-1))*2      ARCD 83
      A(J)=2.000*ETAFAC*AD(J)/DETA2-ETAFAC**2*A1(J)/DETA1      ABCD 84
      CC(J)=2.000*AC(J)/DETA2+A1(J)/DETA1      ABCD 85
      B(J)=-2.000*(1.000+ETAFAC)*AC(J)/DETA2-(1.000-ETAFAC**2)*A1(J)/DETAHCD 86
1A1+A2(J)      ABCD 87
      D(J)=-A3(J)      ABCD 88
70  CCNTINUE      ABCD 89
      RETURN      ARCD 90
      END      ABCD 91

```

```

SUBROUTINE ADDETA (TST,ASYM,ETACLD)      ADET 1
IMPLICIT REAL*8(A-H,O-Z)      ADET 2
REAL*8 NOSE      ADET 3
COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,ADET 4
1101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YCADET 5
2L(101),KORCE(101)      ADET 6
COMMON /GECM/ ALPHA,THETAC,NCSE,RNOSE,WLST,X,XX,WX      ADET 7
COMMON /INTEGR/ IF,IM,KEND,KEND2,KLX,K,L,N3LNT1,IND,KPRT,LPRT,KPR,ADET 8
1LPR      ADET 9
COMMON /SOLPAT/ CW(101),CNW(101),VW(101),GW(101),TW(101),GWN(101),ADET 10
1FWN(101),FW(101),TWN(101),ZW(101),ZWN(101),XIW,DXCXIW,XW,RW      ADET 11
COMMON /XSOLVE/ XSTA(100),DXMAX,DX,DXOLD,DX1,NSOLVE      ADET 12
COMMON /CCOPC/ ETAINF,ETAFAC,ETA0(101),DETA0(101),ADTEST,KADETA ADET 13
DIRECTION FTA2(101), UETA2(101), CW2(101), VW2(101), FW2(101), GW2ADET 14
1(101), TW2(101), F2A(101), F2B(101), F2C(101), G2A(101), G2B(101),ADET 15
2 G2C(101), T2A(101), T2B(101), T2C(101)      ADET 16
DIMENSION F2C(101), T2C(101), G2D(101), ETA(101)      ADET 17
DIMENSION Fw2(101), Z2A(101), Z2B(101), Z2C(101), Z2D(101)      ADET 18
DATA BLUNT,SHARP/5HBLUNT,5HSHARP/      ADET 19
C      ADET 20
C      ADET 21
      IE2=(IE-1)/2      ADET 22
      IF (TST.GT.2.000) GO TO 20      ADET 23
      IF (TST.EQ.2.000) GO TO 10      ADET 24
      ETAIN2=1.100*ETAINF      ADET 25
      WRITE (6,290) X,ETAINF,ETAIN2      ADET 26
      GO TO 30      ADET 27
10  ETAIN2=0.900*ETAINF      ADET 28
      WRITE (6,300) X,ETAINF,ETAIN2      ADET 29
      GO TO 30      ADET 30
20  ETAIN2=ETAINF      ADET 31
      WRITE (6,310) X,ETAOLD,ETAIN2,TST      ADET 32
      GO TO 50      ADET 33
30  CCNTINUE      ADET 34
      IF (ETAFAC.EQ.1.000) DETA1=ETAIN2/DFLOAT(IM)      ADET 35
      IF (ETAFAC.NE.1.000) DETA1=ETAIN2*(ETAFAC-1.000)/(ETAFAC**IM-1.000ADET 36
1)      ADET 37
      DETA2(1)=0.000      ADET 38
      DETA2(2)=DETA1      ADET 39
      ETA(1)=0.000      ADET 40
      ETA2(1)=0.000      ADET 41
      ETA2(2)=DETA2(2)      ADET 42
      DO 40 N=2,IM      ADET 43
      DETA2(N)=DETA2(N)*ETAFAC      ADET 44
      ETA2(N+1)=ETA2(N)+DETA2(N+1)      ADET 45
      ETA(N)=ETAC(N)      ADET 46
40  CCNTINUE      ADET 47
      ET2(IE)=ETAIN2      ADET 48
      ETA(IE)=ETAINF      ADET 49
      GO TO 70      ADET 50
50  CCNTINUE      ADET 51
      IF (ETAFAC.EQ.1.000) DETA1=ETACLD/DFLOAT(IM)      ADET 52
      IF (ETAFAC.NE.1.000) DETA1=ETACLD*(ETAFAC-1.000)/(ETAFAC**IM-1.000ADET 53
1)      ADET 54
      DETA2(1)=0.000      ADET 55
      DETA2(2)=DETA1      ADET 56
      ETA2(1)=0.000      ADET 57

```

```

ETA(1)=0.000                                ADET 58
ETA(2)=ETA2(2)                                ADET 59
DC 60 N=2,IM                                ADET 60
DETA2(N+1)=DETA2(N)*ETAFAC                    ADET 61
ETA(N+1)=ETA(N)+DETA2(N+1)                    ADET 62
ETA2(N)=ETA0(N)                                ADET 63
60  CCNTINUE                                    ADET 64
    ETA(IE)=ETACLD                                ADET 65
    ETA2(IE)=ETAINF                                ADET 66
70  DO 170 N=1,IE                                ADET 67
    IF (ETA2(N).GE.ETACLD) GO TO 160            ADET 68
    J=0                                            ADET 69
80  J=J+1                                        ADET 70
    IF (ETA2(N).GT.ETA(J)) GO TO 80              ADET 71
    IF (J.LT.2) J=2                              ADET 72
    IF (J.GT.(IE-1)) J=IE-1                      ADET 73
    IF (TST.GT.2.000) GO TO 100                 ADET 74
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),CW(J-1),CW(J),CW(J+1) ADET 75
    ),CW2(N))                                    ADET 76
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),VW(J-1),VW(J),VW(J+1) ADET 77
    ),VW2(N))                                    ADET 78
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),FW(J-1),FW(J),FW(J+1) ADET 79
    ),FW2(N))                                    ADET 80
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),TW(J-1),TW(J),TW(J+1) ADET 81
    ),TW2(N))                                    ADET 82
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),ZW(J-1),ZW(J),ZW(J+1) ADET 83
    ),ZW2(N))                                    ADET 84
    IF (CW(IE2).EQ.0.000) GC TO 90              ADET 85
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),GW(J-1),GW(J),GW(J+1) ADET 86
    ),GW2(N))                                    ADET 87
90  CCNTINUE                                    ADET 88
100 IF (TST.EQ.3.000) GO TO 120                 ADET 89
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),F(1,J-1,3),F(1,J,3) ADET 90
    ),F(1,J+1,3),F2C(N))                        ADET 91
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),T(1,J-1,3),T(1,J,3) ADET 92
    ),T(1,J+1,3),T2C(N))                        ADET 93
    IF (G(1,IE2,3).EQ.0.000) GO TO 110          ADET 94
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),G(1,J-1,3),G(1,J,3) ADET 95
    ),G(1,J+1,3),G2C(N))                        ADET 96
110 CCNTINUE                                    ADET 97
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),Z(1,J-1,3),Z(1,J,3) ADET 98
    ),Z(1,J+1,3),Z2C(N))                        ADET 99
120 IF (TST.GT.2.000) GO TO 150                 ADET 100
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),F(2,J-1,2),F(2,J,2) ADET 101
    ),F(2,J+1,2),F2D(N))                        ADET 102
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),T(2,J-1,2),T(2,J,2) ADET 103
    ),T(2,J+1,2),T2D(N))                        ADET 104
    IF (G(2,IE2,2).EQ.0.000) GC TO 130          ADET 105
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),G(2,J-1,2),G(2,J,2) ADET 106
    ),G(2,J+1,2),G2D(N))                        ADET 107
130 CCNTINUE                                    ADET 108
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),Z(2,J-1,2),Z(2,J,2) ADET 109
    ),Z(2,J+1,2),Z2D(N))                        ADET 110
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),F(2,J+1,1),F(2,J,1),F(2,J,1) ADET 111
    ),F2A(N))                                    ADET 112
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),T(2,J-1,1),T(2,J,1) ADET 113
    ),T(2,J+1,1),T2A(N))                        ADET 114
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),Z(2,J-1,1),Z(2,J,1) ADET 115
    ),Z(2,J+1,1),Z2A(N))                        ADET 116
    IF (G(2,IE2,1).EQ.0.000) GC TO 140          ADET 117
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),G(2,J-1,1),G(2,J,1) ADET 118
    ),G(2,J+1,1),G2A(N))                        ADET 119
140 CCNTINUE                                    ADET 120
150 IF (TST.EQ.4.000) GO TO 170                 ADET 121
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),F(1,J-1,2),F(1,J,2) ADET 122
    ),F(1,J+1,2),F2B(N))                        ADET 123
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),T(1,J-1,2),T(1,J,2) ADET 124
    ),T(1,J+1,2),T2B(N))                        ADET 125
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),Z(1,J-1,2),Z(1,J,2) ADET 126
    ),Z(1,J+1,2),Z2B(N))                        ADET 127
    IF (G(1,IE2,2).EQ.0.000) GO TO 170          ADET 128
    CALL INTER3 (ETA2(N),ETA(J-1),ETA(J),ETA(J+1),G(1,J-1,2),G(1,J,2) ADET 129

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	IG(1,J+1,2),G2B(N))	ADET 130
	GO TO 170	ADET 131
160	CH2(N)=1.000	ADET 132
	VW2(N)=VW(1E)	ADET 133
	FW2(N)=1.000	ADET 134
	GW2(N)=GW(1E)	ADET 135
	TW2(N)=1.000	ADET 136
	ZW2(N)=1.000	ADET 137
	F2A(N)=1.000	ADET 138
	F2B(N)=1.000	ADET 139
	F2C(N)=1.000	ADET 140
	F2C(N)=1.000	ADET 141
	G2A(N)=G(2,1E,1)	ADET 142
	G2C(N)=G(1,1E,3)	ADET 143
	G2B(N)=G(1,1E,2)	ADET 144
	G2D(N)=G(2,1E,2)	ADET 145
	T2B(N)=1.000	ADET 146
	T2C(N)=1.000	ADET 147
	T2A(N)=1.000	ADET 148
	T2C(N)=1.000	ADET 149
	Z2A(N)=1.000	ADET 150
	Z2B(N)=1.000	ADET 151
	Z2C(N)=1.000	ADET 152
	Z2C(N)=1.000	ADET 153
170	CCNTINUE	ADET 154
	IF (TST.NE.2.CDC) GO TO 180	ADET 155
	CH2(1E)=1.000	ADET 156
	FW2(1E)=1.000	ADET 157
	GW2(1E)=GW(1E)	ADET 158
	TW2(1E)=1.000	ADET 159
	ZW2(1E)=1.000	ADET 160
	F2A(1E)=1.000	ADET 161
	F2B(1E)=1.000	ADET 162
	F2C(1E)=1.000	ADET 163
	F2C(1E)=1.000	ADET 164
	G2A(1E)=G(2,1E,1)	ADET 165
	G2B(1E)=G(1,1E,2)	ADET 166
	G2C(1E)=G(1,1E,3)	ADET 167
	G2D(1E)=G(2,1E,2)	ADET 169
	T2A(1E)=1.000	ADET 169
	T2B(1E)=1.000	ADET 170
	T2C(1E)=1.000	ADET 171
	T2C(1E)=1.000	ADET 172
	Z2A(1E)=1.000	ADET 173
	Z2B(1E)=1.000	ADET 174
	Z2C(1E)=1.000	ADET 175
	Z2C(1E)=1.000	ADET 176
180	CCNTINUE	ADET 177
	ETA1NF=ETA1N2	ADET 178
	DC 250 J=1,1E	ADET 179
	IF (TST.GT.2.000) GO TO 190	ADET 180
	ETAQ(J)=ETA2(J)	ADET 181
	DETAQ(J)=DETA2(J)	ADET 182
	CH(J)=CH2(J)	ADET 183
	VW(J)=VW2(J)	ADET 184
	FW(J)=FW2(J)	ADET 185
	TW(J)=TW2(J)	ADET 186
	ZW(J)=ZW2(J)	ADET 187
	IF (GW(1E2).EQ.0.000) GO TO 190	ADET 188
	GW(J)=GW2(J)	ADET 189
190	IF (TST.EQ.4.000) GO TO 200	ADET 190
	F(1,J,2)=F2B(J)	ADET 191
	T(1,J,2)=T2B(J)	ADET 192
	Z(1,J,2)=Z2B(J)	ADET 193
	IF (G(1,1E2,2).EQ.0.000) GO TO 200	ADET 194
	G(1,J,2)=G2B(J)	ADET 195
200	IF (TST.GT.2.000) GO TO 210	ADET 196
	F(2,J,1)=F2A(J)	ADET 197
	T(2,J,1)=T2A(J)	ADET 198
	Z(2,J,1)=Z2A(J)	ADET 199
	IF (G(2,1E2,1).EQ.0.000) GO TO 210	ADET 200
	G(2,J,1)=G2A(J)	ADET 201

210	IF (TST.EQ.3.000) GO TO 220	ADET 202
	F(1,J,3)=F2C(J)	ADET 203
	T(1,J,3)=T2C(J)	ADET 204
	Z(1,J,3)=Z2C(J)	ADET 205
	IF (G(1,IE2,3).EQ.0.000) GO TO 220	ADET 206
	G(1,J,3)=G2C(J)	ADET 207
220	IF (TST.GT.2.000) GO TO 230	ADET 208
	F(2,J,2)=F2D(J)	ADET 209
	T(2,J,2)=T2D(J)	ADET 210
	Z(2,J,2)=Z2D(J)	ADET 211
	IF (G(2,IE2,2).EQ.0.000) GO TO 230	ADET 212
	G(2,J,2)=G2D(J)	ADET 213
230	CONTINUE	ADET 214
	IF (TST.GT.2.000) GO TO 240	ADET 215
	CALL DERIV (CW,ETA2,IE,1,CW)	ADET 216
	CALL DERIV (FW,ETA2,IE,1,FW)	ADET 217
	CALL DERIV (TW,ETA2,IE,1,TW)	ADET 218
	CALL DERIV (ZW,ETA2,IE,1,ZW)	ADET 219
	IF (GW(IE2).NE.0.000) CALL DERIV (GW,ETA2,IE,1,GW)	ADET 220
240	IF (TST.EQ.4.000) GO TO 250	ADET 221
	CALL DERIV3 (F,1,2,ETA2,IE,1,FI)	ADET 222
	CALL DERIV3 (T,1,2,ETA2,IE,1,TI)	ADET 223
	CALL DERIV3 (Z,1,2,ETA2,IE,1,ZI)	ADET 224
	IF (G(1,IE2,2).NE.0.000) CALL DERIV3 (G,1,2,ETA2,IE,1,GI)	ADET 225
250	IF (TST.GT.2.000) GO TO 260	ADET 226
	CALL DERIV3 (F,2,1,ETA2,IE,1,FI)	ADET 227
	CALL DERIV3 (T,2,1,ETA2,IE,1,TI)	ADET 228
	CALL DERIV3 (Z,2,1,ETA2,IE,1,ZI)	ADET 229
	IF (G(2,IE2,1).NE.0.000) CALL DERIV3 (G,2,1,ETA2,IE,1,GI)	ADET 230
260	IF (TST.EQ.3.000) GO TO 270	ADET 231
	CALL DERIV3 (F,1,3,ETA2,IE,1,FI)	ADET 232
	CALL DERIV3 (T,1,3,ETA2,IE,1,TI)	ADET 233
	CALL DERIV3 (Z,1,3,ETA2,IE,1,ZI)	ADET 234
	IF (G(1,IE2,3).NE.0.000) CALL DERIV3 (G,1,3,ETA2,IE,1,GI)	ADET 235
270	IF (TST.GT.2.000) GO TO 280	ADET 236
	CALL DERIV3 (F,2,2,ETA2,IE,1,FI)	ADET 237
	CALL DERIV3 (T,2,2,ETA2,IE,1,TI)	ADET 238
	CALL DERIV3 (Z,2,2,ETA2,IE,1,ZI)	ADET 239
	IF (G(2,IE2,2).NE.0.000) CALL DERIV3 (G,2,2,ETA2,IE,1,GI)	ADET 240
280	CONTINUE	ADET 241
	RETURN	ADET 242
C		ADET 243
C		ADET 244
290	FORMAT (10X,22HETAINF INCREASED AT X=,F10.5,13H OLD ETAINF=,F10.5A	ADET 245
	1,13H NEW ETAINF=,F10.5/)	ADET 246
300	FORMAT (10X,22HETAINF DECREASED AT X=,F10.5,13H OLD ETAINF=,F10.5A	ADET 247
	1,13H NEW ETAINF=,F10.5/)	ADET 248
310	FORMAT (10X,24HETACLD INCREASED AT X = ,F10.5,2X,13HOLD ETAINF = ,	ADET 249
	IF10.5,2X,13HNEW ETAINF = ,F10.5,2X,6HTST = ,F4.1/)	ADET 250
	END	ADET 251

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SUBROUTINE AERO
IMPLICIT REAL*8 (A-H,O-Z)
COMMON /FRSTKM/ RHCINF,PINF,TFS,UFS,R,PRL,Q,XMA
COMMON /POLYCC/ CPAIRL(6),CPAIRH(6),ENAIRL(6),ENAIRH(6),CMUAIR(6),AERO
1CMUHE(6),DIFHC(6),CMUANI(6),JIFAP(6),CPCJ2L(6),CPCJ2H(6),FNCJ2L(6),AERO
2ENCO2H(6),CMUCJ2(6),JIFCJ2(6)
COMMON /REF/ PREF,TREF,AMUREF,REINF
COMMON /STAG/ PSTAG,TSTAG,PNC,CNSTAG,HSTAG,HE
COMMON /THERMC/ PRCP,VALUE
COMMON /TMPHTR/ TEMP(101),TOTE(101),TP(101),RTW,TB
DATA ROIN/4HRHOI/,PIN/4HPINF/
C
C RHCINF IS IN SLUGS
C PINF IS IN PSIA
C PSTAG IS IN PSIA
C PREF IS IN PSIA
C CP IN FT**2/SEC**2/DEG.R
C R IN FT**2/SEC**2/DEG.R
C UFS IN FT/SEC
C TWALL,TREF,TSTAG IN DEG.R
C AMUREF IS IN (LB-SEC)/FT**2
C
R=1717.67020G
G=1.400
IF (TFS.EQ.0.000.OR.TSTAG.EQ.0.000) GO TO 10
G=(TSTAG/TFS-1.000)*2.000/XMA**2+1.000
GO TO 30
10 IF (TFS.EQ.0.000) GO TO 20
TSTAG=TFS*(1.000+(G-1.000)/2.000*XMA**2)
GO TO 30
20 TFS=TSTAG/(1.000+(G-1.000)/2.000*XMA**2)
ASQ=G*R*TFS
UFS=DSQRT(ASQ*XMA**2)
IF (PRCP.NE.RCIN) GO TO 40
RHCINF=VALUE
PINF=RHOINF*R*TFS/144.000
PSTAG=PINF/(1.000+(G-1.000)/2.000*XMA**2.000)**(-G/(G-1.000))
GO TO 60
40 IF (PRCP.NE.PIN) GO TO 50
PINF=VALUE
RHCINF=PINF*144.000/R/TFS
PSTAG=PINF/(1.000+(G-1.000)/2.000*XMA**2.000)**(-G/(G-1.000))
GO TO 60
50 CCATINUF
PSTAG=VALUE
PINF=PSTAG*(1.000+(G-1.000)/2.000*XMA**2.000)**(-G/(G-1.000))
RHCINF=PINF*144.000/R/TFS
60 CCATINUF
HSTAG=TSTAG*(G/(G-1.000)*R)
PREF=RHCINF*UFS**2
TREF=UFS**2/R
AMUREF=2.27000*(DSQRT(TREF)**3.000/(TREF+198.600)*1.00-08
AMUINF=2.27000*(DSQRT(TFS)**3.000/(TFS+198.600)*1.00-08
REINF=RHOINF*UFS/AMUINF
RETURN
END
AERO 1
AERO 2
AERO 3
AERO 4
AERO 5
AERO 6
AERO 7
AERO 8
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AERO 56

SUBROUTINE AEROPT (X,Y,N,NPTS,XAXLBL,NXTCHR,NXACHR,YAXLBL,NYTCR,NAEPT
1YACHR,NCALL,NCURVE,JCURVE)
COMMON /AXINFO/ IXAXIS,IYAXIS
COMMON /EXPONT/ IJLCC
COMMON /LEGLBL/ LGNO,ISLHL,IUNIT,KTITLE
COMMON /TITLE/ LABEL(20)
DIMENSION XAXLBL(1),YAXLBL(1)
DIMENSION X(500),Y(500)
DIMENSION XVALN(11),XTIC(11),YVALN(50),YTIC(50)
DIMENSION YLOG(9),YLOGTC(9)
AERPT 1
AERPT 2
AERPT 3
AERPT 4
AERPT 5
AERPT 6
AERPT 7
AERPT 8
AERPT 9
AERPT 10

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	DIMENSION XLG(9), XLOGTC(9)	AEPT 11
	DIMENSION A(9), B(9)	AEPT 12
	DIMENSION NPTS(4)	AEPT 13
C		AEPT 14
C	JCALL=0	AEPT 15
	INTCNT=NPTS(1)	AEPT 16
10	JCALL=JCALL+1	AEPT 17
	IPTS=NPTS(JCALL)	AEPT 18
	IF (JCALL.GT.1) GO TO 130	AEPT 19
	IF (JCURVE.EC.1) IPTS=N	AEPT 20
C		AEPT 21
C	INITIALIZATION OF X AND Y AXIS LIMITS AND LENGTHS	AEPT 22
C		AEPT 23
	GC TO (30,40,50,70), IXAXIS	AEPT 24
20	GC TO (80,90), IYAXIS	AEPT 25
C		AEPT 26
C	FIXED KNOWN LINEAR SCALE--X AXIS	AEPT 27
C		AEPT 28
30	XPIN=0.0	AEPT 29
	XMAX=1.0	AEPT 30
	XALNTH=5.0	AEPT 31
	GO TO 20	AEPT 32
C		AEPT 33
C	UNKNOWN LINEAR SCALE--X AXIS	AEPT 34
C		AEPT 35
40	IJLOG=0	AEPT 36
	CALL MAX (X,N,XMAX,NEXX,NEXNDX)	AEPT 37
	CALL MIN (X,N,XMIN)	AEPT 38
	XALNTH=5.0	AEPT 39
	GO TO 20	AEPT 40
C		AEPT 41
C	SEMI-LOG SCALE--X AXIS	AEPT 42
C		AEPT 43
50	IJLOG=1	AEPT 44
	DO 60 I=1,N	AEPT 45
60	X(I)=ALOG10(X(I))	AEPT 46
	CALL MAX (X,N,XMAX,NEXX,NEXNDX)	AEPT 47
	CALL MIN (X,N,XMIN)	AEPT 48
	XALNTH=5.0	AEPT 49
	GO TO 20	AEPT 50
C		AEPT 51
C	FIXED KNOWN ANGULAR SCALE (0-180 DEGREES)--X AXIS	AEPT 52
C		AEPT 53
70	XMAX=180.0	AEPT 54
	XPIN=0.0	AEPT 55
	XALNTH=5.0	AEPT 56
	GC TO 20	AEPT 57
C		AEPT 58
C	UNKNOWN LINEAR SCALE--Y AXIS	AEPT 59
C		AEPT 60
80	IJLOG=0	AEPT 61
	CALL MAX (Y,N,YMAX,NEXY,NEXNDY)	AEPT 62
	CALL MIN (Y,N,YMIN)	AEPT 63
	YALNTH=6.0	AEPT 64
	GO TO 110	AEPT 65
C		AEPT 66
C	SEMI-LOG SCALE--Y AXIS	AEPT 67
C		AEPT 68
90	IJLOG=1	AEPT 69
	DO 100 I=1,N	AEPT 70
100	Y(I)=ALOG10(Y(I))	AEPT 71
	CALL MAX (Y,N,YMAX,NEXY,NEXNDY)	AEPT 72
	CALL MIN (Y,N,YMIN)	AEPT 73
	YALNTH=10.0/3.0*2.0	AEPT 74
C		AEPT 75
C	SET PEN AT ORIGIN AND FIND THE COORDINATES OF THE LIMITS OF THE	AEPT 76
C	PLOT	AEPT 77
C		AEPT 78
110	IF (NCALL.GT.1) GO TO 120	AEPT 79
	CALL PLOT (3.0,3.5,-3)	AEPT 80
		AEPT 81

120	CALL WHERE (XCRGIN,YORGIN)	AEPT	82
	XLIM=XORGIN+XALNTH	AEPT	83
	YLIM=YORGIN+YALNTH	AEPT	84
C		AEPT	85
C	SCALE THE X AND Y ARRAYS AND PLOT THE CURVE	AEPT	86
C		AEPT	87
	XRANGL=XMAX-XMIN	AEPT	88
	XSCFAC=XRANGE/XALNTH	AEPT	89
	YRANGE=YMAX-YMIN	AEPT	90
	YSCFAC=YRANGE/YALNTH	AEPT	91
130	DO 140 I=1,IPTS	AEPT	92
	X(I)=(X(I)-XFIN)/XSCFAC	AEPT	93
140	Y(I)=(Y(I)-YFIN)/YSCFAC	AEPT	94
	CALL PLOT (X(I),Y(I),3)	AEPT	95
	DC 150 I=1,IPTS	AEPT	96
	CALL SYMBOL (X(I),Y(I),0.13,JCALL,C.0,-2)	AEPT	97
150	CCONTINUE	AEPT	98
	IF (JCALL.EQ.JCURVE) GO TO 170	AEPT	99
	JPTS=NPIS(JCALL+1)	AEPT	100
	DO 160 I=1,JPTS	AEPT	101
	INTCNT=INTCNT+1	AEPT	102
	X(I)=X(INTCNT)	AEPT	103
	Y(I)=Y(INTCNT)	AEPT	104
160	CCONTINUE	AEPT	105
	GO TO 10	AEPT	106
C		AEPT	107
C	DRAW AXES STARTING AT CRGIN AND GOING COUNTERCLOCKWISE	AEPT	108
C		AEPT	109
170	CALL PLOT (XCRGIN,YCRGIN,3)	AEPT	110
	CALL PLOT (XLIM,YCRGIN,2)	AEPT	111
	CALL PLOT (XLIM,YLIM,2)	AEPT	112
	CALL PLOT (XCRGIN,YLIM,2)	AEPT	113
	CALL PLOT (XCRGIN,YORGIN,2)	AEPT	114
	GO TO 200	AEPT	115
C		AEPT	116
C	DETERMINE NUMBER OF CYCLES IF PLOT IS A LOG-PLOT	AEPT	117
C		AEPT	118
C	Y AXIS	AEPT	119
C		AEPT	120
180	NDIVY=YMAX-YMIN	AEPT	121
	DX=0.05	AEPT	122
	YTCINC=YALNTH/NDIVY	AEPT	123
	ICOUNT=NDIVY+1	AEPT	124
	GO TO 370	AEPT	125
C		AEPT	126
C	X AXIS	AEPT	127
C		AEPT	128
190	NDIVX=XMAX-XFIN	AEPT	129
	DY=0.05	AEPT	130
	XTCINC=XALNTH/NDIVX	AEPT	131
	JCOUNT=NDIVX+1	AEPT	132
	GO TO 270	AEPT	133
C		AEPT	134
C	X AXIS TICMARKS AND LABELS (FOR FIXED LINEAR OR ANGULAR SCALES)	AEPT	135
C		AEPT	136
200	GO TO (210,260,190,220), IXAXIS	AEPT	137
210	DY=0.05	AEPT	138
	INT=11	AEPT	139
	XVALUE=XMIN	AEPT	140
	XVAINC=0.1	AEPT	141
	XVALUE=XVALUE-XVAINC	AEPT	142
	GO TO 230	AEPT	143
220	INT=7	AEPT	144
	DY=0.05	AEPT	145
	XVALUE=XMIN	AEPT	146
	XVAINC=30.0	AEPT	147
	XVALUE=XVALUE-XVAINC	AEPT	148
230	DO 240 J=1,INT	AEPT	149
	XVALUE=XVALUE+XVAINC+0.000005	AEPT	150
	XVALNJ(J)=XVALUE+0.0	AEPT	151
	XTIC(J)=XVALUE/XSCFAC	AEPT	152

	CALL PLOT (XTIC(J),YORGIN+DY,3)	AEPT 153
	CALL PLOT (XTIC(J),YORGIN-DY,2)	AEPT 154
240	CCNTINUE	AEPT 155
	CALL PLOT (XCRGIN,YORGIN,3)	AEPT 156
	DY=0.4	AEPT 157
	DX=0.2	AEPT 158
	NDECPL=2	AEPT 159
	IF (IXAXIS.EQ.4) NDECPL=-1	AEPT 160
	IF (IXAXIS.EQ.4) DX=0.1	AEPT 161
	DO 250 J=1,INT	AEPT 162
	CALL NUMBER (XTIC(J)-DX,YORGIN-DY,0.11,XVALNO(J),0.0,NDECPL)	AEPT 163
250	CCNTINUE	AEPT 164
	CALL PLOT (XCRGIN,YORGIN,3)	AEPT 165
	GO TO 360	AEPT 166
C		AEPT 167
C	X AXIS TICMARKS AND LABELS (FOR UNKNOWN LINEAR OR LOG SCALE)	AEPT 168
C		AEPT 169
260	DY=0.05	AEPT 170
	ICCOUNT=11	AEPT 171
	XTCINC=XALNT/10.0	AEPT 172
270	XTCVAL=XORGIN-XTCINC	AEPT 173
	DO 300 J=1,ICCOUNT	AEPT 174
	XTCVAL=XTCVAL+XTCINC	AEPT 175
	XTIC(J)=XTCVAL	AEPT 176
	XVALNO(J)=XTCVAL*XSCFAC*XMIN	AEPT 177
	FAC=0.005	AEPT 178
	IF (NEXNDX.NE.0) GO TO 290	AEPT 179
	MEX=NEXX+2	AEPT 180
	FAC=5.0	AEPT 181
	DO 280 M=1,MFX	AEPT 182
	FAC=FAC/10.0	AEPT 183
280	CCNTINUE	AEPT 184
290	IF (XVALNO(J).LT.0.0) FAC=-FAC	AEPT 185
	XVALNO(J)=XVALNO(J)+FAC	AEPT 186
	CALL PLOT (XTCVAL,YORGIN+DY,3)	AEPT 187
	CALL PLOT (XTCVAL,YORGIN-DY,2)	AEPT 188
300	CCNTINUE	AEPT 189
	CALL PLOT (XCRGIN,YORGIN,3)	AEPT 190
	DX=0.2	AEPT 191
	DY=0.4	AEPT 192
	NDECPL=2	AEPT 193
	INC=2	AEPT 194
	IF (IXAXIS.EQ.3) INC=1	AEPT 195
	IF (NEXNDX.EQ.0) NDECPL=NEXX+1	AEPT 196
	DO 310 M=1,ICCOUNT,INC	AEPT 197
	CALL NUMBER (XTIC(M)-DX,YORGIN-DY,0.11,XVALNO(M),0.0,NDECPL)	AEPT 198
310	CCNTINUE	AEPT 199
	IF (IXAXIS.EQ.3) GO TO 350	AEPT 200
	DX=0.05	AEPT 201
	DY=0.05	AEPT 202
	DO 340 J=1,NDIVX	AEPT 203
	DO 320 K=2,9	AEPT 204
	XLOG(K)=K	AEPT 205
	XLOGTC(K)=ALOG10(XLOG(K))*XTCINC+XTIC(J)	AEPT 206
	CALL PLOT (XLOGTC(K),YORGIN,3)	AEPT 207
	CALL PLOT (XLOGTC(K),YORGIN-DY,2)	AEPT 208
	CALL PLOT (XLOGTC(K)-DX,YORGIN-(DY+0.2),3)	AEPT 209
	CALL WHERE (A(K),B(K))	AEPT 210
320	CCNTINUE	AEPT 211
	DO 330 K=2,8,2	AEPT 212
	CALL NUMBER (A(K),B(K),0.1,XLOG(K),0.0,-1)	AEPT 213
330	CCNTINUE	AEPT 214
340	CCNTINUE	AEPT 215
350	CCNTINUE	AEPT 216
	CALL PLOT (XCRGIN,YORGIN,3)	AEPT 217
C		AEPT 218
C	DRAW TICMARKS ON Y-AXIS AND LABEL ACCORDINGLY	AEPT 219
C		AEPT 220
360	IF (IYAXIS.FQ.2) GO TO 180	AEPT 221
	DX=0.05	AEPT 222
	ICCOUNT=11	AEPT 223

370	YTCINC=YALNTH/10.0	AEPT 224
	YTCVAL=YXRGIN-YTCINC	AEPT 225
	DC 420 J=1,ICOUNT	AEPT 226
	YTCVAL=YTCVAL+YTCINC	AEPT 227
	YTIC(J)=YTCVAL	AEPT 228
	YVALNO(J)=YTCVAL+YSCFAC+YMIN	AEPT 229
	FAC=0.005	AEPT 230
	IF (NEXNDY.NE.0) GO TO 390	AEPT 231
	MEX=NEXY+2	AEPT 232
	FAC=5.0	AEPT 233
	DO 380 M=1,MEX	AEPT 234
	FAC=FAC/10.0	AEPT 235
380	CCNTINUE	AEPT 236
390	IF (YVALNO(J).LT.0.0) FAC=-FAC	AEPT 237
	IF (YVALNO(J).GT.1000.0.CR.YVALNO(J).LT.-1000.0) GO TO 400	AEPT 238
	YVALNO(J)=YVALNO(J)+FAC	AEPT 239
	GO TO 410	AEPT 240
400	FFAC=1.0	AEPT 241
	IF (YVALNO(J).LT.0.0) FFAC=-FFAC	AEPT 242
	ITRUNC=YVALNO(J)	AEPT 243
	YVALNO(J)=ITRUNC+FFAC	AEPT 244
410	CALL PLOT (XCRGIN+DX,YTCVAL,3)	AEPT 245
	CALL PLOT (XCRGIN-DX,YTCVAL,2)	AEPT 246
420	CCNTINUE	AEPT 247
	CALL PLOT (XCRGIN,YCRGIN,3)	AEPT 248
	DX=0.75	AEPT 249
	DY=0.10	AEPT 250
	NDECPL=2	AEPT 251
	INC=2	AEPT 252
	IF (IYAXIS.EQ.2) INC=1	AEPT 253
	IF (NEXNDY.EQ.0) NDECPL=NEXY+1	AEPT 254
	DO 430 M=1,ICOUNT,INC	AEPT 255
	CALL NUMBER (XCRGIN-DX,YTIC(M)-DY,0.1,YVALNO(M),0.0,NDECPL)	AEPT 256
430	CCNTINUE	AEPT 257
	IF (IYAXIS.NE.2) GO TO 470	AEPT 258
	DY=0.05	AEPT 259
	DX=0.05	AEPT 260
	DO 460 J=1,NDIVY	AEPT 261
	DO 440 K=2,9	AEPT 262
	YLOG(K)=K	AEPT 263
	YLOGTC(K)=ALOG10(YLOG(K))+YTCINC+YTIC(J)	AEPT 264
	CALL PLOT (XCRGIN,YLOGTC(K),3)	AEPT 265
	CALL PLOT (XCRGIN-DX,YLOGTC(K),2)	AEPT 266
	CALL PLOT (XCRGIN-(DX+0.2),YLOGTC(K)-DY,3)	AEPT 267
	CALL WHERE (A(K),B(K))	AEPT 268
440	CCNTINUE	AEPT 269
	DO 450 K=2,8,2	AEPT 270
	CALL NUMBER (A(K),B(K),0.1,YLOG(K),0.0,-1)	AEPT 271
450	CCNTINUE	AEPT 272
460	CCNTINUE	AEPT 273
470	CCNTINUE	AEPT 274
	CALL PLOT (XCRGIN,YCRGIN,3)	AEPT 275
C		AEPT 276
C	LABEL THE X AND Y AXES	AEPT 277
C		AEPT 278
	HGT=0.2	AEPT 279
	DX=1.25	AEPT 280
	DY=1.0	AEPT 281
	XLBL=((XCRGIN+XALNTH/2.0))-(((3.0*HGT/4.0)*NXACHR)*0.5)	AEPT 282
	CALL SYMBOL (XLBL,YCRGIN-DY,HGT,XAXLBL,0.0,NXTCHR)	AEPT 283
	CALL PLOT (XCRGIN,YCRGIN,3)	AEPT 284
	YLBL=((YCRGIN+YALNTH/2.0))-(((3.0*HGT/4.0)*NYACHR)*0.5)	AEPT 285
	CALL SYMBOL (XCRGIN-DX,YLBL,HGT,YAXLBL,0.0,NYTCHR)	AEPT 286
C		AEPT 287
C	PLGT THE LEGEND	AEPT 288
C		AEPT 289
	IF (LGND.NE.1) GO TO 480	AEPT 290
	DLX=0.30	AEPT 291
	DLY=-0.30	AEPT 292
	CALL LEGEND (JCURVE,XLIM,YLIM)	AEPT 293
C		AEPT 294

