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ALESEP: A Computer Program for the Analysis of Airfoil Leading Edge Separation Bubbles

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ALESEP: A Computer Program for the Analysis of Airfoil Leading Edge Separation Bubbles

SUMMARY

A program called ALESEP is presented for the analysis of the inviscid-viscous interaction which occurs due to the presence of a closed laminar-transitional separation bubble on an airfoil. The ALESEP code provides an iterative solution of the boundary layer equations expressed in an inverse formulation coupled to a Cauchy integral representation of the inviscid flow. This interaction analysis is treated as a local perturbation to a known solution obtained from a global airfoil analysis; hence, part of the required input to the ALESEP code are the reference displacement thickness and tangential velocity distributions. Special windward differencing may be used in the reversed flow regions of the separation bubble to accurately account for the flow direction in the discretization of the streamwise convection of momentum. The ALESEP code contains both a forced transition model based on a streamwise intermittency function and a natural transition model based on a solution of the integral form of the turbulent kinetic energy equation. Instructions for the input, output, and program usage are given herein along with a sample case.

LIST OF SYMBOLS

a	Structural coefficient
c	Airfoil chord
c_f	Skin friction coefficient
$\mathcal{D}$	Damping factor applied to mixing and dissipation lengths
$\tilde{f}$	Perturbation stream function
F	Velocity ratio, u/u_e
g	Total enthalpy ratio, H/H_e
H	Total enthalpy
ℓ	Mixing length or ratio of local to edge density * molecular viscosity product
L	Reference length or dissipation length
m	Perturbation mass flow
n	Coordinate normal to reference displacement surface
N	Coordinate measured normal to reference displacement surface from the body surface
Pr	Prandtl number
Pr_T	Turbulent Prandtl number
$\bar{q}$	Magnitude of fluctuating velocities
Re	Reference Reynolds number
Re_θ	Local momentum thickness Reynolds number
$\tilde{R}_\theta$	Correlated momentum thickness Reynolds number
R_τ	Turbulent Reynolds number
s, S	Coordinates along reference displacement surface
Tu	Turbulence level
u	Velocity component parallel to reference displacement surface
v	Velocity component normal to reference displacement surface

V	Transformed normal velocity in Prandtl transposition theorem
α	Windward differencing weighting operator
β	Pressure gradient parameter
δ	Boundary layer thickness
δ^*	Displacement thickness
δ_τ	Stress thickness
ε	Eddy viscosity coefficient
κ	von Karman constant
η	Transformed normal coordinate
ν	Kinematic viscosity coefficient
μ	Molecular viscosity coefficient
ξ	Transformed tangential coordinate
ϕ	Velocity potential
ρ	Density
ψ	Stream function
ω	Interaction relaxation parameter

Subscripts

e	Edge of boundary layer
I	Inviscid
ref	Reference solution
t_1	Start of transition
t_2	End of transition
T	Turbulent
v	Viscous
∞	Free stream
1	Start of interaction region

2	End of interaction region

<u>Superscripts</u>

'	Perturbation quantity
+	Inner wall non-dimensionalized coordinate
k	Global inviscid-viscous iteration counter

GENERAL DESCRIPTION

Introduction

It was pointed out by Tani (Ref. 1) that airfoils at moderate incidence angles, prior to either leading edge stall or thin airfoil stall, experience local separation bubbles just downstream of the peak suction (minimum pressure) regions. Figure 1 shows a schematic diagram of an airfoil leading edge bubble which occurs if the Reynolds number is sufficiently low so that the boundary layer remains laminar up to the minimum pressure point. Downstream of this point, separation occurs almost immediately since laminar boundary layers, in contrast with turbulent flows, are extremely sensitive to adverse pressure gradients. A separation bubble forms in which a recirculating streamline pattern is bounded by a shear layer. Since shear layer flows tend to be highly unstable to flow disturbances, transition from laminar to turbulent flow generally occurs in this shear layer. Further downstream, the turbulent mixing between the shear layer flow with the lower dead air region results in entrainment of higher energy air which energizes the flow near the surface thereby resulting in flow reattachment with subsequent turbulent boundary layer flow downstream. As shown in Fig. 1, the initial position of the separation bubble is characterized by a pressure plateau followed by a pressure recovery region after the transition process is initiated, but prior to flow reattachment.

Technical Approach

The approach taken in the ALESEP code for the analysis of closed leading edge separation bubbles is based on an inviscid-viscous interaction technique in which the boundary layer equations are solved iteratively with an inviscid analysis through displacement thickness coupling. Experimental studies (Refs. 2-5) have shown that these closed transitional separation bubbles occupy only a few percent of the airfoil chord. Since the resultant interaction is highly localized, the leading edge transitional bubble problem is treated as a linear perturbation to a known global airfoil solution. The use of a perturbation approach permits an accurate analysis of the flow field structure in this region in contrast with the extremely difficult problem of trying to resolve this small scale phenomena while simultaneously solving the global airfoil flow field. In contrast with previous perturbation treatments of this problem, the approach taken in ALESEP accounts for the influence of the global viscous airfoil flow on the local interaction analysis. A detailed discussion of the approach taken in the ALESEP technique can be found in Refs. 6-8.

The local inviscid analysis in the ALESEP procedure assumes that the disturbance field induced by the presence of a transitional separation bubble can be treated as a small disturbance to the global airfoil flow. An asymptotic analysis is presented in Ref. 8 which formally shows that under a particular limiting condition, the disturbance field induced by the transitional displacement surface can be represented by a distribution of sources placed along a reference displacement surface as shown in Fig. 2. The reference displacement surface is usually defined as the displacement thickness which would exist in the local region due to an attached turbulent boundary layer. It, as well as the reference velocity distribution, are obtained from an airfoil analysis code such as that presented in Refs. 9 or 10 in which instantaneous transition from laminar to turbulent flow is assumed to occur at the predicted laminar separation point. Calculation of the perturbation velocity which occurs due to the difference between the separation bubble displacement thickness and the reference displacement surface as shown in Fig. 2, is performed through a Cauchy integral of the streamwise distributed sources using potential flow considerations. Upon integration of this Cauchy integral for the perturbed velocity, the local inviscid velocity distribution, u_{eI}, due to the interaction with the separation bubble is determined by adding the perturbation velocity and the reference velocity solution.

The viscous solution technique used in ALESEP is the inverse boundary layer procedure presented by Carter (Ref. 11). In this procedure, a perturbation stream function is introduced into the boundary layer equations for the simplification of boundary conditions. The continuity equation is eliminated and the stream function definition is subsequently added to the governing equation set which also included the momentum and energy equations. The governing equations are solved for the local perturbation stream function, velocity ratio, total enthalpy ratio, and viscous edge velocity, u_{eV}, for a prescribed streamwise distribution of perturbation mass flow, $\bar{m} = \rho_e u_e \delta^*$. The numerical solution of the governing equations is obtained using an implicit finite difference technique which is first order accurate in the streamwise direction and second order accurate in the normal direction.

Since the boundary layer equations are parabolic, an instability will arise when the solution marching direction is opposite to the flow direction. Reyhner and Flugge Lotz (FLARE) (Ref. 12) have shown that this instability is easily avoided by assuming that the streamwise convection terms are zero in reversed flow regions. It is apparent, however, that a loss of accuracy in the converged solution is incurred due to the negligence of the streamwise convection terms. As an improvement to the FLARE approximation, a windward finite difference operator may be used in the ALESEP code to calculate the streamwise gradient terms in reversed flow regions. The effects of using the more accurate windward differencing scheme are described in detail in Ref. 8.

The transition from laminar to turbulent flow in the separated shear layer may be modeled using one of two possible techniques available in the ALESEP code. A simple forced transition model in which the onset and length of transition are specified may be used in conjunction with either the Cebeci-Smith (Ref. 13) or the McDonald-Fish-Kreskovsky (Refs. 14 and 15) turbulence models. The forced transition model is based on the streamwise intermittency distribution which was established by Dhawan and Narasimha (Ref. 16). Alternately, the natural transition model of McDonald and Fish (Ref. 14) may be used with the McDonald-Fish-Kreskovsky turbulence model to automatically predict the transition location. Details of these transition and turbulence models in conjunction with the ALESEP inviscid-viscous interaction technique may be found in Refs. 6-8.

The present interaction iteration procedure is based on the inviscid-viscous iteration technique presented by Carter (Ref. 17) and is adopted to the present scheme as outlined in Fig. 3. The key feature of this iteration procedure is that the update formula permits the inverse boundary layer analysis to be directly linked to the inviscid analysis which accounts for displacement thickness effects. It was found by Kwon and Pletcher (Ref. 18) that convergence could be accelerated by making several inner loop passes through the Cauchy integral and the update formula with the boundary layer prediction of the edge velocity frozen at its current global iteration value. This technique is used in the present interaction iteration and has been found to significantly accelerate the global convergence rate of the scheme.

USER INSTRUCTIONS

Code Description

A flow chart of the ALESEP code is shown in Fig. 4. The code has been written to allow for one of two possible modes of operation to be performed. The first mode allows for a direct finite difference boundary layer calcuation for a prescribed edge velocity distribution. The second mode allows for an inviscid-viscous interaction calculation for a prescribed reference displacement surface and reference edge velocity distribution.

The ALESEP code is written in FORTRAN IV language and takes 206,000 octal word storage locations. Typically 20-40 global inviscid-viscous iterations are required to reduce residuals in inviscid-viscous edge velocities to 10^{-3}. On a Cyber 175 computer using the Cebeci-Smith turbulence model, an inviscid-viscous interaction calculation takes approximately 12 seconds per iteration. Using the McDonald-Fish-Kreskovsky turbulence model, an interaction calculation takes approximately 80 seconds per iteration. This increase in computing time is a result of the iterative solution of the turbulent kinetic energy equation required for this model.

Input Description

The input to the ALESEP code is read in five separate blocks. The first block is a namelist file, MASTER, used to define parameters which control the mode of operation, the streamwise computational grid, and input/output options. The second block of input contains the prescribed reference pressure, reference displacement surface, and free stream turbulence level distributions. The third input block is a namelist file, INPUT, which defines the controlling parameters for the boundary layer solution procedure. The fourth block is used to define experimental data which may be used in subsequent plots of the results. Finally, the last block of information required for inviscid-viscous interaction cases is the velocity ratio, perturbation stream function, total enthalpy ratio, and eddy viscosity profiles at the inital station of the interaction region and the initial guess of the perturbation mass flow distribution.

The first three blocks of input information are necessary to execute a direct boundary layer calculation. The input variable, IFIN, located in the MASTER namelist must be set to 2 and INVRSE in the INPUT namelist must be set to 0. The computational grid is determined by the following variables:

Streamwise - IGRID, AK1, AK2, DS, MMAX, SSWTCH, SPIVOT, IPIVOT, AKI1, AKI2, IVGINX, IMAX (namelist MASTER)

Normal - DETA, AK, NMAX1 (namelist Input)

A laminar similarity solution is used at the initial station with a freestream Mach number, AMES, and gradient, BETAS = $(1/M_e)(dM_e/d\xi)$ prescribed in namelist INPUT. The user has a choice of transition and turbulence models through the definition of variables, STRANS, KTRAN, TRNLEN, and ITRBMD located in namelist INPUT. For ITRBMD = 0, the Cebeci-Smith turbulence model is used with forced transition occurring according to specified values of STRANS, KTRAN, and TRNLEN. For ITRBMD = 1 or 2, the McDonald-Fish or McDonald-Fish-Kreskovsky natural transition turbulence model is used and transition is predicted automatically.

For an inviscid-viscous interaction calculation, input blocks 1, 2, 3 and 5 are necessary. The input variable, IFIN, located in namelist MASTER, must be set to 3 and INVRSE in the INPUT namelist must be set to 1. A total of IQUIT global inviscid-viscous iterations are performed. The structure of the computational grid is determined by the same variables previously mentioned for a direct boundary layer calculation with some required constraints which are discussed below. Velocity ratio, perturbation stream funtion, total enthalpy ratio and viscosity profiles at the initial station of the interaction region are required in the fifth input block (NSTART=1 in INPUT namelist) and are obtained from a direct boundary layer calculation extending from the leading edge to the initial station of the inviscid-viscous interaction calculation located somewhat ahead of the laminar separation point. For INTERP=0 in namelist INPUT, the values of AK and NMAX1 which define the computational grid in the normal direction in namelist INPUT should be the same as that used in the direct boundary layer calculation. The value of DETA in namelist INPUT should be the value used in the direct boundary layer calculation scaled by $\sqrt{2\xi}/\rho_e u_e r_o^i \delta^*$ due to the different definitions of the normal coordinate used in the direct and inverse boundary layer formulations. This scaling is performed automatically in subroutine CONVRT at the last computational station of the direct boundary layer calculation when IPRNEW has been set to 1. The value of DETA for the interaction calculation can then be found in the converted profile information for the last station printed out at the end of the direct boundary layer calculation. The value of XCO in namelist INPUT for the interacting calculation should be defined as the value of XC at the last computational station of the direct calculation. The value of AHO also in namelist INPUT should be defined as the value of AH at the last computational station of the direct calculation scaled by the inverse over direct DETA ratio. As in the direct calculation, the user has a choice of transition and turbulence models through definition of the input variables STRANS, KTRAN, TRNLEN, and ITRBMD. In addition to the models described in the direct boundary layer calculation, a forced transition model may be used with the McDonald-Fish (Ref. 14) or McDonald-Fish-Kreskovsky (Ref. 15) turbulence models by setting KTRAN=IQUIT and defining STRANS and TRNLEN. To use the natural transition model of McDonald and Fish with these turbulence models, KTRAN must be set to 0. Special windward differencing may be used in the reverse flow region of the separation bubble through definition of IWINDD and IWINDG in namelist INPUT. Detailed results using the different turbulence models and windward differencing scheme may be found in Refs. 6-8.

Detailed Input Description

Input Block 1:

The first block of input is read in from subroutine Main in a namelist called MASTER. This information defines the streamwise computational mesh and parameters controlling input and output.