C	PLCT THE SUB-LABEL	AEPT 295
C		AEPT 296
480	IF (ISLBL.NE.1) GO TO 490	AEPT 297
	CALL SUBLBL (XORGIN,YORGIN)	AEPT 298
C		AEPT 299
C	PLCT THE TITLE	AEPT 300
C		AEPT 301
490	IF (KTITLE.NE.1) GO TO 500	AEPT 302
	DY=-1.0	AEPT 303
	DX=-2.0	AEPT 304
	HGT=0.1	AEPT 305
	CALL SYMBOL (XORGIN+DX,YORGIN+DY,HGT,LABEL,90.0,80)	AEPT 306
C		AEPT 307
C	FIND THE NEXT ORIGIN OR END THE PLOT	AEPT 308
C		AEPT 309
500	IF (NCALL.EQ.NCURVE) GO TO 510	AEPT 310
	CALL PLOT (XALNTH+5.0,YORGIN,-3)	AEPT 311
	RETURN	AEPT 312
C		AEPT 313
510	CALL PLOT (XALNTH+5.0,YORGIN,-4)	AEPT 314
	RETURN	AEPT 315
	END	AEPT 316

BLCK DATA	BLDA	1
IMPLICIT REAL*8 (A-H,O-Z)	BLDA	2
COMMON /OUTPUT/ CFWEDG,CFWINF,CFXEDG,CFXINF,CHEDGE,CHINF,AMACHE,DERLOA	BLDA	3
IL,CW,OWINF,CWQWQ,S,STEDGE,STINF,TAUETA,TAUX,DELSX,DELPHI,THETAX,BLDA	BLDA	4
2THPHI	BLDA	5
COMMON /POLYCC/ CPAIRL(6),CPAIRH(6),ENAIRL(6),ENAIRH(6),CMUAIR(6),BLDA	BLDA	6
ICMUH(6),DIFHE(6),CMUAR(6),DIFAR(6),CPCU2L(6),CPCO2H(6),ENCO2L(6),BLDA	BLDA	7
2ENCO2H(6),CMUCO2(6),DIFCC2(6)	BLDA	8
DATA CFWEDG,CFWINF,CFXEDG,CFXINF,CHEDGE,CHINF,AMACHE,DEL,CW,OWINF,BLDA	BLDA	9
10WQWQ,S,STEDGE,STINF,TAUETA,TAUX,DELSX,DELPHI,THETAX,THPHI/20=CBLOA	BLDA	10
2.0C0/	BLDA	11
DATA CPAIRL/6.0351797D+3,-9.45C9125D-4,-7.3022675D-4,1.7322782D-6,BLDA	BLDA	12
1-9.7657438D-10,1.7465179D-13/	BLDA	13
DATA CPAIRH/5.9C28D03,3.77C72D-C1,9.64649D-05,-3.53769D-08,3.485678LCA	BLDA	14
1D-12,-1.11502D-16/	BLDA	15
DATA CPCU2L/2.3317627D+2,7.3297C82D+1,-1.342833D-1,1.3090637D-4,-6BLDA	BLDA	16
1.C572879D-8,1.C531763D-11/	BLDA	17
DATA CPCO2H/1.326997D+4,1.0499195D+1,-3.4763828D-3,6.1489558D-7,-5BLDA	BLDA	18
1.568993D-11,2.033227D-15/	BLDA	19
DATA CMUAIR/1.48066D-01,6.95936D-03,-1.49079D-06,2.3759D-10,-1.782RLDA	BLDA	20
142C-14,5.C725F-19/	BLDA	21
DATA CMUHE/7.2044D-01,7.06794D-03,-1.5363D-06,2.80513D-10,-2.28363BLDA	BLDA	22
1D-14,6.74097D-19/	BLDA	23
DATA CMUAR/2.63154D-01,8.61381C-03,-1.84422D-06,3.16427D-10,-2.4788BLDA	BLDA	24
197D-14,7.10697D-19/	BLDA	25
DATA CMUCO2/-7.8143191C-2,6.7732592D-3,-1.7286911D-6,3.8703139D-1CBLDA	BLDA	26
1,-5.1304856D-14,2.7591624D-18/	BLDA	27
DATA DIFHE/-1.988:3D-01,2.31693D-03,2.60637D-06,-4.74411D-11,-1.0C9LDA	BLDA	28
1312D-14,6.79428D-19/	BLDA	29
DATA DIFAR/-6.39025D-02,6.678C3D-04,1.26081D-06,-1.02832D-10,7.3919LDA	BLDA	30
182D-15,-2.18881D-19/	BLDA	31
DATA DIFCO2/1.3094896D-2,-5.6215733D-5,1.4178492D-6,-3.8555763D-10SLDA	BLDA	32
1,6.8405177D-14,-4.7403394D-18/	BLDA	33
DATA ENAIRL/6.0351797D+3,-4.7254562D-4,-2.4340867D-4,4.3306955D-7,RLDA	BLDA	34
1-1.9531487D-1C,2.9138631D-14/	BLDA	35
DATA ENAIRH/5.9C28D03,1.88536D-01,3.21549D-05,-8.844225D-09,6.97138LDA	BLDA	36
14C-13,-1.85037D-17/	BLDA	37
DATA ENCO2L/2.3317627D+2,3.6643541D+1,-4.476139D-2,3.272659D-5,-1.BLDA	BLDA	38
12114575D-8,1.755177D-12/	BLDA	39
DATA ENCO2H/1.326997D+4,5.249597D+0,-1.158694D-3,1.5372389D-7,-1.1BLDA	BLDA	40
1137986D-11,3.388711D-16/	BLDA	41
END	BLDA	42

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SUBROUTINE RLUNT1                                BLU1  1
IMPLICIT REAL*8(A-H,O-Z)                        BLU1  2
REAL*8 NOSE                                       BLU1  3
COMMON /RLUNT/ ZD(100),XB(100),RB(100),PEB(100),UEB(100),TEB(100),BLU1  4
1XMB(100),NBLUNT,NWEDGE,NWPLNB,NBLPL1          BLU1  5
COMMON /EDGE/ UEDG,TEUG,VFDG,PEGG,DEGDX,DEGDW,DUEGDW,DVEGBLU1  6
1DX,DVEGDW,DPEGDX,DPEGDW,D2PDW2,KHODELG,AMUFDG,KMUFDG BLU1  7
COMMON /FSTRM/ PHOINF,PINF,TFS,UFS,K,PRL,G,XMA BLU1  8
COMMON /GECM/ ALPHA,THETAC,NCSE,RNOSF,NLST,X,XX,WX BLU1  9
COMMON /INJECT/ INJCT,NOINJ,GAS2,COLL,MASTRN BLU1 10
COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,KK,L,NBLNT1,IND,KPRT,LPRBLU1 11
1,LPK                                             BLU1 12
COMMON /POLYCU/ CPAIRL(6),CPAIRH(6),ENAIRL(6),ENAIRH(6),CMUAI BLU1 13
1CMUH(6),DIFHE(6),CMUAR(6),DIFAR(6),CPCO2L(6),CPCO2H(6),ENCO2L(6),BLU1 14
2ENCO2H(6),CMUCO2(6),DIFCO2(6)                 BLU1 15
COMMON /PLOTS/ PLJT,KPLCT(4),LPLOT(4),KPRFL(4),LPRFL(4),NPTS(4,2) BLU1 16
COMMON /STAG/ PSTAG,ISTAG,PAC,QWSTAG,HSTAG,HE BLU1 17
COMMON /TRANSN/ KTRANS,KCNSET,XIF,CHI2(101),CHIMAX,XBAR BLU1 18
COMMON /XSOLVE/ XSTA(100),DXMAX,DX,DXJLD,DX1,NSOLVE BLU1 19
DIMENSION ZSTA(100),XPLGT(4)                   BLU1 20
NPLGT=4                                          BLU1 21
CP=G/(G-1.000)*R                               BLU1 22
IF (L.GT.1) GO TO 160                          BLU1 23
READ (10) ARLUNT                                BLU1 24
DO 10 I=1,ARLUNT                                BLU1 25
READ (10) ZB(I),XB(I),RB(I),PEB(I)              BLU1 26
XB(I)=XB(I)*RNOSE                               BLU1 27
ZB(I)=ZB(I)*RNOSE                               BLU1 28
RB(I)=RB(I)*RNOSE                               BLU1 29
CONTINUE                                         BLU1 30
NBLPL1=ARLUNT+1                                 BLU1 31
READ (10) NWEDGE                                BLU1 32
NWPLNB=NBLUNT+NWEDGE                           BLU1 33
DO 20 I=NBLPL1,NWPLNB                          BLU1 34
READ (10) ZB(I),XB(I),RB(I),PEB(I)              BLU1 35
XB(I)=XB(I)*RNOSE                               BLU1 36
ZB(I)=ZB(I)*RNOSE                               BLU1 37
RB(I)=RB(I)*RNOSE                               BLU1 38
CONTINUE                                         BLU1 39
C                                                 BLU1 40
C SAVE THE VALUES XSTA(KCNSET),XSTA(INJCT),XSTA(NOINJ),XSTA(LPLCT) BLU1 41
C                                                 BLU1 42
XTRANS=XSTA(KCNSET)                             BLU1 43
XINJ=XSTA(INJCT)                                BLU1 44
XNCINJ=XSTA(NOINJ)                             BLU1 45
DO 40 I=1,4                                     BLU1 46
IF (LPLOT(I).EQ.0) GO TO 30                     BLU1 47
XPLGT(I)=XSTA(LPLOT(I))                        BLU1 48
GO TO 40                                         BLU1 49
30 NPLGT=I-1                                    BLU1 50
GO TO 50                                         BLU1 51
40 CONTINUE                                     BLU1 52
C                                                 BLU1 53
50 NSOLVE=NSOLVE                                BLU1 54
NSOLVE=NSOLVE+NWEDGE                           BLU1 55
I=NBLPL1                                         BLU1 56
J=1                                              BLU1 57
K=1                                              BLU1 58
CONTINUE                                         BLU1 59
IF (I.GT.NWPLNB) GO TO 70                      BLU1 60
IF (XB(I).LT.XSTA(J)) GO TO 80                 BLU1 61
ZSTA(K)=XSTA(J)                                BLU1 62
J=J+1                                           BLU1 63
K=K+1                                           BLU1 64
IF (K.GT.NSOLVE) GO TO 90                      BLU1 65
IF (I.GT.NWPLNB) GO TO 70                     BLU1 66
IF (J.GT.NSOLVE) GO TO 80                     BLU1 67
GO TO 60                                         BLU1 68
80 ZSTA(K)=XB(I)                                BLU1 69
I=I+1                                           BLU1 70
K=K+1                                           BLU1 71

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      IF (K.GT.NSOLVE) GO TO 90
      IF (I.GT.NWPLN3) GO TO 70
      IF (J.GT.NSOLV1) GO TO 80
      GO TO 60
90    CONTINUE
      DO 110 N=1,NSOLVE
C
      RESET THE VALUES OF KCASET,INJCT,NOINJ AND LPLCT(I),I=1,4
C
      IF (ZSTA(N).EQ.XTRNSN) KCASET=N
      IF (ZSTA(N).EQ.XINJ) INJCT=N
      IF (ZSTA(N).EQ.XNOINJ) ACINJ=N
      DO 100 I=1,NPLCT
      IF (ZSTA(N).EQ.XPLOT(I)) LPLCT(I)=N
100   CONTINUE
C
110   XSTA(N)=ZSTA(N)
      DO 120 I=1,NSOLVE
      WRITE (6,220) I,XSTA(I)
120   CONTINUE
      WRITE (6,230)
      WRITE (6,240)
      WRITE (6,200)
      DO 130 J=1,NWPLN3
      PEB(J)=PEB(J)*PINF*144.000
      XPR(J)=(2.000/(G-1.000))*((PEB(J)/PEB(1))*(-(G-1.000)/G)-1.000))*
10.500
      TEB(J)=TSTAG/(1.000+(G-1.000)/2.000*XMB(J)*2)
      UEB(J)=DSORT(2.000*CP*(TSTAG-TEB(J)))
      WRITE (6,210) J,ZB(J),XB(J),RB(J),PEB(J),UEB(J),TEB(J),XMB(J)
130   CONTINUE
      IF (TEB(1).GT.2000.000) GO TO 140
      CALL POLY (TEB(1),5,ENAIRL,ME)
      GO TO 150
140   CALL POLY (TEB(1),5,ENAIRH,ME)
150   ME=ME*TEB(1)
      WRITE (6,230)
160   CONTINUE
      IF (X.LT.XB(3)) GO TO 190
      J=0
170   J=J+1
      IF (X.GT.XB(J)) GO TO 170
      IF (J.LT.3) J=3
      IF (J.GT.(NWPLN3-2)) J=NWPLN3-2
      CALL INTER5 (X,XR(J-2),XR(J-1),XR(J),XB(J+1),XB(J+2),PEB(J-2),PEB(
1J-1),PEB(J),PEB(J+1),PEB(J+2),PEDG)
      CALL FDS (X,XR(J-2),XR(J-1),XR(J),XB(J+1),XB(J+2),UEB(J-2),UEB(
1J),UEB(J),UEB(J+1),UEB(J+2),DUEGDX)
      CALL FDS (X,XR(J-2),XR(J-1),XR(J),XB(J+1),XB(J+2),TEB(J-2),TEB(
1J),TEB(J),TEB(J+1),TEB(J+2),DTEGDX)
180   IF (X.FQ.0.000) PEDG=PEB(1)
      TEDG=TSTAG*(PEDG/PEB(1))*((G-1.000)/G)
      UEDG=DSORT(2.000*CP*(TSTAG-TEG))
      RHOEDG=PEDG/K/TEG
      DPEGDX=-RHOEDG*UEDG*DUEGDX
      DVEGDX=0.000
      DPEGDW=0.000
      DTEGDW=0.000
      DUEGDW=0.000
      DVEGDW=0.000
      D2PDW2=0.000
      VEDG=0.000
      RETURN
190   CALL INTER5 (X,-XB(3),-XB(2),XB(1),XB(2),XB(3),PEB(3),PEB(2),PEB(
1J),PEB(2),PEB(3),PEDG)
      CALL FDS (X,-XB(3),-XB(2),XB(1),XB(2),XB(3),-UEB(3),-UEB(2),UEB(
1J),UEB(2),UEB(3),DUEGDX)
      CALL FDS (X,-XB(3),-XB(2),XB(1),XB(2),XB(3),+TEB(3),+TEB(2),TEB(
1J),TEB(2),TEB(3),DTEGDX)
      GO TO 180
C

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C		BLU1	143
C		BLU1	144
200	FORMAT (13X,1H1,8X,5H29(1),11X,5HXR(1),11X,5HRB(1),10X,6HPEB(1),10	BLU1	145
	1X,6HUEB(1),10X,6HTEB(1),10X,6HXM(1))	BLU1	146
210	FORMAT (11X,13,7E16.6)	BLU1	147
220	FORMAT (26X,13,5X,F9.6)	BLU1	148
230	FORMAT (1H0)	BLU1	149
240	FORMAT (26X,20HPLUNT CCNE EDGE DATA/)	BLU1	150
	END	BLU1	151
	SUBROUTINE BLUNT2 (ISNT)	BLU2	1
	IMPLICIT REAL*8 (A-H,O-Z)	BLU2	2
	REAL*8 NOSE	BLU2	3
	COMMON /EDGE/ UEDG,TEDE,VEDG,PEDG,DTEGD,CTEGDW,DUEGD,DOEGDW,DVEGBLU2	4	
	10X,DVEGDW,CPEGDX,OPEGDW,U2PDH2,KHDELG,AMUEG,RDMUEG	BLU2	5
	COMMON /FRSTRM/ RHOINF,PINF,TFS,UFS,P,PRL,G,XXMA	BLU2	6
	CCPMCN /GECH/ ALPHA,THETAC,NCSE,RNOSE,WLST,X,XX,WX	BLU2	7
	CCPMCN /INTEGK/ IE,IM,KEAD,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPR,T,KPK,BLU2	8	
	1LPR	BLU2	9
	CCPMCN /OLD/ TCOLD(61),VCOLD(61),CVOLD(61)	BLU2	10
	COMMON /XSGLVE/ XSTA(10C),DXMAX,DX,DXCLD,DX1,NSOLVE	BLU2	11
	DIMENSION A(12,2), B(12,2), C(12,2), D(12,2), VSUM(2), PSUM(2), RHBLU2	12	
	10SLM(2), PHISUM(2), VNSUM(2), PNSUM(2), PHNSUM(2), RONSUM(2), XXS(BLU2	13	
	22), PNNSUM(2)	BLU2	14
	DIMENSION APS(15), ARHOS(15), ACFPHI(15), AVS(15)	BLU2	15
C		BLU2	16
C		BLU2	17
	XN11=X	BLU2	18
	PI=DARCOS(-1.0D0)	BLU2	19
	IF (ALPHA.EQ.C.CD) KLX=7	BLU2	20
	M=2	BLU2	21
C	*****	BLU2	22
C	XN11=BODY FIXED SURFACE DISTANCE	BLU2	23
C	GUNCTR=BODY FIXED SURFACE DISTANCE TO THE SPHERE CONE JUNCTURE	BLU2	24
C	XJUNCT=BODY FIXED AXIAL DISTANCE TO THE SPHERE-CONE JUNCTURE	BLU2	25
C	X=BODY FIXED AXIAL DISTANCE	BLU2	26
	XJUNCT=(1.0D0-DSIN(THETAC))*RNCSE	BLU2	27
	GUNCTR=RNOSE*(PI/2.CD0-THETAC)	BLU2	28
	IF (X.GT.GUNCTR) GO TO 10	BLU2	29
	X=1.CD0-DCOS(X/RNOSE)	BLU2	30
	GO TO 20	BLU2	31
10	X=(X-GUNCTR)*DCOS(THETAC)+XJUNCT	BLU2	32
	X=X/RNOSE	BLU2	33
20	CONTINUE	BLU2	34
C	*****	BLU2	35
C		BLU2	36
C	AXIAL DISTANCE AND FOURIER COEFFICIENTS ARE READ FROM UNIT 10	BLU2	37
30	READ (10) XS,APS,ARHOS,ACFPHI,AVS	BLU2	38
	IF (X.GT.XS) GO TO 40	BLU2	39
	BACKSPACE 10	BLU2	40
	BACKSPACE 10	BLU2	41
	GO TO 30	BLU2	42
40	READ (10) XS,APS,ARHOS,ACFPHI,AVS	BLU2	43
	IF (X.GT.XS) GO TO 40	BLU2	44
	DO 50 J=1,KLX	BLU2	45
	A(J,2)=APS(J)	BLU2	46
	B(J,2)=ARHOS(J)	BLU2	47
	C(J,2)=ACFPHI(J)	BLU2	48
	D(J,2)=AVS(J)	BLU2	49
50	CONTINUE	BLU2	50
	XXS(2)=XS	BLU2	51
	BACKSPACE 10	BLU2	52
	BACKSPACE 10	BLU2	53
	READ (10) XS,APS,ARHOS,ACFPHI,AVS	BLU2	54
	DO 60 J=1,KLX	BLU2	55
	A(J,1)=APS(J)	BLU2	56
		BLU2	57

	B(J,1)=APHCS(J)	BLU2	58
	C(J,1)=ACFPHI(J)	BLU2	59
	D(J,1)=AVS(J)	BLU2	60
60	CCNTINUE	BLU2	61
	XXS(1)=XS	BLU2	62
	MM=M-1	BLU2	63
	APHI=0.000	BLU2	64
	DEG=C.CDO	BLU2	65
	IF (KEND.EQ.1.OR.ALPHA.EC.0.000) GO TO 70	BLU2	66
	DEG=180.000/CFLUAT(KEND-1)	BLU2	67
	APHI=-DEG	BLU2	68
70	CCNTINUE	BLU2	69
	KKL=KLX-1	BLU2	70
	DO 80 I=1,K	BLU2	71
80	APHI=APHI+DEG	BLU2	72
	PHI=APHI*(PI/180.000)	BLU2	73
C		BLU2	74
C	FOURIER SERIES ARE USED TO CCMPUTE THE EDGE PROPERTIES	BLU2	75
C		BLU2	76
	DO 110 I=1,M	BLU2	77
	VSUM(1)=0.000	BLU2	78
	PSUM(1)=0.000	BLU2	79
	RHCSUM(1)=0.000	BLU2	80
	PHISUM(1)=0.000	BLU2	81
	VASUM(1)=0.000	BLU2	82
	PNSUM(1)=0.000	BLU2	83
	PNASUM(1)=0.000	BLU2	84
	RCASUM(1)=0.000	BLU2	85
	PHASUM(1)=0.000	BLU2	86
	DO 90 J=1,KLX	BLU2	87
	Z=DFLOAT(J)-1.000	BLU2	88
	SUM1=A(J,1)*DCOS(Z*PHI)	BLU2	89
	PSUM(1)=PSUM(1)+SUM1	BLU2	90
	SUM2=B(J,1)*DCOS(Z*PHI)	BLU2	91
	RHCSUM(1)=RHCSUM(1)+SUM2	BLU2	92
	SUM4=D(J,1)*DCCS(Z*PHI)	BLU2	93
	VSUM(1)=VSUM(1)+SUM4	BLU2	94
	SUM5=-A(J,1)*Z*DSIN(Z*PHI)	BLU2	95
	PNSUM(1)=PNSUM(1)+SUM5	BLU2	96
	SUM6=-B(J,1)*Z*DSIN(Z*PHI)	BLU2	97
	RCASUM(1)=RCASUM(1)+SUM6	BLU2	98
	SUM8=-D(J,1)*Z*DSIN(Z*PHI)	BLU2	99
	VASUM(1)=VASUM(1)+SUM8	BLU2	100
	SUM9=-A(J,1)*Z**2*DCOS(Z*PHI)	BLU2	101
	PNASUM(1)=PNASUM(1)+SUM9	BLU2	102
90	CCNTINUE	BLU2	103
	DO 100 J=1,KKL	BLU2	104
	H=CFLGAT(J)	BLU2	105
	SUM3=C(J,1)*DSIN(H*PHI)	BLU2	106
	PHISUM(1)=PHISUM(1)+SUM3	BLU2	107
	SUM7=C(J,1)*H*DCCS(H*PHI)	BLU2	108
	PHASUM(1)=PHASUM(1)+SUM7	BLU2	109
100	CCNTINUE	BLU2	110
110	CCNTINUE	BLU2	111
	IF (K.GT.1) GO TO 120	BLU2	112
	PHISUM(MM)=0.000	BLU2	113
	PHISUM(M)=0.000	BLU2	114
	RCASUM(MM)=0.000	BLU2	115
	RCASUM(M)=0.000	BLU2	116
	PNSUM(MM)=0.000	BLU2	117
	PNSUM(M)=0.000	BLU2	118
120	CCNTINUE	BLU2	119
	IF (MM.EQ.M) GO TO 130	BLU2	120
C		BLU2	121
C	INTERPCLATION FOR EDGE PROPERTY VALUES AT X	BLU2	122
C		BLU2	123
	FAC=(X-XXS(MM))/(XXS(M)-XXS(MM))	BLU2	124
	GO TO 140	BLU2	125
130	FAC=0.000	BLU2	126
140	PECG=(PSUM(MM)+FAC*(PSUM(M)-PSUM(MM)))/G/XXMA**2	BLU2	127
	PECG=PECG*RHOINF*UFS**2	BLU2	128

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RHCEG=RHOSUM(MM)+FAC*(RHOSUM(M)-RHOSUM(MM))
RHCEG=RHCEG-RHCEG*RHCEG
TEG=PELG/P/RHCEG
V=VSUM(MM)+FAC*(VSUM(M)-VSUM(MM))
CFA=PHISUM(MM)+FAC*(PHISUM(M)-PHISUM(MM))
UEG=V*DCOS(CFA)*UFS
VEG=V*DSIN(CFA)*UFS
DVEDP=VNSUM(MM)+FAC*(VNSUM(M)-VNSUM(MM))
DPHDP=PHNSUM(MM)+FAC*(PHNSUM(M)-PHNSUM(MM))
DRCDP=(RONSUM(MM)+FAC*(RONSUM(M)-RONSUM(MM)))*RHOINF
DVEGDW=(DVEDP*DCOS(CFA)+V*DCOS(CFA)*DPHDP)*UFS
DUEGDW=(DVEDP*DCOS(CFA)-V*DSIN(CFA)*DPHDP)*UFS
DPEGDW=(PNSUM(MM)+FAC*(PNSUM(M)-PNSUM(MM)))*RHOINF*UFS**2/G/XXMA**BLU2 129
12 DTEGDW=1.000/R*(RHOEDG*DPEGDW-PEGD*DRCDP)/RHOEDG**2 BLU2 130
D2PDW2=(PANSUM(MM)+FAC*(PANSUM(M)-PANSUM(MM)))/G/XXMA**2 BLU2 131
D2PDW2=D2PDW2+RHCINF*UFS**2 BLU2 132
IF (ISNT.EQ.2) GO TO 150 BLU2 133
C CALCULATE THE X DERIVATIVES BLU2 134
C DTEGDX=(TEG-TOLD(K))/DX BLU2 135
C DUEGDX=(UEG-VGLD(K))/DX BLU2 136
C DVEGDX=(VEG-CVGLD(K))/DX BLU2 137
C DPEGDX=-RHOEDG*UEG*DUEGDX BLU2 138
C TGLD(K)=TEG BLU2 139
C VOLD(K)=UEG BLU2 140
C CVGLD(K)=VEG BLU2 141
150 CGATINUE BLU2 142
C RESTORE X TO SURFACE DISTANCE VALUE BLU2 143
C X=XNIT BLU2 144
C RETURN BLU2 145
C END BLU2 146
BLU2 147
BLU2 148
BLU2 149
BLU2 150
BLU2 151
BLU2 152
BLU2 153
BLU2 154
BLU2 155
BLU2 156
BLU2 157
BLU2 158
BLU2 159
BLU2 160
BLU2 161
BLU2 162
BLU2 163

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SUBROUTINE CHANGX
IMPLICIT REAL*8(A-H,C-Z)
REAL*8 NOSE
CCPMCN /RLUNT/ ZP(100),XP(100),PB(100),PEB(100),UEB(100),TEB(100),CHGX 1
1XMB(100),NBLUNT,NWEDGE,NWPLNB,NWPLPI CHGX 2
CCPMCN /CCNVG/ CCNV,NIT1,NIT2,NIT3,NIT CHGX 3
CCPMCN /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),CN(2,101,3),T(2,CHGX 4
1101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YCHGX 5
2L(101),RMC(101) CHGX 6
CCPMCN /GFCM/ ALPHA,THETAC,NCE,PNUSE,WLST,X,XX,WX CHGX 7
CCPMCN /INJECT/ I,JCT,NCIAJ,GAS2,CULL,MASTRN CHGX 8
CCPMCN /INTECH/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,CHGX 9
1LPR CHGX 10
CCPMCN /SOLPAT/ CW(101),CNW(101),VW(101),GW(101),TW(101),GWN(101),CHGX 11
1FWN(101),FW(101),TWN(101),ZW(101),ZWN(101),XTW,DXDXTW,XW,RW CHGX 12
CCPMCN /TRANSN/ KTRANS,KCNSET,XIF,CHI2(101),CHI*AX,XHAR CHGX 13
1PLUS(101),ALET,LANTPB CHGX 14
CCPMCN /XSOLVE/ XSTA(100),DXMAX,DX,DXGLD,DXI,NSOLVE CHGX 15
DATA BLUNT,SHARP/SHBLUNT,SHSHARP/ CHGX 16
C CHGX 17
C CHGX 18
C CHGX 19
C CHGX 20
C CHGX 21
C CHGX 22
C CHGX 23
C CHGX 24
C CHGX 25
C CHGX 26
C CHGX 27
C CHGX 28
C CHGX 29
C CHGX 30
C CHGX 31

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C	IF (X.GE.XSTA(KONSET)) GO TO 140	CHGX	32
	IF (KONSET.EQ.NSOLVE) GO TO 10	CHGX	33
	LAMTRB=1	CHGX	34
	XIF=0.000	CHGX	35
10	CONTINUE	CHGX	36
C		CHGX	37
C	RESET COUNTER FOR INJECTION	CHGX	38
C		CHGX	39
	IF (INJCT.EQ.NSOLVE) GO TO 60	CHGX	40
	IF (X.GT.XSTA(INJCT)) GO TO 60	CHGX	41
	MASTRN=0	CHGX	42
	DO 40 I=1,2	CHGX	43
	DO 30 K=1,3	CHGX	44
	DO 20 J=1,1E	CHGX	45
	Z(I,J,K)=1.000	CHGX	46
	ZN(I,J,K)=0.000	CHGX	47
20	CCONTINUE	CHGX	48
30	CCONTINUE	CHGX	49
40	CCONTINUE	CHGX	50
	DO 50 J=1,1E	CHGX	51
	Z(I,J)=1.000	CHGX	52
	ZMN(J)=0.000	CHGX	53
50	CCONTINUE	CHGX	54
60	IF (X.GE.XSTA(NOINJ)) PASTRN=0	CHGX	55
	RETURN	CHGX	56
70	CCONTINUE	CHGX	57
C		CHGX	58
C	ADJUST DX USING NIT	CHGX	59
C		CHGX	60
	IF (NIT.GT.NIT1) GO TO 80	CHGX	61
	DX=2.000*DX	CHGX	62
	IF (DX.GT.DXMAX) DX=DXMAX	CHGX	63
	GO TO 90	CHGX	64
80	IF (NIT.LT.NIT2) GO TO 90	CHGX	65
	DX=0.500*DX	CHGX	66
90	CCONTINUE	CHGX	67
	IF (X.EQ.XSTA(INJCT)) DX=DX/10.000	CHGX	68
	IF (X.LQ.XSTA(KONSET)) DX=DX/10.000	CHGX	69
	DXOLD=DX	CHGX	70
	IF (IND.EQ.2.AND.X.LE.XB(NWPLNR).AND.NOSE.EQ.BLUNT) GO TO 110	CHGX	71
C		CHGX	72
C	SET DX TO GIVE A SOLUTION AT XSTA(IXSOLV(1))	CHGX	73
C		CHGX	74
	DO 100 I=1,NSOLVE	CHGX	75
	J=1	CHGX	76
	IF (XSTA(I).GT.X.AND.XSTA(I).LE.(X+1.2500*DX)) GO TO 120	CHGX	77
100	CCONTINUE	CHGX	78
110	CCONTINUE	CHGX	79
	X=X+DX	CHGX	80
	GO TO 130	CHGX	81
120	DX=XSTA(J)-X	CHGX	82
	X=XSTA(J)	CHGX	83
130	CONTINUE	CHGX	84
C		CHGX	85
C	BEGIN THE TRANSITION REGIME IF X=XSTA(KONSET)	CHGX	86
C	CALCULATE THE TRANSITION INTERMITTANCY FACTOR FOR	CHGX	87
C	X.GE.XSTA(KONSET)	CHGX	88
C		CHGX	89
	IF (KONSET.EQ.NSOLVE) GO TO 150	CHGX	90
	IF (X.LT.XSTA(KONSET)) GO TO 150	CHGX	91
	IF (X.GT.XSTA(KONSET)) GO TO 140	CHGX	92
	LAMTRB=2	CHGX	93
	WRITE (6,180) X,LAMTRB	CHGX	94
140	CONTINUE	CHGX	95
	IF (KTRANS.EQ.0) XIF=1.000	CHGX	96
	IF (KTRANS.EQ.1) XIF=1.000-DEXP(-0.41200*2.91700**2*(X-XSTA(KONSET)	CHGX	97
	17))/(XSTA(KONSET)*(XBAK-1.000))**2)	CHGX	98
	IF (NIT.LT.0) GO TO 10	CHGX	99
C		CHGX	100
C	BEGIN MASS TRANSFER IF X=XSTA(INJCT)	CHGX	101
		CHGX	102

C			CHGX 103
150	IF (INJCT.EQ.NSCLVE) GO TO 160		CHGX 104
	IF (X.LE.XSTA(INJCT)) GO TO 160		CHGX 105
	IF (MASTRN.EQ.1) GO TO 160		CHGX 106
	MASTRN=1		CHGX 107
	WRITE (6,190) X,MASTRN		CHGX 108
C			CHGX 109
C	END MASS TRANSFER IF X=XSTA(NCINJ)		CHGX 110
C			CHGX 111
160	IF (NCINJ.EQ.NSCLVE) GO TO 170		CHGX 112
	IF (X.NE.XSTA(MQINJ)) GO TO 170		CHGX 113
	MASTRN=0		CHGX 114
	WRITE (6,200) X,MASTRN		CHGX 115
170	RETURN		CHGX 116
C			CHGX 117
C			CHGX 118
180	FORMAT (1H0,10X,27HBEGIN TRANSITION REGIME, X=,E12.6,9H LAMTRB=,		CHGX 119
	12/)		CHGX 120
190	FCPMAT (1H0,10X,23HBEGIN MASS TRANSFER, X=,E12.6,9H MASTRN=,12/)		CHGX 121
200	FORMAT (1H0,10X,21HEND MASS TRANSFER, X=,E12.6,9H MASTRN=,12/)		CHGX 122
	END		CHGX 123

SUBROUTINE CCATRL	CNTL 1
IMPLICIT REAL*8(A-H,O-Z)	CNTL 2
REAL*8 NOSF,LEWLA,LEWTR	CNTL 3
COMMON /ASSVAR/ IFL,KBL	CNTL 4
COMMON /BLUNT/ ZH(100),XH(100),RR(100),PER(100),UEB(100),TEB(100),	CNTL 5
1XMB(100),NBLUNT,NLEDGE,NWPLNB,AHLPL1	CNTL 6
COMMON /CONIC1/ PE(61),TE(61),UE(61),VE(61),DPEOW(61),DTEOW(61),DUCNTL	7
IEDW(61),DVEOW(61),DPEOW2(61),ROWC(61)	CNTL 8
COMMON /CONVPC/ CONV,NIT1,NIT2,NIT3,NIT	CNTL 9
COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,CNTL	10
1101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YCCNTL	11
ZL(101),RORCE(101)	CNTL 12
COMMON /EDGE/ UEDG,TECG,VFEG,PEEG,DTFEGX,DTEGOW,DUEGDX,DUEGOW,DVEGOW,CNTL	13
1DX,DVEGOW,DPEGDX,DPEGOW,D2PDW2,RMGENG,AMUEDG,RCMUEG	CNTL 14
COMMON /EDGW/ PEW,UEW,VEW,TEW,DPEWDX,DPEWOW,DUEWDX,DUEWOW,DVEWDX,CNTL	15
1VENLW,DTEWDX,DTEWOW,DPEWOW2,RMUEW,AMUEW,RUMOW	CNTL 16
COMMON /EDG2/ PE2,TE2,UE2,VE2,DPE2DX,DTE2DX,DUE2DX,DVE2DX,DPE2OW,CNTL	17
1UE2OW,DVE2OW,DTE2OW,AMUE2,RCMU2,R2,RHUF2,REX2	CNTL 18
COMMON /FINOIF/ A(101),Bb(101),R(101),CC(101),OD(101),O(101),E(101,CNTL	19
1),CAI	CNTL 20
COMMON /IRSTAR/ RHCINF,PINF,TFS,UFS,R,PkL,Q,XMA	CNTL 21
COMMON /GASPP/ LEWLA(101),LEWTR(101),PRANDL(101),PRANDT(101),CPCNTL	22
1(101),GAMMA(101),XMU(101),RMC(101),HSMU(101)	CNTL 23
COMMON /GEOM/ ALPHA,THETAC,NCSE,RNCSE,WLST,X,XX,WX	CNTL 24
COMMON /IFCOFF/ R1,U2,B3,G1,G2,F1,F2,DF,AL,EPS,CHI,WINDPT,U1	CNTL 25
COMMON /INJECT/ INJCT,NCINJ,GAS2,COLL,MASTRN	CNTL 26
COMMON /INTEG/ IE,IM,KEND,KEND2,KLX,K,L,NGLNT1,IND,KPNT,LPR3,KPR,CNTL	27
1LPR	CNTL 28
COMMON /OLD/ DUMOLD(61),VOLD(61),CVOLD(61)	CNTL 29
COMMON /OLDFCG/ R3,UE3,RCMU3	CNTL 30
COMMON /OUTPLY/ CFWEDG,CFWINF,CFXEDG,CFXINF,CHEDGE,CHINF,AMACHE,DECNTL	31
1L,CW,QWINF,QHQWQ,S,STEDGE,STINF,TAUETA,TAUX,DELSTX,DELPHI,THETAX,CNTL	32
2THEPHI	CNTL 33
COMMON /POECCF/ AO(101),A1(101),A2(101),A3(101),A4(101),A5(101)	CNTL 34
COMMON /POKEFF/ UREF,CREF	CNTL 35
COMMON /SOLPAT/ CW(101),CNW(101),VW(101),GW(101),TW(101),GWN(101),CNTL	36
1FWN(101),FW(101),TWN(101),7W(101),ZW(101),XIW,OXDXIW,XW,PW	CNTL 37
COMMON /SPWRC/ ZWALL,ZWOLD,BICIFW,AMDOTW,SINLST,ZWPUS,ZWNEG,AMWNEGCNTL	38
1,AMWPOS,WALLV,ZWFRU,NITCHG	CNTL 39
COMMON /STAG/ PSTAG,TSTAG,PNC,QWSTAG,HSTAG,HE	CNTL 40
COMMON /SURFAS/ CWALL,CWINO,PEWINO,VWALL,TWALL,XTW(500),TWX(500),XCNTL	41
1C(500),C1X(500),HWALL,TCCNW,KCI,KTW	CNTL 42
COMMON /TMPRT/ TEMP(101),TOTE(101),TP(101),RTW,TR	CNTL 43
COMMON /TRBLNT/ ASTAR,AKSTAR,ALAMDA,YSUBL,EVSCTY(101),PRT,EDYLAW,ECNTL	44
1PLUS(101),ALET,LAMTRB	CNTL 45