INPLT	Number of global iterations between calls to plotting routines.
IQUIT	Total number of global inviscid-viscous iterations to be computed. Set IQUIT=1 for a direct boundary layer calculation.
RFDT	Relaxation factor applied to the perturbation mass flow in the inviscid-viscous update procedure.
RFVN	Relaxation factor for the injection velocity to represent viscous effects (inactive, set = 1.0).
MMAX	Total number of streamwise grid points used in the boundary layer calculation.
SSWTCH	Arclength location measured from the nose of the body where the boundary layer calculation is initiated.
IPLOT	Value of the global iteration counter at which the plot subroutines are first called.
AK1	The ratio of adjacent grid sizes used in generating the boundary layer grid in the streamwise direction beginning at SSWTCH.
AK2	The ratio of adjacent grid sizes at SSTING where SSTING > SSWTCH.
SSTING	Location where secondary boundary layer stretching, AK2, in the streamwise direction is initiated.
DS	Increment in arclength used at start of boundary layer mesh which begins at SSWTCH.
IVT1	Index in the inviscid streamwise arrays where the tangential velocity VT is read into program (inactive, set = 0).
IVT2	Last index where VT (I) is read into program (inactive, set = 0).
ISMOTH	If equals zero, no smoothing is used; if equals 1, the smoothed VT distribution is used.

MIT2	Inactive, set = 0.
SSTOP	Arclength location measured along the reference surface where the calculation is terminated downstream.
ITEK	Inactive, set = 0.
IAXI	If equals 0, two dimensional flow; if equals 1, axisymmetric flow.
IFIN	If equals 1, program terminates after initial inviscid calculation (this initial inviscid calculation is made with no boundary layer effect). If equals 2, program terminates after initial inviscid calculation and one pass thorugh boundary layer solver. If equals 3, program operates in full interactive mode and terminates after IQUIT iterations.
IFILET	If equals 1, the offset distance between the circular arc, hard surface and a cubic filet coordinate surface will be computed (set = 0).
XT1 XT2 XSTING YSTING RADIUS THICK XLO	Inactive, set = 0.
IWRPMF	If equals 0, bypass. If equals 1, the perturbation mass flow distribution is written to unit 13 for later restart.
CHORD	Reference length which allows rescaling the original axial distance measured from the nose to an alternate coordinate system measured from another location located at distance XOR from the nose.
XOR	Axial location in the original coordinate where the origin of the new coordinate X/C is located. Both XOR and CHORD are used to shift and rescale the axial coordinate used in the program.
SIO	Shift factor which allows the inviscid calculation to start at a downstream location on an open nose body where the flow is not disturbed near the nose. SIO is the distance from the original nose of the body to the downstream location where the inviscid calculation is started (set = 0).
IPLTX	If equals zero, bypass. If equals 1, then the program generates a plot file which will later generate the plots on a TEKTRONICS unit for studying the resuts of individual iterations. The user may select the global iteration(s) for which plots are to be generated.

NDCP — If equals 0, bypass. If equals 1, then experimental CP data versus X will be read into the program and plotted on CALCOMP plot from subroutine PLOTCP.

NDDT — If equals 0, bypass. If equals 1, then experimental displacement thickness distribution versus X/C will be read into the program and plotted along with the computed displacement thickness distribution.

NDCF — If equals 0, bypass. If equals 1, then experimental skin friction data versus X/C will be read into the program and plotted along with the computed skin friction distribution.

NDUE — If equals 0, bypass. If equals 1, experimental tangential velocity data versus X/C will be read in and plotted along with the tangential velocity computed solution.

IPRINT(I) — Array containing global iteration values at which station output is printed (array length = 100).

IGRID — If equals 0, inviscid and boundary layer mesh are generated by their own parameters.

If equals 1, inviscid mesh is set by its own parameters (IMAX, SINO, AKI1, AKI2, SPIVOT, IPIVOT, IVGINX - as described below) and boundary layer mesh is set equal to the inviscid mesh for S > SSWTCH.

If equals -1, inviscid mesh is set equal to the mesh at which geometry is input (i.e., XO, YO, SO) and boundary layer mesh is set equal to inviscid mesh for S > SSWTCH.

If equals -2, inviscid mesh is set equal to the mesh at which geometry is input and boundary layer mesh is generated by its own parameters.

IMAX — Maximum number of points in streamwise direction for the inviscid mesh.

SINO — The arclength at first point in inviscid mesh, or SI(1).

AKI1 — Ratio of adjacent grid sizes used in generating the inviscid grid in the streamwise direction between SINO and SPIVOT.

AKI2 — Ratio of adjacent grid sizes used in generating the inviscid grid in the streamwise direction for S > SPIVOT.

SPIVOT — Arclength at which geometric progression constant changes from AKI1 to AKI2.

IPIVOT — Streamwise mesh index at SPIVOT.

IVGINX — If equals 0, uniform inviscid mesh; if equals 1, a variable mesh using AKI1, AKI2 is used.

LOADDT — If equals 0, reference displacement thickness, DTO = 0; if equals 1, DTO is read in the second input block.

LOADSI — If equals 0, compute arclength from XO, YO; if equals 1, arclength is read in the second input block.

LOADCP — If equals 0, compute CPO using Cauchy integral; if equals 1, CPO is read in the second input block.

Input Block 2:

The second block of input is read in from subroutine INVO in a formated block. This block of information contains the reference displacement surface, reference velocity distribution, and edge turbulence level distribution.

ITITLE	Card 1:	A brief title for the configuration (12A6).
IXY	Card 2:	Number of points at which inviscid input including reference solution is read in. (I3)
XO	Card 3:	Cartesian distance in horizontal direction.
YO		Cartesian distance in vertical direction.
SO		Arclength measured from stagnation point.
CPO		Pressure coefficient, $(P_o - P_\infty)/\frac{1}{2}\rho_\infty U_\infty^2$, from reference solution.
DTO		Displacement thickness from reference solution.
TUO		Freestream turbulence level.

NOTE: IXY values of XO, YO, SO, CPO, DTO, TUO are read in (4F10.7, E10.5, F10.7) format.

GAM	Card 4:	γ, the specific heat ratio.
AMINF		M_∞, freestream Mach number.

NOTE: GAM, AMINF are read in with 2F10.7 format.

Input Block 3:

The third block of input is read in from subroutine TURBID in a namelist called INPUT. The information in this block is used to define the computational grid in the normal direction, the reference freestream flow conditions, the transition and turbulence model, and further output parameters.

NMAX1 Total number of grid points which are used across the boundary layer in the normal direction.

NMXOLD Total number of grid points in the initial profile of the interaction calculation.

DETA Increment in the transformed normal grid spacing, $\Delta\eta$, adjacent to the wall.

AK Ratio of adjacent step sizes in the eta, η, direction which is used to generate the mesh across the boundary layer. A uniform mesh (AK=1) is not currently allowed.

INVRSE If equals 0, then a direct boundary layer calculation is to be performed; if equals 1, then an interacting boundary layer calculation is to be performed.

JPFMAX Total number of points used in the initial guess for the perturbation mass flow distribution, PMFIN to be read in the fifth input block. In the case of restart, i.e., if IRESTR equal to 1, then JPFMAX should be set equal to MMAX.

IRESTR If equals 0, bypass; if equals 1, then a restart capability is used. In this case, the input array for PMFIN obtained from a previous calculation are read from unit 12.

INTERP If equals 0, bypass; if equals 1, then profiles at the initial interaction station are to be interpolated onto the interaction grid (set = 0).

IPRNEW If equals 0, bypass. If equals 1, the computed profiles at M=MMAX from a direct boundary layer calculation are converted from direct variables to inverse variables. Principally, this involves a change in the stream function and in the transformed normal coordinate eta, η.

NSTART If equals 0, program is initiated with the solution of the self-similar equations. If equals 1, profiles for the velocity ratio, stream function, total enthalpy ratio, and viscosity versus eta, η, are read from the fifth input block.

NQMAX Maximum number of column iterations which can be used in the boundary layer solution procedure.

NPRRES — If equals 0, bypass; if equals 1, boundary layer residual information will be printed.

MFIG(I) — Array of index values of the streamwise stations where profiles in the boundary layer solution are printed (array length = 100).

JMAX — The maximum number of boundary layer profiles to be printed out. If JMAX equals zero, then there will be no profiles printed, in which case, MFIG is set to a hundred zeros.

ITPRO — Global iteration counter at which detailed boundary layer residual and profile information is printed out.

PMFO — Multiplicative factor which is used to rescale the perturbation mass flow.

AHO — Initial value of the static temperature integral across the boundary layer which appears explicitly in the boundary layer equations. This parameter is needed when NSTART = 1, i.e., the boundary layer solution is initiated with specified profiles instead of internally generated self-similar solutions.

XCO — Initial value of the transformed (Levy Lees) ξ variable which is needed when NSTART = 1.

RESG — Maximum change in the dependent variable allowed between successive column iterations in the boundary layer calculation. Typical value used is 10^{-4}.

IPLOT(I) — Array containing an index to determine which plots are desired by the user (array length = 8). If IPLOT(I) is equal to 0, plot is bypassed; if IPLOT(I) is equal to 1, then the plot is made. The following order is used in the plotting subroutine. Plot #1 is DT (δ^*, displacement thickness) versus X/C. Plot #2 is CF versus X/C. Plot #3 is UE (VT, the inviscid tangential velocity) versus X/C. Plot #4 is Beta (pressure gradient parameter) versus X/C. Plot #5 is VN versus X/C. Plots #6, 7 and 8 control the plotting of profiles across the boundary layer.

WAKCON
SWK1
SWK2 — The Clauser constant in the Cebeci-Smith eddy viscosity law is varied linearly from 0.0168 at S=SWK1 to 0.0168/WAKCON at S=SWK2 (set WAKCON=1.0, SWK1=10000, SWK2=20000 to deactivate this option).

YORIGN(I) — Array containing the origin of the Y axis for each of the respective plots listed above (array length = 8).

YSCALE(I) — Array containing the scale factor for each of these plots (array length = 8). If the scale factor exceeds 1000, then the scale for these particular plots is determined automatically.

YIN(I) Array containing the number of inches for Y axis in each of the plots listed above (array length = 8).

XORIGN(I) Array containing the origin for X axis in each of these plots (array length = 8).

XSCALE(I) Array containing the scale factor for X axis (array length = 8); Again if this parameter exceeds 1000, the scale factor is determined automatically.

XIN(I) Array containing the number of inches used along the X axis in the respective plots (array length = 8).

XL Reference dimensional length used to convert the present X to a dimensional distance.

NDATA If equals 0, bypass; if equals 1, experimental data will be read from the fourth input block to be plotted with numerical results.

BETAS Value of the pressure gradient parameter, (1/M)(dM/dS), which is required in the self-similar solution.

AMES Value of the streamwise Mach number required in the self-similar solution.

GW Value of the total enthalpy ratio at the wall.

TINFD Reference temperature at infinity in degrees Rankine which is required in the Sutherland law for molecular viscosity.

PRT Turbulent Prandtl number.

PR Prandtl number.

REINF Reynolds number based on the reference (free stream) properties and based on the length which is used to nondimensionalize the coordinate used in the calculation.

STRANS Nondimensional distance along the body at which instantaneous transition is assumed to occur.

KTRAN For Cebeci-Smith turbulence model - (ITRBMD=0): equal to 0, fully laminar calculation; equal to 1, instantaneous transition occurs at STRANS; equal to 2, transition occurs over TRNLEN starting at STRANS. For McDonald-Fish turbulence model - (ITRBMD=1,2): KTRAN is the global iteration number when the McDonald-Fish natural transition model begins to predict the transition location. Forced transition over TRNLEN starting at STRANS is used for all global iterations prior to KTRAN.

IWINDD — Global iteration number when convection windward difference operation is effective.

IWINDG — If equals 0, do not use windward differencing in energy equation; if equals 1, use windward differencing on convection terms in energy equation starting on the IWINDD global iteration.

IWINDS — If equals 0, do not use windward differencing on stream function; if equals 1, use windward differencing on stream function in momentum and energy equations starting on the IWINDD global iteration. This option is not recommended at this time (set = 0).

ITRBMD — If equals 0, Cebeci-Smith turbulence model; if equals 1, McDonald-Fish turbulence model; equals 2, McDonald-Fish-Kreskovsky turbulence model.

Input Block 4:

The fourth block of input is read in from subroutine TURBID in a formated block only when NDATA ≠ 0. This block of information contains experimental data which may be plotted along with the numerical results.

IDST
ICFST
IUST — Card 1: Number of experimental data points to be read for DTE, CFE, or U1 (I3).

J — Card 2: Index of experimental data point (I3).

XDTE
XCF
XU1 — Cartesian distance in horizontal direction for experimental values of DTE, CFE or U1.

DTE — Experimental values of δ^* (NDDT ≠ 0)
CFE — Experimental values of C_f (NDCF ≠ 0)
U1 — Experimental values of U_e (NDUE ≠ 0)

NOTE: IDST, ICFST, or IUST values of
J, XDTE, XCF or XU1 and
DTE, CFE, or U1 are read in (I3, 2F8.4) format

Input Block 5:

The fifth block of input is read in from subroutine TURBID in a formated block only when NSTART=1. This block of information contains profiles for the velocity ratio, perturbation stream function, and total enthalpy ratio to be used at the initial station of the interaction calculation. For ITRBMD $\neq$ 0, the scalar quantities necessary to initialize the turbulent kinetic energy equation as well as the eddy viscosity profiles are also read in this block. The initial guess distribution for the perturbation mass flow parameter is also read in this formated block.

Values of PSI11, PSI12, PSI31, PSI32, EMFK, ALINF, A1MFK, DTINC, DELTU, and A2MA3 are read in 5F16.8 format when ITRBMD $\neq$ 0. These variables define the scalar quantities required for the McDonald-Fish-Kreskovsky turbulence model at the inital station of the interaction case. These values are stored in unit 14 of a direct boundary layer calculation when IPRNEW = 1. See the output description section for the definition of these variables.

NMAX values of YNI, EPSBB, and EPSHB in a 3E16.8 format are read next when ITRBMD $\neq$ 0. These arrays define the viscosity profiles for the McDonald-Fish-Kreskovsky turbulence model at the initial station. These values are stored in unit 14 of a direct boundary layer calculation when IPRNEW = 1. See the output description for the definition of these variables.

NMXOLD values of NN, ETABD, FBD, PSI, and GBD are read in a I5, 4E16.8 format. These arrays define the velocity ratio, perturbation stream function, and total enthalpy ratio profiles at the initial station. These values are stored in unit 14 of a direct boundary layer calculation when IPRNEW = 1. See the output description section for the definition of these variables.