	COMMON /WSOLVE/ CM	CNTL 46
	COMMON /XICORD/ XI,XXI,DXI,XIOLD,DXDXI,DXDXXI	CNTL 47
	COMMON /XSOLVE/ XSTA(100),GXMAX,DX,DXCLD,DXI,NSOLVE	CNTL 48
	COMMON /ZCCGRD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA	CNTL 49
	DIMENSION FULD(101), GCLD(101), TOLD(101), ZCLD(101)	CNTL 50
	DATA BLUNT,SHARP/5HBLUNT,5HSHARP/	CNTL 51
	DATA HEL,AR,CC2,AIR/3HHEL,3HARG,3HCO2,3HAIR/	CNTL 52
	NITOT=0	CNTL 53
	ASYM=1.000	CNTL 54
C		CNTL 55
C	BEGIN THE LOOP FOR STEPPING DOWNSTREAM	CNTL 56
C		CNTL 57
10	CONTINUE	CNTL 58
	L=L+1	CNTL 59
	IFL=1	CNTL 60
	FIND(8*IFL)	CNTL 61
	W=C.000	CNTL 62
	IF (KEND.EQ.1.OR.ALPHA.EC.0.000) GO TO 20	CNTL 63
	OW=WLST/DFLOAT(KEND2-1)	CNTL 64
20	CONTINUE	CNTL 65
	KPR=KPRT	CNTL 66
	IF (L.EQ.1) KLAST=KEND	CNTL 67
C		CNTL 68
C	BEGIN THE CO-LOOP FOR STEPPING AROUND THE CONE	CNTL 69
C		CNTL 70
	DO 470 K=1,KEND	CNTL 71
	WX=W/WLST*180.000	CNTL 72
	IF (KLAST.GT.0) GO TO 30	CNTL 73
	WRITE (6,520)	CNTL 74
	RETURN	CNTL 75
30	IF (K.GT.KLAST) GO TO 440	CNTL 76
40	CONTINUE	CNTL 77
C		CNTL 78
C	OBTAIN EDGE,WALL,AND MIXTURE PROPERTY VALUES AND SET	CNTL 79
C	MICPOINT VALUES TO VALUES OBTAINED FOR THIS PLANE AT	CNTL 80
C	THE LAST STREAMWISE STATION	CNTL 81
C		CNTL 82
	CALL EGPROP	CNTL 83
	CALL WALL	CNTL 84
	DO 50 J=1,IE	CNTL 85
	FW(J)=F(1,J,2)	CNTL 86
	GW(J)=G(1,J,2)	CNTL 87
	GVEL=GW(J)	CNTL 88
	IF (K.EQ.1) GVEL=0.000	CNTL 89
	TH(J)=T(1,J,2)	CNTL 90
	ZH(J)=Z(1,J,2)	CNTL 91
	FWM(J)=FW(1,J,2)	CNTL 92
	GM(J)=G(1,J,2)	CNTL 93
	TWM(J)=TH(1,J,2)	CNTL 94
	ZWM(J)=ZH(1,J,2)	CNTL 95
	TEMP(J)=(TH(J)+HE-UEW**2*(FW(J)**2+GVEL**2)/2.000)/CP(J)	CNTL 96
50	CONTINUE	CNTL 97
	IF (L.EQ.1) CALL VCALL	CNTL 98
	CALL MIXTUR (TH,TEW,UEW,PEW,LEW,LAM,PRANDL,CP,GAMMA,CW,CNW,XMU,RHO,	CNTL 99
	PRODE,ZW,FW,GM,HSUM)	CNTL 100
C		CNTL 101
C	SAVE THE PROFILES FROM THE LAST ITERATION	CNTL 102
C		CNTL 103
60	DO 70 J=1,IF	CNTL 104
	FOLD(J)=F(2,J,2)	CNTL 105
	GOLD(J)=G(2,J,2)	CNTL 106
	TOLD(J)=T(2,J,2)	CNTL 107
	ZOLD(J)=Z(2,J,2)	CNTL 108
70	CONTINUE	CNTL 109
	IF (MASTRN.EQ.0) GO TO 130	CNTL 110
	IF (GAS2.EQ.AIR) GO TO 130	CNTL 111
	IF (CWALL.EQ.0.000) GO TO 130	CNTL 112
C		CNTL 113
C	SOLVE THE SPECIES CONSERVATION EQUATION	CNTL 114
C		CNTL 115
	IF (L.GT.1.AND.K.EQ.1) ZWOLD=ZWZERO	CNTL 116

	IF (L.EQ.1) DETADY=DSORT(2.000*RHO(1))*2*DUEGDX/ROMUM)	CNTL 117
	IF (L.GT.1) DETADY=RHO(1)*UEW*RW/USQRT(2.CDJ*X(W)	CNTL 118
	CALL SPECRC	CNTL 119
	IF (LAMTRB.EQ.2) CALL EGYVIS	CNTL 120
	CALL SPECIE	CNTL 121
	CALL ARCDL (Z)	CNTL 122
	CALL SOLVE (Z,ZA,0.000,ZWALL,1.000)	CNTL 123
	IF (L.GT.1) GC TO 90	CNTL 124
	DO 80 J=1,IE	CNTL 125
	Z(1,J,3)=Z(2,J,2)*2.CDO-Z(2,J,1)	CNTL 126
	ZN(1,J,3)=ZN(2,J,2)*2.CDC-ZN(2,J,1)	CNTL 127
	Z(1,J,2)=Z(2,J,2)	CNTL 128
	ZN(1,J,2)=ZN(2,J,2)	CNTL 129
80	CCONTINUE	CNTL 130
90	CCONTINUE	CNTL 131
	IF (K.GT.1) GC TO 110	CNTL 132
	DO 100 J=1,IE	CNTL 133
	Z(2,J,1)=Z(2,J,2)	CNTL 134
	Z(1,J,3)=Z(1,J,2)	CNTL 135
	ZN(2,J,1)=ZN(2,J,2)	CNTL 136
	ZN(1,J,3)=ZN(1,J,2)	CNTL 137
100	CCONTINUE	CNTL 138
110	CCONTINUE	CNTL 139
	DO 120 J=1,IE	CNTL 140
	IF (K.EQ.KLAST) Z(1,J,3)=Z(2,J,2)-Z(2,J,1)+Z(1,J,2)	CNTL 141
	IF (K.EQ.KLAST) ZN(1,J,3)=ZN(2,J,2)-ZN(2,J,1)+ZN(1,J,2)	CNTL 142
	ZH(J)=Z(2,J,2)*CP1+(1.CDC-CR1)*Z(1,J,2)	CNTL 143
	ZHN(J)=ZN(2,J,2)*C41+(1.CDC-CR1)*ZN(1,J,2)	CNTL 144
	IF (L.EQ.1) ZH(J)=Z(2,J,1)*(1.000-CR1)+Z(2,J,2)*CR1	CNTL 145
120	IF (L.EQ.1) ZHN(J)=ZN(2,J,1)*(1.000-CR1)+ZN(2,J,2)*CR1	CNTL 146
	AMDUTW=-RHO(1)*B17IFW*ZN(2,1,2)*DETADY+RHO(1)*WALLV*ZWALL	CNTL 147
130	CCONTINUE	CNTL 148
C		CNTL 149
C	SOLVE THE ENERGY CONSERVATION EQUATION	CNTL 150
C		CNTL 151
	IF (LAMTRB.EQ.2) CALL EGYVIS	CNTL 152
	TB=HWALL/HE	CNTL 153
	CALL ENERGY	CNTL 154
	CALL ABCDE (T)	CNTL 155
	CALL SOLVE (T,TN,3.000,TB,1.CDO)	CNTL 156
	IF (L.GT.1) GC TO 150	CNTL 157
	DO 140 J=1,IE	CNTL 158
	T(1,J,3)=T(2,J,2)*2.000-T(2,J,1)	CNTL 159
	TN(1,J,3)=TN(2,J,2)*2.000-TN(2,J,1)	CNTL 160
	T(1,J,2)=T(2,J,2)	CNTL 161
	TN(1,J,2)=TN(2,J,2)	CNTL 162
140	CCONTINUE	CNTL 163
150	CCONTINUE	CNTL 164
	IF (K.GT.1) GC TO 170	CNTL 165
	DO 160 J=1,IE	CNTL 166
	T(2,J,1)=T(2,J,2)	CNTL 167
	T(1,J,3)=T(1,J,2)	CNTL 168
	TN(2,J,1)=TN(2,J,2)	CNTL 169
	TN(1,J,3)=TN(1,J,2)	CNTL 170
160	CCONTINUE	CNTL 171
170	CONTINUE	CNTL 172
	DO 180 J=1,IE	CNTL 173
	IF (K.EQ.KLAST) T(1,J,3)=T(2,J,2)-T(2,J,1)+T(1,J,2)	CNTL 174
	IF (K.EQ.KLAST) TN(1,J,3)=TN(2,J,2)-TN(2,J,1)+TN(1,J,2)	CNTL 175
	TH(J)=T(2,J,2)*CR1+T(1,J,2)*(1.000-CR1)	CNTL 176
	TWN(J)=TN(2,J,2)*CR1+TN(1,J,2)*(1.000-CR1)	CNTL 177
	IF (L.EQ.1) TH(J)=T(2,J,1)*(1.000-CR1)+T(2,J,2)*CR1	CNTL 178
	IF (L.EQ.1) TWN(J)=TN(2,J,1)*(1.000-CR1)+TN(2,J,2)*CR1	CNTL 179
180	CCONTINUE	CNTL 180
	DO 190 J=1,IE	CNTL 181
	GVEL=GW(J)	CNTL 182
	IF (K.EQ.1) GVEL=0.000	CNTL 183
	TEMP(J)=(TH(J)*HF-UEW**2*(FW(J)**2+GVEL**2)/2.000)/CP(J)	CNTL 184
190	CCONTINUE	CNTL 185
	CALL MIXTUR (TW,TEW,UEW,PEW,LEW,LAM,PRANDL,CP,GAMMA,CW,CNW,XMU,RHO,	CNTL 186
	IRORDE,ZW,FW,GW,HSUM)	CNTL 187

C		CNTL 188
C	SOLVE THE STREAMWISE MOMENTUM CONSERVATION EQUATION	CNTL 189
C		CNTL 190
	IF (LAMTRB.EQ.2) CALL EDYVIS	CNTL 191
	CALL XMM	CNTL 192
	CALL ABCDE (F)	CNTL 193
	CALL SOLVE (F,FN,0.000,0.000,1.000)	CNTL 194
	IF (L.GT.1) GO TO 210	CNTL 195
	DO 200 J=1,IE	CNTL 196
	F(1,J,3)=F(2,J,2)*2.000-F(2,J,1)	CNTL 197
	FN(1,J,3)=FN(2,J,2)*2.000-FN(2,J,1)	CNTL 198
	F(1,J,2)=F(2,J,2)	CNTL 199
	FN(1,J,2)=FN(2,J,2)	CNTL 200
200	CONTINUE	CNTL 201
210	CONTINUE	CNTL 202
	IF (K.GT.1) GO TO 230	CNTL 203
	DO 220 J=1,IE	CNTL 204
	F(2,J,1)=F(2,J,2)	CNTL 205
	F(1,J,3)=F(1,J,2)	CNTL 206
	FN(2,J,1)=FN(2,J,2)	CNTL 207
	FN(1,J,3)=FN(1,J,2)	CNTL 208
220	CONTINUE	CNTL 209
230	CONTINUE	CNTL 210
	DO 240 J=1,IE	CNTL 211
	IF (K.EQ.KLAST) F(1,J,3)=F(2,J,2)-F(2,J,1)*F(1,J,2)	CNTL 212
	IF (K.EQ.KLAST) FN(1,J,3)=FN(2,J,2)-FN(2,J,1)*FN(1,J,2)	CNTL 213
	FW(J)=F(2,J,2)*CRI+F(1,J,2)*(1.000-CRI)	CNTL 214
	FWN(J)=FN(2,J,2)*CRI+FN(1,J,2)*(1.000-CRI)	CNTL 215
	IF (L.EQ.1) FW(J)=F(2,J,1)*(1.000-CRI)+F(2,J,2)*CRI	CNTL 216
	IF (L.EQ.1) FWN(J)=FN(2,J,1)*(1.000-CRI)+FN(2,J,2)*CRI	CNTL 217
240	CONTINUE	CNTL 218
	IF (ALPHA.EQ.0.000) GO TO 300	CNTL 219
	IF (NOSE.EQ.BLUNT.AND.IND.EQ.1) GO TO 300	CNTL 220
C		CNTL 221
C	SOLVE THE CROSSFLOW MOMENTUM CONSERVATION EQUATION	CNTL 222
C		CNTL 223
	CALL VCALL	CNTL 224
	IF (LAMTRB.EQ.2) CALL EDYVIS	CNTL 225
	CALL PHIMOM	CNTL 226
	CALL ABCDE (G)	CNTL 227
	EDGBC=AL	CNTL 228
	IF (K.EQ.1) EDGBC=WINDPT	CNTL 229
	CALL SOLVE (G,GN,0.000,0.000,EDGBC)	CNTL 230
	IF (L.GT.1) GO TO 260	CNTL 231
	DO 250 J=1,IE	CNTL 232
	G(1,J,3)=G(2,J,2)*2.000-G(2,J,1)	CNTL 233
	GN(1,J,3)=GN(2,J,2)*2.000-GN(2,J,1)	CNTL 234
	G(1,J,2)=G(2,J,2)	CNTL 235
	GN(1,J,2)=GN(2,J,2)	CNTL 236
250	CONTINUE	CNTL 237
260	CONTINUE	CNTL 238
	IF (K.GT.1) GO TO 280	CNTL 239
	DO 270 J=1,IE	CNTL 240
	G(2,J,1)=G(2,J,2)	CNTL 241
	G(1,J,3)=G(1,J,2)	CNTL 242
	GN(2,J,1)=GN(2,J,2)	CNTL 243
	GN(1,J,3)=GN(1,J,2)	CNTL 244
270	CONTINUE	CNTL 245
280	CONTINUE	CNTL 246
	DO 290 J=1,IE	CNTL 247
	IF (K.EQ.KLAST) G(1,J,3)=G(2,J,2)-G(2,J,1)*G(1,J,2)	CNTL 248
	IF (K.EQ.KLAST) GN(1,J,3)=GN(2,J,2)-GN(2,J,1)*GN(1,J,2)	CNTL 249
	GW(J)=G(2,J,2)*CRI+(1.000-CRI)*G(1,J,2)	CNTL 250
	GNW(J)=GN(2,J,2)*CRI+(1.000-CRI)*GN(1,J,2)	CNTL 251
	IF (L.EQ.1) GW(J)=G(2,J,1)*(1.000-CRI)+G(2,J,2)*CRI	CNTL 252
	IF (L.EQ.1) GNW(J)=GN(2,J,1)*(1.000-CRI)+GN(2,J,2)*CRI	CNTL 253
290	CONTINUE	CNTL 254
300	CONTINUE	CNTL 255
	CALL VCALL	CNTL 256
	NIT=NIT+1	CNTL 257
C		CNTL 258

C	THE SOLUTION IS CHECKED FOR CONVERGENCE	CNTL 259
C		CNTL 260
	IF (NIT.LE.NIT3) GO TO 320	CNTL 261
	WRITE (6,503) K,L,NIT	CNTL 262
	IF (K.GT.1) GO TO 310	CNTL 263
	NITTOT=NIT+NITTOT	CNTL 264
	IF (NITTOT.GT.(3*NIT3)) WRITE (6,510) K,L,NITTOT	CNTL 265
	IF (NITTOT.GT.(3*NIT3)) STOP	CNTL 266
	NIT=-1	CNTL 267
	CALL CHANGK	CNTL 268
	NIT=0	CNTL 269
	GO TO 40	CNTL 270
310	CONTINUE	CNTL 271
	KLAST=K-1	CNTL 272
	GO TO 440	CNTL 273
320	CONTINUE	CNTL 274
C		CNTL 275
C	CONVERGENCE TEST ON ALL POINTS OF THE F,G,Z,AND T ARRAYS	CNTL 276
C		CNTL 277
	DIF=0.000	CNTL 278
	DO 340 J=2,IE	CNTL 279
	DIFF=CABS(F(2,J,2)-FOLD(J))/CABS(FOLD(J))	CNTL 280
	IF (DIFF.GT.DIF) DIF=DIFF	CNTL 281
	IF (GOLD(J).EQ.0.000) GO TO 330	CNTL 282
	DIFF=DABS(G(2,J,2)-GOLD(J))/CABS(GOLD(J))	CNTL 283
	IF (DIFF.GT.DIF) DIF=DIFF	CNTL 284
330	CONTINUE	CNTL 285
	DIFF=DABS(T(2,J,2)-TOLD(J))/DABS(TOLD(J))	CNTL 286
	IF (DIFF.GT.DIF) DIF=DIFF	CNTL 287
	DIFF=DABS(Z(2,J,2)-ZOLD(J))/DABS(ZOLD(J))	CNTL 288
	IF (DIFF.GT.DIF) DIF=DIFF	CNTL 289
340	CONTINUE	CNTL 290
C		CNTL 291
C		CNTL 292
	IF (DIF.GT.CONV) GO TO 60	CNTL 293
	IF (NIT.EQ.1) GO TO 60	CNTL 294
	IF (KADETA.EQ.0) GO TO 370	CNTL 295
		CNTL 296
C		CNTL 297
C	TEST THE ASYMPTOTIC NATURE OF THE SOLUTION AND ADJUST ETAINF	CNTL 298
C	IF NECESSARY	CNTL 299
C		CNTL 300
	ASYM=F(2,IE,2)-F(2,IE-4,2)	CNTL 301
	IF (ASYM.LT.ADTEST) GO TO 350	CNTL 302
	TST=1.000	CNTL 303
	ETACLD=ETAINF	CNTL 304
	GO TO 360	CNTL 305
350	IF (KEND.GT.1) GO TO 370	CNTL 306
	IF (ASYM.GT.ADTEST/10.000) GO TO 370	CNTL 307
	TST=2.000	CNTL 308
	ETAOLD=ETAINF	CNTL 309
360	CALL ADDETA (TST,ASYM,ETACLD)	CNTL 310
	GO TO 60	CNTL 311
370	CONTINUE	CNTL 312
	IF (K.EQ.1.OR.K.EQ.(KEND-1)/2) NITHAF=NIT	CNTL 313
	WRITE (8,IFL) (T(2,J,2),F(2,J,2),G(2,J,2),TN(2,J,2),FN(2,J,2),GN(2,J,2),Z(2,J,2),ZN(2,J,2),J=1,IE),ETAINF	CNTL 314
C		CNTL 315
C	STORE BLUNT CONE WEDGE SECTION SOLUTIONS ON UNIT 4 FOR USE AS	CNTL 316
C	STARTING DATA FOR THE AFTERBODY SOLUTION	CNTL 317
C		CNTL 318
	IF (NOSE.EQ.SHARP) GO TO 410	CNTL 319
	IF (KEND.GT.1) GO TO 410	CNTL 320
	IF (IND.EQ.2) GO TO 410	CNTL 321
	IF (X.LT.XB(NBPL1).OR.X.GT.XB(NBPLNB)) GO TO 410	CNTL 322
	DO 380 N=NBPL1,NBPLNB	CNTL 323
	IF (X.LT.XB(N)) GO TO 390	CNTL 324
380	CONTINUE	CNTL 325
	GO TO 410	CNTL 326
390	CONTINUE	CNTL 327
	WRITE (4,KBL) (T(2,J,2),F(2,J,2),G(2,J,2),TN(2,J,2),FN(2,J,2),GN(2,J,2),Z(2,J,2),ZN(2,J,2),J=1,IE),ETAINF	CNTL 328
		CNTL 329

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      IF (X.NE.XB(NHPLN8)) GO TO 410
      DXGLD=DX1
      IFL=1
      KBL=1
400  READ (4*KBL) (T(2,J,2),F(2,J,2),G(2,J,2),TN(2,J,2),FN(2,J,2),GN(2,
      1,J,2),Z(2,J,2),ZN(2,J,2),J=1,IE),ETAOLD
      WRITE (8'IFL) (T(2,J,2),F(2,J,2),G(2,J,2),TN(2,J,2),FN(2,J,2),GN(2,
      1,J,2),Z(2,J,2),ZN(2,J,2),J=1,IE),ETAOLD
      IF (KBL.EQ.KEND2+1) GO TO 410
      GO TO 400
410  CCNTINUE
      C
      C
      C    CALCULATE AND WRITE OUT THE RESULTS OF THE CURRENT SOLUTION
      C
      CALL PPOPTY
      CALL OUT2
      N=N+DN
      C
      C    THE PROGRAM IS SET TO FIND THE SOLUTION AT THE NEXT
      C    CGCOORDINATE POINT
      C
      DO 430 J=1,IE
      IF (K.EQ.1.AND.KEND.GT.1) G(2,J,2)=0.000
      IF (K.EQ.1.AND.KEND.GT.1) GN(2,J,2)=0.000
      F(2,J,1)=F(2,J,2)
      FN(2,J,1)=FN(2,J,2)
      F(1,J,2)=F(1,J,3)
      FN(1,J,2)=FN(1,J,3)
      T(2,J,1)=T(2,J,2)
      TN(2,J,1)=TN(2,J,2)
      T(1,J,2)=T(1,J,3)
      TN(1,J,2)=TN(1,J,3)
      Z(2,J,1)=Z(2,J,2)
      ZN(2,J,1)=ZN(2,J,2)
      Z(1,J,2)=Z(1,J,3)
      ZN(1,J,2)=ZN(1,J,3)
      G(2,J,1)=G(2,J,2)
      GN(2,J,1)=GN(2,J,2)
      G(1,J,2)=G(1,J,3)
      GN(1,J,2)=GN(1,J,3)
      IF (L.NE.1) GO TO 420
      F(1,J,2)=F(2,J,2)
      FN(1,J,2)=FN(2,J,2)
      T(1,J,2)=T(2,J,2)
      TN(1,J,2)=TN(2,J,2)
      Z(1,J,2)=Z(2,J,2)
      ZN(1,J,2)=ZN(2,J,2)
      G(1,J,2)=G(2,J,2)
      GN(1,J,2)=GN(2,J,2)
      F(1,J,3)=F(2,J,2)
      FN(1,J,3)=FN(2,J,2)
      T(1,J,3)=T(2,J,2)
      TN(1,J,3)=TN(2,J,2)
      Z(1,J,3)=Z(2,J,2)
      ZN(1,J,3)=ZN(2,J,2)
      G(1,J,3)=G(2,J,2)
      GN(1,J,3)=GN(2,J,2)
420  CCNTINUE
430  CCNTINUE
      IF (L.EQ.1) GO TO 440
      IF (K.GE.KLAST-1) GO TO 440
      READ (8'IFL) (T(1,J,2),F(1,J,2),G(1,J,2),TN(1,J,2),FN(1,J,2),GN(1,
      1,J,2),Z(1,J,2),ZN(1,J,2),J=1,IE),ETAOLD
      TST=3.000
      IF (ETAOLD.LT.ETAINF) CALL ADDEYA (TST,ASYM,ETAOLD)
      READ (8'IFL) (T(1,J,3),F(1,J,3),G(1,J,3),TN(1,J,3),FN(1,J,3),GN(1,
      1,J,3),Z(1,J,3),ZN(1,J,3),J=1,IE),ETAOLD
      TST=4.000
      IF (ETAOLD.LT.ETAINF) CALL ADDEYA (TST,ASYM,ETAOLD)
      IFL=IFL-2
      FIND(8'IFL)

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440  CONTINUE                                CNTL 401
      IF (K.NE.KEND) GO TO 460                CNTL 402
      READ (8,1) (T(1,J,2),F(1,J,2),G(1,J,2),TN(1,J,2),FN(1,J,2),GN(1,J,2),Z(1,J,2),ZN(1,J,2),J=1,IE),ETALD CNTL 403
      TST=3.000                                CNTL 404
      IF (ETALD.LT.ETAINF) CALL ACDETA (TST,ASYM,ETAOLD) CNTL 405
      DO 450 J=1,IE                            CNTL 406
        T(2,J,1)=T(1,J,2)                      CNTL 407
        TN(2,J,1)=TN(1,J,2)                    CNTL 408
        T(1,J,3)=T(1,J,2)                      CNTL 409
        TN(1,J,3)=TN(1,J,2)                    CNTL 410
        Z(2,J,1)=Z(1,J,2)                      CNTL 411
        ZN(2,J,1)=ZN(1,J,2)                    CNTL 412
        Z(1,J,3)=Z(1,J,2)                      CNTL 413
        ZN(1,J,3)=ZN(1,J,2)                    CNTL 414
        F(2,J,1)=F(1,J,2)                      CNTL 415
        FN(2,J,1)=FN(1,J,2)                    CNTL 416
        F(1,J,3)=F(1,J,2)                      CNTL 417
        FN(1,J,3)=FN(1,J,2)                    CNTL 418
        G(2,J,1)=G(1,J,2)                      CNTL 419
        GN(2,J,1)=GN(1,J,2)                    CNTL 420
        G(1,J,3)=G(1,J,2)                      CNTL 421
        GN(1,J,3)=GN(1,J,2)                    CNTL 422
        GN(1,J,3)=GN(1,J,2)                    CNTL 423
450  CCATINUE                                CNTL 424
460  CCATINUE                                CNTL 425
      NIT=0                                    CNTL 426
      NITTOT=0                                CNTL 427
470  CCATINUE                                CNTL 428
C                                          CNTL 429
C      IF X.EQ.XB(INWPLAB) CONVERT TO BODY-FIXED COORDINATES CNTL 430
C                                          CNTL 431
      NIT=NITHAF                                CNTL 432
      DX=LXOLD                                CNTL 433
      IF (IND.EQ.2) GO TO 480                  CNTL 434
      IF (X.EQ.XB(INWPLAB)) IND=2              CNTL 435
      IF (IND.EQ.1) GO TO 480                  CNTL 436
      X=X-RNOSE*ALPHA                          CNTL 437
      KEAD=KEAD(2)                            CNTL 438
      KLAST=KEND                                CNTL 439
480  CCATINUE                                CNTL 440
      CALL CHANGX                              CNTL 441
      NIT=0                                    CNTL 442
      IF (X.GT.XSTAIN SOLVE) GO TO 490          CNTL 443
      IF (L.NE.1.AND.L.EQ.LPR.CR.LPRT.EQ.1) LPR=LPR+LPRT CNTL 444
      GO TO 10                                CNTL 445
490  CCATINUE                                CNTL 446
      WRITE (6,530)                            CNTL 447
      RETURN                                    CNTL 448
C                                          CNTL 449
C                                          CNTL 450
C                                          CNTL 451
530  FCRMAT (10X,40HFAILED TO GET A CONVERGED SOLUTION AT K=,I3,5X,2HL= CNTL 452
      1,I3,5X,4H,NIT=,I3)                      CNTL 453
510  FCRMAT (10X,57HEXECUTION TERMINATING*****NITTOT.GT.3*NIT3***** CNTL 454
      1 K=,I2,3HL=,I3,8HNITTOT=,I3/)          CNTL 455
520  FCRMAT (10X,40HEXECUTION TERMINATING*****KLAST=0*****/) CNTL 456
530  FCRMAT (10X,7HTHE END)                  CNTL 457
      END                                        CNTL 458

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	SUBROUTINE DERIV (F,X,IMAX,IMIN,FP)	DERV	1
	IMPLICIT REAL*8 (A-H,O-Z)	DERV	2
	DIMENSION F(101), X(101), FP(101)	DERV	3
C		DERV	4
C	SUBROUTINE DERIV3 CALCULATES THE FIRST DERIVATIVES OF F WITH	DERV	5
C	RESPECT TO X AND RETURNS THE ARRAY FP.	DERV	6
	DO 10 J=IMIN,IMAX	DERV	7
	K=J	DERV	8
	IF (K.LT.(IMIN+1)) K=IMIN+1	DERV	9
	IF (K.GT.(IMAX-1)) K=IMAX-1	DERV	10
10	CALL FD3 (X(J),X(K-1),X(K),X(K+1),F(K-1),F(K),F(K+1),FP(J))	DERV	11
	CONTINUE	DERV	12
	RETURN	DERV	13
	END	DERV	14
		DERV	15

	SUBROUTINE DERIV3 (FX,II,KK,X,IMAX,IMIN,FPX)	DER3	1
	IMPLICIT REAL*8 (A-H,O-Z)	DER3	2
	REAL*8 NOSE	DER3	3
	COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,KDUM,L,NBLNT1,IND,KPRT,LPR,K	DER3	4
	1PR,LPR	DER3	5
	DIMENSION X(101), FX(2,101,3), FP(101), F(101), FFX(2,101,3)	DER3	6
C		DER3	7
C	SUBROUTINE DERIV3 CALCULATES THE FIRST DERIVATIVES OF F WITH	DER3	8
C	RESPECT TO X AND RETURNS THE ARRAY FP.	DER3	9
	DO 10 J=1,IE	DER3	10
	F(J)=FX(II,J,KK)	DER3	11
10	CONTINUE	DER3	12
	DO 20 J=IMIN,IMAX	DER3	13
	K=J	DER3	14
	IF (K.LT.(IMIN+1)) K=IMIN+1	DER3	15
	IF (K.GT.(IMAX-1)) K=IMAX-1	DER3	16
	CALL FD3 (X(J),X(K-1),X(K),X(K+1),F(K-1),F(K),F(K+1),FP(J))	DER3	17
20	CONTINUE	DER3	18
	DO 30 J=1,IE	DER3	19
	FPX(II,J,KK)=FP(J)	DER3	20
30	CONTINUE	DER3	21
	RETURN	DER3	22
	END	DER3	23
		DER3	24

	SUBROUTINE DISKIN	DISK 1
	IMPLICIT REAL*8 (A-H,O-Z)	DISK 2
	REAL*8 NOSE	DISK 3
	CCPMCN /FLODAT/ FLCFLD(5,15),BLUNTZ(40),BLUNTP(40),III	DISK 4
	CCMCHN /GECM/ DUHMY,THETAC,NCSE,RNCSE,WLST,O,XX,IX	DISK 5
	CCPMCN /INTEGR/ IE,IM,IDEITA,KEND2,KLX,KK,LL,KBLNT1,IND,KPRT,LPRT,KOISK	DISK 6
	1PR,LPR	DISK 7
	CCPMCN /UNIT10/ DXINVS,DISK	DISK 8
	DIMENSION XI(20,15), P(20,15), RHO(20,15), CFPHI(20,15), V(20,15),	DISK 9
	1PS(15), RHOS(15), CFPHIS(15), VS(15), PSS(15), RHOS(15), FPHISS(10	DISK 10
	25), VSS(15)	DISK 11
	DIMENSION APS(15), ARHCS(15), ACFPHI(15), AVS(15)	DISK 12
	DATA BLUNT,SHARP/SHRLUNT,SHSHARP/	DISK 13
	WRITE (30,350)	DISK 14
	WRITE (30,220)	DISK 15
	WRITE (30,220)	DISK 16
	IF (NOSE.EQ.SHARP) GO TO 10	DISK 17
C		DISK 18
C	AXIAL DISTANCE IN NOSE RADII,AND PRESSURE FROM THE MODIFIED	DISK 19
C	INVERSE SOLUTION METHCD ARE READ IN	DISK 20
C		DISK 21
	READ (25) III	DISK 22
	III=III-2	DISK 23
	READ (25) (BLUNTZ(II),I=1,III)	DISK 24
	READ (25) (BLUNTP(II),I=1,III)	DISK 25
10	CONTINUE	DISK 26
	IF (NOSE.EQ.BLUNT) READ (25) AA,AB,ALPHA,R,PINF,RHGINF,TINF,XMA,THD	DISK 27
	1ETAC,YB,JL,KL,ISTA,G	DISK 28
	IF (NOSE.EQ.SHARP) READ (25) AA,AB,ALPHA,R,PINF,RHGINF,TINF,XMA,THD	DISK 29
	1ETAC,YB,JL,KL,ICUM,G	DISK 30
	VINF=XMA*DSQRT(1.4GG*R*TINF)	DISK 31
	IF (NOSE.EQ.SHARP) GO TO 30	DISK 32
	DO 20 I=1,III	DISK 33
20	BLUNTP(II)=BLUNTP(II)/PINF	DISK 34
30	CONTINUE	DISK 35
C		DISK 36
C	READ THE FIRST METHOD OF CHARACTERISTICS SOLUTION	DISK 37
C		DISK 38
	READ (25) (FLOFLC(1,K),FLCFLC(2,K),FLOFLD(3,K),FLOFLD(4,K),FLOFLD(	DISK 39
	15,K),K=1,KL)	DISK 40
C		DISK 41
C	FLOFLD(1,K)=AXIAL DISTANCE	DISK 42
C	FLOFLD(2,K)=CROSSFLOW ANGLE	DISK 43
C	FLOFLD(3,K)=PRESSURE	DISK 44
C	FLCFLD(4,K)= DENSITY	DISK 45
C	FLCFLD(5,K)=VELOCITY	DISK 46
C	KL IS THE NUMBER OF PLANES	DISK 47
C	K=1 IS THE LEeward PLANE	DISK 48
C	K=KL IS THE WINDWARD PLANE	DISK 49
C		DISK 50
	PI=DARCOS(-1.000)	DISK 51
	WRITE (30,220)	DISK 52
	WRITE (30,230) KL	DISK 53
	WRITE (30,220)	DISK 54
	XB=FLCFLD(1,KL)	DISK 55
	THETA=THETAC*(180.000/PI)	DISK 56
	ALPH=ALPHA*(180.000/PI)	DISK 57
	WRITE (30,240) ALPH,THETA,XMA	DISK 58
	WRITE (30,220)	DISK 59
C		DISK 60
C	UNIT 10 IS THE EDGE PROPERTY DATA SET	DISK 61
C		DISK 62
	WRITE (10) G,R,THETA,ALPH,XMA,KL	DISK 63
	IF (NOSE.EQ.SHARP) GO TO 60	DISK 64
	DO 40 I=1,KL	DISK 65
40	FLOFLD(3,I)=FLOFLD(3,I)/PINF	DISK 66
C		DISK 67
C	SUBROUTINE WEDGE CALCULATES EDGE PROPERTIES FOR THE BLUNT BODY	DISK 68
C	AND WEDGE SECTIONS OF THE CONE	DISK 69
C		DISK 70
	CALL WEDGE (KL,XMA,THETAC,ALPHA,IDEITA,YB,XR)	DISK 71

50	DO 50 I=1,KL	DISK 72
	FLCFLD(3,I)=FLCFLD(3,I)*PINF	DISK 73
60	CCONTINUE	DISK 74
	XS=FLOFLD(1,1)	DISK 75
	WRITE (30,220)	DISK 76
	WRITE (30,340)	DISK 77
	WRITE (30,220)	DISK 78
C		DISK 79
C	WRITE (30,260)	DISK 80
	WRITE (30,220)	DISK 81
	DO 70 K=1,KL	DISK 82
	WRITE (30,270) K,(FLOFLD(1,K),I=1,5)	DISK 83
70	CCONTINUE	DISK 84
	WRITE (30,220)	DISK 85
	GO TO 140	DISK 86
80	CCONTINUE	DISK 87
	IF (NOSE.EQ.SHARP) RETURN	DISK 88
C		DISK 89
C	FLCNFIELD DATA FROM THE METHOD OF CHARACTERISTICS SOLUTION IS	DISK 90
C	READ FROM UNIT 25	DISK 91
C		DISK 92
	READ (25,END=210) ISTA,(FLOFLD(1,K),FLOFLD(2,K),FLOFLD(3,K),FLOFLD(4,K),FLCFLD(5,K),K=1,KL)	DISK 93
		DISK 94
C		DISK 95
	IF (L.EQ.0.AND.FLOFLD(1,1).GT.XS) GO TO 90	DISK 96
	GO TO 100	DISK 97
90	CCONTINUE	DISK 98
	BACKSPACE 25	DISK 99
	BACKSPACE 25	DISK 100
	GO TO 80	DISK 101
100	CCONTINUE	DISK 102
	FLCFLD(2,KL)=0.(D)	DISK 103
	WRITE (30,250) ISTA	DISK 104
	WRITE (30,220)	DISK 105
	WRITE (30,260)	DISK 106
	WRITE (30,220)	DISK 107
	DO 110 K=1,KL	DISK 108
	WRITE (30,270) K,(FLOFLD(1,K),I=1,5)	DISK 109
110	CCONTINUE	DISK 110
	WRITE (30,220)	DISK 111
	L=L+1	DISK 112
	DO 120 K=1,KL	DISK 113
	X(L,K)=FLOFLD(1,K)	DISK 114
	P(L,K)=FLOFLD(3,K)/PINF	DISK 115
	CFPHI(L,K)=-FLOFLD(2,K)	DISK 116
	RHO(L,K)=FLCFLD(4,K)/RHOINF	DISK 117
120	V(L,K)=FLOFLD(5,K)/VINP	DISK 118
	IF (X(L,KL).LT.XS) GO TO 80	DISK 119
C		DISK 120
C	INTERPOLATE FOR FUNCTION VALUES AT KL PLANES	DISK 121
C		DISK 122
	FAC=(XS-X(L-1,1))/(X(L,1)-X(L-1,1))	DISK 123
	DO 130 K=1,KL	DISK 124
	PS(K)=P(L-1,K)+FAC*(P(L,K)-P(L-1,K))	DISK 125
	RHCS(K)=RHO(L-1,K)+FAC*(RHO(L,K)-RHO(L-1,K))	DISK 126
	CFPHIS(K)=CFPHI(L-1,K)+FAC*(CFPHI(L,K)-CFPHI(L-1,K))	DISK 127
130	VS(K)=V(L-1,K)+FAC*(V(L,K)-V(L-1,K))	DISK 128
	GO TO 160	DISK 129
140	CCONTINUE	DISK 130
	DO 150 K=1,KL	DISK 131
	PS(K)=FLOFLD(3,K)/PINF	DISK 132
	RHCS(K)=FLOFLD(4,K)/RHOINF	DISK 133
	CFPHIS(K)=-FLOFLD(2,K)	DISK 134
	VS(K)=FLOFLD(5,K)/VINP	DISK 135
150	CONTINUE	DISK 136
160	CCONTINUE	DISK 137
	CFPHIS(1)=0.000	DISK 138
	CFPHIS(KL)=0.000	DISK 139
	WRITE (30,310) XS	DISK 140
	WRITE (30,220)	DISK 141
		DISK 142