JPFMAX values of PMFIN in a 7F10.7 format followed by JPFMAX values of SPMF in the same format are read in to define the initial distribution of the perturbation mass flow.

Output Description

An example test case for the NACA 66_3-018 airfoil tested experimentally by Gault (Ref. 2) at a chord Reynolds number of $2x10^6$ and a 0.0 degree angle of attack is given in Appendix A. A comparison between the predicted and experimental pressure distributions is shown in Fig. 5(a). The predicted displacement thickness and skin friction distributions are shown in Figs. 5(b) and 5(c), respectively. In this case, the reference pressure distribution was taken to be the experimental high Reynolds number (Re = 10^7) case in which transition naturally occurred before laminar separation could take place. A direct boundary layer calculation was run from the leading edge stagnation point of the airfoil to an s/c = 0.5 using the reference pressure distribution as the edge boundary condition. The velocity ratio, perturbation stream function, total enthalpy ratio, and eddy viscosity profiles were taken at the s/c = 0.5 station from the direct calculation and used as initial profiles for the interacting calculation. The reference displacement thickness was held constant at that value predicted by the direct boundary layer calculation at s/c = 0.5. A total of 99 grid points were distributed evenly between s/c = 0.5 and s/c = 0.99 in the interaction calculation. The McDonald-Fish turbulence model was used in this case with transition being forced to occur between s/c = .693 and .703. The local edge turbulence level was calculated from a 0.2 percent freestream turbulence level and the local to upstream inviscid velocity ratio using the assumption of frozen turbulence. The FLARE approximation of the streamwise convection was used in this case. Windward differencing was found to have little affect on the predicted results. Further comparisons of predicted results using the ALESEP technique with experimental data may be found in Refs. 6-8.

The notation used in the output of the ALESEP code conforms to that used in the description of the governing equations in Refs. 6-8. A dictionary of the variables used in the output can be found in the following section.

Reference Distribution Output

XO, YO
XB, YB — Input Cartesian coordinates of body shape.

SO — Input arclength.

CPO — Input reference pressure coefficient.

DTO — Input reference displacement thickness.

TUO, TUB — Input boundary layer edge turbulence level.

VT — Input boundary layer edge velocity at same location as input body coordinates.

SI — Body arclength measured from stagnation point at nose of body to same location as input body coordinates.

XOC — Shifted and rescaled value of axial coordinate, XO.
XOC = (XO - XOR)/CHORD

PMF
PMFB — Input perturbation mass flow paramter, $m = \rho_e u_e r_o^i \delta^*$ (interacting case only).

S — Body arclength measured from stagnation point to boundary layer computational stations.

SPMF — Body arclength measured from stagnation point to boundary layer stations where perturbation mass flow is defined.

XOCBL — Same as XOC, but measured from stagnation point to boundary layer computational stations.

RO — If flow is axisymmetric, RO is the body radius; for 2-D flow RO=1.

VTBL — Boundary layer edge velocity at boundary layer computational stations.

Similarity Solution Output

NQ — Boundary layer column iteration counter.

RES1 — Maximum change in dependent variable between two successive column iterations.

AHO — Static temperature integral, h.

FNW — Normalized wall shear, $\left.\frac{\partial F}{\partial \eta}\right|_{\eta=0}$ where $F = u/u_e$

ETA — Transformed coordinate normal to surface, η.

F — Streamwise velocity ratio, $u/u_e = F$.

SF — Transformed stream function, $\tilde{f}$.

G — Total enthalpy ratio, $H/H_e = G$.

Initial Profiles

If NSTART equals 0, then the initial profile is the same as the laminar self-similar solution. If NSTART equals 1, then the initial profiles are the same as those which are read in (ETABD = ETA, FBD = F, PSI = SF, GBD = G). Note however that if INTERP equals 1, then these profiles have been interpolated onto a new η-mesh.

Station Output (Summary Chart No. 1)

M — Streamwise station index

PMF — In direct calculation, this is $\sqrt{2\xi}$ where ξ is the streamwise Levy Lees variable; in an interacting case, this is the prescribed distribution of perturbation mass flow, $m = \rho_e u_e r_o^i \delta^*$.

PMFCHK — This is $\rho_e u_e r_o^i \delta^*$; in an inverse calculation, this quantity is a check to see that the computed velocity profiles give the same displacement thickness as that prescribed and thus, in the interacting mode, we should always get PMFCHK = PMF.

BETA — Pressure gradient parameter, $\beta = (1/M_e)(dM_e/d\xi)$.

BETCHK — Calculated pressure gradient parameter (interacting case only).

UEP — Boundary layer edge velocity. In direct mode, UEP is the same as the prescribed VTBL; in the inverse mode, it is computed as part of the solution.

AMACH — Boundary layer edge Mach number.

AH — Static temperature integral, $h = \int_o^\infty (T/T_e - 1)d\eta$.

CF — Skin friction coefficient based on free stream dynamic head, $C_f = \tau_w^*/\frac{1}{2}\rho_\infty^* U_\infty^{*2}$ where asterisk denotes dimensional quantity.

NMCH — Index where inner and outer edge viscosity laws are matched (Cebeci-Smith turbulence model).

RTHETA — Reynolds number based on momentum thickness.

<u>McDonald-Fish-Kreskovsky Turbulence Model Output</u> (ITRBMD $\neq$ 0)

MREF — Reference free stream Mach number. Same as AMINF in third input block.

TREFD — Reference free stream static temperature. Same as TINFD in INPUT namelist.

TREF — Nondimensional reference free stream static temperature.

REYREF — Reference free stream Reynolds number. Same as REINF in INPUT namelist.

ME2 — Boundary layer edge Mach number at current streamwise station.

UE2 — Nondimensional boundary layer edge velocity at current streamwise station.

TE2 — Nondimensional boundary layer edge temperature at current streamwise station.

RHOE2	Nondimensional boundary layer edge density at current streamwise station.
TU2	Boundary layer edge turbulence level at current streamwise station.
RO2	Geometry coefficient, RO, at current streamwise station.
QE2	Boundary layer edge perturbation velocity magnitude at current streamwise station.
MUE2	Nondimensional boundary layer edge molecular viscosity at current streamwise station.
ME1	Boundary layer edge Mach number at previous streamwise station.
UE1	Nondimensional boundary layer edge velocity at previous streamwise station.
TE1	Nondimensional boundary layer edge temperature at previous streamwise station.
RHOE1	Nondimensional boundary layer edge density at previous streamwise station.
RO1	Geometry coefficient, RO, at previous streamwise station.
QE1	Boundary layer edge perturbation velocity magnitude at previous streamwise station.
ACLINF	Free stream dissipation length, L, at current streamwise station.
ALINFN	Free stream mixing length, ℓ, at current streamwise station.
ALINFO	Free stream mixing length, ℓ, at previous streamwise station.
A1MFKN	Structural coefficient, a_1, at current streamwise station.
A1MFKO	Structural coefficient, a_1, at previous streamwise station.
A2MFK	Structural coefficient, a_2, at current streamwise station.
A3MFK	Structural coefficient, a_3, at current streamwise station.
BLTHK	Boundary layer thickness at current streamwise station scaled by $\sqrt{R_{e_\infty}}$.
DELIN	Inner boundary layer thickness at current streamwise station.
DELTU2	Value of turbulent displacement thickness, δ_τ, at current streamwise station.

DELTU1	Value of turbulent displacement thickness, δ_τ, at previous streamwise station.
DTINC2	Incompressible displacement thickness at current streamwise station.
VEDGE	Nondimensional boundary layer edge normal velocity component, v_e, at current streamwise station.
NDELTU	Index of normal grid point where DELTU2 is located.
NINNER	Index of normal grid point where DELIN is located.
PSI11N	Value of first set of terms of the ϕ_1 integral in turbulent kinetic energy equation at current streamwise station.
PSI12N	Value of second set of terms of the ϕ_1 integral in the turbulent kinetic energy equation of the current streamwise station.
PSI11O	Value of first set of terms of the ϕ_1 integral in the turbulent kinetic energy equation at the previous streamwise station.
PSI12O	Value of second set of terms of the ϕ_1 integral in the turbulent kinetic energy equation at the previous streamwise station.
PSI21N	Value of the ϕ_2 integral in the turbulent kinetic energy equation at the current streamwise station.
PSI31N	Value of the first set of terms of the ϕ_3 integral in the turbulent kinetic energy equation at the current streamwise station.
PSI32N	Value of the second set of terms of the ϕ_3 integral in the turbulent kinetic energy equation at the current streamwise station.
EMFK	Value of the source term, E, in the turbulent kinetic energy equation at the current streamwise station.
RTAU	Value of the turbulent Reynolds number, R_τ, at the current streamwise station.
RTHEAT	Value of the correlated momentum thickness Reynolds number, $\tilde{R}_\theta$, at the current streamwise station.
A2MA3N	Value of the difference of structural coefficient, a_2-a_3, at the current streamwise station.

Profile Output

ETA Transformed normal coordinate, η.

YBL Nondimensional physical distance from surface.

F2 Streamwise velocity ratio, u/u_e.

SF2 Transformed stream function, $\tilde{f}$.

G2 Total enthalpy ratio, H/H_e.

EPSBAR $1 + \varepsilon/\mu$ where ε is the eddy viscosity coefficient and μ is the molecular viscosity coefficient.

RHOMUR $\ell = \rho\mu/\rho_e\mu_e$.

T Static temperature ratio, T/T_e.

For ITRBMD $\neq$ 0, the following additional profiles are printed:

YN Nondimensional physical distance from the surface scaled by $\sqrt{Re_\infty}$

YPLUS Nondimensional scaled distance from the surface, $y+ = y\sqrt{\tau/\rho}/\nu$

DUDY Nondimensional velocity normal gradient, $\partial F/\partial YN$

TAU Shear stress, $(\mu+\mu_T)\ \partial u/\partial YN$

DAMP Damping factor squared, $\mathcal{D}^2$.

FUN Local mixing length distribution in normal direction.

FMFK McDonald-Kreskovsky function, f_τ, on mixing length formula.

Station Output (Summary Chart No. 2)

M Streamwise index.

XLE Cartesian coordinate of station location.

DT* Scaled displacement thickness, $\delta^* \sqrt{Re_\infty}$.

THETA* Scaled momentum thickness, $\theta \sqrt{Re_\infty}$.

CPBL C_p obtained from interacting boundary layer calculation.

UEP u_e obtained from interacting boundary layer calculation.

QW	Heat transfer coefficient at the wall.
STAN	Stanton number.
STRINT	Intermittency parameter in streamwise direction.
CFX	Scaled skin friction coefficient, $c_f \sqrt{Re_\infty}$.

Summary of Convergence History

INTRAC	Interaction global iteration counter.
DDTMAX	Maximum change in DT.
RMSDT	Root mean square change in DT.
SMDT	Streamwise location where DDTMAX occurs.
DUEMAX	Maximum change in UE.
RMSUE	Root mean square change in UE.
SMUE	Streamwise location for maximum change in UE.
DSFMAX	Maximum change in perturbation stream function, $\tilde{f}$.
DFMAX	Maximum change in velocity ratio, F.
DGMAX	Maximum change in total enthalpy ratio, G.

Brief Description of Files

The following files are used to write information for plotting, restart, and interaction purposes.

Unit Number	Purpose
8	Write velocity and temperature profiles to be used for plotting purposes later on (TURBID).
9	Write stream function profile to be used for plotting purposes later on (TURBID).
10	Write eddy viscosity coefficient profile to be used for plotting purposes later on (TURBID).
12	Read information for restart run (TURBID).

13 Write information for later restart (WR13).

14 Write the profiles in inverse variables from a direct boundary layer run at the last streamwise station (CONVRT).

17 Write the weak interaction solution from a direct boundary layer run for use as a reference solution (TURBID).

18 Direct access file to store information for windward differencing scheme (TURBID).

22 Write station quantities for Tektronics plotting (WR22).

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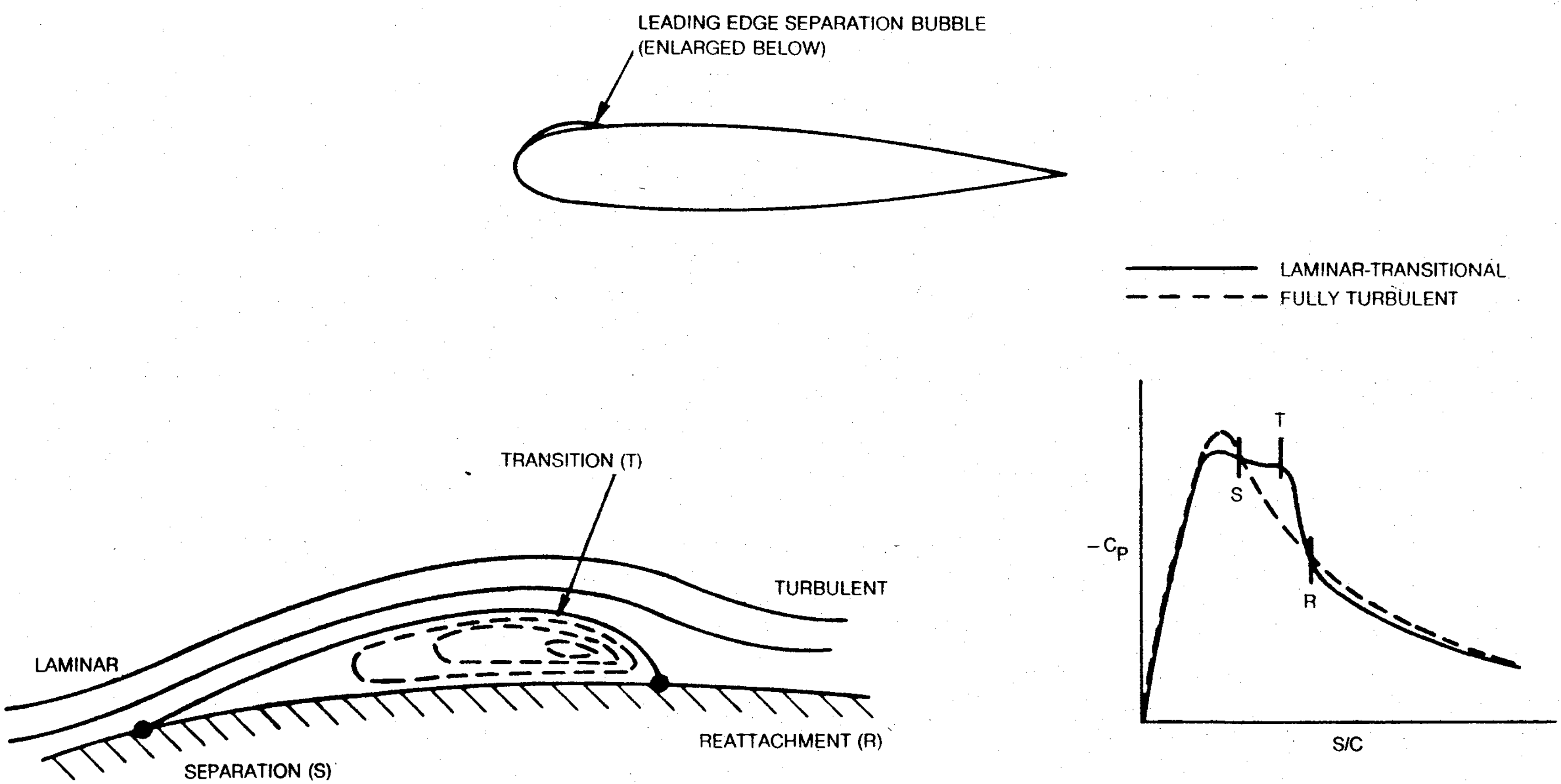


Fig. 1 Schematic diagram of airfoil laminar-transitional separation bubble and pressure distribution

82–6–7–1

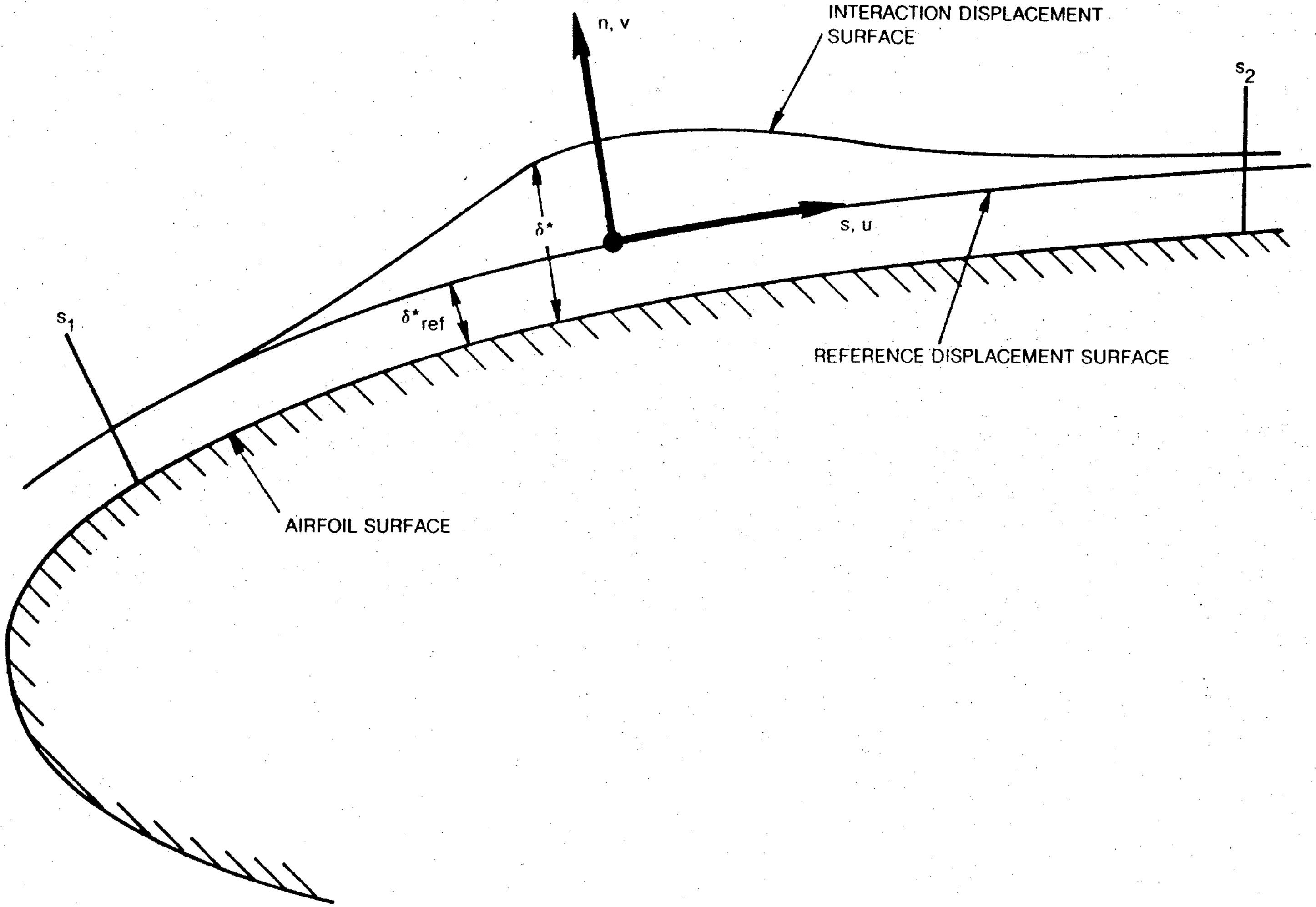


Fig. 2 Local interaction region coordinate system

82–6–7–2

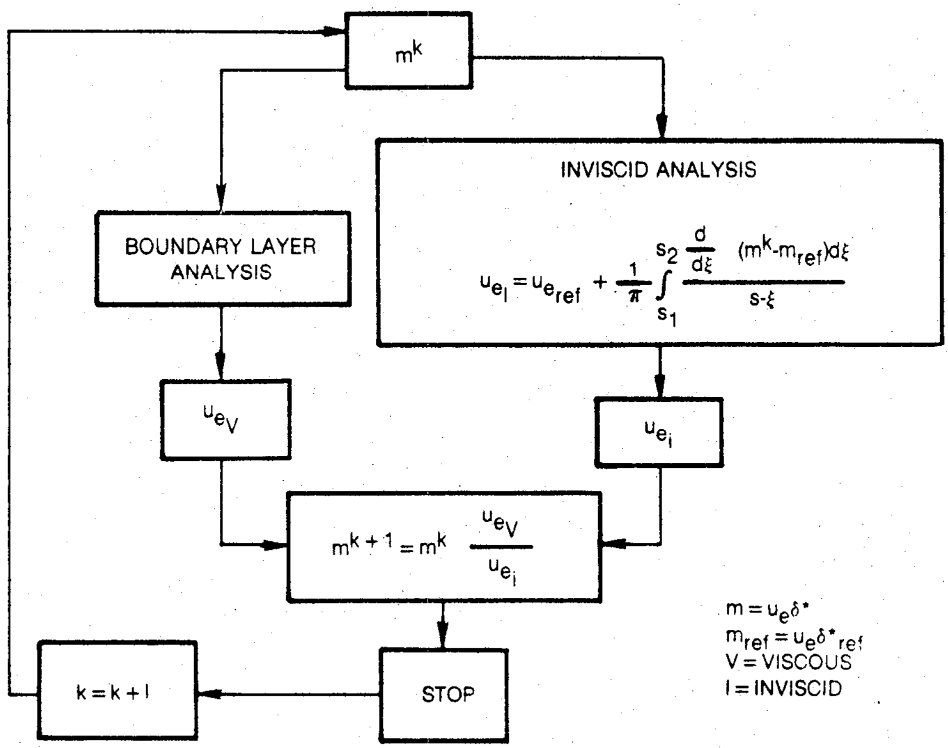
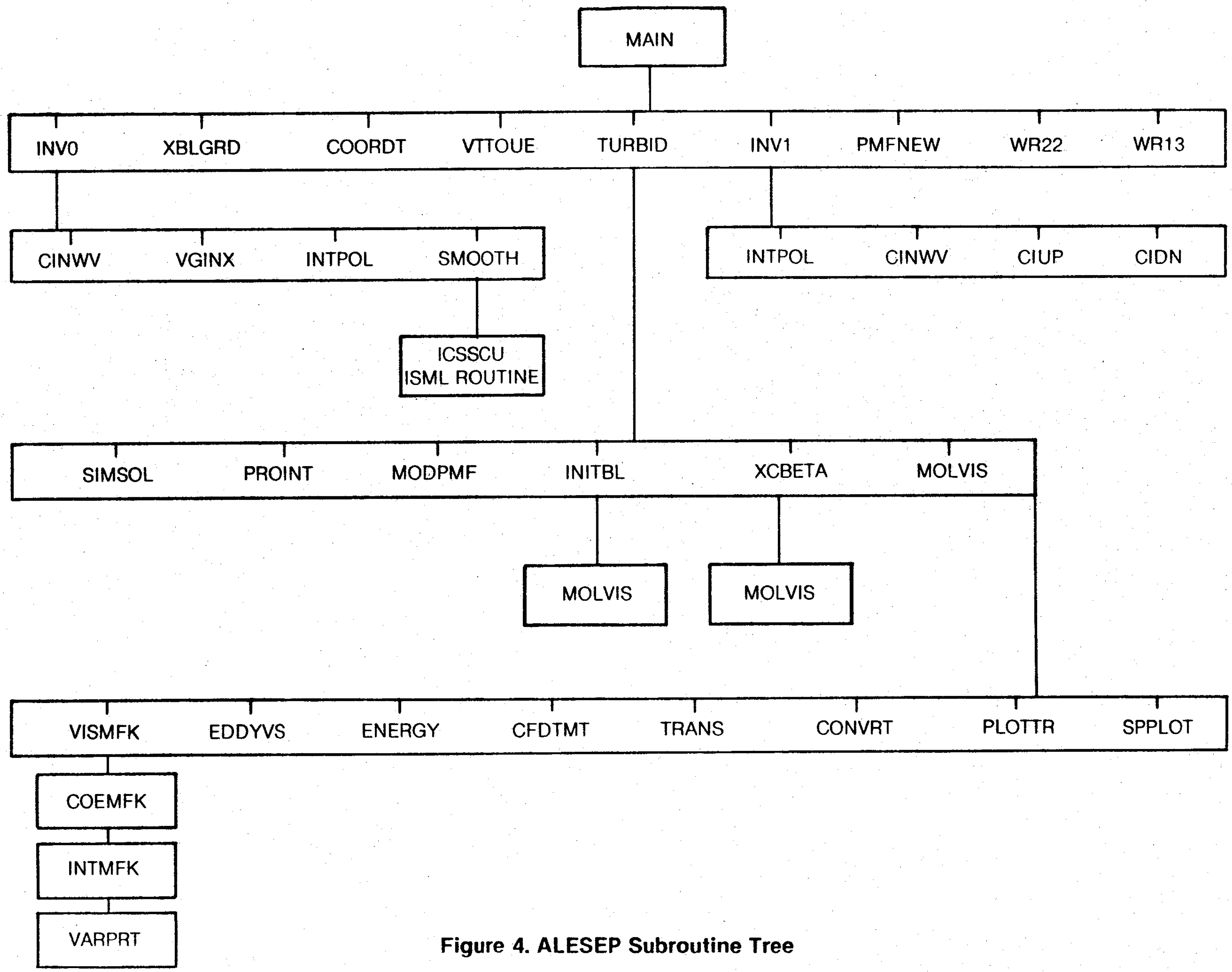


Fig. 3 Inviscid-viscous interaction procedure

82–6–7–3



83–10–72–1

Figure 4. ALESEP Subroutine Tree

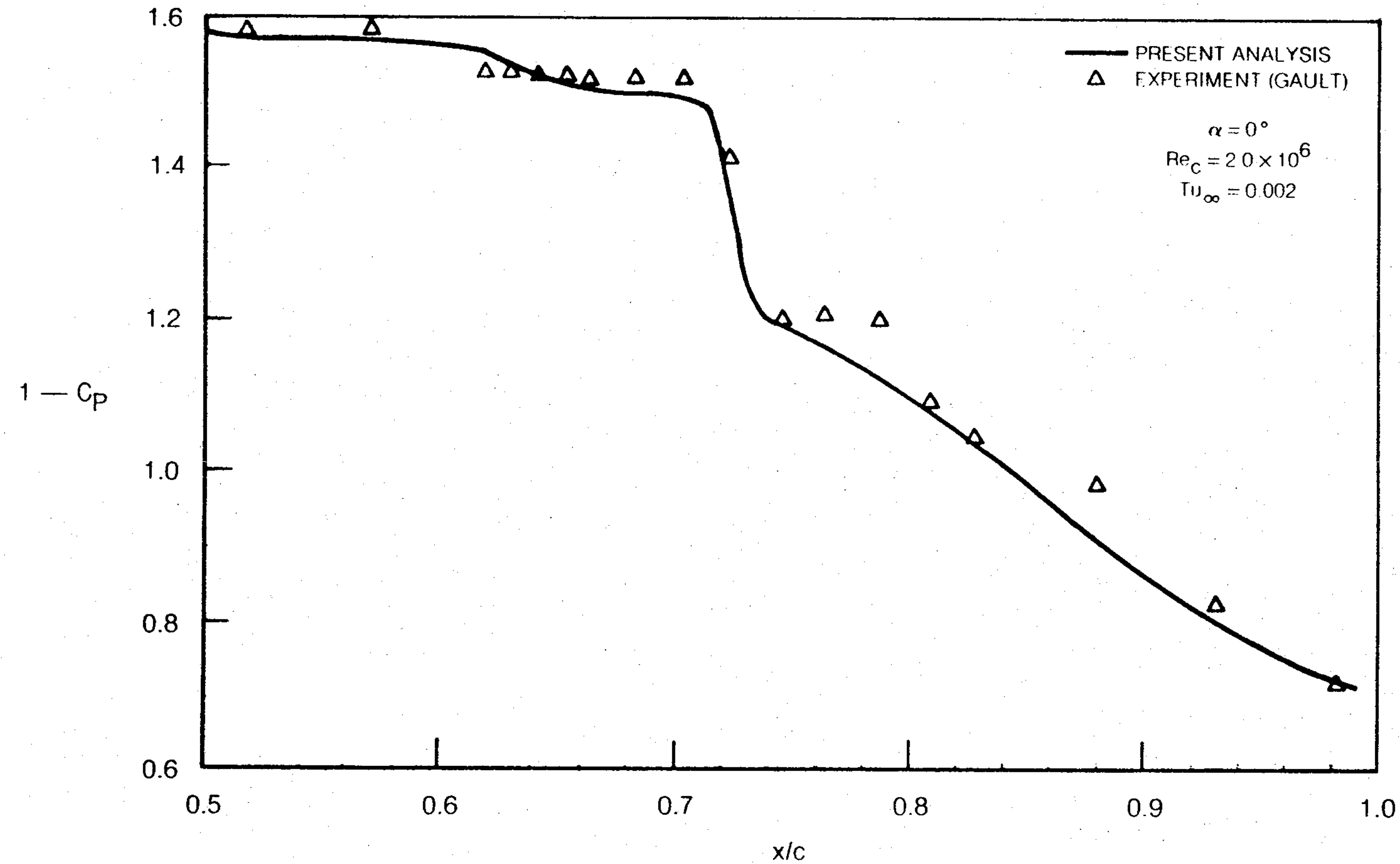


Fig. 5 Predicted results for NACA 66_3-018 airfoil.
(a) Pressure distribution.