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      WRITE (30,320)
      WRITE (30,220)
      DO 170 MC=1,KL
      WRITE (30,330) PS(MC),RHCS(MC),CFPHIS(MC),VS(MC)
170  CCNTINUE
      WRITE (30,22C)
C
C      INVERT EDGE PROPERTY ARRAYS TO BE COMPATIBLE WITH THE BOUNDARY
C      LAYER*****AFRAYS PREVIOUSLY WENT FROM THE LEEWARD PLANE TO THE
C      WINDWARD PLANE AND WILL NOW GO FROM THE WINDWARD TO THE LEEWARD
C      PLANE*****THIS ALLOWS THE CORRECT CALCULATION OF THE TRANSVERSE
C      EDGE PROPERTY DERIVATIVES FOR THE BOUNDARY LAYER
C
      DO 180 N=1,KL
      JK=KL-N+1
      PSS(N)=PS(JK)
      RHGSS(N)=RHOS(JK)
      FPHISS(N)=CFPHIS(JK)
      VSS(N)=VS(JK)
180  CCNTINUE
C
C      EDGE PROPERTIES ARE CONVERTED TO FOURIER COEFFICIENTS
C
      CALL FCRIER (PSS,APS,KL,1)
      CALL FORIER (RHGSS,ARHCS,KL,1)
      CALL FORIER (FPHISS,ACFPHI,KL,2)
      CALL FCRIER (VSS,AVS,KL,1)
      WRITE (30,28C)
      WRITE (30,220)
      WRITE (30,29C)
      WRITE (30,220)
      WRITE (10) XS,APS,ARHCS,ACFPHI,AVS
      DO 200 K=1,KL
      IF (K.EQ.KL) GO TO 190
      WRITE (30,300) APS(K),ARHOS(K),ACFPHI(K),AVS(K)
      GO TO 200
190  WRITE (30,360) APS(K),ARHOS(K),AVS(K)
200  CCNTINUE
      WRITE (30,22C)
      L=0
      XS=XS+DX
      GO TO 80
C
C
210  RETURN
C
C
220  FORMAT (1H )
230  FORMAT (10X,39HNUMBER OF PLANES IN THE INVISCID DATA =,I3)
240  FORMAT (10X,6HALPHA=,F6.2,5X,7HTHETAC=,F6.2,5X,5HMINF=,F6.2)
250  FORMAT (5X,20HWALL DATA AT STATION,1X,I3)
260  FORMAT (2X,1FK,10X,1HX,15X,3HPHI,15X,1HP,15X,3HFO,15X,1HV)
270  FORMAT (1X,12,5(9X,E12.5))
280  FORMAT (30X,20HFOURIER COEFFICIENTS)
290  FORMAT (36X,3HAPS,18X,5HARHOS,17X,6HACFPHI,17X,3HAVS)
300  FORMAT (30X,4(E15.8,7X))
310  FORMAT (30X,31HSTREAMWISE INTERPOLATION AT X =,F12.6)
320  FORMAT (1H ,35X,1HP,20X,3HRC,18X,3HPI,21X,1HV)
330  FORMAT (30X,4(E17.5,10X))
340  FORMAT (10X,58HUNIFORM FLOW STARTING SOLUTION FOR THE INVISCID FLOW
1H FIELD)
350  FORMAT (40X,52HINVISCID EDGE CONDITIONS FOR BOUNDARY LAYER SOLUTION
1N/47X,39HTAKEN FROM THE INVISCID FLOW FIELD DATA/59X,14HCREATED BY
2 THE/36X,60HMETHOD OF CHARACTERISTICS PROGRAM FOR NONUNIFORM FLOW
3 FIELDS/65X,2HEY/54X,25H.R. BLACK AND C.H. LEWIS/54X,25HARL 73-012
44 AUGUST 1973)
360  FORMAT (30X,2(E15.8,7X),22X,F15.8)
      END

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SUBROUTINE ECGCOF
  IMPLICIT REAL*8(A-H,O-Z)
  REAL*8 NOSE
  COMMON /EDGW/ PEW,UEW,VEW,TEW,DPEWDX,DPEWDW,DUEWDX,DUEWDW,DVEWDX,DECOF
  IVEWDX,DTEWDX,DTEWDW,DPEWDW2,RHGEW,AMUEW,RUMUW
  COMMON /FRSTRM/ RHGINF,PINF,TF5,UFS,K,PRL,G,XMA
  COMMON /GECM/ ALPHA,THETAC,NCSE,RNOSE,WLST,X,XX,WX
  COMMON /IECCF/ B1,B2,B3,G1,G2,F1,F2,DE,AL,EPS,CHI,WINDPT,U1
  COMMON /INTEGR/ IC,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,ECOF
  ILPR
  COMMON /PDEKEF/ UREF,CREF
  COMMON /SILPNT/ CW(101),CNW(101),VW(101),GW(101),TW(101),CWN(101),
  IFW(101),FW(101),TWN(101),ZW(101),ZWN(101),XIW,DXDXIW,XW,RW
  COMMON /STAG/ PSTAG,1STAG,PNC,CWSTAG,HSTAG,HE
  COMMON /XICGAD/ XI,XXI,DXI,XIGLE,DXDXI,DXDXXI
  DATA SHARP,BLUNT/5HSHARP,5HBLUNT/

  SUBROUTINE IECCOF CALCULATE GROUPS OF EDGE QUANTITIES USED IN
  THE COEFFICIENTS OF THE GOVERNING PARTIAL DIFFERENTIAL EQUATIONS

  PI=DARCOS(-1.000)
  CP=G/(G-1.000)*P
  IF (NGSE.EQ.BLUNT.AND.IND.EQ.1) XJUNCT=RNOSE*(PI/2.000-THETAC+ALPHECOF
  1A)
  IF (NGSE.EQ.BLUNT.AND.IND.EQ.2) XJUNCT=RNOSE*(PI/2.000-THETAC)
  IF (NGSE.EQ.PLUNT.AND.X.EQ.0.000) GO TO 10
  B1=2.000*XIW*DUEWDX/UEW
  B2=2.000*XIW*DVEWDX/UEW
  B3=UEW**2/HE
  G1=DUEWDW/UEW
  G2=DVEWDW/UEW
  U1=UEW/UREF
  F1=0.000
  F2=0.000
  WINDPT=G2
  CHI=DPEWDW2/UEW**2/RHGEW
  AL=VEW/UEW
  IF (NGSE.EQ.SHAPPI) DE=2.000/(3.000*DSIN(THETAC))
  IF (NGSE.EQ.BLUNT.AND.K.EQ.1) DE=2.000*XIW/RW**3/CREF/UREF
  IF (NGSE.EQ.SHAPPI) EPS=2.000/3.000
  IF (NGSE.EQ.BLUNT.AND.XW.LE.XJUNCT) EPS=2.00*XIW*DXDXIW*DCOS(XW/PNECOF
  10SEI)/RW
  IF (NGSE.EQ.BLUNT.AND.XW.GT.XJUNCT) EPS=2.00*XIW*DXDXIW*DSIN(THETAC)
  1C1/RW
  GO TO 20
  B1=0.500
  B2=0.000
  B3=0.000
  G1=0.000
  G2=0.000
  U1=1.000
  F1=0.000
  F2=0.000
  WINDPT=0.000
  CHI=C.000
  DE=0.500
  EPS=0.500
  AL=0.000
  20
  CCNTINUE
  RETURN
  END

SUBROUTINE ECVVIS
  IMPLICIT REAL*8(A-H,O-Z)
  REAL*8 KLEB,LFHLAM,LEWTRB
  COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,101,3),
  1101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YDEVIS

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2L(101),RORGF(101) EVIS 6
COMMON /EDGW/ PEW,UEW,VEW,TEW,DPEWDX,DPEWCH,DUEWDX,DUEWDW,DVEWDX,DEVIS 7
1VENUM,DTFMDX,DTFMDW,DPMWDZ,PHGEW,AMUEW,RQMUM EVIS 8
CCPMCN /FRSTRM/ RHGINF,PIKF,TFS,UFS,R,PKL,Q,XMA EVIS 9
COMMON /GASPRP/ LE=LAM(101),LEHTRH(101),PRANDL(101),PRANDT(101),CPEVIS 10
1(101),GAMMA(101),XMU(101),RHG(101),HSMU(101) EVIS 11
CCPMCN /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,EVIS 12
1LPR EVIS 13
COMMON /SOLPNT/ CW(101),CNW(101),VW(101),GW(101),TW(101),CWN(101),EVIS 14
1FWN(101),FW(101),TWN(101),ZW(101),ZWN(101),X1W,DXXIW,XW,RW EVIS 15
CCPMCN /SURFAS/ CWALL,CWIND,PHWIND,VWALL,TWALL,XTW(500),TWX(500),XEVIS 16
1CI(500),CXI(500),HWALL,TCCNW,KCI,KTW EVIS 17
CCPMCN /TKBLNT/ ASTAR,AKSTAR,ALAMDA,YSUBL,EVSCTY(101),PRT,EDYLAW,EVIS 18
1PLUS(101),ALFT,LAMTPB EVIS 19
CCPMCN /XICURC/ X1,XI,DXXI,XICLD,DXXI,DXXI EVIS 20
CCPMCN /ZCGORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTFST,KACETA EVIS 21
DIMENSION TAU(101),DAMP(101),EPSIN(101),EPSOUT(101),SCALAR(101)EVIS 22
1),VELCTY(101),YPLUS(101) EVIS 23
DATA SHARP,HLUNT/5HSHARP,5HBLUNT/ EVIS 24
DATA REI,VAN/3HREI,3HVAN/ EVIS 25
DATA CONST/5+CONST/ EVIS 26
C EVIS 27
IF (X1.EQ.0.000) RETURN EVIS 28
C EVIS 29
C CALCULATE THE PHYSICAL NORMAL DISTANCE PROFILE EVIS 30
C EVIS 31
RETHET=0.000 EVIS 32
Y(1)=0.000 EVIS 33
YTRANS=DSORT(2.CDO*XIW)/(RHOEW*UEW*RW) EVIS 34
DO 10 J=2,IE EVIS 35
Y(J)=Y(J-1)+YTRANS*(1.000/ROROE(J)+1.000/ROROE(J-1))*DETA(J)/2.CDOEVIS 36
RETHET=RETHET+(FW(J)*(1.000-FW(J))+FW(J-1)*(1.000-FW(J-1)))*(Y(J)-EVIS 37
1Y(J-1))/2.000 EVIS 38
CCONTINUE EVIS 39
C EVIS 40
C CALCULATE THE CONSTANT YSUBL EVIS 41
C EVIS 42
DO 20 N=1,IE EVIS 43
VELCTY(N)=DSORT((FW(N)*UEW)**2+(GW(N)*UEW)**2)/DSORT(UEW**2+(GW(1)EVIS 44
1)*UEW)**2) EVIS 45
NN=N-1 EVIS 46
IF (VELCTY(N).GE.0.9900) GO TO 30 EVIS 47
CCONTINUE EVIS 48
30 YSUBL=(Y(NN)+(Y(NN+1)-Y(NN))*(0.9900-VELCTY(NN))/(VELCTY(NN+1)-VELCEVIS 49
1Y(NN)) EVIS 50
C EVIS 51
C CALCULATE THE TOTAL SHEAR FOR USE IN THE VAN DRIEST DAMPING TERM EVIS 52
C CALCULATE THE SCALAR VELCCITY FUNCTION USED IN THE EDDY VISCOSITY EVIS 53
C EVIS 54
C EVIS 55
DO 40 N=1,IE EVIS 56
DUDY=FWN(N)*RHO(N)*UEW*RW/DSORT(2.000*XIW) EVIS 57
IF (K.EQ.1) DWDY=DUDY EVIS 58
IF (K.GT.1) DWDY=GWN(N)*PHC(N)*UEW*RW/DSORT(2.000*XIW) EVIS 59
TAU(N)=XMU(N)*ULW=DSORT(DUDY**2+DWDY**2) EVIS 60
SCALAR(N)=UEW*DSORT(DUDY**2+DWDY**2) EVIS 61
40 CCONTINUE EVIS 62
IF (EDYLAW.EQ.REI).GO TO 70 EVIS 63
C EVIS 64
C CALCULATE THE VAN DRIEST DAMPING TERM FOR THE INNER LAW EVIS 65
C EVIS 66
DO 50 N=1,IE EVIS 67
VWPLUS=CWALL*RHCINF*UFS/RHU(1)/DSORT(TAU(1)/RHO(N)) EVIS 68
ASTAR=26.000*DEXP(1-5.900*VWPLUS) EVIS 69
DAMP(N)=1.000-DEXP(-Y(N)*DSORT(TAU(N)*RHO(N))/XMU(N)/ASTAR)**2 EVIS 70
CCONTINUE EVIS 71
C EVIS 72
C CALCULATE THE INNER EDDY VISCOSITY, VAN DRIEST EQ. EVIS 73
C EVIS 74
DO 60 N=1,IE EVIS 75
EPSIN(N)=RHO(N)*AKSTAR**2*Y(N)**2*DAMP(N)*SCALAR(N) EVIS 76
60 CCONTINUE

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	GO TO 100	EVIS 77
C		EVIS 78
C	CALCULATE THE INNER EDDY VISCOSITY, REICHARDT EQ.	EVIS 79
C		EVIS 80
70	CCATINUE	EVIS 81
	UPLIST=1.000	EVIS 82
	UPLUS=0.000	EVIS 83
	UPL=C.000	EVIS 84
	EPSIN(1)=0.000	EVIS 85
	YPLUS(1)=0.C00	EVIS 86
	DO 90 N=2,IE	EVIS 87
	VOPUS=CHALL*RHOINF*UFS/RHC(1)/DSQRT(TAU(1)/RHO(N))	EVIS 88
	YPLUSA=3.6500/(VOPUS+0.34400)	EVIS 89
	YPLUS(N)=Y(N)*DSQRT(TAU(1)*RHO(N))/XMU(N)	EVIS 90
	EPSIN(N)=XMU(N)*0.400*(YPLUS(N)-YPLUSA*DTANH(YPLUS(N)/YPLUSA))	EVIS 91
	IF (VOPUS.FG.0.000) GO TO 90	EVIS 92
80	CCNTINUE	EVIS 93
	FACTR=DSQRT(1.000+VOPUS*UPLLS)	EVIS 94
	EPSITR=EPSIN(N)*FACTR	EVIS 95
	UPL2=UPLUS	EVIS 96
	UPLUS=UPL+((1.000+UPLUS*VOPUS)/(1.000+EPSITR)+UPLLIST)*(YPLUS(N)-YE	EVIS 97
	IPLUS(N-1))/2.C00	EVIS 98
	IF (UPL2.EC.C.000) GO TO 80	EVIS 99
	IF (DABS(UPLUS-UPL2)/UPL2).GT.C.0100) GO TO 80	EVIS 100
	EPSIN(N)=EPSIN(N)*DSQRT(1.000+UPLUS*VOPUS)	EVIS 101
	UPLLIST=(1.000+UPLUS*VOPLLS)/(1.000+EPSIN(N))	EVIS 102
	UPL=UPLUS	EVIS 103
90	CONTINUE	EVIS 104
100	CCNTINUE	EVIS 105
C		EVIS 106
C	CALCULATE THE OUTER EDDY VISCOSITY	EVIS 107
C	KLEB IS THE KLEBANOFF INTERMITTANCY FACTOR	EVIS 108
C		EVIS 109
	DO 110 N=1,IE	EVIS 110
	KLEB=1.000/(1.000+5.500*(Y(N)/YSUBL)**6)	EVIS 111
	EPSCUT(N)=RHC(N)*ALAMCA**2*YSUBL**2*SCALAR(N)*KLEB	EVIS 112
110	CCATINUE	EVIS 113
C		EVIS 114
	CUT=C.000	EVIS 115
	DC 140 N=1,IE	EVIS 116
	IF (CUT.EO.1.000) GO TC 120	EVIS 117
	IF (EPSIN(N).GE.EPSCUT(N)) GO TO 120	EVIS 118
	EVSCYT(N)=EPSIN(N)	EVIS 119
	GO TO 130	EVIS 120
120	OUT=1.000	EVIS 121
	EVSCYT(N)=EPSCUT(N)	EVIS 122
130	EPLUS(N)=EVSCYT(N)/XMU(N)	EVIS 123
140	CCATINUE	EVIS 124
	IF (PRT.NE.CCNST) CALL TRBPRL (TAU,RETHE7)	EVIS 125
	RETURN	EVIS 126
C		EVIS 127
	END	EVIS 128

SUBROUTINE EGPROP	EPRP	1
IMPLICIT REAL*8(A-H,O-Z)	EPRP	2
REAL*8 NOSE	EPRP	3
COMMON /BLUNT/ ZN(100),XR(100),RR(100),PED(100),UEB(100),TEB(100),EPRP	EPRP	4
1XMB(100),NBLUNT,NWEDGE,KWPLNB,NRPL1	EPRP	5
COMMON /LONIC/ PE(1),TE(1),UF(1),VF(1),DPEDW(1),DTEDW(1),DUEPRP	EPRP	6
1EDW(1),DVEDW(1),DPEPW(1),RWPE(1)	EPRP	7
COMMON /EDGE/ UFGG,TELG,VEGG,PEGG,DTFGDX,DTGGDW,DUEGGX,DUEGGW,DVEGGPRP	EPRP	8
1DX,DVEGG,DPEGGX,DPEGGW,DZPDW,RHODG,AMUDG,RQUDG	EPRP	9
COMMON /EDGW/ PEW,UEW,VFW,TEW,CPFWDX,DPEWDX,DUEWDX,DVEWDX,DEPRP	EPRP	10
1VEWDX,DTFWDX,DTEWDX,DPEWDX,RHCEW,AMUFW,NCMUW	EPRP	11
COMMON /EDGZ/ PEZ,TCZ,CLZ,VFZ,DPEZDX,DT CZDX,DUEZDX,DVEZDX,DPEZDW,DEPRP	EPRP	12
1UEZDW,DVEZDW,DTZDW,RHPLZ,KMUZ,RZ,RHGFZ,KEXZ	EPRP	13
COMMON /FINDIF/ A(101),RB(101),U(101),CC(101),DD(101),D(101),E(101)EPRP	EPRP	14

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11,CRI
COMMON /GEOM/ ALPHA,THFTAC,NCSE,RNOSE,WLST,X,XX,WX
COMMON /INTGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPR,KPR,EPRP 15
1LPR
COMMON /OLD/ TOLD(61),VOLD(61),CVOLD(61)
COMMON /GLD/ DG/ R3,UF3,KLMU3
COMMON /PIEF/ UREF,CREF
COMMON /POLYCC/ CPAIRL(6),CPAIRH(6),ENAIRL(6),ENAIRH(6),CMUAIR(6),EPRP 16
1CMUHE(6),DIFHE(6),CMUAR(6),DIFAR(6),CPCO2L(6),CPCO2H(6),ENCO2L(6),EPRP 17
2ENCO2H(6),CMUCO2(6),DIFCO2(6)
COMMON /SGLPNT/ CW(101),CWH(101),VW(101),CW(101),TW(101),GWN(101),EPRP 18
1FWN(101),FW(101),TWN(101),ZW(101),ZWN(101),XIW,OXDXIW,XW,RW
COMMON /STAG/ PSTAG,TSTAG,PNC,UNSTAG,MSTAG,Hc
COMMON /XICURD/ X1,XX1,CX1,X1LIO,DXCX1,DXDXX1
COMMON /XSOLVF/ XSTA(100),DXMAX,DX,DXOLD,DX1,NSJLVE
LATA BLUNT,SHARP/5HBLUNT,5HSHARP/
IF (NCSE.EQ.BLUNT) GO TO 40
C
C SHARP CODE EDGE QUANTITIES ARE OBTAINED
C
IF (1.GT.1) GC TC 20
AKK=1.000
DPEWDX=0.000
DTEWDX=0.000
DUWDX=0.000
DVEWDX=0.000
DPEWDX=0.000
CALL SHARP1 (AKK)
PE(K)=PELG
TE(K)=TELG
UE(K)=UELG
VE(K)=VELG
DPEW(K)=DPELGW
DTEW(K)=DTELGW
DUW(K)=DUELGW
DVEW(K)=DVELGW
DPEW2(K)=D2PEW2
RHEW(K)=RHELGW
IF (K.EQ.1) GC TO 10
IF (CRI.EQ.1.000) GO TO 10
CALL SHARP1 (CRI)
10
CONTINUE
PEW=PELG
UEW=UELG
VEW=VELG
TEW=TELG
DPEW=DUPELGW
DUW=DUPELGW
DVEW=DVELGW
DTEW=DTELGW
DPEW2=D2PEW2
RHEW=RHELGW
CALL PCLY (TEW,5,CMUAIR,AMUEW)
AMUEW=AMUEW*1.0-7
RCPW=RHEW*AMUEW
CONTINUE
PE2=PE(K)
TE2=TE(K)
UE2=UE(K)
VE2=VE(K)
DPE2W=DPEW(K)
DTE2W=DTEW(K)
DU2W=DUEW(K)
DVE2W=DVEW(K)
DPE2DX=DPEWDX
DTE2DX=DTEWDX
DU2DX=DUEWDX
DVE2DX=DVEWDX
D2PDW2=DPEW2(K)
RHE2=RHEW(K)
CALL PCLY (TE2,5,CMUAIR,AMUE2)
AMUE2=AMUE2*1.0-7
EPRP 19
EPRP 20
EPRP 21
EPRP 22
EPRP 23
EPRP 24
EPRP 25
EPRP 26
EPRP 27
EPRP 28
EPRP 29
EPRP 30
EPRP 31
EPRP 32
EPRP 33
EPRP 34
EPRP 35
EPRP 36
EPRP 37
EPRP 38
EPRP 39
EPRP 40
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EPRP 73
EPRP 74
EPRP 75
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EPRP 77
EPRP 78
EPRP 79
EPRP 80
EPRP 81
EPRP 82
EPRP 83
EPRP 84
EPRP 85

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	RCMU2=PHOE2*AMUE2	EPRP 86
	UEO=UE2	EPRP 87
	RCMUO=ROMU2	EPRP 88
	IF (L.EQ.1) GO TO 30	EPRP 89
	PEW=PE2	EPRP 90
	TEW=TE2	EPRP 91
	UEW=UE2	EPRP 92
	VEW=VE2	EPRP 93
	DPEWDX=DPE2DX	EPRP 94
	OTEWDX=OTE2DX	EPRP 95
	OUEWDX=OUE2DX	EPRP 96
	DUEWDX=DUE2DX	EPRP 97
	RHCEW=RHCE2	EPRP 98
	DPHDX=D2PDW2	EPRP 99
	AMUEW=AMUE2	EPRP 100
	RCMUW=ROMU2	EPRP 101
30	CONTINUE	EPRP 102
	IF (L.EQ.1) XX=X	EPRP 103
	IF (L.NE.1) XX=X-CX/2.000	EPRP 104
	CALL GMTRY (XX,R0,Z0)	EPRP 105
	CALL GMTRY (X,R2,Z2)	EPRP 106
	RW=R2	EPRP 107
	IF (CR1.LT.1.000) RW=R0	EPRP 108
	GO TO 80	EPRP 109
40	CONTINUE	EPRP 110
C		EPRP 111
C	BLUNT CONE EDGE QUANTITIES ARE OBTAINED	EPRP 112
C		EPRP 113
	X1=X	EPRP 114
	XX=X	EPRP 115
	ISNT=1	EPRP 116
	IF (IND.EQ.1) CALL BLUNT1	EPRP 117
	IF (IND.EQ.2) CALL BLUNT2 (ISNT)	EPRP 118
	PE2=PE0G	EPRP 119
	TE2=TE0G	EPRP 120
	UE2=UE0G	EPRP 121
	VE2=VE0G	EPRP 122
	DPE2DX=DPEGDX	EPRP 123
	OTE2DX=OTEGDX	EPRP 124
	DUE2DX=DUPEGDX	EPRP 125
	OUE2DX=OUEGDX	EPRP 126
	DPE2DX=DPEGDX	EPRP 127
	OTE2DX=OTEGDX	EPRP 128
	DUE2DX=DUPEGDX	EPRP 129
	OUE2DX=OUEGDX	EPRP 130
	RHCE2=RHCE0G	EPRP 131
	CALL PGLY (TE2,5,CMUAIR,AMUE2)	EPRP 132
	AMUE2=AMUE2*1.0-7	EPRP 133
	RCMU2=RCMU2*AMUE2	EPRP 134
	UEO=UE2	EPRP 135
	RCMUO=ROMU2	EPRP 136
	IF (CR1.LT.1.000) GO TO 50	EPRP 137
	PEW=PE2	EPRP 138
	TEW=TE2	EPRP 139
	UEW=UE2	EPRP 140
	VEW=VE2	EPRP 141
	DPEWDX=DPE2DX	EPRP 142
	OTEWDX=OTE2DX	EPRP 143
	OUEWDX=OUE2DX	EPRP 144
	DUEWDX=DUE2DX	EPRP 145
	DPEWDX=DPE2DX	EPRP 146
	OTEWDX=OTE2DX	EPRP 147
	DUEWDX=DUE2DX	EPRP 148
	OUEWDX=OUE2DX	EPRP 149
	RHCEW=RHCE2	EPRP 150
	AMUEW=AMUE2	EPRP 151
	RCMUW=ROMU2	EPRP 152
	DPHDX=D2PDW2	EPRP 153
50	CALL GMTRY (X,R2,Z2)	EPRP 154
	IF (L.EQ.1) GO TO 60	EPRP 155
	ISNT=2	EPRP 156

	X=X-DX/2.000	EPRP 157
	XX=X	EPRP 158
	IF (IND.EQ.1) CALL BLUNT1	EPRP 159
	IF (IND.EQ.2) CALL BLUNT2 (ISNT)	EPRP 160
	UEO=UEDG	EPRP 161
	CALL POLY (TEDG,5,CMUAIR,AMUEEG)	EPRP 162
	AMUEEG=AMUEEG*1.0-7	EPRP 163
	ROMUEG=RHOCUG*AMUEEG	EPRP 164
	ROMUO=ROMUEG	EPRP 165
	IF (CRI.EQ.1.000) GO TO 60	EPRP 166
	PEH=PEEG	EPRP 167
	TEH=TEEG	EPRP 168
	UEH=UEEG	EPRP 169
	VEH=VEEG	EPRP 170
	OPENCX=OPEGDX	EPRP 171
	OTENDX=OTECDX	EPRP 172
	DUENDX=DUFGDX	EPRP 173
	DVEWDX=DVEGDX	EPRP 174
	DPEWDH=DPEGDH	EPRP 175
	OTENDH=OTEGDH	EPRP 176
	DUEWDH=DUEGDH	EPRP 177
	DVEWDH=DVEGDH	EPRP 178
	DPHDW2=DZPDW2	EPRP 179
	RHCEW=PHOEG	EPRP 180
	CALL POLY (TEH,5,CMUAIR,AMUEH)	EPRP 181
	AMUEH=AMUEH*1.0-7	EPRP 182
	ROMUH=RHCEW*AMUEH	EPRP 183
60	CCATINUE	EPRP 184
	CALL GMTRY (XX,PQ,ZO)	EPRP 185
	X=X1	EPRP 186
	IF (IND.EQ.2) GO TO 80	EPRP 187
	IF (X.LT.XB(NBLPL1),CR.X.GT.XB(NWPLNB)) GO TO 80	EPRP 188
	DO 70 J=NBLPL1,NWPLNB	EPRP 189
	IF (X.NE.XB(J)) GO TO 70	EPRP 190
	N=J-NBLUNT	EPRP 191
	TCLU(N)=T(2	EPRP 192
	VOLO(N)=UE2	EPRP 193
	CVCLD(N)=VE2	EPRP 194
70	CCATINUE	EPRP 195
80	CCATINUE	EPRP 196
C		EPRP 197
C	PROPERTIES AT THE BOUNCARY LAYER EDGE ARE CALCULATED	EPRP 198
	IF (NOSE.EQ.BLUNT.AND.L.EQ.1) PNC=DSORT(2.000*RHOE2*DUE2DX/AMUE2)	EPRP 199
	IF (L.EQ.1.OR.K.GT.1) GO TO 90	EPRP 200
C		EPRP 201
C	THE VALUE OF X1 IS INTEGRATED TO X USING THE STEP-AT-A-TIME	EPRP 202
C	SIMPSONS FORMULA FOR INTEGRATION OF AN INDEFINITE INTEGRAL	EPRP 203
C		EPRP 204
	DX1=DX/6.000*(UE2*ROMU2*K2**2+4.000*UEO*ROMUO*R0**2+UE3*ROMU3*R3**2)	EPRP 205
12)		EPRP 206
	X1=XICLD+DX1	EPRP 207
	DXCX1=1.000/(ROMU2*UE2*R2**2)	EPRP 208
	XX1=XICLD+DX/24.000*(5.000*UE3*ROMU3*R3**2+6.000*UEO*ROMUO*R0**2+UE2*ROMU2*K2**2)	EPRP 209
	XICLD=X1	EPRP 210
	DXDXX1=1.000/(ROMU3*UEO*R0**2)	EPRP 211
90	CCATINUE	EPRP 212
	IF (K.GT.1) GO TO 100	EPRP 213
	CREF=ROMUH	EPRP 214
	UREF=UFH	EPRP 215
	R3=K2	EPRP 216
	UE3=UE2	EPRP 217
	ROMU3=ROMU2	EPRP 218
100	CCATINUE	EPRP 219
	IF (NOSE.EQ.SPAPP) GO TO 110	EPRP 220
	DPEWDX=DPE2DX*DXDXX1	EPRP 221
	OTENDX=OTE2DX*DXDXX1	EPRP 222
	DUEWDX=DUE2DX*DXDXX1	EPRP 223
	DVEWDX=DVE2DX*DXDXX1	EPRP 224
	DPE2DX=DPE2DX*DXDXX1	EPRP 225
		EPRP 226
		EPRP 227

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DTF2DX=DTE2DX*DXDXI      EPRP 228
DUE2DX=DUE2DX*DXDXI      EPRP 229
DVE2DX=DVE2DX*DXDXI      EPRP 230
110 CCATINUE                EPRP 231
    IF (L.EQ.1) GO TO 120  EPRP 232
    Xh=X-DX*(1.000-CRI)    EPRP 233
    CALL GMTRY (Xh,RW,ZDUM) EPRP 234
    XIW=XI                  EPRP 235
    DXCXIW=DXDXI           EPRP 236
    IF (CRI.EQ.1.000) GO TO 120 EPRP 237
    XIW=XXI                EPRP 238
    DXDXIW=DXDXXI          EPRP 239
120 CALL EDGCOF             EPRP 240
    RETURN                  EPRP 241
    END                     EPRP 242

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SUBROUTINE ENERGY          ENGY 1
IMPLICIT REAL*8(A-H,O-Z)   ENGY 2
REAL*8 NOSE,LEWLAN,LEWTRB  ENGY 3
COMMON /FKSTRM/ PHOINF,PINF,TFS,UFS,P,PRL,Q,XMA  ENGY 4
COMMON /GASPRP/ LEWLAN(101),LEWTRB(101),PRANDL(101),PRANDT(101),CPENGY 5
1(101),GAMMA(101),XMU(101),PHC(101),HSUM(101)  ENGY 6
COMMON /GEOM/ ALPHA,THETAC,NCSE,RNGSE,WLST,X,XX,XX  ENGY 7
COMMON /IECCF/ B1,B2,B3,G1,G2,F1,F2,DE,AL,EPS,CHI,WINDPY,UI  ENGY 8
COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNTI,IND,KPRT,LPRT,KPR,ENGY 9
ILPR                        ENGY 10
COMMON /PDECCF/ A0(101),A1(101),A2(101),A3(101),A4(101),A5(101)  ENGY 11
COMMON /SOLPNT/ CW(101),CWN(101),VW(101),GW(101),TW(101),GWN(101),FNGY 12
1FWN(101),FW(101),TWN(101),ZW(101),ZWN(101),XIW,DXDXIW,XW,RW  ENGY 13
COMMON /TRANSN/ KTRANS,KCNSRT,XIF,CHI2(101),CHIMAX,XBAR  ENGY 14
COMMON /TRBLAT/ ASTAR,AKSTAR,ALAMDA,YSUBL,EVSCTY(101),PRT,EDYLAN,EEENGY 15
1PLUS(101),ALET,LAMTRB  ENGY 16
COMMON /XICURD/ XI,XXI,DAL,XICLC,DXDXI,DXDXXI  ENGY 17
COMMON /ZCQIND/ FIATNF,ETAFAC,ETA(101),DETA(101),ADTFST,KADETA  ENGY 18
DIMENSION RCMU1(101),RCMUIN(101),RCMU2(101),RCMU3(101),RCMU3N(ENGY 19
1101)  ENGY 20
DIMENSION ROMUZN(101)      ENGY 21
DIMENSION FWN(101),GWN(101)  ENGY 22
DATA SHARP,BLUNT,SHSHARP,SHBLUNT/  ENGY 23
C                                ENGY 24
C SUBROUTINE ENERGY SETS UP THE COEFFICIENTS OF THE PARTIAL  ENGY 25
C DIFFERENTIAL ENERGY EQUATION  ENGY 26
C                                ENGY 27
DO 10 J=1,IF               ENGY 28
RCMU1(J)=CW(J)/PRANDL(J)*(1.000+XIF*EPLUS(J)*PRANDL(J)/PRANDT(J))  ENGY 29
RCMU2(J)=CW(J)/PRANDL(J)*(1.000+XIF*EPLUS(J)*PRANDL(J)/PRANDT(J))-ENGY 30
1CW(J)*(1.000+XIF*EPLUS(J))  ENGY 31
RCMU3(J)=(CW(J)/PRANDL(J))*((LEWLAN(J)*XIF*EPLUS(J)*PRANDL(J)/PRANDENGY 32
1T(J)+(TBLAT(J))-(1.000+XIF*EPLUS(J)*PRANDL(J)/PRANDT(J)))*HSUM(J)ENGY 33
2*ZWN(J)  ENGY 34
10 CCATINUE                ENGY 35
CALL DERIV (RCMU1,ETA,IE,1,RCMUIN)  ENGY 36
CALL DERIV (RCMU2,ETA,IE,1,RCMU2N)  ENGY 37
CALL DERIV (RCMU3,ETA,IE,1,RCMU3N)  ENGY 38
CALL DERIV (FWN,ETA,IE,1,FWN)  ENGY 39
CALL DERIV (GWN,ETA,IE,1,GWN)  ENGY 40
DO 20 J=1,IE               ENGY 41
A0(J)=RCMU1(J)*UI          ENGY 42
A1(J)=RCMUIN(J)*UI-VW(J)  ENGY 43
A2(J)=U.ORD                ENGY 44
A3(J)=-B3*UI*(RCMU2(J)*(FWN(J)**2+FW(J)*FWNN(J)+GWN(J)**2+GW(J)*GWNENGY 45
1N(J))+RCMU2N(J)*(FW(J)*FWN(J)+GW(J)*GWN(J)))+RCMU3N(J)*UI  ENGY 46
IF (K.EQ.1) A3(J)=-B3*(RCMU2(J)*(FWN(J)**2+FW(J)*FWNN(J))+RCMU2N(JENGY 47
1)*(FW(J)*FWN(J))+RCMU3N(J))  ENGY 48
A4(J)=-2.000*XIW*FW(J)    ENGY 49
A5(J)=-DE*GW(J)           ENGY 50
IF (K.EQ.1) A5(J)=0.000  ENGY 51

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20	CCNTINUE	ENGY	52
	RETURN	ENGY	53
	END	ENGY	54

	SUBROUTINE FD3 (X,X1,X2,X3,F1,F2,F3,FX)	FD3	1
	IMPLICIT REAL*8 (A-H,O-Z)	FD3	2
C		FD3	3
C	SUBROUTINE FD3 CALCULATES THE FIRST DERIVATIVE-FX-CORRESPONDING	FD3	4
C	TO POINT X USING 3 POINT LAGRANGIAN DIFFERENTIATION FORMULA.	FD3	5
C		FD3	6
C	ASSUMES X1 .LE. X .LE. X3.	FD3	7
C		FD3	8
	A1=2.0*X-X2-X3	FD3	9
	A2=2.0*X-X1-X3	FD3	10
	A3=2.0*X-X1-X2	FD3	11
	D1=(X1-X2)*(X1-X3)	FD3	12
	D2=(X2-X1)*(X2-X3)	FD3	13
	D3=(X3-X1)*(X3-X2)	FD3	14
	C1=A1/D1	FD3	15
	C2=A2/D2	FD3	16
	C3=A3/D3	FD3	17
	FX=C1*F1+C2*F2+C3*F3	FD3	18
	RETURN	FD3	19
	END	FD3	20

	SUBROUTINE FD5 (X,X1,X2,X3,X4,X5,F1,F2,F3,F4,F5,FX)	FD5	1
	IMPLICIT REAL*8 (A-H,O-Z)	FD5	2
C		FD5	3
C	SUBROUTINE FD5 CALCULATES THE FIRST DERIVATIVE-FX-CORRESPONDING	FD5	4
C	TO POINT X USING 5 POINT LAGRANGIAN DIFFERENTIATION FORMULA	FD5	5
C		FD5	6
C	ASSUMES X1 .LE. X .LE. X5.	FD5	7
C		FD5	8
	A1=(X-X4)*(X-X5)*(2.0*X-X2-X3)*(X-X2)*(X-X3)*(2.0*X-X4-X5)	FD5	9
	A2=(X-X4)*(X-X5)*(2.0*X-X1-X3)*(X-X1)*(X-X3)*(2.0*X-X4-X5)	FD5	10
	A3=(X-X4)*(X-X5)*(2.0*X-X1-X2)*(X-X1)*(X-X2)*(2.0*X-X4-X5)	FD5	11
	A4=(X-X3)*(X-X5)*(2.0*X-X1-X2)*(X-X1)*(X-X2)*(2.0*X-X3-X4)	FD5	12
	A5=(X-X3)*(X-X4)*(2.0*X-X1-X2)*(X-X1)*(X-X2)*(2.0*X-X3-X4)	FD5	13
	D1=(X1-X2)*(X1-X3)*(X1-X4)*(X1-X5)	FD5	14
	D2=(X2-X1)*(X2-X3)*(X2-X4)*(X2-X5)	FD5	15
	D3=(X3-X1)*(X3-X2)*(X3-X4)*(X3-X5)	FD5	16
	D4=(X4-X1)*(X4-X2)*(X4-X3)*(X4-X5)	FD5	17
	D5=(X5-X1)*(X5-X2)*(X5-X3)*(X5-X4)	FD5	18
	C1=A1/D1	FD5	19
	C2=A2/D2	FD5	20
	C3=A3/D3	FD5	21
	C4=A4/D4	FD5	22
	C5=A5/D5	FD5	23
	FX=C1*F1+C2*F2+C3*F3+C4*F4+C5*F5	FD5	24
	RETURN	FD5	25
	END	FD5	26

	SUBROUTINE FCRIER (AR,BR,KL,KK)	FORI 1
C		FORI 2
C	BR IS THE OUTPUT ARRAY OF FOURIER COEFFICIENTS	FORI 3
C	KL IS THE NUMBER OF INPUT DATA POINTS	FORI 4
C	KK = 1 OUTPUTS COEFFICIENTS FOR A COSINE SERIES	FORI 5
C	KK = 2 OUTPUTS COEFFICIENTS FOR A SINE SERIES	FORI 6
C		FORI 7
C	AR IS THE INPUT ARRAY OF FUNCTION VALUES	FORI 8
	IMPLICIT REAL*8(A-H,O-Z)	FORI 9
	DIMENSION AR(15), BR(15)	FORI 10
	PI=DACOS(-1.000)	FORI 11
	G=DFLOAT(KL-1)	FORI 12
	FAC=2.000/G	FORI 13
	IF (KK.EQ.2) GO TO 30	FORI 14
	M=KL-1	FORI 15
	DO 20 N=1,KL	FORI 16
	F=DFLOAT(N-1)	FORI 17
	A=C.000	FORI 18
	DO 10 K=2,M	FORI 19
	E=DFLOAT(K-1)	FORI 20
	A=A+AR(K)*DCOS(F*PI*E/G)	FORI 21
10	CCATINUE	FORI 22
	BR(N)=FAC*((I(AR(1)+AR(KL)*DCOS(F*PI)))/2.000)+A)	FORI 23
20	CCNTINUE	FORI 24
	BR(1)=BR(1)/2.000	FORI 25
	BR(KL)=BR(KL)/2.000	FORI 26
	RETURN	FORI 27
30	CCNTINUE	FORI 28
	DC 50 N=1,M	FORI 29
	F=DFLOAT(N)	FORI 30
	B=0.000	FORI 31
	DC 40 K=2,M	FORI 32
	E=DFLOAT(K-1)	FORI 33
	B=B+AR(K)*DSIN(F*PI*E/G)	FORI 34
40	CCATINUE	FORI 35
	BR(N)=FAC*B	FORI 36
50	CCATINUE	FORI 37
	RETURN	FORI 38
	END	FORI 39

	SUBROUTINE GMTY (X,R,Z)	GMTY	1
	IMPLICIT REAL*8(A-M,O-Z)	GMTY	2
	REAL*8 NUSE	GMTY	3
	CCPMON /BLUNT/ ZP(100),XB(100),XB(100),PEB(100),UEB(100),TEB(100),GMTY	4	
	1XMB(100),NBLUNT,NWEDGE,NWPLNR,NBLPL1	GMTY	5
	CCPMON /GCM/ ALPHA,THETAC,NCSE,RNOSF,WLST,DUM1,XX,XX	GMTY	6
	CCPMON /INTEGR/ IE,IN,KEND,KEND2,KLX,K,L,NHLNT1,IND,KPRT,LPRT,KPR,GMTY	7	
	1LPR	GMTY	8
	DATA BLUNT,SHARP/SHBLUNT,SHSHARP/	GMTY	9
	PI=CARCOS(-1.300)	GMTY	10
	IF (NCSE.EC.BLUNT) GO TO 10	GMTY	11
	R=X*DSIN(THETAC)	GMTY	12
	Z=X*CCOS(THETAC)	GMTY	13
	RETURN	GMTY	14
10	IF (IND.EQ.2) GO TO 30	GMTY	15
20	BETA=X/RNCSF	GMTY	16
	Z=RNCSF-RNCSF*DCOS(BETA)	GMTY	17
	R=RNCSF*DSIN(BETA)	GMTY	18
	RETURN	GMTY	19
30	XJUNCT=RNOSF*(PI/2.000-THETAC)	GMTY	20
	IF (X.GT.XJUNCT) GO TO 40	GMTY	21
	GO TO 20	GMTY	22
40	RJUNCT=RNOSF*DSIN(PI/2.000-THETAC)	GMTY	23
	ZJUNCT=RNCSF-RNCSF*DCOS(PI/2.000-THETAC)	GMTY	24
	R=RJUNCT*(X-XJUNCT)*DSIN(THETAC)	GMTY	25
	Z=ZJUNCT*(X-XJUNCT)*DCOS(THETAC)	GMTY	26
	RETURN	GMTY	27
	END	GMTY	28

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SUBROUTINE INIT                                INIT 1
IMPLICIT REAL*8 (A-H,O-Z)                     INIT 2
REAL*8 NUSE,LEWLAM,LEWTRB                     INIT 3
COMMON /ASSVAR/ TFL,KHL                        INIT 4
COMMON /BLUNT/ ZR(100),XR(100),RR(100),PEB(100),UEB(100),TEB(100),INIT 5
1XMB(100),NBLUNT,NWEDGE,NWPLNR,NBLPL1        INIT 6
COMMON /CCNVRG/ CCNV,NIT1,NIT2,NIT3,NIT       INIT 7
COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,INIT 8
101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YCINIT 9
2L(101),RCRCL(101)                            INIT 10
COMMON /FRSTPM/ RMCINF,PINF,TFS,UFS,K,PRL,Q,XMA INIT 11
COMMON /GASMP/ LFWLAP(101),LFWTRB(101),PRANDL(101),PRANDT(101),CPINIT 12
1(101),GAMMA(101),X*U(101),P*U(101),H*U(101) INIT 13
COMMON /GLCM/ ALPHA,THETAC,NLSF,MNSE,WLST,X,XX,XX INIT 14
COMMON /INJECT/ INJCT,NINJ,GAS2,CCL,MASTRN    INIT 15
COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,INIT 16
1LPP                                             INIT 17
COMMON /PLOTS/ PLOT,KPLCT(4),I PLOT(4),KPRFL(4),LPRFL(4),APTS(4,2) INIT 18
COMMON /SOLPNT/ CW(101),CN(101),VW(101),GW(101),TW(101),GWN(101),INIT 19
1FWN(101),FW(101),TWN(101),ZW(101),ZWN(101),XIW,OXOXIW,XW,RW INIT 20
COMMON /SPWBC/ WALL,ZWCLD,BIDIFW,AMOOTW,S INLT,ZWPOS,ZWNEG,AMWNEGINIT 21
1,AKWPOS,WALLV,ZWZERO,NITCG                     INIT 22
COMMON /SURFAS/ CWALL,CWINO,PEWINO,VWALL,TWALL,XTW(500),TWX(500),XINIT 23
1CI(500),CIX(500),HWALL,TCCNW,KCI,KTW          INIT 24
COMMON /TRANS/ KTRANS,KCNSET,XIF,CHI2(101),CHIPAX,XPAR INIT 25
COMMON /TRBLNT/ ASTA,AKSTAK,ALAMDA,YSURL,EVSCTY(101),PRT,EDYLAWEINIT 26
1PLUS(101),ALET,LAMTRB                         INIT 27
COMMON /TMPRT/ TEMP(101),TOTE(101),TP(101),RTW,TB INIT 28
COMMON /WSOLVE/ DW                             INIT 29
COMMON /XICORD/ XI,XXI,DXI,XICLD,DXDXI,DXDXXI INIT 30
COMMON /XSOLVE/ XSTA(100),DXMAX,DX,DXOLD,DXI,NSOLVE INIT 31
COMMON /ZCCORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA INIT 32
DATA BLUNT,SHARP,5HBLUNT,5HSHARP/              INIT 33
IF (NCSE.EQ.SHARP.AND.ALPHA.EQ.C.CC) GO TO 10    INIT 34
READ (10)'Q,R,THET1,ALPHA,XMA,KLX              INIT 35
THETAC=THET1*CAFCCS(-1.000)/180.000           INIT 36
ALPHA=ALPHA*CARCCS(-1.000)/180.000             INIT 37
WLST=DARCUS(-1.000)                            INIT 38
ZWCLD=1.000                                     INIT 39
SIALST=0.000                                    INIT 40
X=C.CC0                                         INIT 41
DX=DX1                                          INIT 42
XX=0.000                                        INIT 43
XI=0.000                                        INIT 44
DXI=C.CC0                                       INIT 45
DXCXI=0.000                                    INIT 46
XXI=0.000                                      INIT 47
DXDXXI=0.000                                  INIT 48
XII=0.000                                      INIT 49
DXDXI=0.000                                   INIT 50
RW=0.000                                       INIT 51
XW=0.000                                       INIT 52
XICLD=0.000                                    INIT 53
DXCLD=DX                                       INIT 54
XIF=0.000                                      INIT 55
IF (LAMTRB.EQ.2) XIF=1.000                    INIT 56
CWIND=CWALL                                    INIT 57
VWALL=0.000                                    INIT 58
DO 30 J=1,4                                    INIT 59
DO 20 I=1,2                                    INIT 60
20 NPTS(J,I)=0                                INIT 61
30 CCNTINUE                                    INIT 62
DO 40 I=1,100                                  INIT 63
XB(I)=1000.000                                INIT 64
40 CCNTINUE                                    INIT 65
DO 50 N=1,11                                    INIT 66
PRANDL(N)=0.71                                 INIT 67
PRANDT(N)=C.9CC                                INIT 68
EPLUS(N)=0.000                                 INIT 69
LEWLAM(N)=1.000                                INIT 70
LEWTRB(N)=ALET                                 INIT 71

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	CHI2(N)=0.000	INIT	72
	GAMMA(N)=0	INIT	73
	CP(N)=Q/(Q-1.000)*R	INIT	74
50	EVSCTY(N)=0.000	INIT	75
	IND=1	INIT	76
	IF (NOSE.EQ.SHARP) IND=2	INIT	77
	NBLNT1=1	INIT	78
	NWPLNB=1	INIT	79
	KBL=1	INIT	80
	L=0	INIT	81
	NIT=0	INIT	82
	LPR=LPR1	INIT	83
	KEND=KEND2	INIT	84
	IF (NOSE.EQ.PLUNT) KEND=1	INIT	85
	IM=IE-1	INIT	86
	DW=1.000	INIT	87
	DETA(1)=0.000	INIT	88
	ETA(1)=0.000	INIT	89
	ETA(IE)=ETAINF	INIT	90
	IF (ETAFAC.LC.1.000) GC TC 60	INIT	91
	DETA(2)=ETAINF*(ETAFAC-1.000)/(ETAFAC**IM-1.000)	INIT	92
	GO TC 70	INIT	93
60	DETA(2)=ETAINF/DFLOAT(IM)	INIT	94
70	ETA(2)=DETA(2)	INIT	95
	DO 80 I=3,IM	INIT	96
	DETA(I)=ETAFAC*DETA(I-1)	INIT	97
	ETA(I)=ETA(I-1)+DETA(I)	INIT	98
80	CONTINUE	INIT	99
	DETA(IE)=DETA(IM)*ETAFAC	INIT	100
	WINDPT=0.07500	INIT	101
	IF (ALPHA.EQ.C.000) WINDPT=0.000	INIT	102
	IF (NOSE.EQ.BLUNT) WINDPT=C.000	INIT	103
C		INIT	104
C	CALCULATE INITIAL PROFILES	INIT	105
C		INIT	106
	DC 110 I=1,2	INIT	107
	DC 100 N=1,3	INIT	108
	DO 90 J=1,IE	INIT	109
	F(I,J,N)=1.000-DEXP(-ETA(J))	INIT	110
	G(I,J,N)=WINDPT*F(I,J,N)	INIT	111
	T(I,J,N)=RTW*(1.000-RTW)*F(I,J,N)	INIT	112
	Z(I,J,N)=1.000	INIT	113
	ZN(I,J,N)=C.000	INIT	114
90	CONTINUE	INIT	115
100	CONTINUE	INIT	116
110	CONTINUE	INIT	117
	DO 120 J=1,IE	INIT	118
	Y(J)=C.000	INIT	119
	YOL(J)=0.000	INIT	120
	GW(J)=G(2,J,1)	INIT	121
	FN(J)=F(1,J,2)	INIT	122
120	CONTINUE	INIT	123
	DO 140 I=1,2	INIT	124
	DO 130 N=1,3	INIT	125
	CALL DERIV3 (F,I,N,ETA,IF,1,FN)	INIT	126
	CALL DERIV3 (G,I,N,ETA,IE,1,GN)	INIT	127
	CALL DERIV3 (T,I,N,ETA,IE,1,TN)	INIT	128
130	CONTINUE	INIT	129
140	CONTINUE	INIT	130
	RETURN	INIT	131
	ENC	INIT	132

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SUBROUTINE INPUT
IMPLICIT REAL*8 (A-H,O-Z)
REAL*8 NOSE
COMMON /CONVPG/ CCNV,NIT1,NIT2,NIT3,NIT
COMMON /EDGE/ UEDG,TECG,VEDG,PEDG,DTEGDW,DUEGDW,OVEGDW,OVEG
ICX,DVEGDW,CPEGDW,IPEDGW,C2PDW2,PHOEIG,AMUGG,PUMUEG
COMMON /FINDIF/ A(101),B(101),C(101),CC(101),DD(101),D(101),F(101)
1),CRI
COMMON /FRSTRM/ RHOINF,PINF,TFS,UFS,R,PRL,C,XMA
COMMON /GEOM/ ALPHA,THETAG,ACSE,KNUSE,WLST,X,XX,WX
COMMON /INJECT/ INJCT,NCINJ,GASZ,CICL,MASTRN
COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,
ILPR
COMMON /PLOTS/ PLJT,KPLCT(4),IPLGT(4),KPRFL(4),LPRL(4),NPTS(4,2)
COMMON /STAG/ PSTAG,TSTAG,PNC,QWSTAG,HSTAG,HE
COMMON /SURFAS/ CWALL,CWIND,PEWIND,VWALL,TWALL,XTW(500),TWX(500),XINPT
IC(500),CIX(500),HWALL,ICCNW,KCI,KTW
COMMON /THERPC/ PCOP,VALUE
COMMON /TITLE/ LABEL(20)
COMMON /TMPTRP/ TCMPL(101),TOTE(101),TP(101),RTW,TB
COMMON /TRANS/ KTRANS,KUNSET,XIF,CH12(101),CHIMAX,XBAR
COMMON /TPPLAT/ ASTAR,AKSTAR,ALAMDA,YSUBL,EVSCTY(101),PRT,EDYLAW,E
1PLUS(101),ALET,LANTRH
COMMON /UNITIG/ CXINVS,DISK
COMMON /XSGIVE/ XSTA(100),DXMAX,DX,DXOLD,DXI,NSOLVE
COMMON /ZCCORD/ ETAINF,ETAFAC,ETA(101),DELTA(101),ADTEST,KADETA
DIMENSION STRING(20)
DATA BLUNT,SHARP/5HBLUNT,5HSHARP/
DATA ROIN/4HRHGI/,PIN/4HPINF/
C
C THE INPUT QUANTITIES ARE READ IN
C
J=69
10 READ (5,160,END=20) (STRING(IPOS),IPOS=1,20)
WRITE (J,160) (STRING(IPCS),IPCS=1,20)
GC TO 10
20 ENC FILE J
REWIND J
READ (J,160) LABEL
READ (J,100) IE
READ (J,100) INJCT
READ (J,100) KADETA
READ (J,100) KEND2
READ (J,100) KUNSET
READ (J,100) KPRT
READ (J,100) KTRANS
READ (J,100) LANTRH
READ (J,100) LPRT
READ (J,100) NIT1
READ (J,100) NIT2
READ (J,100) NIT3
READ (J,100) NCINJ
READ (J,100) NOSE
READ (J,100) NSOLVE
READ (J,90) (KPLCT(I),I=1,4)
READ (J,90) (KPRFL(I),I=1,4)
READ (J,90) (IPLGT(I),I=1,4)
READ (J,90) (LPRL(I),I=1,4)
READ (J,110) AUTEST
READ (J,110) AKSTAR
READ (J,110) ALAMDA
READ (J,110) ALET
READ (J,110) ALPHA
READ (J,110) ASTAR
READ (J,170) COCL
READ (J,110) CWALL
READ (J,120) CRI
READ (J,110) CONV
READ (J,130) DISK
READ (J,110) DXINVS
READ (J,110) DXMAX
INPT 1
INPT 2
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READ (J,120) DX1	INPT 72
READ (J,170) EDYLAH	INPT 73
READ (J,110) ETAFAC	INPT 74
READ (J,110) ETAINF	INPT 75
READ (J,170) GAS2	INPT 76
READ (J,130) PLCT	INPT 77
READ (J,110) PKL	INPT 78
READ (J,150) PRT	INPT 79
READ (J,140) PRGP	INPT 80
READ (J,110) RTW	INPT 81
READ (J,110) TFS	INPT 82
READ (J,110) TSTAG	INPT 83
READ (J,110) VALUE	INPT 84
READ (J,110) XBAR	INPT 85
IF (NOSE.EQ.SHARP) GO TO 30	INPT 86
READ (J,110) RNOSE	INPT 87
30 CCNTINUE	INPT 88
IF (NOSE.EQ.BLUNT) GO TO 40	INPT 89
IF (ALPHA.GT.0.000) GO TO 40	INPT 90
READ (J,110) C	INPT 91
READ (J,110) R	INPT 92
READ (J,110) THET1	INPT 93
READ (J,110) XMA	INPT 94
READ (J,110) PCOG	INPT 95
READ (J,110) UEDG	INPT 96
READ (J,110) TEDG	INPT 97
READ (J,110) RHCEGD	INPT 98
THETAC=THET1*CAPCOS(-1.000)/180.000	INPT 99
ALPHA=ALPHA*CARCOS(-1.000)/180.000	INPT 100
40 CCNTINUE	INPT 101
DO 50 I=1,NSOLVE	INPT 102
READ (J,80) XSTA(I)	INPT 103
50 CCNTINUE	INPT 104
KTB=0	INPT 105
KCI=0	INPT 106
I=0	INPT 107
60 I=I+1	INPT 108
READ (J,180,END=70) XTB(I),TBX(I),XCI(I),CIX(I)	INPT 109
IF (XTW(I).EQ.0.000) XTW(I)=XCI(I)	INPT 110
IF (XCI(I).EQ.0.000) XCI(I)=XTW(I)	INPT 111
IF (CIX(I).EQ.0.000.AND.KCI.EQ.0) KCI=I-1	INPT 112
GO TO 60	INPT 113
70 KTB=I-1	INPT 114
IF (KCI.EQ.0) KCI=I-1	INPT 115
REWIND J	INPT 116
MASTRN=0	INPT 117
IF (KONSET.EQ.0) KONSET=NSOLVE	INPT 118
IF (LAMTPB.EQ.2) KONSET=NSOLVE	INPT 119
IF (INJCT.EQ.C) INJCT=NSOLVE	INPT 120
IF (NCSE.EQ.SHARP.AND.INJCT.EQ.1) INJCT=2	INPT 121
IF (INJCT.EQ.1) MASTRN=1	INPT 122
IF (MASTRN.EQ.1) INJCT=NSOLVE	INPT 123
IF (NOINJ.EQ.0) NCINJ=NSOLVE	INPT 124
C	INPT 125
C	INPT 126
RETURN	INPT 127
C	INPT 128
C	INPT 129
C	INPT 130
80 FORMAT (2F12.6)	INPT 131
90 FCRMAT (49X,4I3)	INPT 132
100 FORMAT (49X,I3)	INPT 133
110 FCRMAT (49X,E14.6)	INPT 134
120 FORMAT (49X,F5.3)	INPT 135
130 FCRMAT (49X,A2)	INPT 136
140 FCRMAT (49X,A4)	INPT 137
150 FORMAT (49X,A5)	INPT 138
160 FORMAT (20A4)	INPT 139
170 FCRMAT (49X,A3)	INPT 140
180 FCRMAT (4E12.6)	INPT 141
END	INPT 142

C	SUBROUTINE INTER3 (X,X1,X2,X3,F1,F2,F3,F)	NTR3	1
C	IMPLICIT REAL*8(A-H,O-Z)	NTR3	2
C		NTR3	3
C	SUBROUTINE INTER3 INTERPOLATES FOR THE VALUE F CORRESPONDING TO	NTR3	4
C	POINT X USING 3 POINT LAGRANGIAN INTERPOLATION.	NTR3	5
C		NTR3	6
C	ASSUMES X1 .LE. X .LE. X3.	NTR3	7
		NTR3	8
	A1=(X-X2)*(X-X3)	NTR3	9
	A2=(X-X1)*(X-X3)	NTR3	10
	A3=(X-X1)*(X-X2)	NTR3	11
	D1=(X1-X2)*(X1-X3)	NTR3	12
	D2=(X2-X1)*(X2-X3)	NTR3	13
	D3=(X3-X1)*(X3-X2)	NTR3	14
	C1=A1/D1	NTR3	15
	C2=A2/D2	NTR3	16
	C3=A3/D3	NTR3	17
	F=C1*F1+C2*F2+C3*F3	NTR3	18
	RETURN	NTR3	19
	END	NTR3	20

C	SUBROUTINE INTER5 (X,X1,X2,X3,X4,X5,F1,F2,F3,F4,F5,F)	NTR5	1
C	IMPLICIT REAL*8 (A-H,O-Z)	NTR5	2
C		NTR5	3
C	SUBROUTINE INTER5 INTERPOLATES FOR THE VALUE F CORRESPONDING TO	NTR5	4
C	POINT X USING 5 POINT LAGRANGIAN INTERPOLATION FORMULA.	NTR5	5
C		NTR5	6
C	ASSUMES X1 .LE. X .LE. X5.	NTR5	7
		NTR5	8
	A1=(X-X2)*(X-X3)*(X-X4)*(X-X5)	NTR5	9
	A2=(X-X1)*(X-X3)*(X-X4)*(X-X5)	NTR5	10
	A3=(X-X1)*(X-X2)*(X-X4)*(X-X5)	NTR5	11
	A4=(X-X1)*(X-X2)*(X-X3)*(X-X5)	NTR5	12
	A5=(X-X1)*(X-X2)*(X-X3)*(X-X4)	NTR5	13
	D1=(X1-X2)*(X1-X3)*(X1-X4)*(X1-X5)	NTR5	14
	D2=(X2-X1)*(X2-X3)*(X2-X4)*(X2-X5)	NTR5	15
	D3=(X3-X1)*(X3-X2)*(X3-X4)*(X3-X5)	NTR5	16
	D4=(X4-X1)*(X4-X2)*(X4-X3)*(X4-X5)	NTR5	17
	D5=(X5-X1)*(X5-X2)*(X5-X3)*(X5-X4)	NTR5	18
	C1=A1/D1	NTR5	19
	C2=A2/D2	NTR5	20
	C3=A3/D3	NTR5	21
	C4=A4/D4	NTR5	22
	C5=A5/D5	NTR5	23
	F=C1*F1+C2*F2+C3*F3+C4*F4+C5*F5	NTR5	24
	RETURN	NTR5	25
	END	NTR5	26

	SUBROUTINE LEGEND (JCURVF,XAL,YAL)	LGND	1
	COMMON /LEGRL/ LGND,ISLBI,IUNIT,KTITLE	LGND	2
	COMMON /PRFILE/ XC,PHI	LGND	3
	DIMENSION XC(5), PHI(5)	LGND	4
	DIMENSION RGMESM(15)	LGND	5
	DIMENSION FLPA(5)	LGND	6
	DATA KC4ESH/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,2H&A,2H&B,2H&C,2H&D,2H&E,2H&F/	LGND	7
	DATA LIST1/2H5=/,LIST2/3H7U=/	LGND	8
	DATA LIST3/4H5OL=/	LGND	9
	DX=0.30	LGND	10
	DY=-0.30	LGND	11
	IF (IUNIT.EQ.20) GO TO 40	LGND	12
	IF (IUNIT.EQ.14.OR.IUNIT.EQ.13) GO TO 20	LGND	13
	LEGARG=LIST1	LGND	14
		LGND	15

	LGCHAR=2	LGND 16
	NDECPL=3	LGND 17
	DC 10 M=1, JCURVE	LGND 18
10	FLPN(M)=XC(M)	LGND 19
	GO TO 60	LGND 20
20	LEGARG=LIST2	LGND 21
	LGCHAR=3	LGND 22
	NDECPL=1	LGND 23
	DC 30 M=1, JCURVE	LGND 24
30	FLPN(M)=PHI(M)	LGND 25
	GO TO 60	LGND 26
40	LEGARG=LIST3	LGND 27
	LGCHAR=4	LGND 28
	NDECPL=0	LGND 29
	CC 50 M=1, JCURVE	LGND 30
50	FLPN(M)=M	LGND 31
60	CCATINUE	LGND 32
	DX=DX+0.25	LGND 33
	CALL SYMBOL (XAL+DX,YAL+DY,,15,9H3#LEGEND2,0.0,9)	LGND 34
	DY=DY-0.2	LGND 35
	DX1=DX+0.05	LGND 36
	YAL=YAL+DY	LGND 37
	DY1=-0.3	LGND 38
	DO 70 MCALL=1, JCURVE	LGND 39
	DX=DX1	LGND 40
	DY=DY1	LGND 41
	ACALL=FLOAT(MCALL)	LGND 42
	DY=DY*ACALL	LGND 43
	CALL PLOT (XAL+DX,YAL+DY,3)	LGND 44
	CALL SYMBOL (XAL+DX,YAL+DY,,13,MCALL,0.0,-1)	LGND 45
	DX=DX+0.25	LGND 46
	DY=DY-0.05	LGND 47
	CALL SYMBOL (XAL+DX,YAL+DY,,13,LEGARG,0.0,LGCHAR)	LGND 48
	CALL WHERE (MCX,RCY)	LGND 49
	DX=-.15	LGND 50
	CALL NUMBER (RCX+CX,RCY,0.13,FLPN(MCALL),0.0,NDECPL)	LGND 51
70	CCATINUE	LGND 52
	RETURN	LGND 53
	END	LGND 54

	SUBROUTINE MAX (ARRAY,IELE,AMAX,KEX,NEXIND)	MAX 1
	CCPHON /EXPORT/ IJLOG	MAX 2
	DIMENSION ARRAY(IELE)	MAX 3
	NEXIND=1	MAX 4
	TMAX=ARRAY(1)	MAX 5
	DO 10 I=1,IELE	MAX 6
10	IF (ARRAY(I).LT.TMAX) TMAX=ARRAY(I)	MAX 7
	IF (TMAX.GT.C.0) GO TO 20	MAX 8
	IF (TMAX.EQ.C.0) GO TO 110	MAX 9
	IF (TMAX.LT.C.0) GO TO 120	MAX 10
20	IF (TMAX.GE.1.0) GO TO 60	MAX 11
	IF (IJLOG.EQ.1) GO TO 100	MAX 12
	NEXIND=0	MAX 13
	DO 30 KEX=1,15	MAX 14
	TMAX=TMAX*10.0	MAX 15
	IF (TMAX.LT.1.0) GO TO 30	MAX 16
	NMAX=TMAX	MAX 17
	AMAX=NMAX+1.0	MAX 18
	GO TO 40	MAX 19
30	CCATINUE	MAX 20
40	DO 50 LEX=1,KEX	MAX 21
50	AMAX=AMAX/10.0	MAX 22
	RETURN	MAX 23
C		MAX 24
60	IF (TMAX.LT.10.0) GO TO 100	MAX 25
	IF (IJLOG.EQ.1) GO TO 100	MAX 26
	DO 70 KEX=1,10	MAX 27

	TMAX=TMAX/10.0	MAX	28
	IF (TMAX.GT.10.0) GO TO 70	MAX	29
	NMAX=TMAX	MAX	30
	AMAX=NMAX+1.0	MAX	31
	GO TO 80	MAX	32
70	CONTINUE	MAX	33
80	DO 90 LEX=1,KEX	MAX	34
	AMAX=AMAX+10.0	MAX	35
90	CONTINUE	MAX	36
	RETURN	MAX	37
C		MAX	38
100	NMAX=TPAX	MAX	39
	APAX=NMAX+1.0	MAX	40
	RETURN	MAX	41
C		MAX	42
110	APAX=TPAX	MAX	43
	RETURN	MAX	44
C		MAX	45
120	IF (TMAX.GT.-1.0) GO TO 140	MAX	46
	IF (TMAX.GT.-10.0) GO TO 130	MAX	47
	GO TO 150	MAX	48
C		MAX	49
130	NMAX=TPAX	MAX	50
	APAX=NMAX	MAX	51
	RETURN	MAX	52
C		MAX	53
140	AMAX=0.0	MAX	54
	RETURN	MAX	55
C		MAX	56
150	IF (IJLOG.EQ.1) GO TO 130	MAX	57
	DO 160 KEX=1,10	MAX	58
	TMAX=TMAX/10.0	MAX	59
	IF (TMAX.LT.-10.0) GO TO 160	MAX	60
	NMAX=TMAX	MAX	61
	AMAX=NMAX	MAX	62
	GO TO 80	MAX	63
160	CONTINUE	MAX	64
	RETURN	MAX	65
	END	MAX	66

	SUBROUTINE MIN (ARRAY,IELE,AMIN)	MIN	1
	COMMON /EXPORT/ IJLOG	MIN	2
	DIMENSION ARRAY(IELE)	MIN	3
	TMIN=ARRAY(1)	MIN	4
	DO 10 I=1,IELE	MIN	5
10	IF (ARRAY(I).LT.TMIN) TMIN=ARRAY(I)	MIN	6
	IF (TMIN.GE.C.0) TMIN=0.0	MIN	7
	IF (TMIN.LT.0.0) GO TO 20	MIN	8
	GO TO 70	MIN	9
20	IF (TMIN.GT.-1.0) GO TO 30	MIN	10
	IF (TMIN.LT.-10.0) GO TO 90	MIN	11
	GO TO 80	MIN	12
30	IF (IJLOG.EQ.1) GO TO 80	MIN	13
	DO 40 KEX=1,15	MIN	14
	TMIN=TMIN+10.0	MIN	15
	IF (TMIN.GT.-1.0) GO TO 40	MIN	16
	NMIN=TMIN	MIN	17
	AMIN=NMIN-1.0	MIN	18
	GO TO 50	MIN	19
40	CONTINUE	MIN	20
50	DO 60 LEX=1,KEX	MIN	21
60	AMIN=AMIN/10.0	MIN	22
	RETURN	MIN	23
C		MIN	24
70	AMIN=TMIN	MIN	25
	RETURN	MIN	26
C		MIN	27

80	AMIN=TMIN	MIN	28
	AMIN=AMIN-1.0	MIN	29
	RETURN	MIN	30
C		MIN	31
90	IF (IJLOG.EQ.1) GO TO 80	MIN	32
	DO 100 KEX=1,15	MIN	33
	TMIN=TMIN/10.0	MIN	34
	IF (TMIN.LE.-10.0) GO TO 100	MIN	35
	NMIN=TMIN	MIN	36
	AMIN=AMIN-1.0	MIN	37
	GO TO 110	MIN	38
100	CCATINUE	MIN	39
110	DO 120 LEX=1,KEX	MIN	40
	AMIN=AMIN-10.0	MIN	41
120	CCATINUE	MIN	42
	RETURN	MIN	43
	END	MIN	44
	SUBROUTINE MIXTUR (T,TE,UE,PE,LEWIS,PRNDL,SPHT,CPOCV,C,CN,XMU,RHO,MXTR		1
	1RCROE,Z,F,G,HSUM)		2
	IMPLICIT REAL*8(A-H,O-Z)		3
	REAL*8 M1,M2,LEWIS		4
	COMMON /INJECT/ INJCT,NCINJ,GAS2,COOL,MASTRN		5
	COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR		6
	ILPR		7
	COMMON /PDEREF/ UREF,CREF		8
	COMMON /POLYCC/ CPAIRL(6),CPAIRH(6),ENAIRL(6),ENAIRH(6),CMUAIR(6),MXTR		9
	1CMLH(6),DIFHE(6),CMUAR(6),DIFAR(6),CPCO2L(6),CPCO2H(6),ENCO2L(6),MXTR		10
	2ENCO2H(6),CMUCO2(6),DIFCO2(6)		11
	COMMON /SPWBC/ ZWALL,ZWCLO,RIDIFW,AMDCTW,SINLST,ZWPOS,ZWNEG,AMWNEG,MXTR		12
	1,AMWPOS,WALLV,ZWZERO,NITCHG		13
	COMMON /STAG/ PSTAG,TSTAG,FNC,CNSTAG,HSTAG,HE		14
	COMMON /SURFAS/ C-WALL,CWIND,PFWIND,VWALL,TWALL,XTW(500),TWX(500),XMXTTR		15
	1C(1500),CIX(500),HWALL,TCCNW,KCI,KTW		16
	COMMON /TPPTR/ TEMP(101),TOTE(101),TP(101),RTW,TB		17
	COMMON /ZCCORD/ ETAINF,ETAFAC,ETA(101),DETAF(101),ADTESF,KADETA		18
	DIMENSION T(101), LEWIS(101), PRNDL(101), SPHT(101), CPOCV(101), CMXTTR		19
	1(101), CN(101), XMU(101), RHO(101), HSUM(101), KCRDE(101), TT(101),MXTR		20
	DIMENSION F(101), G(101), Z(101)		21
	DATA HEL,AR,CC2,AIR/3HHEL,3HARG,3HCO2,3HAIR/		22
	HEFW=4.007600		23
	ARFW=39.94800		24
	CC2MW=44.0095500		25
	AIRMW=28.96610		26
	UNIGAS=49754.03500		27
	M1=AIRMW		28
	KTT=0		29
C			30
C	CCPYUTE THE FLUID PROPERTIES OF AIR		31
C			32
10	CONTINUE		33
	TEMP(1)=TWALL		34
	TEMP(IE)=TE		35
	INDT=0		36
	KTT=KTT+1		37
	IF (KTT.GT.6) GO TO 130		38
	DO 100 I=1,IE		39
	IF (K.EQ.1) G(1)=0.000		40
	IF (TEMP(1).LT.90.000) TEMP(1)=90.000		41
	IF (TEMP(1).GT.12600.000) TEMP(1)=12600.000		42
	IF (TEMP(1).GT.2000.000) GO TO 20		43
	CALL POLY (TEMP(1),5,CPAIRL,CP1)		44
	CALL POLY (TEMP(1),5,ENAIRL,EN1)		45
	GO TO 30		46
20	CALL POLY (TEMP(1),5,CPAIRH,CP1)		47
	CALL POLY (TEMP(1),5,ENAIRH,EN1)		48
30	EN1=EN1*TEMP(1)		49