83–9–99–23

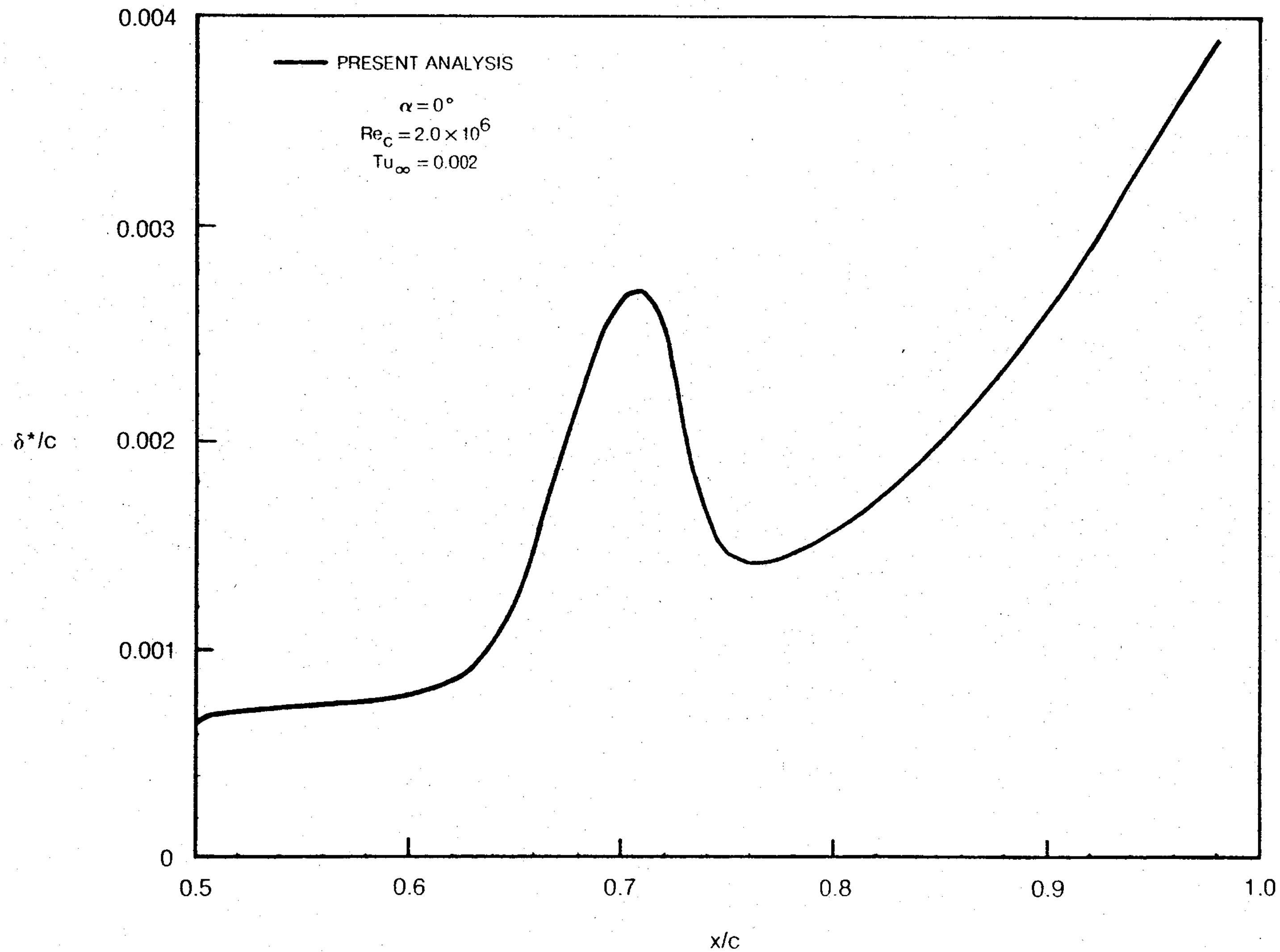


Fig. 5 Predicted results for NACA 66_3-018 airfoil (b) Displacement thickness.

83–9–99–24

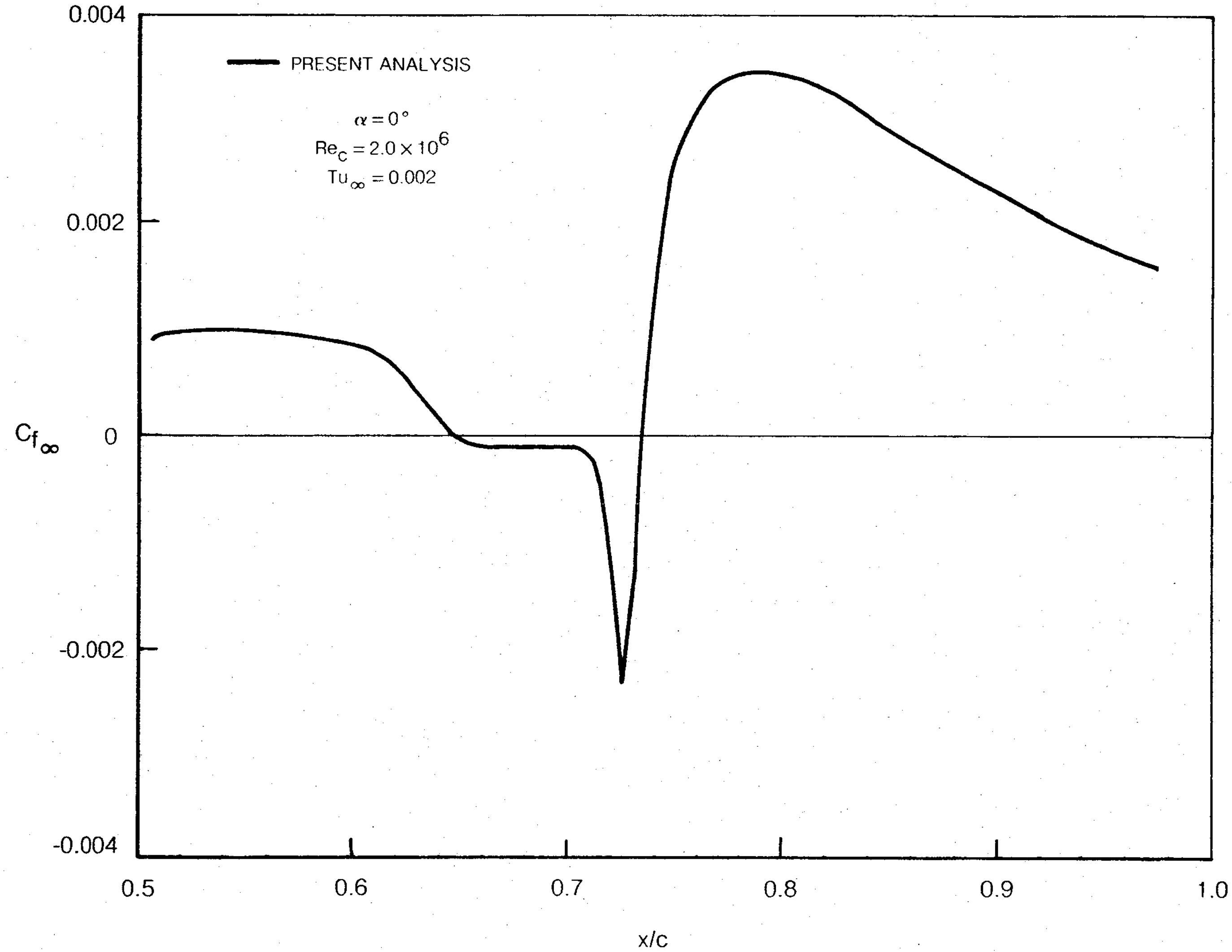


Fig. 5 Predicted results for NACA 66_3-018 airfoil.
(c) Skin friction.

83-9-99-25

APPENDIX A

```
INVERSE RUN CASE, REC=2.*10**6 -- .2% TURBULENCE
 $MASTER
 INTPLT=199,
 IQUIT=40,
 RFDT=1.0,
 RFVN=1.,
 MMAX=199,
 SSWTCH=0.500001,
 IPLOT=199,
 IGRID=1,
 AK1=1.,
 AK2=1.,
 SSTING= .6,
 DS=.01,
 IVT1=0,
 IVT2=0,
 ISMOTH=0,
 MIT2=25,
 SSTOP=1.0,
 ITEK=0,
 IAXI=0,
 IFIN=3,
 IFILET=0,
 XT1= 8.44,
 XT2= 9.34,
 XSTING= 10.,
 YSTING=0.,
 RADIUS=0.,
 XLO=10.,THICK=0.,SIO=0.,XOR=0.,CHORD=1.,
 IWRPMF = 1,
 IPLTX = 1,
 NDCP = 0,
 NDDT = 0,
 NDCF = 0,
 NDUE = 1,
 LOADSI=0 ,LOADCP=1, LOADDT=0, IMAX=199, SINO=0.,
 SPIVOT= 0.5, IPIVOT=101 , AKI1= 1.0 , AKI2=1.0 ,IVGINX=00 ,
  IPRINT=10,20,30,40,96*0,
 $END
 NACA 663018 AIRFOIL REFERENCE SOLUTION AT REC=10**7
 34
.00000     0.0        0.0        1.0000     .0006568  .002
.00496     0.0        0.0        .78366     .0006568  .002
.00992     0.0        0.0        .49007     .0006568  .002
.01929     0.0        0.0        .15011     .0006568  .002
.02922     0.0        0.0        -.01987    .0006568  .002
.07497     0.0        0.0        -.21413    .0006568  .002
.13120     0.0        0.0        -.34216    .0006568  .002
.19184     0.0        0.0        -.42605    .0006568  .002
.25138     0.0        0.0        -.48565    .0006568  .002
.29989     0.0        0.0        -.50331    .0006568  .002
.34895     0.0        0.0        -.52539    .0006568  .002
.39691     0.0        0.0        -.54525    .0006568  .002
.45700     0.0        0.0        -.56733    .0006568  .002
.49835     0.0        0.0        -.57837    .0006568  .002
.54355     0.0        0.0        -.59161    .0006568  .002
.59592     0.0        0.0        -.60044    .0006568  .002
.62018     0.0        0.0        -.60706    .0006568  .002
.63671     0.0        0.0        -.58940    .0006568  .002
.65215     0.0        0.0        -.56071    .0006568  .002
.66924     0.0        0.0        -.48786    .0006568  .002
```

```
.69405    0.0      0.0      -.40618   .0006568  .002
.71555    0.0      0.0      -.35099   .0006568  .002
.73319    0.0      0.0      -.30464   .0006568  .002
.75469    0.0      0.0      -.24724   .0006568  .002
.77894    0.0      0.0      -.18543   .0006568  .002
.80044    0.0      0.0      -.13687   .0006568  .002
.81918    0.0      0.0      -.09272   .0006568  .002
.83903    0.0      0.0      -.04415   .0006568  .002
.85667    0.0      0.0      .00662    .0006568  .002
.88423    0.0      0.0       .07064   .0006568  .002
.90849    0.0      0.0       .12362   .0006568  .002
.93109    0.0      0.0       .17660   .0006568  .002
.95755    0.0      0.0       .22958   .0006568  .002
.97960    0.0      0.0       .27373   .0006568  .002
 1.4      .04
 $INPUT
 NMAX1=100,
 NMXOLD=100,
 DETA=.926310668E-03,
 AK=1.09,
 INVRSE=1,
 JPFMAX=3,
 IRESTR=0,
 INTERP=0,
 IPRNEW=1,
 NSTART=1,
 NQMAX=10,
 NPRRES=0,
 MFIG(1)=23,25,27,30,32,34,38,42,44,45,46,89*0,
 JMAX=7,
 ITPRO=40,
 PMFO=1.0,
 AHO=.74830154697E-03,
 XCO=.58400446,
 RESG=.1E-03,
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 YORIGN(1)=0.,-1.,0.,0.,-.2,3*0.,
 YSCALE(1)=.01,1.,.5,1C00.,.1,3*1.,
 YIN(1)=4.,4.,4.,4.,5.,8.,8.,8.,
 XORIGN(1)=0.,0.,0.,0.,0.,0.,0.,0.,
 XSCALE(1)=.2,.2,.2,.2,.2,.2,.2,.2,
 XIN=6.,6.,6.,7.,7.,5.,5.,5.,
 XL=1.5,
 NDATA=1,
 BETAS=0.0,
 AMES=0.04,
 GW=1.0,
 TINFD=530.,
 PRT=.95,
 PR=.72,
 REINF=2.E+06,
 STRANS=.693,KTRAN=50,TRNLEN=0.01,
 SWK1=1000.,SWK2=2000., WAKCON=1.,
 IWINDD=0,
 IWINDS=0,
 IWINDG=0,
 ITRBMD=1,
 $END
 30
   0.0          0.0
   .01593       .78876
```

```
   .01977     .89005
   .02416     .94728
   .03789    1.0277
   .05931    1.0777
   .09061    1.1264
   .11752    1.1509
   .16804    1.1911
   .22021    1.1930
   .32125    1.2172
   .42120    1.2354
   .52004    1.2561
   .57221    1.2570
   .62164    1.2354
   .63207    1.2345
   .64415    1.2327
   .65513    1.2327
   .66502    1.2309
   .68369    1.2318
   .70456    1.2309
   .72378    1.1883
   .74629    1.0952
   .76442    1.0976
   .78803    1.0952
   .80945    1.0450
   .82812    1.0212
   .88029     .9923
   .93081     .9087
   .98298     .8502
  .12287869E+00  0.                          .88376051E-01    .56463549E-02  0.
  .24187592E-04   .12341232E-02    .23148450E-02    .92858617E+00   .27786348E+01
  .89969357E+00
0.                .10000000E+01    .10000000E+01
  .86090352E-03   .10000003E+01    .10000002E+01
  .17992883E-02   .10000012E+01    .10000009E+01
  .28221277E-02   .10000022E+01    .10000016E+01
  .39370226E-02   .10000030E+01    .10000023E+01
  .51522580E-02   .10000035E+01    .10000027E+01
  .64768644E-02   .10000038E+01    .10000029E+01
  .79206854E-02   .10000040E+01    .10000030E+01
  .94944501E-02   .10000041E+01    .10000031E+01
  .11209854E-01   .10000043E+01    .10000032E+01
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  .19760641E-01   .10000048E+01    .10000036E+01
  .22400001E-01   .10000049E+01    .10000037E+01
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  .28412724E-01   .10000053E+01    .10000040E+01
  .31830770E-01   .10000056E+01    .10000042E+01
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  .39617417E-01   .10000062E+01    .10000047E+01
  .44043882E-01   .10000065E+01    .10000049E+01
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  .54127808E-01   .10000074E+01    .10000056E+01
  .59860204E-01   .10000079E+01    .10000060E+01
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  .72919167E-01   .10000093E+01    .10000071E+01
  .80342776E-01   .10000102E+01    .10000077E+01
  .88434506E-01   .10000112E+01    .10000085E+01
  .97254486E-01   .10000125E+01    .10000094E+01
  .10686826E+00   .10000139E+01    .10000106E+01
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.12876937E+00	.10000178E+01	.10000135E+01
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.16958192E+00	.10000276E+01	.10000209E+01
.18570508E+00	.10000325E+01	.10000247E+01
.20327928E+00	.10000387E+01	.10000293E+01
.22243513E+00	.10000465E+01	.10000353E+01
.24331496E+00	.10000564E+01	.10000428E+01
.26607391E+00	.10000690E+01	.10000523E+01
.29088109E+00	.10000851E+01	.10000645E+01
.31792083E+00	.10001058E+01	.10000802E+01
.34739404E+00	.10001322E+01	.10001002E+01
.37951968E+00	.10001659E+01	.10001257E+01
.41453645E+00	.10002086E+01	.10001581E+01
.45270450E+00	.10002622E+01	.10001987E+01
.49430739E+00	.10003283E+01	.10002488E+01
.53965418E+00	.10004081E+01	.10003093E+01
.58908172E+00	.10005015E+01	.10003801E+01
.64295718E+00	.10006067E+01	.10004598E+01
.70168071E+00	.10007191E+01	.10005450E+01
.76568849E+00	.10008316E+01	.10006302E+01
.83545587E+00	.10009347E+01	.10007084E+01
.91150096E+00	.10010184E+01	.10007718E+01
.99438844E+00	.10010738E+01	.10008139E+01
.10847338E+01	.10010955E+01	.10008303E+01
.11832078E+01	.10010821E+01	.10008201E+01
.12905415E+01	.10010357E+01	.10007850E+01
.14075319E+01	.10009609E+01	.10007282E+01
.15350475E+01	.10008626E+01	.10006538E+01
.16740351E+01	.10007463E+01	.10005656E+01
.18255268E+01	.10006170E+01	.10004676E+01
.19906477E+01	.10004805E+01	.10003641E+01
.21706245E+01	.10003429E+01	.10002599E+01
.23667942E+01	.10002135E+01	.10001618E+01
.25806147E+01	.10001068E+01	.10000809E+01
.28136754E+01	.10000387E+01	.10000293E+01
.30677086E+01	.10000246E+01	.10000186E+01
.33446027E+01	.10000131E+01	.10000099E+01
.36464160E+01	.10000055E+01	.10000042E+01
.39753918E+01	.10000017E+01	.10000013E+01
.43339751E+01	.10000003E+01	.10000003E+01
.47248308E+01	.10000000E+01	.10000000E+01
.51508635E+01	.10000000E+01	.10000000E+01
.56152392E+01	.10000000E+01	.10000000E+01
.61214086E+01	.10000000E+01	.10000000E+01
.66731333E+01	.10000000E+01	.10000000E+01
.72745132E+01	.10000000E+01	.10000000E+01
.79300173E+01	.10000000E+01	.10000000E+01
.86445167E+01	.10000000E+01	.10000000E+01
.94233212E+01	.10000000E+01	.10000000E+01
.10272218E+02	.10000000E+01	.10000000E+01
.11197515E+02	.10000000E+01	.10000000E+01
.12206090E+02	.10000000E+01	.10000000E+01
.13305436E+02	.10000000E+01	.10000000E+01
.14503723E+02	.10000000E+01	.10000000E+01
.15809856E+02	.10000000E+01	.10000000E+01
.17233541E+02	.10000000E+01	.10000000E+01
.18785357E+02	.10000000E+01	.10000000E+01
.20476837E+02	.10000000E+01	.10000000E+01
.22320551E+02	.10000000E+01	.10000000E+01

.24330198E+02	.10000000E+01	.10000000E+01
.26520714E+02	.10000000E+01	.10000000E+01
.28908376E+02	.10000000E+01	.10000000E+01
.31510928E+02	.10000000E+01	.10000000E+01
.34347709E+02	.10000000E+01	.10000000E+01
.37439801E+02	.10000000E+01	.10000000E+01
.40810181E+02	.10000000E+01	.10000000E+01
.44483895E+02	.10000000E+01	.10000000E+01
.48488244E+02	.10000000E+01	.10000000E+01

1	0.	0.	0.	.10000000E+01
2	.92631067E-03	.57779368E-03	.62300234E-03	.99999996E+00
3	.19359893E-02	.12074963E-02	.13013172E-02	.99999992E+00
4	.30365390E-02	.18937622E-02	.20397801E-02	.99999988E+00
5	.42361382E-02	.26416613E-02	.28436354E-02	.99999983E+00
6	.55437013E-02	.34567163E-02	.37185682E-02	.99999978E+00
7	.69689451E-02	.43449423E-02	.46707373E-02	.99999973E+00
8	.85224608E-02	.53128905E-02	.57068113E-02	.99999967E+00
9	.10215793E-01	.63676947E-02	.68340058E-02	.99999960E+00
10	.12061525E-01	.75171234E-02	.80601231E-02	.99999953E+00
11	.14073373E-01	.87696348E-02	.93935925E-02	.99999945E+00
12	.16266287E-01	.10134437E-01	.10843514E-01	.99999937E+00
13	.18656564E-01	.11621556E-01	.12419700E-01	.99999928E+00
14	.21261965E-01	.13241901E-01	.14132724E-01	.99999918E+00
15	.24101853E-01	.15007348E-01	.15993959E-01	.99999908E+00
16	.27197330E-01	.16930818E-01	.18015629E-01	.99999896E+00
17	.30571400E-01	.19026371E-01	.20210849E-01	.99999884E+00
18	.34249137E-01	.21309298E-01	.22593666E-01	.99999871E+00
19	.38257870E-01	.23796234E-01	.25179100E-01	.99999857E+00
20	.42627389E-01	.26505264E-01	.27983173E-01	.99999841E+00
21	.47390165E-01	.29456050E-01	.31022937E-01	.99999825E+00
22	.52581590E-01	.32669961E-01	.34316493E-01	.99999807E+00
23	.58240244E-01	.36170216E-01	.37882989E-01	.99999788E+00
24	.64408176E-01	.39982034E-01	.41742611E-01	.99999768E+00
25	.71131223E-01	.44132799E-01	.45916549E-01	.99999746E+00
26	.78459344E-01	.48652235E-01	.50426938E-01	.99999723E+00
27	.86446995E-01	.53572589E-01	.55296766E-01	.99999699E+00
28	.95153536E-01	.58928829E-01	.60549738E-01	.99999673E+00
29	.10464366E+00	.64758855E-01	.66210097E-01	.99999645E+00
30	.11498790E+00	.71103715E-01	.72302380E-01	.99999617E+00
31	.12626313E+00	.78007839E-01	.78851095E-01	.99999587E+00
32	.13855312E+00	.85519276E-01	.85880315E-01	.99999556E+00
33	.15194921E+00	.93689939E-01	.93413154E-01	.99999523E+00
34	.16655095E+00	.10257585E+00	.10147112E+00	.99999490E+00
35	.18246685E+00	.11223740E+00	.11007330E+00	.99999457E+00
36	.19981517E+00	.12273955E+00	.11923535E+00	.99999423E+00
37	.21872485E+00	.13415212E+00	.12896828E+00	.99999390E+00
38	.23933640E+00	.14654988E+00	.13927694E+00	.99999357E+00
39	.26180298E+00	.16001278E+00	.15015820E+00	.99999327E+00
40	.28629156E+00	.17462592E+00	.16159876E+00	.99999299E+00
41	.31298411E+00	.19047956E+00	.17357253E+00	.99999276E+00
42	.34207899E+00	.20766885E+00	.18603745E+00	.99999258E+00
43	.37379241E+00	.22629341E+00	.19893186E+00	.99999246E+00
44	.40836004E+00	.24645651E+00	.21217008E+00	.99999245E+00
45	.44603876E+00	.26826393E+00	.22563746E+00	.99999254E+00
46	.48710856E+00	.29182205E+00	.23918464E+00	.99999278E+00
47	.53187464E+00	.31723535E+00	.25262119E+00	.99999320E+00
48	.58066966E+00	.34460269E+00	.26570878E+00	.99999383E+00
49	.63385624E+00	.37401233E+00	.27815412E+00	.99999470E+00
50	.69182962E+00	.40553519E+00	.28960229E+00	.99999586E+00
51	.75502059E+00	.43921598E+00	.29963139E+00	.99999735E+00
52	.82389876E+00	.47506169E+00	.30774977E+00	.99999920E+00

53	.89897596E+00	.51302703E+00	.31339816E+00	.10000014E+01
54	.98081010E+00	.55299638E+00	.31595943E+00	.10000041E+01
55	.10700093E+01	.59476232E+00	.31478001E+00	.10000071E+01
56	.11672365E+01	.63800108E+00	.30920794E+00	.10000105E+01
57	.12732141E+01	.68224683E+00	.29865301E+00	.10000141E+01
58	.13887296E+01	.72686850E+00	.28267359E+00	.10000177E+01
59	.15146416E+01	.77105565E+00	.26109145E+00	.10000212E+01
60	.16518857E+01	.81382354E+00	.23412754E+00	.10000241E+01
61	.18014817E+01	.85405039E+00	.20253739E+00	.10000262E+01
62	.19645414E+01	.89055980E+00	.16770507E+00	.10000270E+01
63	.21422764E+01	.92225495E+00	.13163546E+00	.10000263E+01
64	.23360076E+01	.94829517E+00	.96779963E-01	.10000240E+01
65	.25471746E+01	.96828012E+00	.65661795E-01	.10000203E+01
66	.27773466E+01	.98238077E+00	.40346863E-01	.10000157E+01
67	.30282341E+01	.99134826E+00	.21918951E-01	.10000110E+01
68	.33017015E+01	.99636185E+00	.10197160E-01	.10000067E+01
69	.35997809E+01	.99874678E+00	.38854174E-02	.10000036E+01
70	.39246875E+01	.99966941E+00	.11334402E-02	.10000016E+01
71	.42788357E+01	.99994059E+00	.22514800E-03	.10000005E+01
72	.46648572E+01	.99999444E+00	.23287468E-04	.10000001E+01
73	.50856207E+01	.99999996E+00	.18475729E-06	.10000000E+01
74	.55442529E+01	.10000000E+01	-.15012213E-07	.10000000E+01
75	.60441619E+01	.10000000E+01	.29056131E-08	.10000000E+01
76	.65890628E+01	.10000000E+01	-.11354242E-08	.10000000E+01
77	.71830048E+01	.10000000E+01	-.55375260E-10	.10000000E+01
78	.78304015E+01	.10000000E+01	-.33267700E-09	.10000000E+01
79	.85360640E+01	.10000000E+01	-.27216229E-09	.10000000E+01
80	.93052360E+01	.10000000E+01	-.27842084E-09	.10000000E+01
81	.10143634E+02	.10000000E+01	-.28311975E-09	.10000000E+01
82	.11057487E+02	.10000000E+01	-.27817126E-09	.10000000E+01
83	.12053587E+02	.10000000E+01	-.28074609E-09	.10000000E+01
84	.13139336E+02	.10000000E+01	-.28096370E-09	.10000000E+01
85	.14322803E+02	.10000000E+01	-.27862201E-09	.10000000E+01
86	.15612781E+02	.10000000E+01	-.28340663E-09	.10000000E+01
87	.17018858E+02	.10000000E+01	-.27713165E-09	.10000000E+01
88	.18551482E+02	.10000000E+01	-.28319036E-09	.10000000E+01
89	.20222041E+02	.10000000E+01	-.27793323E-09	.10000000E+01
90	.22042951E+02	.10000000E+01	-.28226577E-09	.10000000E+01
91	.24027743E+02	.10000000E+01	-.28013991E-09	.10000000E+01
92	.26191166E+02	.10000000E+01	-.28120839E-09	.10000000E+01
93	.28549298E+02	.10000000E+01	-.28395108E-09	.10000000E+01
94	.31119661E+02	.10000000E+01	-.27875791E-09	.10000000E+01
95	.33921356E+02	.10000000E+01	-.28552849E-09	.10000000E+01
96	.36975205E+02	.10000000E+01	-.27997915E-09	.10000000E+01
97	.40303900E+02	.10000000E+01	-.28755531E-09	.10000000E+01
98	.43932177E+02	.10000000E+01	-.28403413E-09	.10000000E+01
99	.47886999E+02	.10000000E+01	-.29081892E-09	.10000000E+01
100	.52197755E+02	.10000000E+01	.10133663E-08	.10000000E+01

1.1667 1.2978 1.2978

.6 .8 1.0