	CALL POLY (TEMP(I),5,CPUAIR,XMU1)	MXTR	50
	XMU1=XMU1*1.0-7	MXTR	51
	CV1=CP1-UNIGAS/AIRMW	MXTR	52
	TCON1=0.2500*(9.000*CP1/CV1-5.000)*CV1*XMU1	MXTR	53
	IF (MASTRN.EQ.3) GO TO 80	MXTR	54
	IF (GAS2.NE.FEL) GO TO 40	MXTR	55
C		MXTR	56
C	CCMPUTE THE FLUID PROPERTIES OF HELIUM	MXTR	57
C		MXTR	58
	M2=HEMW	MXTR	59
	CP2=3.1025004	MXTR	60
	EN2=CP2*TEMP(I)	MXTR	61
	CALL POLY (TEMP(I),5,CPUHE,XMU2)	MXTR	62
	CV2=CP2-UNIGAS/HEMW	MXTR	63
	TCON2=0.2500*(9.000*CP2/CV2-5.000)*CV2*XMU2	MXTR	64
	CALL POLY (TEMP(I),5,DIFHE,BIDIF)	MXTR	65
	BIDIF=BIDIF/PE	MXTR	66
	GO TO 90	MXTR	67
40	IF (GAS2.NE.AR) GO TO 50	MXTR	68
C		MXTR	69
C	COMPUTE THE FLUID PROPERTIES OF ARGON	MXTR	70
C		MXTR	71
	M2=ARMW	MXTR	72
	CP2=3.11151003	MXTR	73
	CV2=CP2-UNIGAS/ARMW	MXTR	74
	EN2=CP2*TEMP(I)	MXTR	75
	CALL POLY (TEMP(I),5,CPUAR,XMU2)	MXTR	76
	TCON2=0.2500*(9.000*CP2/CV2-5.000)*CV2*XMU2	MXTR	77
	CALL POLY (TEMP(I),5,DIFAR,BIDIF)	MXTR	78
	BIDIF=BIDIF/PE	MXTR	79
	GO TO 90	MXTR	80
50	IF (GAS2.NE.CO2) GO TO 80	MXTR	81
C		MXTR	82
C	COMPUTE THE FLUID PROPERTIES OF CARBON DIOXIDE	MXTR	83
C		MXTR	84
	M2=CC2MW	MXTR	85
	IF (TEMP(I).GT.(330.000) WRITE (6,140)	MXTR	86
	IF (TEMP(I).GT.(300.000) STOP	MXTR	87
	IF (TEMP(I).GT.(2000.000) GO TO 60	MXTR	88
	CALL POLY (TEMP(I),5,CPCC2L,CP2)	MXTR	89
	CALL POLY (TEMP(I),5,ENCC2L,EN2)	MXTR	90
	GO TO 70	MXTR	91
60	CALL POLY (TEMP(I),5,CPCC2H,CP2)	MXTR	92
	CALL POLY (TEMP(I),5,ENCC2H,EN2)	MXTR	93
70	EN2=EN2*TEMP(I)	MXTR	94
	CV2=CP2-UNIGAS/CC2MW	MXTR	95
	CALL POLY (TEMP(I),5,CMUCO2,XMU2)	MXTR	96
	TCON2=0.2500*(9.000*CP2/CV2-5.000)*CV2*XMU2	MXTR	97
	CALL POLY (TEMP(I),5,DIFCO2,BIDIF)	MXTR	98
	BIDIF=BIDIF/PE	MXTR	99
	GO TO 90	MXTR	100
80	CCNTINUE	MXTR	101
C		MXTR	102
C	COMPUTE THE MIXTURE PROPERTIES FOR 100% AIR	MXTR	103
C		MXTR	104
	BIDIF=0.000	MXTR	105
	IF (I.EQ.1) TCONW=TCON1	MXTR	106
	IF (I.EQ.1) MWALL=EN1	MXTR	107
	CPCCV(I)=CP1/CV1	MXTR	108
	XMU(I)=XMU1	MXTR	109
	SPHT(I)=CP1	MXTR	110
	MSUM(I)=EN1/PE	MXTR	111
	PRNDL(I)=CP1*XMU1/TCON1	MXTR	112
	TT(I)=TEMP(I)-(EN1-TT(I))*HE-UE**2*(F(I)**2+G(I)**2)/2.000)/CP1	MXTR	113
	IF (TT(I).LT.90.000) TT(I)=90.000	MXTR	114
	IF (TT(I).GT.12600.000) TT(I)=12600.000	MXTR	115
	RHC(I)=PE*M1/UNIGAS/TT(I)	MXTR	116
	C(I)=RHO(I)*XMU1	MXTR	117
	LEHIS(I)=1.000	MXTR	118
	GO TO 100	MXTR	119
90	CCNTINUE	MXTR	120

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C
C
C      COMPUTE MIXTURE PROPERTIES FOR FOREIGN GAS INJECTION
MXTR 121
MXTR 122
MXTR 123
MXTR 124
MXTR 125
MXTR 126
MXTR 127
MXTR 128
MXTR 129
MXTR 130
MXTR 131
MXTR 132
MXTR 133
MXTR 134
MXTR 135
MXTR 136
MXTR 137
MXTR 138
MXTR 139
MXTR 140
MXTR 141
MXTR 142
MXTR 143
MXTR 144
MXTR 145
MXTR 146
MXTR 147
MXTR 148
MXTR 149
MXTR 150
MXTR 151
MXTR 152
MXTR 153
MXTR 154
MXTR 155
MXTR 156
MXTR 157
MXTR 158
MXTR 159
MXTR 160
MXTR 161
MXTR 162
MXTR 163
MXTR 164
MXTR 165
MXTR 166
MXTR 167
MXTR 168
MXTR 169
MXTR 170
MXTR 171
MXTR 172
MXTR 173

100  XMU2=XMU2*1.D-7
      TCCN2=TCCN2*1.D-7
      IF (1.EQ.1) BIDIF=BIDIF
      HSUM(1)=(EN1-EN2)/HE
      CV=(1.0D0-Z(1))*CV2+Z(1)*CV1
      SPHT(1)=(1.0D0-Z(1))*CP2+Z(1)*CP1
      ENLPHY=(1.0D0-Z(1))*EN2+Z(1)*EN1
      IF (1.EQ.1) HWALL=ENLPHY
      X2=((1.0D0-Z(1))/42)/(Z(1)/M1+(1.0D0-Z(1))/M2)
      X1=(Z(1)/M1)/(Z(1)/41+(1.0D0-Z(1))/M2)
      IF (X1.LT.1.D-40) X1=1.D-40
      IF (X2.LT.1.D-40) X2=1.D-40
      G12MU=1.0D0/DSQRT(8.0D0)*1.0D0/DSQRT(1.0D0+M1/M2)*(1.0D0+DSQRT(XMU2))
      G21MU=1.0D0/DSQRT(8.0D0)*1.0D0/DSQRT(1.0D0+M2/M1)*(1.0D0+DSQRT(XMU2))
      XMU(1)=XMU2/(1.0D0+G21MU*X1/X2)+XMU1/(1.0D0+G12MU*X2/X1)
      TCCN=TCCN2/(1.0D0+G21MU*X1/X2)+TCCN1/(1.0D0+G12MU*X2/X1)
      IF (1.EQ.1) TCCN=TCCN
      TT(1)=TEMP(1)-(ENTLPHY-(T(1)*E-UE**2*(F(1)**2+G(1)**2)/2.0D0))/SPHMXTR
      IT(1)
      IF (TT(1).LT.90.0D0) TT(1)=90.0D0
      IF (TT(1).GT.12600.0D0) TT(1)=12600.0D0
      KMO(1)=PE/LNIGAS/TT(1)*(M1*M2)/(Z(1)*(42-M1)+M1)
      CPDCV(1)=SPHT(1)/CV
      C(1)=RHO(1)*XMU(1)
      PRADL(1)=SPHT(1)*XMU(1)/TCCN
      LEHIS(1)=RHO(1)*BIDIF*SPHT(1)/TCCN
110  CCAIAUE
120  TT(1)=TWALL
      TT(1E)=TE
      DO 120 N=1,IE
      IF (GARS(1.GD0-TT(N)/TEMP(N)).GT.1.D-4) INOT=1
      TEMP(N)=TT(N)
      TOTL(N)=TEMP(N)/TE
      RCROE(N)=RHC(N)/PHO(1E)
      IF (LPR.EQ.-10) GO TO 110
      C(N)=C(N)/CREF
      GC TO 120
110  C(N)=C(N)/C(1E)
120  CCAIAUE
      IF (INOT.EQ.1) GO TO 10
      IF (KIT.EQ.1) GO TO 10
130  CALL DERIV (C,ETA,IE,1,CN)
      CALL DERIV (TOTL,ETA,IE,1,TP)
      RETURN
C
140  FORMAT (5X,102HTEMPERATURE HAS EXCEEDED THE 6300 DEG. MAXIMUM FOR
      ICARBON DIOXIDE CURVE FIT DATA-EXECUTION TERMINATING/)
      END

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SUBROUTINE OUT1
IMPLICIT REAL*8 (A-H,O-Z)
REAL*8 NOSE
COMMON /CONVRG/ CONV,NIT1,NIT2,NIT3,NIT
COMMON /FINDIF/ A(101),BB(101),B(101),CC(101),DD(101),D(101),E(101)
1),CRI
COMMON /FRSTPM/ RHOINF,PINF,TFS,UFS,R,PRL,G,XMA
COMMON /GFUM/ ALPHA,THETAG,NOSE,RNJSF,WLST,X,XX,WX
COMMON /INJECT/ INJCT,NCINJ,GAS2,COUL,MASTRN
COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NRLNT1,IND,KPRT,LPRT,KPR
1LPR
COMMON /REF/ PREF,TREF,APURLF,REINF
COMMON /STAG/ PSTAG,TSTAG,PNC,CWSTAG,HSTAG,HE
OUT1 1
OUT1 2
OUT1 3
OUT1 4
OUT1 5
OUT1 6
OUT1 7
OUT1 8
OUT1 9
OUT1 10
OUT1 11
OUT1 12
OUT1 13

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CGMCMN /SURFAS/ CWALL,CWIND,PEWIND,VWALL,TWALL,XTW(500),TWF(500),XOUT1 14
IC(500),CIX(500),HWALL,TCURM,KCI,KTM OUT1 15
CCPMCN /THERMC/ PHOP,VALUE OUT1 16
CCPMCN /THPPTR/ TEMPI(101),TOTE(101),TP(101),RTW,TM OUT1 17
CCPMCN /TRBLNT/ ASTAR,AKSTAR,ALAMDA,YSUBL,EVSCTY(101),PRT,EOLYAW,EOUT1 18
1PLUS(101),ALET,LAMTMB OUT1 19
CGMCMN /XICORD/ XI,XXI,DXI,XICLD,DXDXI,DXDXXI OUT1 20
CGMCMN /XSOLVE/ XSTA(100),DXMAX,DX,CACLU,DXI,NSOLVE OUT1 21
CGMCMN /ZCCGRD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA OUT1 22
DIMENSION STRING(20) OUT1 23
DATA BLUNT,SHARP,SH3BLUNT,SHSHARP/ OUT1 24
THET1=THETAC*180.000/DANCOS(-1.000) OUT1 25
ATTAK=ALPHA*180.000/DANCCS(-1.000) OUT1 26
WRITE (3,50) OUT1 27
WRITE (3,60) OUT1 28
WRITE (6,100) OUT1 29
J=69 OUT1 30
10 READ (J,240,END=20) (STRING(I),I=1,20) OUT1 31
WRITE (6,250) (STRING(I),I=1,20) OUT1 32
GO TO 10 OUT1 33
20 WRITE (6,90) OUT1 34
WRITE (6,110) PSTAG OUT1 35
WRITE (6,120) TSTAG OUT1 36
WRITE (6,130) MSTAG OUT1 37
WRITE (6,140) PINF OUT1 38
WRITE (6,260) RHCINF OUT1 39
WRITE (6,150) TFS OUT1 40
WRITE (6,160) UFS OUT1 41
WRITE (6,170) XMA OUT1 42
WRITE (6,180) G OUT1 43
WRITE (6,190) R OUT1 44
WRITE (6,200) RTW OUT1 45
WRITE (6,210) ATTAK OUT1 46
WRITE (6,220) THET1 OUT1 47
WRITE (6,70) OUT1 48
IF (HUSE.EQ.BLUNT) GO TO 40 OUT1 49
DO 30 I=1,NSCLVF OUT1 50
WRITE (6,80) I,XSTA(I) OUT1 51
30 CCNTINUE OUT1 52
WRITE (6,230) OUT1 53
40 CCNTINUE OUT1 54
C OUT1 55
C OUT1 56
RETURN OUT1 57
C OUT1 58
C OUT1 59
C OUT1 60
50 FORMAT (43X,37HPROPERTIES AT THE WINDWARD STEAMLINE/) OUT1 61
60 FORMAT (16X,5HS/REF,14X,1HS,13X,6HCFXINF,10X,5HSTINF,10X,7HWD(01M) OUT1 62
1,9X,9HWD/OWSTAG,7X,5H2WALL/) OUT1 63
70 FORMAT (26X,45HPOINTS AT WHICH A SOLUTION IS TO BE OBTAINED://28X, OUT1 64
11H1,6X,7HXSTA(I)/) OUT1 65
80 FCPMAT (26X,13,5X,F9.6) OUT1 66
90 FORMAT (//26X,42HFREE STEAM, STAGNATION, AND VEHICLE DATA://) OUT1 67
100 FORMAT (146X,40HTHREE-DIMENSIONAL BOUNDARY LAYER PROGRAM/65X,3HFOR/ OUT1 68
154X,25HLAMINAR OR TURBULENT FLOW/64X,4HWITH/56X,20HMINARY GAS IN/ OUT1 69
2CTIQA/60X,12HDEVELOPED BY/52X,28H M.C. FRIEDERS /50X, OUT1 70
332HAEROSPACE ENGINEERING DEPARTMENT/40X,51HVIRGINIA POLYTECHNIC IN/ OUT1 71
4STITUTE AND STATE UNIVERSITY/56X,21HBLACKSBURG, VA. 24060//26X,32 OUT1 72
5HINPUT DATA CARDS ARE AS FOLLOWS://) OUT1 73
110 FORMAT (26X,7HPSTAG =,E13.6,5H PSIA) OUT1 74
120 FORMAT (26X,7HTSTAG =,E13.6,6H DEG.R) OUT1 75
130 FORMAT (26X,7HMTAG =,E13.6,13H FT**2/SEC**2) OUT1 76
140 FGRMAT (26X,7HPINF =,E13.6,5H PSIA) OUT1 77
150 FORMAT (26X,7HTINF =,E13.6,6H DEG.R) OUT1 78
160 FORMAT (26X,7HUIINF =,E13.6,7H FT/SEC) OUT1 79
170 FGRMAT (26X,7HMINF =,E13.6) OUT1 80
180 FCRMAT (26X,7HCP/CV =,E13.6) OUT1 81
190 FORMAT (26X,7HR =,E13.6,19H FT**2/SEC**2/DEG.R) OUT1 82
200 FOPMAT (26X,7HTW/TO =,F13.6) OUT1 83
210 FORMAT (26X,7HALPHA =,E13.6,5H DEG.) OUT1 84

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220	FCRMAI (26X,7HTHETAC=,E13.6,5H DEG.//)	OUT1	85
230	FCRMAI (1H0)	OUT1	86
240	FCRMAI (2044)	OUT1	87
250	FORMAT (26X,20A4)	OUT1	88
260	FCRMAI (26X,7HRH0INF=,E13.6,12H SLUGS/FT**3)	OUT1	89
	END	OUT1	90

	SUBROUTINE OUT2	OUT2	1
	IMPLICIT REAL*8 (A-H,C-Z)	OUT2	2
	REAL*8 NJSE,LEWLAM,LEWTRB	OUT2	3
	COMMON /CONVRC/ CCNV,NIT1,NIT2,NIT3,NIT	OUT2	4
	CCPMCN /DLPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,CUT2	OUT2	5
	1101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YOCUT2	OUT2	6
	2L(101),RORCF(101)	OUT2	7
	COMMON /EDG2/ PE2,TE2,LE2,VE2,DPE2DX,DTE2DX,DUE2DX,DVE2DX,DPE2DW,DOUT2	OUT2	8
	1UE2DW,DVE2DW,DTL2DW,AMU2,ROMU2,R2,RHOE2,RE42	OUT2	9
	CCPMCN /GASPRP/ LEWLAM(101),LEWTRB(101),PRANDL(101),PRANDT(101),CPCUT2	OUT2	10
	11(101),GAMMA(101),XMU(101),RHC(101),MSUM(101)	OUT2	11
	CCPMCN /GECM/ ALPHA,THETAC,NCSF,RNOSE,WLST,X,XX,WX	OUT2	12
	CCPMCN /INJECT/ INJECT,NOINJ,GAS2,CUCL,MASTRN	OUT2	13
	CCPMCN /INTEGR/ IE,IF,KEND,KEND2,KLX,K,L,NRLNT1,IND,KPRT,LPRT,KPR,OUT2	OUT2	14
	1LPR	OUT2	15
	COMMON /OUTPUT/ CFWEDG,CFWINF,CFXENG,CFXINF,CHEDGE,CHINF,AMACHE,DEOUT2	OUT2	16
	1L,QW,QWINF,QWQWQ,S,STEDGE,STINF,TAUETA,TAUX,DELSTX,DELPHI,THETAX,OUT2	OUT2	17
	2THEPHI	OUT2	18
	CCPMCN /PLOTS/ PLCT,KPLCT(4),LPLOT(4),KPRFL(4),LPRFL(4),NPTS(4,2) CUT2	OUT2	19
	COMMON /SLPNT/ CW(101),CNW(101),VW(101),GW(101),TW(101),GWN(101),OUT2	OUT2	20
	1FWN(101),F(101),TWN(101),ZW(101),ZWN(101),XW,QADXW,XW,RW	OUT2	21
	CCPMCN /SUFFAS/ CWALL,CWIND,PEWIND,VWALL,TWALL,XTW(500),TWX(500),XGOUT2	OUT2	22
	1C(500),CX(500),HWALL,TCCW,KCI,KTW	OUT2	23
	COMMON /TEMPTR/ TEMP(101),TOTE(101),TP(101),RTW,TB	OUT2	24
	CCPMCN /TRANSN/ TRANS,KCNSET,XIF,CH12(101),CHIMAX,XBAR	OUT2	25
	CCPMCN /TRBLT/ ASTAP,AKSTAR,ALAMDA,YSUBL,EVSCTY(101),PRT,EDYLAN,EOUT2	OUT2	26
	1PLUS(101),ALET,LAMTRB	OUT2	27
	CCPMCN /XICORD/ XI,XXI,DXI,XICLC,DXOXI,DXOXXI	OUT2	28
	CCPMCN /XSOLVE/ XSTA(100),DXMAX,DX,DXJLO,DXI,NSOLVE	OUT2	29
	CCPMCN /ZCCGRC/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA	OUT2	30
	DATA BLUNT,SHARP/SHBLUNT,SHSHARP/	OUT2	31
	DATA AND/2HAC/	OUT2	32
	CALL GMPHY (X,DUMR,ZAX)	OUT2	33
	IF (NOSE.EQ.BLUNT) ZUREF=ZAX/RNCSE	OUT2	34
	IF (NOSE.EQ.SHARP) ZUREF=ZAX/XSTA(NSOLVE)	OUT2	35
	IF (NOSE.EQ.BLUNT) ROREF=RZ/PNCSE	OUT2	36
	IF (NOSE.EQ.SHARP) ROREF=RZ/XSTA(NSOLVE)	OUT2	37
C		OUT2	38
C	CREATE THE PLCTTER DATA SET	OUT2	39
C		OUT2	40
	IF (PLOT.EC.AND) GO TO 80	OUT2	41
	DO 30 I=1,4	OUT2	42
	IF (LPLOT(I).EQ.C) GO TO 40	OUT2	43
	IF (X.NE.XSTA(LPLOT(I))) GO TO 30	OUT2	44
	IF (X.EQ.O.UCCI) GO TO 10	OUT2	45
	NPTS(I,2)=NPTS(I,2)+1	OUT2	46
	WRITE (16,340) X,WX,PE2,AMACHE,CCL,CFXINF,STINF,QWQWQ,CFWINF,DELSOUT2	OUT2	47
	1TX	OUT2	48
10	CONTINUE	OUT2	49
	DO 20 N=1,4	OUT2	50
	IF (KPLCT(N).EQ.O) GO TO 20	OUT2	51
	IF (K.NE.KPLCT(N)) GO TO 20	OUT2	52
	WRITE (15,35C) X,WX,(YCL(J),F(2,J,2),G(2,J,2),TOTE(J),Z(2,J,2),EPLOUT2	OUT2	53
	1US(J),J=2,IF)	OUT2	54
23	CONTINUE	OUT2	55
30	CONTINUE	OUT2	56
40	CONTINUE	OUT2	57
	DO 70 I=1,4	OUT2	58
	IF (KPLCT(I).EQ.O) GO TO 80	OUT2	59
	IF (K.NE.KPLCT(I)) GO TO 70	OUT2	60

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      IF (X.EQ.0.000) GO TO 50
      NPTS(1,1)=NPTS(1,1)+1
      WRITE (13,340) X,WX,PE2,AMACHE,CCL,CFXINF,STINF,QWOQWO,CFWINF,DELSOUT2
50    1TX
      CCNTINUE
      DO 60 N=1,4
      IF (LPLCT(N).EQ.0) GO TO 60
      IF (X.NE.XSTA(LPLOT(N))) GO TO 60
      WRITE (14,350) X,WX,(YCL(J),F(2,J,2),G(2,J,2),TOTE(J),Z(2,J,2),EPLOUT2
      IUS(J),J=2,IE)
60    CCNTINUE
70    CCNTINUE
80    CCNTINUE
C
      IF (L.NE.1.AND.L.NE.LPR) GO TO 140
C
      WRITE (6,160) X,S,ZAX,ZCREF,R2,RDREF,DX,NIT,WX
      WRITE (6,170) XI,DXI,OXDXI,CWALL
      WRITE (6,180)
      WRITE (6,190) PE2,TE2,LE2,VE2,AMACHE,DPE2DX,DTE2DX,DUE2DX,DVE2DX,P
      HDE2,DPE2DW,DTE2DW,DUE2DW,DVE2DW,ROMU2
      WRITE (6,330) REX2
      IF (L.EQ.1.AND.NOSE.EQ.SHARP) GO TO 90
      WRITE (6,360)
      WRITE (6,200)
      WRITE (6,210) CFXINF,CFXEDG,CFWINF,CFWEDG,CHEGE,CHINF,STEDGE,STINF
      IF,QWINF,CHIMAX
      WRITE (6,220)
      WRITE (6,230) TAUX,DELSTX,THETAX,TAUETA,DLLPHI,THEPHI,QW,DEL
      IF (X.GE.XSTA(KCNSET).AND.KCNSET.NE.NSOLVE) WRITE (6,320) XIF
      WRITE (6,310)
90    CCNTINUE
      IF (K.NE.1.AND.K.NE.KPR) GO TO 130
      IF (K.NE.1.OR.KPRT.EQ.1) KPR=KPP+KPRT
      WRITE (6,250)
      DO 100 N=1,IE,2
      WRITE (6,260) ETA(N),Y(N),F(2,N,2),FN(2,N,2),G(2,N,2),GN(2,N,2),T
      I(2,N,2),TV(2,N,2),C(N),CN(N),Vh(N)
100   CCNTINUE
      WRITE (6,310)
      WRITE (6,280)
      DO 110 N=1,IF,2
      WRITE (6,270) ETA(N),YCL(N),RGRCE(N),XMU(N),EPLUS(N),CHIZ(N),LEWLA
      I(N),LEWTRB(N),PRANDL(N),PRANDT(N),CP(N)
110   CCNTINUE
      WRITE (6,310)
      WRITE (6,300)
      DO 120 N=1,IE,2
      WRITE (6,290) ETA(N),YCL(N),Z(2,N,2),ZN(2,N,2),TEMP(N),TCTE(N),TPI
      I(N),GAMMA(N),RHC(N)
120   CCNTINUE
      IF (K.FU.1) WRITE (3,150) S,X,CFXINF,STINF,QW,QWOQWO,Z(2,1,2)
130   CCNTINUE
      WRITE (6,240)
140   CCNTINUE
C
C
      RETURN
C
C
C
150   FORMAT (10X,6E16.6,2X,F10.6)
160   FORMAT (10X,6HS      =,E13.6,4X,6HS/REF=,E13.6,4X,6HZ      =,E13.6,4X,
16HZ/PEF=,E13.6/10X,6HR      =,E13.6,4X,6HK/REF=,E13.6,4X,6HDX      =,E1
22.5,5X,6MHIT =,13,10X,6MPH =,F6.2,5H DEG.)
170   FORMAT (10X,6HXI      =,E13.6,4X,6HDXI      =,E13.6,4X,6HDXDXI=,E13.6,4X,
16HCWALL=,E13.6//)
180   FORMAT (10X,27HDIMENSIONAL EDGE PROPERTIES/)
190   FORMAT (10X,6HPE      =,E13.6,5X,6HTE      =,E13.6,5X,6HUE      =,E13.6,5X,
16HVE      =,E13.6,5X,6HACHEF =,E13.6/10X,6HDPEDX=,E13.6,5X,6HDTEDX=,
2E13.6,5X,6HDUEUX=,E13.6,5X,6HDVLDX=,E13.6,5X,6HRRHOE      =,E13.6/10X,

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36MDPEDW=.E13.6,5X,6MDTEDW=.E13.6,5X,6MDUEDW=.E13.6,5X,6MDVEDW=.E13OUT2 132
4.6,5X,6MDHEDW=.E13.6//) OUT2 133
200 FCRMAT (10X,41HNO DIMENSIONAL BCUNARY LAYERS PARAMETERS/) OUT2 134
210 FCRMAT (10X,7HCFXINF=.E13.6,5X,7HCFXEDG=.E13.6,5X,7HCFXINF=.E13.6,OUT2 135
15X,7HCFWEDG=.E13.6/10X,7HCHEDCF=.E13.6,5X,7HCHINF=.E13.6,5X,7HSTFOUT2 136
20GE=.E13.6,5X,7HSTINF=.E13.6/10X,7HGW=.E13.6,5X,7HCHIMAX=.E13OUT2 137
3.6//) OUT2 138
220 FCRMAT (10X,37HNO DIMENSIONAL BCUNARY LAYER PARAMETERS/) OUT2 139
230 FCRMAT (10X,27HLONGITUDINAL SKIN FRICTION=.E13.6,4H PSF,5X,12HDELTAOUT2 140
1A*(X) =.F13.6,5X,11HHTFT(X) =.F13.6/10X,27HTRANSVERSE SKIN FRICTION2 141
2TICN =.E13.6,4H PSF,5X,12HDELTA*(PHI)=.E13.6,5X,11HHTETA*(PHI)=.E1OUT2 142
33.6/10X,27HWALL HEAT TRANSFER RATE =.E13.6,4H BTU,5X,12HDELTA (FOU2 143
4T) =.E13.6) OUT2 144
240 FCRMAT (1H0,48X,3(5H****,10X)//) OUT2 145
250 FCRMAT (7X,3HETA,11X,1HY,1CX,1HF,10X,2HFN,9X,1HC,10X,2HGN,9X,1HH,1OUT2 146
10X,2HNN,9X,1HC,10X,2HCN,9X,1HV//) OUT2 147
260 FCRMAT (1X,F12.6,3X,E9.3,1X,B(F10.6,1X),E10.3) OUT2 148
270 FCRMAT (1X,F12.6,3X,E9.3,1X,F10.5,3(1X,E10.4),4(1X,F10.6),3X,E10.4OUT2 149
1) OUT2 150
280 FCRMAT (6X,3HETA,10X,3HY/L,7X,5HPRORF,9X,3HXMU,10X,2HE+,11X,3HCHI,OUT2 151
18X,3HLEL,8X,3HLET,8X,3HPRL,8X,3HPRT,9X,5HSP HT//) OUT2 152
290 FCRMAT (1X,F12.6,3X,E9.3,2(1X,F10.6),3(2X,E12.6),1X,F10.6,3X,E12.6OUT2 153
1) OUT2 154
300 FCRMAT (6X,3HETA,10X,3HY/L,9X,1HZ,9X,2HZN,10X,4HTEMP,10X,4HT/TE,11OUT2 155
1X,2HTN,10X,5HCP/CV,9X,3HRC//) OUT2 156
310 FCRMAT (1H0) OUT2 157
320 FCRMAT (1H0,9X,34HTRANSITION INTERMITTENCY FACTOR =.E12.6) OUT2 158
330 FCRMAT (1CX,28HLOCAL EDGE REYNOLDS NUMBER =.E12.6//) OUT2 159
340 FCRMAT (10E12.6) OUT2 160
350 FCRMAT (2(25E12.6),10E12.6) OUT2 161
360 FCRMAT (1H) OUT2 162
END OUT2 163

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SUBROUTINE PHIMOM
IMPLICIT REAL*8(A-H,O-Z)
REAL*8 NOSE
COMMON /DEPVFR/ F(2,101,3),FN(2,101,3),G(2,101,3),GH(2,101,3),T(2,PHIM 1
1101,3),TA(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CH(101),Y(101),YCPHIM 2
2L(101),MGRGE(101) PHIM 3
COMMON /IECOFF/ R1,R2,R3,G1,G2,F1,F2,DE,AL,EPS,CHI,INDPT,U1 PHIM 4
COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,PHIM 5
1LPR PHIM 6
COMMON /PDECOFF/ A1(101),A2(101),A3(101),A4(101),A5(101) PHIM 7
COMMON /SOLPRT/ CW(101),CN(101),V(101),GW(101),TW(101),GWN(101),PHIM 8
1FWN(101),FW(101),TWN(101),ZW(101),ZWN(101),XW,DXDXW,XW,PW PHIM 9
COMMON /TRANS/ KTRANS,KCNSET,XIF,CHI2(101),CHIMAX,XHAR PHIM 10
COMMON /TRBLNT/ ASTAR,AKSTAR,ALAND,YSUBL,EVSCTY(101),PAT,EDYLAW,EPHIM 11
1PLUS(101),ALET,LATRB PHIM 12
COMMON /XICORD/ XI,XXI,XXI,XICLD,DXEXI,DXDXXI PHIM 13
COMMON /ZCOORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA PHIM 14
DIMENSION RCMU1(101),RCMU1N(101) PHIM 15
DATA SHARP,BLUNT/5HSHARP,5HBLUNT/ PHIM 16
C SUBROUTINE PHIMOM SETS UP THE COEFFICIENTS OF THE PARTIAL PHIM 17
C DIFFERENTIAL PHIMOMENTUM EQUATION PHIM 18
C PHIM 19
DO 10 J=1,IE PHIM 20
RCMU1(J)=CW(J)*(1.0DD+XIF+EPLUS(J)) PHIM 21
CONTINUE PHIM 22
CALL DLRIV (RCMU1,ETA,IE,1,RCMU1N) PHIM 23
DO 20 J=1,IE PHIM 24
AC(J)=RCMU1(J)*U1 PHIM 25
A1(J)=RCMU1N(J)*U1-VW(J) PHIM 26
A2(J)=-FW(J)*(R1+EPS)-DE*G1*GW(J) PHIM 27
IF (K.EQ.1) A2(J)=-FW(J)*(R1+EPS)-DE*GW(J) PHIM 28
A3(J)=-((1.0DD/RORDE(J))*(-P2-DE*AL*G2-EPS*AL) PHIM 29
IF (K.EQ.1) A3(J)=-DE*CHI*1.0DD/RORDE(J) PHIM 30
PHIM 31
PHIM 32
PHIM 33
PHIM 34

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	A4(J)=-2.000*XIN*FM(J)	PHIM	35
	A5(J)=-DE*GW(J)	PHIM	36
	IF (K.EQ.1) A5(J)=0.000	PHIM	37
20	CCNTINUE	PHIM	38
	RETURN	PHIM	39
	END	PHIM	40
	SUBROUTINE PLOTFR	PLTR	1
	REAL*8 NGSE,SHARP,RLUNT,XSTA,DXMAX,DX,DXOLD,DX1,DUM1,ANGLE,THETAC,PLTR	2	
	CCMMCN /AXINFO/ IXAXIS,IYAXIS	PLTR	3
	CCMMCN /GECH/ ANGLE,THETAC,NGSE,RNGSE,MLST,DUM2,DUM3,WX	PLTR	4
	CCMMCN /INTEGR/ IE,IM,KEND,KEND2,KLX,KDUM,LDUM,NBLNT1,INO,KPRT,LPRPLTR	5	
	IT,KPR,LPR	PLTR	6
	CCMMCN /LEGLHL/ LGND,ISLPL,IUNIT,KTITLE	PLTR	7
	CCMMCN /PLOTS/ LUM1,KPLOT(4),LPLOT(4),KPOINT(4),LPOINT(4),NPTS(4,2PLTR	8	
	1)	PLTR	9
	CCMMCN /PROFILE/ XC,PHI	PLTR	10
	CCMMGN /TITLE/ LABEL(20)	PLTR	11
	CCMMCN /XSOLVE/ XSTA(100),DXMAX-DX,DXOLD,DX1,XSOLVE	PLTR	12
	DIMENSION X(500), QWQW0(500), DEL(500), PE2(500), AMACHE(500), STINFLTR	13	
	1INF(500), CF*INF(500), CF*INF(500), DELSTR(500), DUMPHI(5)	PLTR	14
	DIMENSION XX(500)	PLTR	15
	DIMENSION XC(5), PHI(5), F(500), G(500), T(500), Z(500)	PLTR	16
	DIMENSION DPHI(500)	PLTR	17
	DIMENSION PLUS(500)	PLTR	18
	DIMENSION Y(500), YY(500)	PLTR	19
	DIMENSION IPTS(4), IPTDUM(4)	PLTR	20
	DIMENSION CPAPP(4)	PLTR	21
	DATA SHARP,RLUNT/5HSHARP,5HRLUNT/	PLTR	22
	DATA ISTRM1/3H5/L/,JSTRM1/3/,KSTRM1/3/,ISTRM2/2H7U/,JSTRM2/2/,KSTRPLTR	23	
	IM2/I/	PLTR	24
	DATA ISTRM3/4H5/PN/,JSTRM3/4/,KSTRM3/4/	PLTR	25
	ISLHL=0	PLTR	26
	KTITLE=1	PLTR	27
	LGND=1	PLTR	28
	I=0	PLTR	29
	LUCB=0	PLTR	30
	NCALL=0	PLTR	31
	IE=IE-1	PLTR	32
	NCLKVE=56	PLTR	33
	IUNIT=13	PLTR	34
	IYAXIS=1	PLTR	35
	IF (NGSE.LO.RLUNT) GO TO 10	PLTR	36
	ILIST=ISTRM1	PLTR	37
	JLIST=JSTRM1	PLTR	38
	KLIST=KSTRM1	PLTR	39
	IXAXIS=1	PLTR	40
	GO TO 20	PLTR	41
10	ILIST=ISTRM3	PLTR	42
	JLIST=JSTRM3	PLTR	43
	KLIST=KSTRM3	PLTR	44
	IXAXIS=2	PLTR	45
20	DO 30 J=1,4	PLTR	46
30	IPTS(J)=NPTS(J,1)	PLTR	47
40	CCNTINUE	PLTR	48
C	WRITE (6,920) IUNIT	PLTR	49
50	CCNTINUE	PLTR	50
	I=I+1	PLTR	51
	READ (IUNIT,1120,END=60) X(1),DPHI(1),PE2(1),AMACHE(1),DEL(1),CFXIPLTR	52	
	INF(1),STINF(1),QWQW0(1),CF*INF(1),DELSTR(1)	PLTR	53
C	WRITE (6,940) X(1),DPHI(1),PE2(1),AMACHE(1),DEL(1),CF*INF(1),STINFPLTR	54	
C	11)	PLTR	55
C	WRITE (6,950) QWQW0(1),CF*INF(1),DELSTR(1)	PLTR	56
	GO TO 50	PLTR	57
60	CCNTINUE	PLTR	58
	LIM1=1-1	PLTR	59
	DO 70 J=1,4	PLTR	60

70	IF (IPTS(J).EQ.0) GO TO 80	PLTR 61
	CONTINUE	PLTR 62
	JCURVE=J	PLTR 63
	GO TO 90	PLTR 64
80	JCURVE=J-1	PLTR 65
	IF (JCURVE.EQ.0) GO TO 810	PLTR 66
90	LOC=0	PLTR 67
	IF (IUNIT.EQ.16) GO TO 140	PLTR 68
	IF (NOSE.EQ.BLUNT.AND.KEND2.EQ.1) GO TO 110	PLTR 69
	IF (NOSE.EQ.SHARP) GO TO 110	PLTR 70
100	IF (NOSE.EQ.BLUNT.AND.X(LOC+1).EQ.X(LOC+2)) GO TO 110	PLTR 71
	LOC=LOC+1	PLTR 72
	XX(LOC)=X(LOC)/PNOSE	PLTR 73
	GO TO 100	PLTR 74
110	LOCB=LOC	PLTR 75
	DO 130 I=1,JCURVE	PLTR 76
	L=1+LOCB	PLTR 77
	DO 120 K=L,LIMIT,JCURVE	PLTR 78
	LOC=LOC+1	PLTR 79
	IF (NOSE.EQ.SHARP) XX(LOC)=X(K)/XSTAIN(SOLVE)	PLTR 80
	IF (NOSE.EQ.BLUNT) XX(LOC)=X(K)/RNOSE	PLTR 81
120	CONTINUE	PLTR 82
130	CONTINUE	PLTR 83
	GO TO 160	PLTR 84
140	DO 150 I=1,LIMIT	PLTR 85
150	XX(I)=DPHI(I)	PLTR 86
160	CONTINUE	PLTR 87
	IF (IUNIT.EQ.16) GO TO 160	PLTR 88
	DO 170 I=1,JCURVE	PLTR 89
170	PHI(I)=DPHI(I+LOCB)	PLTR 90
	GO TO 200	PLTR 91
180	J=0	PLTR 92
	DO 190 I=1,JCURVE	PLTR 93
	J=J+IPTS(I)	PLTR 94
190	XC(I)=X(J)	PLTR 95
200	CONTINUE	PLTR 96
	LCC=0	PLTR 97
	DO 210 I=1,LIMIT	PLTR 98
	X(I)=XX(I)	PLTR 99
	IF (IUNIT.EQ.16) Y(I)=PE2(I)	PLTR 100
210	CONTINUE	PLTR 101
	IF (IUNIT.EQ.16) GO TO 260	PLTR 102
	IF (LOCB.EQ.0) GO TO 230	PLTR 103
	DO 220 I=1,LOCB	PLTR 104
	LOC=LOC+1	PLTR 105
220	Y(LOC)=PE2(I)	PLTR 106
230	CONTINUE	PLTR 107
	DO 250 I=1,JCURVE	PLTR 108
	L=J+LOCB	PLTR 109
	DO 240 K=L,LIMIT,JCURVE	PLTR 110
	LCC=LCC+1	PLTR 111
	Y(LOC)=PF2(K)	PLTR 112
240	CONTINUE	PLTR 113
250	CONTINUE	PLTR 114
260	NCALL=NCALL+1	PLTR 115
	CALL AEROPT (X,Y,LIMIT,IPTS,ILIST,JLIST,KLIST,15HPE (6#X#PSF22),1	PLTR 116
	15,8,NCALL,NCURVE,JCURVE)	PLTR 117
	LOC=0	PLTR 118
	DO 270 I=1,LIMIT	PLTR 119
	X(I)=XX(I)	PLTR 120
	IF (IUNIT.EQ.16) Y(I)=AMACHE(I)	PLTR 121
270	CONTINUE	PLTR 122
	IF (IUNIT.EQ.16) GO TO 320	PLTR 123
	IF (LOCB.EQ.0) GO TO 290	PLTR 124
	DO 280 I=1,LOCB	PLTR 125
	LOC=LOC+1	PLTR 126
280	Y(LOC)=AMACHE(I)	PLTR 127
290	CONTINUE	PLTR 128
	DO 310 I=1,JCURVE	PLTR 129
	L=J+LOCB	PLTR 130
	DO 300 K=L,LIMIT,JCURVE	PLTR 131

	LCC=LOC+1	PLTR 132
	Y(LOC)=AMACHE(K)	PLTR 133
300	CCNTINUE	PLTR 134
310	CCNTINUE	PLTR 135
320	NCALL=NCALL+1	PLTR 136
	CALL AEROPT (X,Y,LIMIT,IPTS,ILIST,JLIST,KLIST,3HME,3,2,NCALL,NCUP	PLTR 137
	1VF,JCURVE)	PLTR 138
	LCC=0	PLTR 139
	DO 330 I=1,LIMIT	PLTR 140
	X(I)=XX(I)	PLTR 141
	IF (IUNIT.EQ.16) Y(I)=DEL(I)	PLTR 142
330	CCNTINUE	PLTR 143
	IF (IUNIT.EQ.16) GO TO 380	PLTR 144
	IF (LOC.EQ.0) GO TO 350	PLTR 145
	DO 340 I=1,LOC	PLTR 146
	LOC=LCC+1	PLTR 147
340	Y(LOC)=DEL(I)	PLTR 148
350	CCNTINUE	PLTR 149
	DO 370 I=1,JCURVE	PLTR 150
	L=I+LOC	PLTR 151
	DO 360 K=L,LIMIT,JCURVE	PLTR 152
	LOC=LOC+1	PLTR 153
	Y(LOC)=DEL(K)	PLTR 154
360	CCNTINUE	PLTR 155
370	CCNTINUE	PLTR 156
380	NCALL=NCALL+1	PLTR 157
	CALL AEROPT (X,Y,LIMIT,IPTS,ILIST,JLIST,KLIST,14H?ED (C?FT22),14	PLTR 158
	1,7,NCALL,NCURVE,JCURVE)	PLTR 159
	LCC=0	PLTR 160
	IYAXIS=2	PLTR 161
	DO 390 I=1,LIMIT	PLTR 162
	X(I)=XX(I)	PLTR 163
	IF (IUNIT.EQ.16) Y(I)=ABS(CFXINF(I))	PLTR 164
390	CCNTINUE	PLTR 165
	IF (IUNIT.EQ.16) GO TO 440	PLTR 166
	IF (LOC.EQ.0) GO TO 410	PLTR 167
	DO 400 I=1,LOC	PLTR 168
	LCC=LOC+1	PLTR 169
400	Y(LOC)=ABS(CFXINF(I))	PLTR 170
410	CCNTINUE	PLTR 171
	DO 430 I=1,JCURVE	PLTR 172
	L=I+LOC	PLTR 173
	DO 420 K=L,LIMIT,JCURVE	PLTR 174
	LCC=LOC+1	PLTR 175
	Y(LOC)=ABS(CFXINF(K))	PLTR 176
420	CCNTINUE	PLTR 177
430	CCNTINUE	PLTR 178
440	NCALL=NCALL+1	PLTR 179
	CALL AEROPT (X,Y,LIMIT,IPTS,ILIST,JLIST,KLIST,13HC9#64FX2 INF2,13,	PLTR 180
	17,NCALL,NCURVE,JCURVE)	PLTR 181
	LOC=0	PLTR 182
	DO 450 I=1,LIMIT	PLTR 183
	X(I)=XX(I)	PLTR 184
	IF (IUNIT.EQ.16) Y(I)=ABS(STINF(I))	PLTR 185
450	CCNTINUE	PLTR 186
	IF (IUNIT.EQ.16) GO TO 500	PLTR 187
	IF (LOC.EQ.0) GO TO 470	PLTR 188
	DO 460 I=1,LOC	PLTR 189
	LOC=LOC+1	PLTR 190
460	Y(LOC)=ABS(STINF(I))	PLTR 191
470	CCNTINUE	PLTR 192
	DO 490 I=1,JCURVE	PLTR 193
	L=I+LOC	PLTR 194
	DO 480 K=L,LIMIT,JCURVE	PLTR 195
	LOC=LOC+1	PLTR 196
	Y(LOC)=ABS(STINF(K))	PLTR 197
480	CCNTINUE	PLTR 198
490	CCNTINUE	PLTR 199
500	NCALL=NCALL+1	PLTR 200
	CALL AEROPT (X,Y,LIMIT,IPTS,ILIST,JLIST,KLIST,10HS4#6T INF2,10,6,N	PLTR 201
	1CALL,NCURVE,JCURVE)	PLTR 202

LCC=0	PLTR 203
DO 510 I=1,LIMIT	PLTR 204
X(I)=XX(I)	PLTR 205
IF (IUNIT.EQ.16) Y(I)=ABS(QWCQWQ(I))	PLTR 206
510 CCNTINUE	PLTR 207
IF (IUNIT.EQ.16) GO TO 560	PLTR 208
IF (LOCB.EQ.0) GO TO 530	PLTR 209
DO 520 I=1,LOCB	PLTR 210
LCC=LCC+1	PLTR 211
520 Y(LCC)=ABS(QWCQWQ(I))	PLTR 212
530 CCNTINUE	PLTR 213
DO 550 I=1,JCURVE	PLTR 214
L=I+LOCB	PLTR 215
DO 540 K=L,LIMIT,JCURVE	PLTR 216
LOC=LOC+1	PLTR 217
Y(LOC)=ABS(QWCQWQ(K))	PLTR 218
540 CCNTINUE	PLTR 219
550 CCNTINUE	PLTR 220
560 NCALL=NCALL+1	PLTR 221
CALL AERDPT (X,Y,LIMIT,IPTS,ILIST,JLIST,KLIST,14HQ\$W/Q\$W STAG,14	PLTR 222
I,10,NCALL,ACURVF,JCURVE)	PLTR 223
LOC=0	PLTR 224
JCUM=0	PLTR 225
IF (IUNIT.EQ.13) GO TO 590	PLTR 226
PP=0	PLTR 227
DO 570 I=1,LIMIT	PLTR 228
IF (CFWINF(I).EQ.0.0) GO TO 570	PLTR 229
MM=MM+1	PLTR 230
X(M)=XX(I)	PLTR 231
Y(M)=ABS(CFWINF(I))	PLTR 232
570 CCNTINUE	PLTR 233
LIPDUM=MM	PLTR 234
JCCUM=JCURVE	PLTR 235
LL=1	PLTR 236
DO 580 I=1,JCURVE	PLTR 237
IF (IPTS(I).EQ.KEND2) LL=2	PLTR 238
IPTDUM(I)=IPTS(I)-LL	PLTR 239
LL=1	PLTR 240
580 CCNTINUE	PLTR 241
GO TO 720	PLTR 242
590 DO 600 I=1,LIMIT	PLTR 243
X(I)=XX(I)	PLTR 244
600 CCNTINUE	PLTR 245
IF (LOCB.EQ.0) GO TO 620	PLTR 246
DO 610 I=1,LCCB	PLTR 247
LCC=LCC+1	PLTR 248
610 Y(LCC)=ABS(CFWINF(I))	PLTR 249
620 CCNTINUE	PLTR 250
DO 640 I=1,JCURVE	PLTR 251
L=I+LOCB	PLTR 252
DO 630 K=L,LIMIT,JCURVE	PLTR 253
LOC=LOC+1	PLTR 254
Y(LCC)=ABS(CFWINF(K))	PLTR 255
630 CCNTINUE	PLTR 256
640 CCNTINUE	PLTR 257
DO 650 M=1,JCURVE	PLTR 258
DUPPHI(M)=PHI(M)	PLTR 259
IF (IUNIT.EQ.13.AND.PHI(1).EQ.0.0) GO TO 660	PLTR 260
GO TO 700	PLTR 261
660 IF (JCURVE.EC.1) GO TO 74C	PLTR 262
N=0	PLTR 263
ICUM=IPTS(1)+1	PLTR 264
DO 670 I=IDUM,LIMIT	PLTR 265
N=N+1	PLTR 266
X(N)=X(I)	PLTR 267
Y(N)=Y(I)	PLTR 268
670 CCNTINUE	PLTR 269
LIPDUM=N	PLTR 270
JCDUM=JCURVE-1	PLTR 271
DO 680 M=2,JCURVE	PLTR 272
680 IPTDUM(M-1)=IPTS(M)	PLTR 273

	JDUM=1	PLTR 274
	DC 690 M=1,JCDUM	PLTR 275
690	PHI(M)=DUMPHI(M+1)	PLTR 276
	GO TO 720	PLTR 277
700	LIMDUM=LIMIT	PLTR 278
	JCCDUM=JCURVE	PLTR 279
	DO 710 M=1,JCURVE	PLTR 280
710	IPTDUM(M)=IPTS(M)	PLTR 281
720	NCALL=NCALL+1	PLTR 282
	CALL AEROPT (X,Y,LIMDUM,IPTDUM,ILIST,JLIST,KLIST,12HC84EF7U INF2,1	PLTR 283
	12,7,ACALL,NCURVE,JCDUM)	PLTR 284
	IF (JCDUM.EQ.0) GO TO 740	PLTR 285
	DO 730 M=1,JCURVE	PLTR 286
730	PHI(M)=DUMPHI(M)	PLTR 287
740	CCONTINUE	PLTR 288
	LOC=0	PLTR 289
	DO 750 I=1,LIMIT	PLTR 290
	X(I)=XX(I)	PLTR 291
	IF (IUNIT.EQ.16) Y(I)=ABS(DELSTR(I))	PLTR 292
750	CCONTINUE	PLTR 293
	IF (IUNIT.EQ.16) GO TO 800	PLTR 294
	IF (LCCB.EQ.0) GO TO 770	PLTR 295
	DO 760 I=1,LCCB	PLTR 296
	LOC=LCC+1	PLTR 297
760	Y(LOC)=ABS(DELSTR(I))	PLTR 298
770	CCONTINUE	PLTR 299
	DO 780 I=1,JCURVE	PLTR 300
	L=I+LCCB	PLTR 301
	DO 780 K=L,LIMIT,JCURVE	PLTR 302
	LOC=LCC+1	PLTR 303
	Y(LOC)=ABS(DELSTR(K))	PLTR 304
780	CCONTINUE	PLTR 305
790	CCONTINUE	PLTR 306
800	NCALL=NCALL+1	PLTR 307
	CALL AEROPT (X,Y,LIMIT,IPTS,ILIST,JLIST,KLIST,4H76D*,4,2,NCALL,ACUPLTR 308	
	IRVE,JCURVE)	PLTR 309
810	IF (ANGLE.EQ.0.C.CR.KEND2.EQ.1) GO TO 830	PLTR 310
	IF (IUNIT.EQ.16) GO TO 840	PLTR 311
	IUNIT=16	PLTR 312
	I=C	PLTR 313
	IXAXIS=4	PLTR 314
	IYAXIS=1	PLTR 315
	ILIST=ISTPM2	PLTR 316
	JLIST=JSTKM2	PLTR 317
	KLIST=KSTKM2	PLTR 318
	DC 820 J=1,4	PLTR 319
820	IPTS(J)=NPTS(J,2)	PLTR 320
	GO TO 40	PLTR 321
830	NCURVE=NCURVE-A	PLTR 322
840	CCONTINUE	PLTR 323
	IXAXIS=1	PLTR 324
	IYAXIS=2	PLTR 325
	IF (ANGLE.EQ.0.C.CR.KEND2.EQ.1) GO TO 1070	PLTR 326
	DO 860 J=1,4	PLTR 327
	IF (LPCINT(J).EQ.0) GO TO 850	PLTR 328
	DPAKM(J)=XSTA(LPLDT(LPCINT(J)))	PLTR 329
	GO TO 860	PLTR 330
850	DPAKM(J)=1.0E-6	PLTR 331
	NCURVE=NCURVE-5	PLTR 332
860	CCONTINUE	PLTR 333
	ISLBL=1	PLTR 334
	IUNIT=14	PLTR 335
870	KKK=0	PLTR 336
880	KKK=KKK+1	PLTR 337
	IF (DPAKM(KKK).EQ.1.0E-6) GO TO 1080	PLTR 338
890	MBEG=1	PLTR 339
	MEAD=1E	PLTR 340
	ICURVE=0	PLTR 341
900	ICURVE=ICURVE+1	PLTR 342
	IF (ICURVE.EQ.5) GO TO 940	PLTR 343
910	READ (IUNIT,1130,END=940) XC(ICURVE),PHI(ICURVE),{Y(M),F(M),G(M),T,PLTR 344	

1(M),7(M),EPLUS(M),M=MBEG,MEND)	PLTR 345
C WRITE (6,970) IUNIT,XC(ICURVE),PHI(ICURVE)	PLTR 346
C DO 740 K=MBEG,MEND	PLTR 347
C WRITE (6,980) Y(K),F(K),G(K),T(K),Z(K),EPLUS(K)	PLTR 348
C 740 CONTINUE	PLTR 349
IF (IUNIT.EQ.15) GO TO 920	PLTR 350
IF (ABS(XC(ICURVE)-DPARM(KKK)).GT.0.001) GO TO 930	PLTR 351
MBEG=MEND+1	PLTR 352
MEND=MEND+IE	PLTR 353
GO TO 900	PLTR 354
920 IF (ABS(PHI(ICURVE)-DPARM(KKK)).GT.0.01) GO TO 910	PLTR 355
MBEG=MEND+1	PLTR 356
MEND=MEND+IE	PLTR 357
GO TO 900	PLTR 358
930 IF (ICURVE.EC.1) GO TO 890	PLTR 359
940 JCURVE=ICURVE-1	PLTR 360
IF (JCURVE.EC.0) GO TO 1060	PLTR 361
LIMIT=JCURVE*IE	PLTR 362
DO 950 J=1,JCURVE	PLTR 363
950 IPTS(J)=IE	PLTR 364
DO 960 I=1,LIMIT	PLTR 365
960 YY(I)=Y(I)	PLTR 366
DO 970 I=1,LIMIT	PLTR 367
X(I)=F(I)	PLTR 368
970 CCNTINUE	PLTR 369
NCALL=NCALL+1	PLTR 370
CALL AEROPT (X,Y,LIMIT,IPTS,SHU/UE,5,4,3HY/L,3,3,NCALL,NCURVE,JCUPLTR	PLTR 371
1PVE)	PLTR 372
IXAXIS=2	PLTR 373
KGZERC=0	PLTR 374
DO 980 I=1,LIMIT	PLTR 375
X(I)=G(I)	PLTR 376
IF (X(I).GT.0.000) KGZERC=1	PLTR 377
Y(I)=YY(I)	PLTR 378
980 CCNTINUE	PLTR 379
NCALL=NCALL+1	PLTR 380
IF (KGZERC.EQ.0) GO TO 940	PLTR 381
CALL AEROPT (X,Y,LIMIT,IPTS,SHU/UE,5,4,3HY/L,3,3,NCALL,NCURVE,JCUPLTR	PLTR 382
1PVE)	PLTR 383
990 DO 1000 I=1,LIMIT	PLTR 384
X(I)=T(I)	PLTR 385
Y(I)=YY(I)	PLTR 386
1000 CCNTINUE	PLTR 387
NCALL=NCALL+1	PLTR 388
CALL AEROPT (X,Y,LIMIT,IPTS,SHU/UE,5,4,3HY/L,3,3,NCALL,NCURVE,JCUPLTR	PLTR 389
1PVE)	PLTR 390
IXAXIS=1	PLTR 391
KZCNE=0	PLTR 392
DO 1010 I=1,LIMIT	PLTR 393
X(I)=7(I)	PLTR 394
IF (X(I).LT.1.000) KZCNE=1	PLTR 395
Y(I)=YY(I)	PLTR 396
1010 CCNTINUE	PLTR 397
NCALL=NCALL+1	PLTR 398
IF (KZCNE.EQ.0) GO TO 1020	PLTR 399
CALL AFROPT (X,Y,LIMIT,IPTS,1M2,1,1,3HY/L,3,3,NCALL,NCURVE,JCURVE)	PLTR 400
GO TO 1030	PLTR 401
1020 NCURVE=NCURVE-1	PLTR 402
1030 IXAXIS=3	PLTR 403
KEPLUS=0	PLTR 404
DO 1040 I=1,LIMIT	PLTR 405
X(I)=EPLUS(I)	PLTR 406
IF (X(I).GT.0.000) KEPLUS=1	PLTR 407
Y(I)=YY(I)	PLTR 408
1040 CCNTINUE	PLTR 409
NCALL=NCALL+1	PLTR 410
IF (KEPLUS.EQ.0) GO TO 1050	PLTR 411
CALL AEROPT (X,Y,LIMIT,IPTS,4M7&E+,4,2,3HY/L,3,3,NCALL,NCURVE,JCURPLTR	PLTR 412
1PVE)	PLTR 413
GO TO 1060	PLTR 414
1050 NCURVE=NCURVE-1	PLTR 415

1060	IF (IUNIT.EQ.14) REWIND 14	PLTR 416
	IF (IUNIT.EQ.15) REWIND 15	PLTR 417
	IXAXIS=1	PLTR 418
	GO TO 880	PLTR 419
1070	NCURVE=NCUPVE-20	PLTR 420
1080	IF (IUNIT.EQ.15) GO TO 1110	PLTR 421
	REWIND 14	PLTR 422
	IXAXIS=1	PLTR 423
	IUNIT=15	PLTR 424
	DO 1100 J=1,4	PLTR 425
	IF (KPOINT(J).EQ.0) GO TO 1090	PLTR 426
	DPARM(J)=DUMPH(KPCINT(J))	PLTR 427
	GO TO 1100	PLTR 428
1090	DPARM(J)=1.0E-6	PLTR 429
	NCURVE=NCUPVE-5	PLTR 430
1100	CONTINUE	PLTR 431
	GO TO 870	PLTR 432
1110	CONTINUE	PLTR 433
	RETURN	PLTR 434
C		PLTR 435
C	920 FORMAT (1H1,3X,I3)	PLTR 436
C	940 FOPMAT (2X,7(5X,E12.6))	PLTR 437
C	950 FOPMAT (6X,3(6X,E12.6))	PLTR 438
C	970 FOPMAT (10X,13,5X,E12.6,5X,E12.6)	PLTR 439
C	980 FORMAT (3X,6(3X,E12.6))	PLTR 440
C		PLTR 441
1120	FORMAT (10E12.6)	PLTR 442
1130	FCRMT (2(25CE12.6),102F12.6)	PLTR 443
	END	PLTR 444

	SUBROUTINE PCLY (TEMP,KDEGR,A,C)	POLY 1
	IMPLICIT REAL*8 (A-H,O-Z)	POLY 2
	DIMENSION A(6)	POLY 3
C		POLY 4
C	EVALUATES POLYNOMIALS USING HORNER'S RULE	POLY 5
C		POLY 6
C	TEMP = TEMPERATURE	POLY 7
C	KDEGR = DEGREE OF POLYNOMIALS	POLY 8
C	A = POLYNOMIAL COEFFICIENTS	POLY 9
C	C = VALUE OF POLYNOMIAL	POLY 10
C		POLY 11
	KD=KDEGR+1	POLY 12
	C=A(KD)	POLY 13
	DO 10 I=1,KDEGR	POLY 14
	KC=KD-1	POLY 15
10	C=TEMP*C+A(KC)	POLY 16
	RETURN	POLY 17
	END	POLY 18

	SUBROUTINE PROPTY	PROP 1
	IMPLICIT REAL*8 (A-H,C-Z)	PROP 2
	REAL*8 NOSE,LEWLAM,LEWTRR	PROP 3
	COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YCN(101),ROKCE(101)	PROP 4
	COMMON /CDG2/ PE2,TE2,LE2,VE2,CPE2DX,DTE2DX,DVE2DX,DPE2DX,DPRO2	PROP 5
	1UE2DX,DVE2DX,DTE2DX,AMUE2,RDMU2,K2,RMCE2,REX2	PROP 6
	COMMON /FRSTRM/ RHOINF,PINF,TFS,UFS,R,PRL,C,XMA	PROP 7
	COMMON /GASPRP/ LEWLAM(101),LEWTRR(101),PRANDL(101),PRANDT(101),CPRUP	PROP 8
	1(101),GAMMA(101),XMU(101),PHI(101),HSUM(101)	PROP 9
	COMMON /GECH/ ALPHA,INETAC,NCSE,RNCSE,WLST,X,XX,WX	PROP 10
	COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,INO,KPRT,LPRT,KPR,PROD	PROP 11
	1LPR	PROP 12
		PROP 13
		PROP 14

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COMMON /OUTPUT/ CFWEDG,CFWINF,CFXEDG,CFXINF,CHEDGE,CHINF,AMACHE,DEPPROP 15
11, CH, QWINF, QWQWQO, S, STEDGE, STINF, TAUETA, TAUX, DELSTX, DELPHI, THETAX, PKCP 16
2THPEPHI 17
COMMON /STAG/ PSTAG, YSTAG, PNC, QWSTAG, HSTAG, HE 18
COMMON /SURFAS/ CWALL, CWINO, PEWIND, VWALL, TWALL, XTW(500), TWX(500), XPROP 19
1C1(500), C1X(500), HWALL, TCCAW, KCI, KTW 20
COMMON /TMPRT/ TEMP(101), TOTE(101), TP(101), RTW, TR 21
COMMON /TRANS/ KTRANS, KCNSET, XIF, CHI2(101), CHIMAX, XBAR 22
COMMON /TRBLT/ ASTAR, AKSTAR, ALAMDA, YSUBL, EVSCTY(101), PRT, EDYLAN, EPROP 23
1PLUS(101), ALFT, LAMTRB 24
COMMON /XCORC/ X1, XXI, DX1, XICLC, DXDXI, DXDXXI 25
COMMON /XSCLVE/ XSTA(100), CXMAX, DX, DXULU, DX1, NSCLVE 26
COMMON /ZCCUFD/ FTAINF, ETAFAC, ETA(101), DELTA(101), AUTEST, KADETA 27
DIMENSION U(101), T2(101), Z2(101), F2(101), G2(101) 28
DATA BLUNT, SHARP, SHULUNT, SHSHARP/ 29
IF (NOSE.EQ.SHARP) S=X/XSTA(NSCLVE) 30
IF (NOSE.EQ.BLUNT) S=X/RNGSE 31
DO 10 J=1, IE 32
Z2(J)=Z(2, J, 2) 33
F2(J)=F(2, J, 2) 34
G2(J)=G(2, J, 2) 35
IF (K.EQ.1) G2(J)=0.000 36
T2(J)=T(2, J, 2) 37
10 TEP(J)=(T2(J)-HE-UE2**2*(F2(J)**2+G2(J)**2)/2.000)/CP(J) 38
LPR1=LPR 39
LPR=-10 40
CALL PIXTUR (T2, TE2, UE2, PE2, LEWLAN, PRANDL, CP, GAMMA, C, CN, XMU, RHO, ROP) 41
IROE, Z2, F2, G2, NSUP) 42
LPH=LPR1 43
C 44
C THE OUTPUT QUANTITIES ARE CALCULATED 45
C 46
C IF (L.EQ.1.AND.NOSE.EQ.SHARP) GO TO 50 47
C 48
C CALCULATE PHYSICAL AGRPAL DISTANCE PROFILE 49
C 50
DELSTX=0.000 51
DELPHI=0.000 52
THETAX=0.000 53
THEPHI=0.000 54
CHIMAX=0.000 55
CHI2(1)=0.000 56
G2IE=G(2, IE, 2) 57
IF (G2IE.EQ.0.000) G2IE=1.000 58
Y(1)=0.000 59
YCL(1)=0.000 60
IF (X1.EQ.0.000) YTRANS=1.000/PNC 61
IF (X1.GT.0.000) YTRANS=DSORT(2.000*X1)/(RHOE2*UC2*R2) 62
C 63
C CALCULATE DISPLACEMENT AND MOMENTUM THICKNESSES 64
C 65
DO 20 J=2, IE 66
Y(J)=Y(J-1)+YTRANS*(1.000/ROROE(J)+1.000/ROROE(J-1))*DETA(J)/2.000PKOP 67
YCL(J)=Y(J)/XSTA(NSCLVE) 68
DELSTX=DELSTX+YTRANS*((1.000/ROROE(J)-F(2, J, 2))/(1.000/ROROE(J-1)-PKOP 69
IF(2, J-1, 2)))*DETA(J)/2.000 70
THETAX=THETAX+YTRANS*(F(2, J, 2)*(1.000-F(2, J, 2))+F(2, J-1, 2)*(1.000-PROP 71
IF(2, J-1, 2))*DETA(J)/2.000 72
THEPHI=THEPHI+YTRANS*(G(2, J, 2)/G2IE*(1.000-G(2, J, 2)/G2IE)+G(2, J-1, PROP 73
12)/G2IE*(1.000-G(2, J-1, 2)/G2IE))*DETA(J)/2.000 74
DELPHI=DELPHI+YTRANS*((1.000/ROROE(J)-G(2, J, 2)/G2IE)+(1.000/ROROE(PROP 75
1J)-G(2, J, 2)/G2IE))*DETA(J)/2.000 76
CHI2(J)=Y(J)**2*FN(2, J, 2)*RHOE(J)**2*RHOE2*UE2*(1.000/YTRANS)/XMUPROP 77
1(J) 78
IF (CHI2(J).GT.CHIMAX) CHIMAX=CHI2(J) 79
20 CONTINUE 80
C 81
C CALCULATE BOUNDARY LAYER THICKNESS 82
C 83
DO 30 N=1, IE 84
U(N)=F(2, N, 2) 85

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	IF (U(N).GE.0.99500) NN=N-1	PROP 86
	IF (U(N).GE.0.99500) GC TO 40	PROP 87
30	CCNTINUE	PROP 88
40	DEL=Y(NN)+(Y(NN+1)-Y(NN))*(0.99500-U(NN))/(U(NN+1)-U(NN))	PROP 89
C		PROP 90
50	CCNTINUE	PROP 91
	REX2=RHCE2*UE2*X/AMUE2	PROP 92
	AMACHE=UE2/OSQRT(Q*TE2)	PROP 93
	RECFAC=PRANDL(1)**(1.000/DFLGAT(LAMTRB+1))	PROP 94
	TAW=TSTAG*RECFAC+TFS*(1.000-RECFAC)	PROP 95
	IF (X.EQ.0.000) GU TO 60	PROP 96
C		PROP 97
C	CALCULATE SURFACE PARAMETERS	PROP 98
C		PROP 99
	DWDETA=GN(2,1,2)	PROP 100
	IF (K.EQ.1.UF.K.EQ.KEND) DWDETA=0.000	PROP 101
	CFXINF=2.000*C(1)*RMU2*UE2**2*R2*FN(2,1,2)/RHOINF/US**2/DSQRT(2.000*X)	PROP 102
	1000*X	PROP 103
	CFXINF=2.000*C(1)*RMU2*UE2**2*R2*DWDETA/RHOINF/US**2/DSQRT(2.000*X)	PROP 104
	1*X	PROP 105
	CFXEDG=2.000*C(1)*AMUE2*R2*FN(2,1,2)/DSQRT(2.000*X)	PROP 106
	CFHEDG=2.000*C(1)*RUMU2*UE2*R2*GN(2,1,2)/RHJF2/UE2/DSQRT(2.000*X)	PROP 107
	QWINF=TCONW/CP(1)*RHC(1)*UE2*R2/DSQRT(2.000*X)*(HE*TN(2,1,2)+HE*(1.000-TN(2,1,2)))	PROP 108
	1LEWLAN(1)-1.000)*HSUM(1)*ZN(2,1,2)/RHOINF/US**3	PROP 109
	QWINF=QWINF*(-1.000)	PROP 110
	TAUX=CFXINF*RHCINF*US**2/2.000	PROP 111
	TAUETA=CFWINF*RHCINF*US**2/2.000	PROP 112
	Qh=QWINF*RHOINF*US**3*1.2860-C3	PROP 113
	IF (L.EQ.2.AND.FOSE.EQ.SHARP.AND.K.EQ.1) QWSTAG=QW	PROP 114
	QhCQhQ=Qh/QWSTAG	PROP 115
	STEDGE=-Qh/RHCE2/UE2/(HE*(1.000-T(2,1,2)))*778.300	PROP 116
	CHEDGE=-Qh/RHCE2/UE2/CP(1)/(TAW-TWALL)*778.300	PROP 117
	GC TO 70	PROP 118
60	IF (NCSE.EQ.SHARP) GO TO 70	PROP 119
C		PROP 120
C	CALCULATE HEAT TRANSFER FOR A BLUNT CONE STAGNATION POINT	PROP 121
C		PROP 122
	QWINF=1CONW/CP(1)*FNC=PGFUE(1)*(HE*TN(2,1,2)+HE*(1LEWLAN(1)-1.000)*HSUM(1)*ZN(2,1,2)/RHOINF/US**3	PROP 123
	1HSUM(1)*ZN(2,1,2)/RHOINF/US**3	PROP 124
	QWINF=QWINF*(-1.000)	PROP 125
	Qh=QWINF*RHOINF*US**3*1.2860-C3	PROP 126
	QWSTAG=QW	PROP 127
	QhCQhQ=1.000	PROP 128
C		PROP 129
70	CCNTINUE	PROP 130
	STINF=-QW/RHCINF/US/(HE*(1.000-T(2,1,2)))*778.300	PROP 131
	CHINF=-QW/RHCINF/US/CP(1)/(TAW-TWALL)*778.300	PROP 132
	RETURN	PROP 133
	END	PROP 134
	SUBROUTINE SHARP1 (CRAB)	SHRP 1
	IMPLICIT REAL*8(A-H,O-Z)	SHRP 2
	REAL*8 NOSE	SHRP 3
	COMMON /EDGE/ UEDC,TEHG,VEDG,PEDG,DTEGDX,DTEGDW,DUE;DX,DUEGDW,DVEGSHRP	4
	1DX,DVEGDW,DPEGDX,DPEGDW,U2PDW2,RHOEDG,AMUCDG,AMUEG	SHRP 5
	COMMON /FSTRM/ RHOINF,PINF,TFS,US,R,P,L,G,XXMA	SHRP 6
	COMMON /GECM/ ALPHA,THETAC,NCSE,RHCE,WLST,X,XX,WX	SHRP 7
	COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPR,T,KPR	SHRP 8
	1LPR	SHRP 9
	COMMON /POLYCC/ CPAIRL(6),CPAIRH(6),ENAIRL(6),ENAIRH(6),CMUAIR(6),SHRP	10
	1CMUHF(6),UIFHC(6),CMUAR(6),UIFAR(6),CPCO2L(6),CPCO2H(6),ENCO2L(6),SHRP	11
	2ENCO2H(6),CMUCU2(6),DIFCC2(6)	SHRP 12
	COMMON /STAG/ PSTAG,TSTAG,PNC,QWSTAG,HSTAG,HE	SHRP 13
	DIMENSION APS(15), AKHOS(15), ACFPHI(15), AVS(15), A(15), B(15), CSHRP	14
	1(15), D(15)	SHRP 15
C		SHRP 16
C	FOURIER COEFFICIENTS ARE READ IN ALONG WITH AXIAL DISTANCE	SHRP 17

C	FROM UNIT 10	
C	IF (ALPHA.EQ.0.000) GO TO 70	SHRP 18
	READ (10) XS,APS,ARHOS,ACFPHI,AVS	SHRP 19
	BACKSPACE 10	SHRP 20
	IF (ALPHA.EQ.0.000) K LX=7	SHRP 21
	DO 10 J=1,K LX	SHRP 22
	A(J)=APS(J)	SHRP 23
	B(J)=ARHOS(J)	SHRP 24
	C(J)=ACFPHI(J)	SHRP 25
	D(J)=AVS(J)	SHRP 26
10	CCNTINUE	SHRP 27
	PI=DARCOS(-1.000)	SHRP 28
	APHI=0.000	SHRP 29
	DEG=0.000	SHRP 30
	IF (KEND.EQ.1.OR.ALPHA.EQ.0.000) GO TO 20	SHRP 31
	DEG=18C.000/(DFLOAT(KEND)-1.000)	SHRP 32
	APHI=-DEG	SHRP 33
20	CCNTINUE	SHRP 34
	KKL=KLX-1	SHRP 35
	DO 30 I=1,K	SHRP 36
30	APHI=APHI+DEG	SHRP 37
	IF (L.EQ.1.OP.K.EQ.KENC) APHI=APHI-(1.000-CRNB)*DEG	SHRP 38
	PHI=APHI*(PI/18C.000)	SHRP 39
	VSUM=0.000	SHRP 40
	PSUM=0.000	SHRP 41
	RHCSUM=0.000	SHRP 42
	PHISUM=0.000	SHRP 43
	VNSUM=0.000	SHRP 44
	PNSUM=0.000	SHRP 45
	PNSUM=0.000	SHRP 46
	RCASUM=0.000	SHRP 47
	PHASUM=0.000	SHRP 48
	DO 40 J=1,K LX	SHRP 49
	Z=DFLOAT(J)-1.000	SHRP 50
	SUM1=A(J)*DCOS(Z*PHI)	SHRP 51
	PSUM=PSUM+SUM1	SHRP 52
	SUM2=B(J)*DCOS(Z*PHI)	SHRP 53
	RHCSUM=RHCSUM+SUM2	SHRP 54
	SUM4=D(J)*DCOS(Z*PHI)	SHRP 55
	VSUM=VSUM+SUM4	SHRP 56
	SUM5=-A(J)*Z*DSIN(Z*PHI)	SHRP 57
	PNSUM=PNSUM+SUM5	SHRP 58
	SUM6=-B(J)*Z*DSIN(Z*PHI)	SHRP 59
	RCASUM=RCASUM+SUM6	SHRP 60
	SUM8=-D(J)*Z*DSIN(Z*PHI)	SHRP 61
	VNSUM=VNSUM+SUM8	SHRP 62
	SUM9=-A(J)*Z*Z*DCOS(Z*PHI)	SHRP 63
	PNSUM=PNSUM+SUM9	SHRP 64
40	CCNTINUE	SHRP 65
	DO 50 J=1,K KL	SHRP 66
	H=DFLOAT(J)	SHRP 67
	SUM3=C(J)*DSIN(H*PHI)	SHRP 68
	PHISUM=PHISUM+SUM3	SHRP 69
	SUM7=C(J)*H*DCOS(H*PHI)	SHRP 70
	PHASUM=PHASUM+SUM7	SHRP 71
50	CCNTINUE	SHRP 72
	IF (K.NE.1) GO TO 60	SHRP 73
	PHISUM=0.000	SHRP 74
	RCNSUM=0.000	SHRP 75
	PNSUM=0.000	SHRP 76
60	CCNTINUE	SHRP 77
	PEOG=PSUM*RHCINF*UFS**2/G/XXMA**2	SHRP 78
	RHCEDG=RHDSUM*RHGINF	SHRP 79
	V=VSUM	SHRP 80
	CFA=PHISUM	SHRP 81
	UEDG=V*DCOS(CFA)*UFS	SHRP 82
	VEDG=V*DSIN(CFA)*UFS	SHRP 83
	DZPDW2=PNSUM*RHCINF*UFS**2/G/XXMA**2	SHRP 84
	DPEGCh=PNSUM*RHGINF*UFS**2/G/XXMA**2	SHRP 85
	DRCOP=RONSUM*RHGINF	SHRP 86
		SHRP 87
		SHRP 88

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DVEDP=VNSUM
DPFUP=PHNSUM
DVEGDH=(DVEDP*DSIN(CFA)+V*DCOS(CFA)*DPHDP)*UFS
TECG=PECG/KHCECG/R
DTEGDH=1.00/K*(KHCECG*DPEGDW-PEDG*DRNDP)/RHOEDG**2
DUEGDH=(DVEDP*DCOS(CFA)-V*DSIN(CFA)*DPHDP)*UFS
70 CONTINUE
IF (K.GT.1) GO TO 100
IF (TECG.GT.2000.000) GO TO 80
CALL POLY (TECG,5,ENAIPL,HE)
GO TO 90
80 CALL POLY (TECG,5,ENAIPL,HE)
90 HE=HE*TECG*UEDG**2/2.000
100 CCNTINUE
C
C CALCULATE X DERIVATIVES
C
DPEGDX=0.000
DTEGDH=0.000
DUEGDH=0.000
DVEGDH=0.000
IF (ALPHA.NE.0.000) GO TO 110
DZPDW2=0.000
VECG=0.000
DPEGUW=0.000
DTEGDH=0.000
DUEGDH=0.000
DVEGDH=0.000
110 CCNTINUE
RETURN
END

```