```
*****************************************************************************************
*                                                                                       *
* INVERSE RUN CASE, REC=2.*10**6 -- .2% TURBULENCE                                      *
*                                                                                       *
*****************************************************************************************
```

I	XO	YO	SO	CPO	DTO	TUO
1	.00000	.00000	.00000	1.00000	.00000	.00200
2	.00496	.00000	.00496	.78366	.00000	.00200
3	.00992	.00000	.00992	.49007	.00000	.00200
4	.01929	.00000	.01929	.15011	.00000	.00200
5	.02922	.00000	.02922	-.01987	.00000	.00200
6	.07497	.00000	.07497	-.21413	.00000	.00200
7	.13120	.00000	.13120	-.34216	.00000	.00200
8	.19184	.00000	.19184	-.42605	.00000	.00200
9	.25138	.00000	.25138	-.48565	.00000	.00200
10	.29989	.00000	.29989	-.50331	.00000	.00200
11	.34895	.00000	.34895	-.52539	.00000	.00200
12	.39691	.00000	.39691	-.54525	.00000	.00200
13	.45700	.00000	.45700	-.56733	.00000	.00200
14	.49835	.00000	.49835	-.57837	.00000	.00200
15	.54355	.00000	.54355	-.59161	.00000	.00200
16	.59592	.00000	.59592	-.60044	.00000	.00200
17	.62018	.00000	.62018	-.60706	.00000	.00200
18	.63671	.00000	.63671	-.58940	.00000	.00200
19	.65215	.00000	.65215	-.56071	.00000	.00200
20	.66924	.00000	.66924	-.48786	.00000	.00200
21	.69405	.00000	.69405	-.40618	.00000	.00200
22	.71555	.00000	.71555	-.35099	.00000	.00200
23	.73319	.00000	.73319	-.30464	.00000	.00200
24	.75469	.00000	.75469	-.24724	.00000	.00200
25	.77894	.00000	.77894	-.18543	.00000	.00200
26	.80044	.00000	.80044	-.13687	.00000	.00200
27	.81918	.00000	.81918	-.09272	.00000	.00200
28	.83903	.00000	.83903	-.04415	.00000	.00200
29	.85667	.00000	.85667	.00662	.00000	.00200
30	.88423	.00000	.88423	.07064	.00000	.00200
31	.90849	.00000	.90849	.12362	.00000	.00200
32	.93109	.00000	.93109	.17660	.00000	.00200
33	.95755	.00000	.95755	.22958	.00000	.00200
34	.97960	.00000	.97960	.27373	.00000	.00200

I	SI	SMOOTH VT	INPUT VT
1	.000000	.020361	.019994
2	.005000	.425875	.467394
3	.010000	.699747	.715935
4	.015000	.844383	.826788
5	.020000	.927411	.928191
6	.025000	.977170	.972494
7	.030000	1.007916	1.011455
8	.035000	1.023320	1.021509
9	.040000	1.032699	1.031564
10	.045000	1.041805	1.041618
11	.050000	1.051586	1.051672

12	.055000	1.061665	1.061727
13	.060000	1.071823	1.071781
14	.065000	1.082059	1.081836
15	.070000	1.092131	1.091890
16	.075000	1.100931	1.101914
17	.080000	1.107198	1.106952
18	.085000	1.112209	1.111989
19	.090000	1.117077	1.117027
20	.095000	1.122055	1.122065
21	.100000	1.127091	1.127102
22	.105000	1.132134	1.132140
23	.110000	1.137174	1.137177
24	.115000	1.142230	1.142215
25	.120000	1.147328	1.147252
26	.125000	1.152390	1.152290
27	.130000	1.157037	1.157327
28	.135000	1.160750	1.160772
29	.140000	1.163807	1.163712
30	.145000	1.166692	1.166653
31	.150000	1.169596	1.169594
32	.155000	1.172531	1.172535
33	.160000	1.175474	1.175476
34	.165000	1.178416	1.178417
35	.170000	1.181356	1.181358
36	.175000	1.184304	1.184299
37	.180000	1.187267	1.187240
38	.185000	1.190221	1.190181
39	.190000	1.193029	1.193122
40	.195000	1.195479	1.195515
41	.200000	1.197630	1.197590
42	.205000	1.199684	1.199665
43	.210000	1.201742	1.201740
44	.215000	1.203813	1.203814
45	.220000	1.205888	1.205889
46	.225000	1.207962	1.207964
47	.230000	1.210037	1.210039
48	.235000	1.212123	1.212114
49	.240000	1.214235	1.214189
50	.245000	1.216327	1.216264
51	.250000	1.218166	1.218338
52	.255000	1.219425	1.219450
53	.260000	1.220255	1.220195
54	.265000	1.220966	1.220940
55	.270000	1.221687	1.221685
56	.275000	1.222427	1.222429
57	.280000	1.223173	1.223174
58	.285000	1.223917	1.223919
59	.290000	1.224656	1.224664
60	.295000	1.225401	1.225408
61	.300000	1.226190	1.226157
62	.305000	1.227063	1.227072
63	.310000	1.227979	1.227986
64	.315000	1.228899	1.228901
65	.320000	1.229816	1.229816
66	.325000	1.230730	1.230730
67	.330000	1.231645	1.231645
68	.335000	1.232561	1.232560
69	.340000	1.233478	1.233474
70	.345000	1.234389	1.234389
71	.350000	1.235276	1.235287
72	.355000	1.236127	1.236123

73	.360000	1.236962	1.236959
74	.365000	1.237795	1.237794
75	.370000	1.238630	1.238630
76	.375000	1.239466	1.239466
77	.380000	1.240302	1.240302
78	.385000	1.241141	1.241138
79	.390000	1.241978	1.241974
80	.395000	1.242799	1.242809
81	.400000	1.243579	1.243584
82	.405000	1.244325	1.244321
83	.410000	1.245060	1.245057
84	.415000	1.245794	1.245794
85	.420000	1.246530	1.246531
86	.425000	1.247267	1.247267
87	.430000	1.248004	1.248004
88	.435000	1.248740	1.248741
89	.440000	1.249478	1.249477
90	.445000	1.250220	1.250214
91	.450000	1.250960	1.250951
92	.455000	1.251667	1.251687
93	.460000	1.252291	1.252301
94	.465000	1.252843	1.252834
95	.470000	1.253371	1.253366
96	.475000	1.253899	1.253899
97	.480000	1.254431	1.254431
98	.485000	1.254962	1.254964
99	.490000	1.255494	1.255496
100	.495000	1.256030	1.256028
101	.500000	1.256583	1.256577
102	.505000	1.257157	1.257159
103	.510000	1.257739	1.257741
104	.515000	1.258322	1.258323
105	.520000	1.258905	1.258905
106	.525000	1.259487	1.259487
107	.530000	1.260074	1.260069
108	.535000	1.260662	1.260651
109	.540000	1.261227	1.261233
110	.545000	1.261711	1.261743
111	.550000	1.262088	1.262076
112	.555000	1.262419	1.262410
113	.560000	1.262746	1.262744
114	.565000	1.263077	1.263078
115	.570000	1.263412	1.263412
116	.575000	1.263746	1.263745
117	.580000	1.264078	1.264079
118	.585000	1.264405	1.264413
119	.590000	1.264736	1.264747
120	.595000	1.265107	1.265081
121	.600000	1.265576	1.265582
122	.605000	1.266137	1.266121
123	.610000	1.266767	1.266660
124	.615000	1.267326	1.267199
125	.620000	1.267245	1.267737
126	.625000	1.265871	1.265719
127	.630000	1.263788	1.263606
128	.635000	1.261366	1.261492
129	.640000	1.258419	1.258333
130	.645000	1.254932	1.254630
131	.650000	1.250508	1.250926
132	.655000	1.244107	1.244412
133	.660000	1.235921	1.235776

134	.665000	1.227241	1.227141
135	.670000	1.219083	1.218777
136	.675000	1.211836	1.211932
137	.680000	1.204989	1.205087
138	.685000	1.198164	1.198242
139	.690000	1.191397	1.191397
140	.695000	1.185024	1.184814
141	.700000	1.179283	1.179346
142	.705000	1.173836	1.173879
143	.710000	1.168411	1.168411
144	.715000	1.162907	1.162944
145	.720000	1.157279	1.157267
146	.725000	1.151586	1.151565
147	.730000	1.145858	1.145863
148	.735000	1.140062	1.140085
149	.740000	1.134182	1.134175
150	.745000	1.128265	1.128264
151	.750000	1.122351	1.122354
152	.755000	1.116476	1.116452
153	.760000	1.110665	1.110672
154	.765000	1.104878	1.104893
155	.770000	1.099088	1.099114
156	.775000	1.093336	1.093335
157	.780000	1.087748	1.087670
158	.785000	1.082406	1.082429
159	.790000	1.077182	1.077188
160	.795000	1.071959	1.071947
161	.800000	1.066647	1.066706
162	.805000	1.061172	1.061156
163	.810000	1.055607	1.055577
164	.815000	1.050003	1.049998
165	.820000	1.044310	1.044363
166	.825000	1.038481	1.038445
167	.830000	1.032595	1.032526
168	.835000	1.026614	1.026607
169	.840000	1.020265	1.020454
170	.845000	1.013343	1.013324
171	.850000	1.006183	1.006195
172	.855000	.999214	.999066
173	.860000	.992778	.992739
174	.865000	.986759	.986816
175	.870000	.980864	.980892
176	.875000	.974959	.974969
177	.880000	.969045	.969046
178	.885000	.963178	.963149
179	.890000	.957396	.957403
180	.895000	.951663	.951657
181	.900000	.945938	.945912
182	.905000	.940152	.940166
183	.910000	.934162	.934235
184	.915000	.927902	.927878
185	.920000	.921514	.921521
186	.925000	.915132	.915164
187	.930000	.908913	.908807
188	.935000	.903038	.903036
189	.940000	.897395	.897429
190	.945000	.891813	.891822
191	.950000	.886226	.886215
192	.955000	.880608	.880607
193	.960000	.874906	.874913
194	.965000	.869062	.869127

195	.970000	.863087	.863341
196	.975000	.857375	.857555
197	.980000	.853250	.852232
198	.985000	.852002	.852232
199	.990000	.852229	.852232

I	SI	SMOOTH PMF	INPUT PMF
1	.000000	.000000	.000000
2	.005000	.000000	.000000
3	.010000	.000000	.000000
4	.015000	.000000	.000000
5	.020000	.000000	.000000
6	.025000	.000000	.000000
7	.030000	.000000	.000000
8	.035000	.000000	.000000
9	.040000	.000000	.000000
10	.045000	.000000	.000000
11	.050000	.000000	.000000
12	.055000	.000000	.000000
13	.060000	.000000	.000000
14	.065000	.000000	.000000
15	.070000	.000000	.000000
16	.075000	.000000	.000000
17	.080000	.000000	.000000
18	.085000	.000000	.000000
19	.090000	.000000	.000000
20	.095000	.000000	.000000
21	.100000	.000000	.000000
22	.105000	.000000	.000000
23	.110000	.000000	.000000
24	.115000	.000000	.000000
25	.120000	.000000	.000000
26	.125000	.000000	.000000
27	.130000	.000000	.000000
28	.135000	.000000	.000000
29	.140000	.000000	.000000
30	.145000	.000000	.000000
31	.150000	.000000	.000000
32	.155000	.000000	.000000
33	.160000	.000000	.000000
34	.165000	.000000	.000000
35	.170000	.000000	.000000
36	.175000	.000000	.000000
37	.180000	.000000	.000000
38	.185000	.000000	.000000
39	.190000	.000000	.000000
40	.195000	.000000	.000000
41	.200000	.000000	.000000
42	.205000	.000000	.000000
43	.210000	.000000	.000000
44	.215000	.000000	.000000
45	.220000	.000000	.000000
46	.225000	.000000	.000000
47	.230000	.000000	.000000
48	.235000	.000000	.000000
49	.240000	.000000	.000000
50	.245000	.000000	.000000
51	.250000	.000000	.000000
52	.255000	.000000	.000000

53	.260000	.000000	.000000
54	.265000	.000000	.000000
55	.270000	.000000	.000000
56	.275000	.000000	.000000
57	.280000	.000000	.000000
58	.285000	.000000	.000000
59	.290000	.000000	.000000
60	.295000	.000000	.000000
61	.300000	.000000	.000000
62	.305000	.000000	.000000
63	.310000	.000000	.000000
64	.315000	.000000	.000000
65	.320000	.000000	.000000
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69	.340000	.000000	.000000
70	.345000	.000000	.000000
71	.350000	.000000	.000000
72	.355000	.000000	.000000
73	.360000	.000000	.000000
74	.365000	.000000	.000000
75	.370000	.000000	.000000
76	.375000	.000000	.000000
77	.380000	.000000	.000000
78	.385000	.000000	.000000
79	.390000	.000000	.000000
80	.395000	.000000	.000000
81	.400000	.000000	.000000
82	.405000	.000000	.000000
83	.410000	.000000	.000000
84	.415000	.000000	.000000
85	.420000	.000000	.000000
86	.425000	.000000	.000000
87	.430000	.000000	.000000
88	.435000	.000000	.000000
89	.440000	.000000	.000000
90	.445000	.000000	.000000
91	.450000	.000000	.000000
92	.455000	.000000	.000000
93	.460000	.000000	.000000
94	.465000	.000000	.000000
95	.470000	.000000	.000000
96	.475000	.000000	.000000
97	.480000	.000000	.000000
98	.485000	.000000	.000000
99	.490000	.000000	.000000
100	.495000	.000000	.000000
101	.500000	.000000	.000000
102	.505000	.000000	.000000
103	.510000	.000000	.000000
104	.515000	.000000	.000000
105	.520000	.000000	.000000