```

SHRP 89
SHRP 90
SHRP 91
SHRP 92
SHRP 93
SHRP 94
SHRP 95
SHRP 96
SHRP 97
SHRP 98
SHRP 99
SHRP 100
SHRP 101
SHRP 102
SHRP 103
SHRP 104
SHRP 105
SHRP 106
SHRP 107
SHRP 108
SHRP 109
SHRP 110
SHRP 111
SHRP 112
SHRP 113
SHRP 114
SHRP 115
SHRP 116
SHRP 117
SHRP 118
SHRP 119

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SUBROUTINE SOLVE (W,MN,EE1,FF1,EDGBC)
IMPLICIT REAL*8(A-H,O-Z)
REAL*8 NUSE
COMMON /CONVRG/ CONV,NIT1,NIT2,NIT3,NIT
COMMON /FINDIF/ A(101),BP(101),B(101),CC(101),DD(101),D(101),E(101)
1),CRI
COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,KDUM,L,NBLNT1,IND,KPRT,LPR,K
1PR,LPR
COMMON /ZCCORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA
DIMENSION EE(101), FF(101), W(2,101,3), MN(2,101,3)
C
C SUBROUTINE SOLVE CALCULATES THE SOLUTION OF A GENERAL PARABOLIC
C PARTIAL DIFFERENTIAL EQUATION WHEN THE P.D.E. IS REPRESENTED
C BY A SYSTEM OF IMPLICIT, THREE-POINT FINITE-DIFFERENCE EQUATIONS.
C THE THOMAS ALGORITHM AS SOLVED BY RICHMEYER IS USED TO SOLVE THE
C SYSTEM.
C
EE(1)=EE1
FF(1)=FF1
DO 10 J=2,IM
AP=A(J)
BP=B(J)
CP=CC(J)
DP=D(J)
EE(J)=-CP/(BP+AP*EE(J-1))
FF(J)=(DP-AP*FF(J-1))/(BP+AP*EE(J-1))
10 CONTINUE
W(2,IE,2)=EDGBC
K=IM
DO 20 J=2,IE
W(2,K,2)=EE(K)*W(2,K+1,2)+FF(K)
K=K-1
20 CCNTINUE
CALL DERIV3 (W,2,2,ETA,IE,1,MN)
RETURN
END

```

```

SOLV 1
SOLV 2
SOLV 3
SOLV 4
SOLV 5
SOLV 6
SOLV 7
SOLV 8
SOLV 9
SOLV 10
SOLV 11
SOLV 12
SOLV 13
SOLV 14
SOLV 15
SOLV 16
SOLV 17
SOLV 18
SOLV 19
SOLV 20
SOLV 21
SOLV 22
SOLV 23
SOLV 24
SOLV 25
SOLV 26
SOLV 27
SOLV 28
SOLV 29
SOLV 30
SOLV 31
SOLV 32
SOLV 33
SOLV 34
SOLV 35
SOLV 36

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SUBROUTINE SPECBC
  IMPLICIT REAL*8(A-H,O-Z)
  REAL*8 LEWLAP,LEWTRA
  COMMON /CONVGR/ CONV,NIT1,NIT2,NIT3,NIT
  COMMON /DEPVAR/ F(2,101,3),FNI(2,101,3),G(2,101,3),GN(2,101,3),T(2,101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YD,SPBC
  2L(101)
  COMMON /EDGE/ UFG,TEGG,VEGG,PEGG,DTEGDX,DTEGDW,DUEGDX,DUEGDW,DVEGDX,DVEGDW,SPBC
  1DX,DVEGDW,DPEGDX,DPEGDW,D2PDW2,RHOEDG,AMUFG,KCMUEG
  COMMON /EDGW/ PFH,UEH,VEH,TEH,CPEHDX,DPEHDX,DUEHDX,DUEHDX,DVEHDX,DVEHDX,SPBC
  1VEHDX,DTEHDX,DTEHDX,DPEHDX,RHCEW,AMUEW,ROMUW
  COMMON /FRSTRM/ RHOINF,PINF,TFS,UFS,R,PRL,Q,XMA
  COMMON /GASPRP/ LEWLAM(101),LEWTRA(101),PRANDL(101),PRANDT(101),CPSPRC
  1(101),GAMMA(101),XU(101),KMC(101),MSUM(101)
  COMMON /INJECT/ INJCT,ACINJ,GAS2,CCOL,MASTRN
  COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,SPBC
  1LPR
  COMMON /SOLPNT/ CH(101),CNH(101),VH(101),GH(101),TH(101),GHN(101),SPBC
  1FWN(101),FW(101),TWN(101),ZW(101),ZHN(101),XIW,DXDXIW,XW,RW
  COMMON /SPHRC/ ZWALL,ZWCLC,BIDIFW,AMDQW,SINLST,ZWNEG,AMWNEG,SPBC
  1,AMWPOS,WALLV,ZWZERC,NITCHG
  COMMON /SURFAS/ CHIND,PEWIND,VWALL,TWALL,XTW(500),TWX(500),XSPHC
  1C(500),CX(500),KCI,KTW
  COMMON /XSOLVE/ XSTAI(101),DXMAX,DX,DXOLD,DX1,NSOLVE
  IF (NIT.EQ.0) NITCHG=0
  IF (NIT.NE.NITCHG) RETURN
  IF (L.EQ.1) DETADY=DSQRT(2.0D0*RHO(1))*2*DUEGDX/ROMUW
  IF (L.GT.1) DETADY=RHO(1)*UEW*RW/DSQRT(2.0D0)*XIW
  WALLV=ZWALL*RHOINF*(UFS/RHO(1))
  ZWALL=BIDIFW/WALLV*ZN(2,1,2)*DETADY
  IF (NIT.EQ.0) AMDQW=C.CD0
  PERCNT=(DFLOAT(NIT)+1.0D0)/2C0.0D0
  IF (NIT.EQ.0) PERCNT=0.0D0
  ZWALL=PERCNT*ZWALL+(1.0D0-PERCNT)*ZWOLD
  IF (AMDQW) 10,70,20
  AMWNEG=AMDQW
  ZWNEG=ZWCLC
  SIGN=-1.0D0
  GO TO 30
  20
  AMWPOS=AMDQW
  ZWPOS=ZWCLC
  SIGN=1.0D0
  30
  IF (SINLST) 40,60,40
  40
  IF (SIGN*SINLST) 50,60,60
  50
  ZWALL=ZWPOS-(ZWPOS-ZWNEG)*AMWPOS/(AMWPOS-AMWNEG)
  60
  SINLST=SIGN
  70
  CONTINUE
  IF (ZWALL.LT.0.0D0) ZWALL=0.000
  IF (ZWALL.GT.1.0D0) ZWALL=1.000
  ZWCLC=ZWALL
  IF (K.EQ.1) ZWZERO=ZWCLC
  NITCHG=NITCHG+1
  RETURN
END

```

	SUBROUTINE SPECIE	SPEC	1
	IMPLICIT REAL*8(A-M,O-Z)	SPEC	2
	REAL*8 NOISE,LEWLAH,LEWTRB	SPEC	3
	COMMON /FPSTRM/ RHOINF,PINF,TFS,UFS,R,PRL,Q,XMA	SPEC	4
	COMMON /GASPRP/ LEWLAH(101),LEWTRB(101),PRANDL(101),PRANDT(101),CPSPEC	SPEC	5
	I(101),GAMMA(101),XMU(101),RHC(101),HSUM(101)	SPEC	6
	COMMON /GFCH/ ALPHA,THETAC,ACSE,RNOISE,WLST,X,XX,XX	SPEC	7
	COMMON /IECOEF/ B1,B2,P3,G1,G2,F1,F2,DE,AL,EPS,CHI,WINDPT,U1	SPEC	8
	COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,L*RT,KPR,SPFC	SPEC	9
	1LPR	SPEC	10
	COMMON /PDECOF/ A0(101),A1(101),A2(101),A3(101),A4(101),A5(101)	SPEC	11
	COMMON /SULPNT/ C1(101),C2(101),VW(101),GW(101),TW(101),CWN(101),SPEC	SPEC	12
	IFW(101),FW(101),TWN(101),Zw(101),ZW(101),X1W,DXXIXW,XW,RW	SPEC	13
	COMMON /TRANSP/ KTKANS,KONSET,XIF,CHI2(101),CHIMAX,XBAR	SPEC	14
	COMMON /TRBLNT/ ASTAR,AKSTAR,ALAMDA,YSUBL,EVSCTY(101),PRT,EDYLAH,FSPEC	SPEC	15
	1PLUS(101),ALET,LAMTRA	SPEC	16
	COMMON /XICORD/ X1,XX1,DX1,XICLD,DXXDI,DXXDI	SPEC	17
	COMMON /ZCCORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA	SPEC	18
	DIMENSION ROMU1(101), ROMUIN(101)	SPEC	19
C		SPEC	20
C	SUBROUTINE SPECIE SETS UP THE COEFFICIENTS OF THE PARTIAL	SPEC	21
C	DIFFERENTIAL SPECIES EQUATION	SPEC	22
C		SPEC	23
	DO 10 J=1,IE	SPEC	24
	RCMU1(J)=CW(J)*(LEWLAH(J)/PRANDL(J)+LEWTRB(J)*XIF+EPLUS(J)/PRANDT(SPEC	SPEC	25
	1J))	SPEC	26
10	CCATINUE	SPEC	27
	CALL DERIV (ROMU1,ETA,IE,1,RCMUIN)	SPEC	28
	DO 20 J=1,IE	SPEC	29
	A0(J)=ROMU1(J)*U1	SPEC	30
	A1(J)=VW(J)-RCMUIN(J)*U1	SPEC	31
	A2(J)=FW(J)*F1+DE*GW(J)*F2	SPEC	32
	A3(J)=C.000	SPEC	33
	A4(J)=2.000*X1W*FW(J)	SPEC	34
	A5(J)=DE*Gw(J)	SPEC	35
20	IF (K.EQ.1) A5(J)=0.000	SPEC	36
	CCONTINUE	SPEC	37
	RETURN	SPEC	38
	END	SPEC	39
	SUBROUTINE SUBLBL (XCR,YOR)	SLBL	1
	COMMON /LEGLBL/ LGND,ISLPL,IUNIT,KTITLE	SLBL	2
	COMMON /PHFILE/ XC,PHI	SLBL	3
	DIMENSION XC(5), PHI(5)	SLBL	4
	DATA LIST1/3H?U=/,LIST2/2HS=/	SLBL	5
	IF (IUNIT.EQ.14) GO TO 10	SLBL	6
	LBLARG=LIST1	SLBL	7
	LBCHAR=3	SLBL	8
	NDECPL=1	SLBL	9
	FLPN=PHI(1)	SLBL	10
	GO TO 20	SLBL	11
10	LBLARG=LIST2	SLBL	12
	LBCHAR=2	SLBL	13
	NDECPL=3	SLBL	14
	FLPN=XC(1)	SLBL	15
20	CCONTINUE	SLBL	16
	DX=1.5	SLBL	17
	DY=1.5	SLBL	18
	CALL SYMBOL (XCR+DX,YOR-DY,0.15,LBLARG,0.0,LBCHAR)	SLBL	19
	CALL WHERE (RCX,RCY)	SLBL	20
	DX=0.2	SLBL	21
	CALL NUMBER (ROX+DX,ROY,0.15,FLPN,0.0,NDECPL)	SLBL	22
	RETURN	SLBL	23
	END	SLBL	24

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SUBROUTINE TRBPRL (TAU,RETHET)
IMPLICIT REAL*8(A-H,O-Z)
REAL*8 LEWLAM,LEWTRB,KH,KH,MEIER
CCPMCN /UEPVAR/ F(2,101,3),FA(2,101,3),G(2,101,3),GN(2,101,3),Y(2,101,3),YOTRPR
1101,3),T(2,101,3),Z(2,101,3),ZA(2,101,3),C(101),CN(101),Y(101),YOTRPR
21(101),XCPCE(101)
CCPMCN /FDGW/ PEW,UEW,VEW,TEW,DPEWDX,DPEWDW,DUEWDX,DUEWDW,DVEWDX,DTRPR
1VENCW,OT(NDX,OTEWDW,DPEWDW,KHCEW,AMUEW,FOMUW
CCPMCN /FRSTPR/ RHCINF,PINF,TFS,UFS,R,PRL,Q,XMA
CCPMCN /GASPRP/ LEWLAM(101),LEWTRB(101),PRANDL(101),PRANDL(101),CPTRPR
1(101),GAMMA(101),XMU(101),PHC(101),HSUM(101)
CCPMCN /JATEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRTR,KPR,TRPR
1LPR
CCPMCN /SURFAS/ CWALL,CWIND,PEWIND,VWALL,TWALL,XTW(500),TWX(500),XTRPR
1C(500),CIX(500),HWALL,TCGNW,KCI,KTH
CCPMCN /TRBLNT/ ASTAR,AKSTAR,ALAMCA,YSUBL,EVSCTY(101),PRT,EDYLAW,ETRPR
1PLUS(101),ALEY,LAMTRB
DATA ROTTA,SHANG,CEBECI,MEIER,SHROTTA,SHSHANG,SHCEBEC,SHMEIER/
DIMENSION TAU(101)
C
C
DO 80 N=1,IE
IF (PRT.NE.ROTTA) GO TO 10
C
C
ROTTA'S TURBULENT PRANDTL NO.
C
PRANDT(N)=C.9500-0.4500*(Y(N)/YSUBL)**2
GO TO 60
10
CONTINUE
IF (PRT.NE.SHANG) GO TO 20
C
C
SHANG'S TURBULENT PRANDTL NO.
C
PR1=C.300
PR2=C.900
PRANDT(N)=PR1*DEXP(-10.000*Y(N)/YSUBL)+PR2*(1.000-0.200*Y(N)/YSUBL)
1)
GC TO 20
20
CONTINUE
IF (PRT.NE.CEBECI) GO TO 60
C
C
CEBECI'S TURBULENT PRANDTL NO.
C
ZDAMP=RHC(N)*UEW*RETHET/XMU(N)*1.0-03
CFC2=2.000*TAU(1)/KHNEW/UEW**2
VWPLUS=CWALL*RHCINF*UFS/RHC(1)/DSQRT(TAU(1)/RHO(N))
PPLUS=XMU(N)/RHC(N)/UEW**2*DUEWDX*DSQRT(CFC2)**(-3)
IF (VWPLUS.FC.0.005) GC TO 30
AN=(XMU(1)/AMUEW*(RHCIN/RHC(1))**2+PPLUS/VWPLUS*(1.000-DEXP(11.800*TRPR
1*XMU(1)/XMU(N)+VWPLUS))*DEXP(11.800*XMU(1)/XMU(N)+VWPLUS))*0.2500*TRPR
GC TO 40
30
AN=1.000
40
USFRIC=DSQRT(TAU(1)/RHO(N))*AN
APLUS=26.000+14.000/(1.000+7*ZDAMP**2)
BPLUS=35.000+25.000/(1.000+0.5500*ZDAMP**2)
A=APLUS*XMU(N)/PHC(N)*USFRIC/USFRIC**2
B=BPLUS*XMU(N)/RHL(N)*USFRIC/USFRIC**2
KH=0.400+0.1900/(1.000+0.4900*ZDAMP**2)
KH=0.4400+0.2200/(1.000+0.4200*ZDAMP**2)
IF (N.GT.1) GC TO 50
PRANDT(N)=KH*B/(KH*A)
GO TO 80
50
PRANDT(N)=KH*(1.000-DEXP(-Y(N)/A))/(KH*(1.000-DEXP(-Y(N)/B)))
GC TO 80
60
CONTINUE
C
C
MEIER'S TURBULENT NO.
C
AQ=34.400
A=26.500
AK=0.400

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      AKQ=0.44700
      PRTINF=0.000
      YPLUS=Y(N)*DSQRT(TAU(1)*HMO(N))/XMU(N)
      IF (YPLUS.GT.C.000) GO TO 70
      PRANDT(N)=PRTINF*(AQ/A)**2
      GO TO 80
70    PRANDT(N)=((AK*(1.000-DEXP(-YPLUS/A)))/(AKQ*(1.000-DEXP(-YPLUS/AQ)
      1)))**2
80    CCATINUE
      RETURN
      END

```

TRPR 72
 TRPR 73
 TRPR 74
 TRPR 75
 TRPR 76
 TRPR 77
 TRPR 78
 TRPR 79
 TRPR 80
 TRPR 81
 TRPR 82

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      SUBROUTINE VCALC
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,VCAL
      1101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CH(101),Y(101),YCVCAL
      2L(101),RORCE(101)
      COMMON /IECONF/ B1,B2,B3,G1,G2,F1,F2,DE,AL,EPS,CHI,WINDPT,U1
      COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,VCAL
      3LPR
      COMMON /SOLPAT/ CW(101),CWX(101),VW(101),GW(101),TW(101),GWN(101),VCAL
      4FMN(101),FW(101),TWN(101),ZWN(101),XIW,DXDXIW,XW,RW
      COMMON /SURFAS/ CWALL,CWIND,PEWIND,VWALL,TWALL,XTW(500),TWX(500),XVCAL
      5C(1500),CIX(500),HWALL,TCCNW,KCI,KTW
      COMMON /WSOLVE/ Cb
      COMMON /XICOPD/ XI,XXI,DXI,XICLD,DXOXI,DXOXXI
      COMMON /XSOLVE/ XSTA(100),DXMAX,DX,DXCLD,DXI,NSOLVE
      COMMON /ZCCORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA
      C
      C THIS SUBROUTINE CALCULATES THE VALUE OF V
      C
      VW(1)=VWALL
      DO 50 J=2,IE
      IF (K.GT.1) GO TO 10
      DGCW1=GW(J)
      DGCW2=GW(J-1)
      GO TO 30
10    IF (L.GT.1) GO TO 20
      DGDW1=(G(2,J,2)-G(2,J,1))/DW
      DGDW2=(G(2,J-1,2)-G(2,J-1,1))/DW
      GO TO 30
20    DGDW1=(G(2,J,2)-G(2,J,1)+G(1,J,3)-G(1,J,2))/2.000/DW
      DGDW2=(G(2,J-1,2)-G(2,J-1,1)+G(1,J-1,3)-G(1,J-1,2))/2.000/DW
30    DFDX11=C.000
      DFCX12=0.000
      IF (L.EQ.1) GO TO 40
      DFCX11=(F(2,J,2)-F(1,J,2))/DXI
      DFCX12=(F(2,J-1,2)-F(1,J-1,2))/DXI
40    VW(J)=VW(J-1)-(2.000*XIW*(DFDX11+DFDX12)+FW(J)+FW(J-1)+DE*(DGDW1+DVCAL
      5JGDW2))*DETA(J)/2.000
      CCATINUE
      RETURN
      END

```

VCAL 1
 VCAL 2
 VCAL 3
 VCAL 4
 VCAL 5
 VCAL 6
 VCAL 7
 VCAL 8
 VCAL 9
 VCAL 10
 VCAL 11
 VCAL 12
 VCAL 13
 VCAL 14
 VCAL 15
 VCAL 16
 VCAL 17
 VCAL 18
 VCAL 19
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 VCAL 38
 VCAL 39
 VCAL 40
 VCAL 41

	SUBROUTINE WALL	1
	IMPLICIT REAL*8(A-H,O-Z)	2
	REAL*8 NOSE	3
	COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YCHALL	4
	2L(101),RORCF(101)	5
	COMMON /EDGE/ UEDG,TEHG,VEDG,PERG,DTEGUX,DTEGOW,DUEGDX,DUEGOW,DVEGWALL	6
	IDX,DVEGOW,DPEGDX,DPEGOW,U2PDW2,RHUEDG,AMUEDG,ROMUEG	7
	COMMON /EDGW/ PEW,UEW,VW,TEW,DPEWDX,DPEWOW,DUEWDX,DUEWOW,DVENDX,DWALL	8
	IVEWOW,DLENOW,DTEWOW,DPEWOW,PHUEW,AMUEW,RCMUW	9
	COMMON /FRSTRM/ RHCINF,PINF,TFS,UFS,R,PRL,Q,XMA	10
	COMMON /GROM/ ALPHA,THETAC,NGSE,RNGSE,ALST,X,XX,XX	11
	COMMON /IECOFF/ B1,B2,B3,G1,G2,F1,F2,DF,AL,EPS,CHI,WINDPT,UI	12
	COMMON /INJECT/ INJCT,ACINJ,GAS2,COOL,MASTNN	13
	COMMON /INTEGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR	14
	ILPR	15
	COMMON /SOLPNT/ CW(101),CNW(101),VW(101),GW(101),TW(101),GWN(101)	16
	IFWNI(101),FW(101),TN(101),ZN(101),ZWN(101),X(4,DXDXTW,XW,RW	17
	COMMON /STAG/ PSTAG,TSTAG,PNC,QKSTAG,HSTAG,HE	18
	COMMON /SURFAS/ CWall,CHIND,PEWIND,VWall,TWall,XTW(500),TWX(500),XWall	19
	IC(1500),CIX(500),HWall,TCCNW,KCI,KTW	20
	COMMON /TMPRT/ TEMP(101),TGTE(101),TP(101),RTW,TB	21
	COMMON /XICORD/ XI,XXI,DXI,XIOLD,DXXI,DXXXI	22
	DATA BLUNT,SHARP/SHBLUNT,SHSHARP/	23
	DATA ARL,ATK/3HABL,3HATR/	24
	PI=DARCO(-1.000)	25
C	INTERPOLATE FOR VALUES OF CWall AT THE WINDWARD STREAMLINE	26
C	IF (MASTRN.EQ.0) GO TO 50	27
C	IF (K.GT.1) GO TO 20	28
	PEWIND=PEW	29
	IF (KCI.EQ.0) GO TO 20	30
	IF (XW.GT.XCI(KCI)) GO TO 50	31
	J=0	32
10	J=J+1	33
	IF (XW.GT.XCI(J)) GO TO 10	34
	IF (J.LT.2) J=2	35
	IF (J.GT.KCI-1) J=KCI-1	36
	CALL INTER3 (XW,XCI(J-1),XCI(J),XCI(J+1),CIX(J-1),CIX(J),CIX(J+1),	37
	CHIND)	38
	CWall=CHIND	39
	GO TO 60	40
20	IF (CCOL.EQ.ARL) CWall=CHIND*CCGS(XW*PI/180.000)**2	41
	IF (COOL.EQ.TRAI) GO TO 40	42
	IF (XW.LT.90.000) GO TO 40	43
	CWall=0.000	44
	DO 30 N=1,IE	45
	Z(2,N,2)=1.000	46
	ZN(2,N,2)=0.000	47
	ZW(N)=1.000	48
	ZWN(N)=0.000	49
30	CCATINUE	50
40	IF (COOL.EQ.TRAI) CWall=CHIND*PEWIND/PEW	51
	GO TO 60	52
50	CWall=0.000	53
60	CCATINUE	54
C	INTERPOLATE FOR VALUES OF TWall AT THE WINDWARD STREAMLINE	55
C	IF (K.GT.1) GO TO 90	56
	IF (KTW.EQ.0) GO TO 80	57
	J=0	58
70	J=J+1	59
	IF (XW.GT.XTW(J)) GO TO 70	60
	IF (J.LT.2) J=2	61
	IF (J.GT.KTW-1) J=KTW-1	62
	CALL INTER3 (XW,XTW(J-1),XTW(J),XTW(J+1),TWX(J-1),TWX(J),TWX(J+1),	63
	TWall)	64
	GO TO 90	65
80	TWall=RTW*TSTAG	66

90	CCNTINUE	WALL	72
C		WALL	73
C	CALCULATE THE VALUE OF BIG V AT THE WALL	WALL	74
C		WALL	75
	IF (NOSE.EQ.SHARP.AND.XIW.EQ.0.000) GO TO 110	WALL	76
	IF (XIW.EQ.0.000) GO TO 100	WALL	77
	VWALL=CWALL*PHICINF*UFS*DE*RW**2/DSQRT(2.000*XIW)	WALL	78
	GO TO 110	WALL	79
100	VWALL=CWALL*RHOINF*UFS*DSQRT(1.000/(2.000*RHOEW*DUEDGX*AMUEW))	WALL	80
110	CCNTINUE	WALL	81
	RETURN	WALL	82
	ENC	WALL	83

	SUBROUTINE WEDGE (KL,XPA,THETAC,ALPHA,IDETA,YB,XB)	WEDG	1
	IMPLICIT REAL*8 (A-H,O-Z)	WEDG	2
	COMMON /FLOCAT/ FLOFLD(5,15),BLUNTZ(40),BLUNTP(40),III	WEDG	3
	DIMENSION BETA(70), BR(70), RZ(70), Z(40), PRESS(40), P(15), AP(15)	WEDG	4
	1), PSUP(70), X(40), R(40)	WEDG	5
	WRITE (30,160)	WEDG	6
	WRITE (30,120)	WEDG	7
	WRITE (30,160)	WEDG	8
	WRITE (30,130)	WEDG	9
C		WEDG	10
	DO 10 I=1,III	WEDG	11
	Z(I)=BLUNTZ(I)	WEDG	12
	PRESS(I)=BLUNTP(I)	WEDG	13
10	CCNTINUE	WEDG	14
	KCUNT=III	WEDG	15
	WRITE (10) KCUNT	WEDG	16
	PHI=0.000	WEDG	17
	DO 20 M=1,KCUNT	WEDG	18
	X(M)=DARCOS(1.000-Z(M))	WEDG	19
	R(M)=DSIN(X(M))	WEDG	20
	P1=DARCOS(-1.000)	WEDG	21
	BETAD=X(M)*(180.000/P1)	WEDG	22
	WRITE (30,140) M,PHI,BETAD,X(M),R(M),Z(M),PRESS(M)	WEDG	23
20	CCNTINUE	WEDG	24
C		WEDG	25
C	BLUNT BODY SOLUTION IS ADDED TO THE EDGE PROPERTIES DATA SET	WEDG	26
C		WEDG	27
	DO 30 I=1,KCUNT	WEDG	28
	WRITE (10) Z(I),X(I),R(I),PRESS(I)	WEDG	29
30	CCNTINUE	WEDG	30
	GAMMA=DARCCS(YB)	WEDG	31
	WRITE (30,160)	WEDG	32
	DEG=180.000/(CFLD3T(IDETA)-1.000)	WEDG	33
	PHI=180.000*DEG	WEDG	34
	L=IDETA	WEDG	35
	WRITE (30,170)	WEDG	36
	WRITE (30,160)	WEDG	37
	IF (ALPHA.EQ.0.000) L=1	WEDG	38
	DO 40 I=1,L	WEDG	39
	PHI=PHI-DEG	WEDG	40
	PHIU=PHI*(PI/180.000)	WEDG	41
	BETA(I)=DARCOS(DSIN(GAMMA)*DCOS(ALPHA)-DCOS(GAMMA)*DSIN(ALPHA)*DCGW*DG	WEDG	42
	1S(PHIU))	WEDG	43
	BETAD=BETA(I)*(180.000/PI)	WEDG	44
	BR(I)=DSIN(BETA(I))	WEDG	45
	BZ(I)=1.000-NCOS(BETA(I))	WEDG	46
	WRITE (30,150) I,PHI,BETAD,BETA(I),BR(I),BZ(I)	WEDG	47
40	CONTINUE	WEDG	48
	WRITE (30,160)	WEDG	49
	WRITE (30,160)	WEDG	50
	WRITE (30,160)	WEDG	51
	WRITE (30,200)	WEDG	52
	WRITE (30,160)	WEDG	53
	DO 50 I=1,KCUNT	WEDG	54

50	WRITE (30,190) I,Z(I),X(I),R(I),PRESS(I)	WEDG	55
	CONTINUE	WEDG	56
	WRITE (10) L	WEDG	57
	DO 60 J=1,KL	WEDG	58
60	P(J)=FLOFLO(I,J)	WEDG	59
	IF (ALPHA.EQ.0.000.OR.KL.EQ.L) GO TO 70	WEDG	60
C		WEDG	61
C	FIND PRESSURES ALONG THE BODY FIXED PLANE TERMINATING THE WEDGE	WEDG	62
C	SECTION OR THE BLUNT BODY SECTION	WEDG	63
C		WEDG	64
	CALL FORIER (P,AP,KL,I)	WEDG	65
	APHI=180.000+DEG	WEDG	66
70	DO 100 I=1,L	WEDG	67
	IF (ALPHA.EQ.0.000.OR.KL.EQ.L) GO TO 90	WEDG	68
	APHI=APHI-DEG	WEDG	69
	PHI=APHI*(PI/180.000)	WEDG	70
	PSUM(I)=0.000	WEDG	71
	DO 80 K=1,KL	WEDG	72
	H=DFLOAT(K)-1.000	WEDG	73
	SUMI=AP(K)*DCOS(H*PHI)	WEDG	74
	PSUM(I)=PSUM(I)+SUMI	WEDG	75
80	CONTINUE	WEDG	76
90	N=KCUNT+I	WEDG	77
	IF (ALPHA.EQ.0.000) PSUM(I)=P(I)	WEDG	78
	IF (KL.EQ.L) PSUM(I)=P(L+1-I)	WEDG	79
	WRITE (30,190) N,UZ(I),BETA(I),BR(I),PSUM(I)	WEDG	80
100	CONTINUE	WEDG	81
C		WEDG	82
C	WEDGE SECTION SOLUTION IS ADDED TO THE EDGE PROPERTIES DATA SET	WEDG	83
C		WEDG	84
	DO 110 I=1,L	WEDG	85
	WRITE (10) UZ(I),BETA(I),BR(I),PSUM(I)	WEDG	86
110	CONTINUE	WEDG	87
	RETURN	WEDG	88
C		WEDG	89
C		WEDG	90
C		WEDG	91
120	FORMAT (10X,19HBLUNT BODY SOLUTION)	WEDG	92
130	FORMAT (3X,1H1,6X,3HPHI,20X,4HBETA,20X,1HS,22X,1HR,21X,1HZ,21X,1HP	WEDG	93
	1)	WEDG	94
140	FORMAT (2X,12,2X,F12.6,5(10X,F12.6))	WEDG	95
150	FORMAT (1H,1X,12,2X,F12.6,4(10X,F12.6))	WEDG	96
160	FORMAT (1H)	WEDG	97
170	FORMAT (1H0,51HPPOINTS NEEDED FOR THE WEDGE BOUNDARY LAYER SOLUTION	WEDG	98
	1//3X,1H1,7X,3HPHI,20X,4HBETA,19X,1HS,22X,1HR,21X,1HZ)	WEDG	99
180	FORMAT (10X,1SHDATA PUT ON UNIT 10)	WEDG	100
190	FORMAT (1X,13,1X,E12.6,3(5X,E12.6))	WEDG	101
200	FORMAT (11X,2HZA,14X,4HXSTA,14X,2HRZ,15X,2HPZ)	WEDG	102
	END	WEDG	103

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SUBROUTINE XPMOM                                XMOH  1
IMPLICIT REAL*8(A-H,O-Z)                        XMOH  2
REAL*8 NOSE                                     ,XMOH  3
COMMON /DEPVAR/ F(2,101,3),FN(2,101,3),G(2,101,3),GN(2,101,3),T(2,XMOH  4
101,3),TN(2,101,3),Z(2,101,3),ZN(2,101,3),C(101),CN(101),Y(101),YCXMOH  5
2L(101),RORCE(101)                             XMOH  6
COMMON /GECM/ ALPHA,THETAC,NCSE,RNOSF,WLST,X,XX,XX XMOH  7
COMMON /IECOFF/ B1,B2,B3,C1,G2,P1,F2,DE,AL,EPS,CHI,WINDPT,U1 XMOH  8
COMMON /INTGR/ IE,IM,KEND,KEND2,KLX,K,L,NBLNT1,IND,KPRT,LPRT,KPR,XMOH  9
1LPR                                             XMOH 10
COMMON /PDECOF/ AJ(101),A1(101),A2(101),A3(101),A4(101),A5(101) XMOH 11
COMMON /SOLPNT/ CW(101),CNW(101),VW(101),GW(101),TW(101),GWN(101),XMOH 12
1FW(101),FW(101),TW(101),ZW(101),ZN(101),XIW,DXDXIW,XW,RW XMOH 13
COMMON /TRANS/ KTRANS,KCNSET,XIF,CHI2(101),CHIMAX,XBAR XMOH 14
COMMON /TRBLNT/ ASTAR,AKSTAR,ALAMDA,YSUBL,EVSCTY(101),PRT,EQVLAW,XMOH 15
1PLUS(101),ALET,LAMTHB XMOH 16
COMMON /XICORD/ XI,XXI,DXI,XIOLD,DXDXI,DXDXXI XMOH 17
COMMON /ZCOORD/ ETAINF,ETAFAC,ETA(101),DETA(101),ADTEST,KADETA XMOH 18
DIMENSION RCMU1(101), RCMUIN(101) XMOH 19
DATA SHARP,BLUNT/5HSHARP,5HBLUNT/ XMOH 20
C XMOH 21
C SUBROUTINE SETS UP THE COEFFICIENTS OF THE PARTIAL DIFFERENTIAL XMOH 22
C X MOMENTUM EQUATION XMOH 23
C XMOH 24
DO 10 J=1,IE XMOH 25
RCMU1(J)=CW(J)*(1.0DC*XIF+EPLUS(J)) XMOH 26
10 CCNTINUE XMOH 27
CALL DERIV (RCMU1,ETA,IE,1,RCMUIN) XMOH 28
DO 20 J=1,IE XMOH 29
A0(J)=RCMU1(J)*U1 XMOH 30
A1(J)=RCMUIN(J)*U1-VW(J) XMOH 31
A2(J)=-DE*G1*GW(J)-B1*FW(J) XMOH 32
A3(J)=1.0DC/RORCE(J)*(B1+DL*AL*G1-EPS*AL**2)+EPS*GW(J)**2 XMOH 33
IF (K.EQ.1.AND.ACSE.EC.SHARP) A3(J)=0.0DC XMOH 34
IF (K.EQ.1.AND.ACSE.EC.BLUNT) A3(J)=B1*(1.0DC/RORCE(J)) XMOH 35
A4(J)=-2.0DC*XIW*FW(J) XMOH 36
A5(J)=-DE*GW(J) XMOH 37
IF (K.EQ.1) A5(J)=0.0DC XMOH 38
20 CCNTINUE XMOH 39
RETURN XMOH 40
END XMOH 41

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NOMENCLATURE

Note: All quantities are dimensional unless otherwise noted.

A_0-A_5	Coefficients in the governing partial differential equations
A^*	Van Driest damping constant
C_i	Mass fraction of species i
C_f	Skin-friction coefficient
C_h	Heat-transfer coefficients
C_p	Constant pressure specific heat, $\text{ft}^2/\text{sec}^2\text{-}^\circ\text{R}$
C_v	Constant volume specific heat, $\text{ft}^2/\text{sec}^2\text{-}^\circ\text{R}$
D_{if}	Binary diffusion coefficient, ft^2/sec
E	Scalar velocity function used in the Van Driest inner eddy viscosity law
H	Mean total enthalpy, ft^2/sec^2
H'	Fluctuating total enthalpy, ft^2/sec^2
h	Mean static enthalpy, ft^2/sec^2
I_f	Transition intermittency factor
k	Thermal conductivity
k_*	Mixing length constant for the Van Driest inner eddy viscosity law
Le	Molecular Lewis number
Le_t	Turbulent Lewis number
l_*	Mixing length
M_i	Molecular weight of species i
P	Pressure, lb/ft^2
Pr	Molecular Prandtl number
Pr_t	Turbulent Prandtl number

$\dot{q}_w$	Wall heat transfer rate, ft-lb/ft ² -sec
R	Universal gas constant, 49,754.035 ft ² /sec ² -°R
r	Local body radius, ft.
r_f	Recovery factor
St	Local Stanton number
T	Mean static temperature, °R
u	Mean streamwise velocity component, ft/sec
u'	Fluctuating streamwise velocity component, ft/sec
V	Transformed normal velocity, Eq. (38)
v	Mean normal velocity component, ft/sec
v'	Fluctuating normal velocity component, ft/sec
w	Mean transverse velocity component, ft/sec
w'	Fluctuating transverse velocity component, ft/sec
x	Local surface distance from the stagnation point, ft.
x_T	Location of the end of transition, ft.
x_t	Location of the beginning of transition, ft.
y	Distance normal to the surface, ft.
y_ℓ	Boundary-layer thickness as used in the outer eddy viscosity law, Eq. (76)
z	Free-stream species concentration profile, C_i/C_{i_e}
ϵ	Eddy viscosity, lb-sec/ft ²
ϵ_i	Inner region eddy viscosity, lb-sec/ft ²
ϵ_o	Outer region eddy viscosity, lb-sec/ft ²
ϵ^+	ϵ/μ
δ	Boundary-layer thickness, ft.

λ	Mixing length constant in the outer eddy viscosity law
ϕ	Transverse coordinate, Radians
ρ	Mean density, slugs/ft ³
θ	Stagnation enthalpy profile, Eq. (49); Momentum thickness, Eq. (142-145), ft.
τ	Local skin friction, lb/ft ²
ξ	Transformed coordinate as defined by Eq. (28)
η	Transformed coordinate as defined by Eq. (29)
η_x	Derivative, $\partial\eta/\partial x$
η_ϕ	Derivative, $\partial\eta/\partial\phi$

Subscripts

aw	Adiabatic wall
e	Outer edge of boundary layer
i	Designates properties of species i
f	Designates free-stream specie properties
r	Reference conditions, taken to be the edge conditions at the windward streamline
t	Designates turbulent quantities
w	Wall conditions
x	In the x direction
ϕ	In the ϕ direction
∞	Designates free-stream conditions