106	.525000	.000000	.000000
107	.530000	.000000	.000000
108	.535000	.000000	.000000
109	.540000	.000000	.000000
110	.545000	.000000	.000000
111	.550000	.000000	.000000
112	.555000	.000000	.000000
113	.560000	.000000	.000000

114	.565000	.000000	.000000
115	.570000	.000000	.000000
116	.575000	.000000	.000000
117	.580000	.000000	.000000
118	.585000	.000000	.000000
119	.590000	.000000	.000000
120	.595000	.000000	.000000
121	.600000	.000000	.000000
122	.605000	.000000	.000000
123	.610000	.000000	.000000
124	.615000	.000000	.000000
125	.620000	.000000	.000000
126	.625000	.000000	.000000
127	.630000	.000000	.000000
128	.635000	.000000	.000000
129	.640000	.000000	.000000
130	.645000	.000000	.000000
131	.650000	.000000	.000000
132	.655000	.000000	.000000
133	.660000	.000000	.000000
134	.665000	.000000	.000000
135	.670000	.000000	.000000
136	.675000	.000000	.000000
137	.680000	.000000	.000000
138	.685000	.000000	.000000
139	.690000	.000000	.000000
140	.695000	.000000	.000000
141	.700000	.000000	.000000
142	.705000	.000000	.000000
143	.710000	.000000	.000000
144	.715000	.000000	.000000
145	.720000	.000000	.000000
146	.725000	.000000	.000000
147	.730000	.000000	.000000
148	.735000	.000000	.000000
149	.740000	.000000	.000000
150	.745000	.000000	.000000
151	.750000	.000000	.000000
152	.755000	.000000	.000000
153	.760000	.000000	.000000
154	.765000	.000000	.000000
155	.770000	.000000	.000000
156	.775000	.000000	.000000
157	.780000	.000000	.000000
158	.785000	.000000	.000000
159	.790000	.000000	.000000
160	.795000	.000000	.000000
161	.800000	.000000	.000000
162	.805000	.000000	.000000
163	.810000	.000000	.000000
164	.815000	.000000	.000000
165	.820000	.000000	.000000
166	.825000	.000000	.000000
167	.830000	.000000	.000000
168	.835000	.000000	.000000
169	.840000	.000000	.000000
170	.845000	.000000	.000000
171	.850000	.000000	.000000
172	.855000	.000000	.000000
173	.860000	.000000	.000000
174	.865000	.000000	.000000

175	.870000	.000000	.000000
176	.875000	.000000	.000000
177	.880000	.000000	.000000
178	.885000	.000000	.000000
179	.890000	.000000	.000000
180	.895000	.000000	.000000
181	.900000	.000000	.000000
182	.905000	.000000	.000000
183	.910000	.000000	.000000
184	.915000	.000000	.000000
185	.920000	.000000	.000000
186	.925000	.000000	.000000
187	.930000	.000000	.000000
188	.935000	.000000	.000000
189	.940000	.000000	.000000
190	.945000	.000000	.000000
191	.950000	.000000	.000000
192	.955000	.000000	.000000
193	.960000	.000000	.000000
194	.965000	.000000	.000000
195	.970000	.000000	.000000
196	.975000	.000000	.000000
197	.980000	.000000	.000000
198	.985000	.000000	.000000
199	.990000	.000000	.000000

SMOOTHED REFERENCE SOLUTION ON COMPUTATIONAL MESH

I	SI	XB	YB	VT	PMFB	TUB
1	.00000	.00000	.00000	.02036	.00000	.00200
2	.00500	.00500	.00000	.42588	.00000	.00200
3	.01000	.01000	.00000	.69975	.00000	.00200
4	.01500	.01500	.00000	.84438	.00000	.00200
5	.02000	.02000	.00000	.92741	.00000	.00200
6	.02500	.02500	.00000	.97717	.00000	.00200
7	.03000	.03000	.00000	1.00792	.00000	.00200
8	.03500	.03500	.00000	1.02332	.00000	.00200
9	.04000	.04000	.00000	1.03270	.00000	.00200
10	.04500	.04500	.00000	1.04181	.00000	.00200
11	.05000	.05000	.00000	1.05159	.00000	.00200
12	.05500	.05500	.00000	1.06166	.00000	.00200
13	.06000	.06000	.00000	1.07182	.00000	.00200
14	.06500	.06500	.00000	1.08206	.00000	.00200
15	.07000	.07000	.00000	1.09213	.00000	.00200
16	.07500	.07500	.00000	1.10093	.00000	.00200
17	.08000	.08000	.00000	1.10720	.00000	.00200
18	.08500	.08500	.00000	1.11221	.00000	.00200
19	.09000	.09000	.00000	1.11708	.00000	.00200
20	.09500	.09500	.00000	1.12206	.00000	.00200
21	.10000	.10000	.00000	1.12709	.00000	.00200
22	.10500	.10500	.00000	1.13213	.00000	.00200
23	.11000	.11000	.00000	1.13717	.00000	.00200
24	.11500	.11500	.00000	1.14223	.00000	.00200
25	.12000	.12000	.00000	1.14733	.00000	.00200
26	.12500	.12500	.00000	1.15239	.00000	.00200
27	.13000	.13000	.00000	1.15704	.00000	.00200
28	.13500	.13500	.00000	1.16075	.00000	.00200
29	.14000	.14000	.00000	1.16381	.00000	.00200

30	.14500	.14500	.00000	1.16669	.00000	.00200
31	.15000	.15000	.00000	1.16960	.00000	.00200
32	.15500	.15500	.00000	1.17253	.00000	.00200
33	.16000	.16000	.00000	1.17547	.00000	.00200
34	.16500	.16500	.00000	1.17842	.00000	.00200
35	.17000	.17000	.00000	1.18136	.00000	.00200
36	.17500	.17500	.00000	1.18430	.00000	.00200
37	.18000	.18000	.00000	1.18727	.00000	.00200
38	.18500	.18500	.00000	1.19022	.00000	.00200
39	.19000	.19000	.00000	1.19303	.00000	.00200
40	.19500	.19500	.00000	1.19548	.00000	.00200
41	.20000	.20000	.00000	1.19763	.00000	.00200
42	.20500	.20500	.00000	1.19968	.00000	.00200
43	.21000	.21000	.00000	1.20174	.00000	.00200
44	.21500	.21500	.00000	1.20381	.00000	.00200
45	.22000	.22000	.00000	1.20589	.00000	.00200
46	.22500	.22500	.00000	1.20796	.00000	.00200
47	.23000	.23000	.00000	1.21004	.00000	.00200
48	.23500	.23500	.00000	1.21212	.00000	.00200
49	.24000	.24000	.00000	1.21423	.00000	.00200
50	.24500	.24500	.00000	1.21633	.00000	.00200
51	.25000	.25000	.00000	1.21817	.00000	.00200
52	.25500	.25500	.00000	1.21943	.00000	.00200
53	.26000	.26000	.00000	1.22026	.00000	.00200
54	.26500	.26500	.00000	1.22097	.00000	.00200
55	.27000	.27000	.00000	1.22169	.00000	.00200
56	.27500	.27500	.00000	1.22243	.00000	.00200
57	.28000	.28000	.00000	1.22317	.00000	.00200
58	.28500	.28500	.00000	1.22392	.00000	.00200
59	.29000	.29000	.00000	1.22466	.00000	.00200
60	.29500	.29500	.00000	1.22540	.00000	.00200
61	.30000	.30000	.00000	1.22619	.00000	.00200
62	.30500	.30500	.00000	1.22706	.00000	.00200
63	.31000	.31000	.00000	1.22798	.00000	.00200
64	.31500	.31500	.00000	1.22890	.00000	.00200
65	.32000	.32000	.00000	1.22982	.00000	.00200
66	.32500	.32500	.00000	1.23073	.00000	.00200
67	.33000	.33000	.00000	1.23165	.00000	.00200
68	.33500	.33500	.00000	1.23256	.00000	.00200
69	.34000	.34000	.00000	1.23348	.00000	.00200
70	.34500	.34500	.00000	1.23439	.00000	.00200
71	.35000	.35000	.00000	1.23528	.00000	.00200
72	.35500	.35500	.00000	1.23613	.00000	.00200
73	.36000	.36000	.00000	1.23696	.00000	.00200
74	.36500	.36500	.00000	1.23780	.00000	.00200
75	.37000	.37000	.00000	1.23863	.00000	.00200
76	.37500	.37500	.00000	1.23947	.00000	.00200
77	.38000	.38000	.00000	1.24030	.00000	.00200
78	.38500	.38500	.00000	1.24114	.00000	.00200
79	.39000	.39000	.00000	1.24198	.00000	.00200
80	.39500	.39500	.00000	1.24280	.00000	.00200
81	.40000	.40000	.00000	1.24358	.00000	.00200
82	.40500	.40500	.00000	1.24433	.00000	.00200
83	.41000	.41000	.00000	1.24506	.00000	.00200
84	.41500	.41500	.00000	1.24579	.00000	.00200
85	.42000	.42000	.00000	1.24653	.00000	.00200
86	.42500	.42500	.00000	1.24727	.00000	.00200
87	.43000	.43000	.00000	1.24800	.00000	.00200
88	.43500	.43500	.00000	1.24874	.00000	.00200
89	.44000	.44000	.00000	1.24948	.00000	.00200
90	.44500	.44500	.00000	1.25022	.00000	.00200

91	.45000	.45000	.00000	1.25096	.00000	.00200
92	.45500	.45500	.00000	1.25167	.00000	.00200
93	.46000	.46000	.00000	1.25229	.00000	.00200
94	.46500	.46500	.00000	1.25284	.00000	.00200
95	.47000	.47000	.00000	1.25337	.00000	.00200
96	.47500	.47500	.00000	1.25390	.00000	.00200
97	.48000	.48000	.00000	1.25443	.00000	.00200
98	.48500	.48500	.00000	1.25496	.00000	.00200
99	.49000	.49000	.00000	1.25549	.00000	.00200
100	.49500	.49500	.00000	1.25603	.00000	.00200
101	.50000	.50000	.00000	1.25658	.00000	.00200
102	.50500	.50500	.00000	1.25716	.00000	.00200
103	.51000	.51000	.00000	1.25774	.00000	.00200
104	.51500	.51500	.00000	1.25832	.00000	.00200
105	.52000	.52000	.00000	1.25890	.00000	.00200
106	.52500	.52500	.00000	1.25949	.00000	.00200
107	.53000	.53000	.00000	1.26007	.00000	.00200
108	.53500	.53500	.00000	1.26066	.00000	.00200
109	.54000	.54000	.00000	1.26123	.00000	.00200
110	.54500	.54500	.00000	1.26171	.00000	.00200
111	.55000	.55000	.00000	1.26209	.00000	.00200
112	.55500	.55500	.00000	1.26242	.00000	.00200
113	.56000	.56000	.00000	1.26275	.00000	.00200
114	.56500	.56500	.00000	1.26308	.00000	.00200
115	.57000	.57000	.00000	1.26341	.00000	.00200
116	.57500	.57500	.00000	1.26375	.00000	.00200
117	.58000	.58000	.00000	1.26408	.00000	.00200
118	.58500	.58500	.00000	1.26441	.00000	.00200
119	.59000	.59000	.00000	1.26474	.00000	.00200
120	.59500	.59500	.00000	1.26511	.00000	.00200
121	.60000	.60000	.00000	1.26558	.00000	.00200
122	.60500	.60500	.00000	1.26614	.00000	.00200
123	.61000	.61000	.00000	1.26677	.00000	.00200
124	.61500	.61500	.00000	1.26733	.00000	.00200
125	.62000	.62000	.00000	1.26725	.00000	.00200
126	.62500	.62500	.00000	1.26587	.00000	.00200
127	.63000	.63000	.00000	1.26379	.00000	.00200
128	.63500	.63500	.00000	1.26137	.00000	.00200
129	.64000	.64000	.00000	1.25842	.00000	.00200
130	.64500	.64500	.00000	1.25493	.00000	.00200
131	.65000	.65000	.00000	1.25051	.00000	.00200
132	.65500	.65500	.00000	1.24411	.00000	.00200
133	.66000	.66000	.00000	1.23592	.00000	.00200
134	.66500	.66500	.00000	1.22724	.00000	.00200
135	.67000	.67000	.00000	1.21908	.00000	.00200
136	.67500	.67500	.00000	1.21184	.00000	.00200
137	.68000	.68000	.00000	1.20499	.00000	.00200
138	.68500	.68500	.00000	1.19816	.00000	.00200
139	.69000	.69000	.00000	1.19140	.00000	.00200
140	.69500	.69500	.00000	1.18502	.00000	.00200
141	.70000	.70000	.00000	1.17928	.00000	.00200
142	.70500	.70500	.00000	1.17384	.00000	.00200
143	.71000	.71000	.00000	1.16841	.00000	.00200
144	.71500	.71500	.00000	1.16291	.00000	.00200
145	.72000	.72000	.00000	1.15728	.00000	.00200
146	.72500	.72500	.00000	1.15159	.00000	.00200
147	.73000	.73000	.00000	1.14586	.00000	.00200
148	.73500	.73500	.00000	1.14006	.00000	.00200
149	.74000	.74000	.00000	1.13418	.00000	.00200
150	.74500	.74500	.00000	1.12826	.00000	.00200
151	.75000	.75000	.00000	1.12235	.00000	.00200

152	.75500	.75500	.00000	1.11648	.00000	.00200
153	.76000	.76000	.00000	1.11067	.00000	.00200
154	.76500	.76500	.00000	1.10488	.00000	.00200
155	.77000	.77000	.00000	1.09909	.00000	.00200
156	.77500	.77500	.00000	1.09334	.00000	.00200
157	.78000	.78000	.00000	1.08775	.00000	.00200
158	.78500	.78500	.00000	1.08241	.00000	.00200
159	.79000	.79000	.00000	1.07718	.00000	.00200
160	.79500	.79500	.00000	1.07196	.00000	.00200
161	.80000	.80000	.00000	1.06665	.00000	.00200
162	.80500	.80500	.00000	1.06117	.00000	.00200
163	.81000	.81000	.00000	1.05561	.00000	.00200
164	.81500	.81500	.00000	1.05000	.00000	.00200
165	.82000	.82000	.00000	1.04431	.00000	.00200
166	.82500	.82500	.00000	1.03848	.00000	.00200
167	.83000	.83000	.00000	1.03260	.00000	.00200
168	.83500	.83500	.00000	1.02661	.00000	.00200
169	.84000	.84000	.00000	1.02026	.00000	.00200
170	.84500	.84500	.00000	1.01334	.00000	.00200
171	.85000	.85000	.00000	1.00618	.00000	.00200
172	.85500	.85500	.00000	.99921	.00000	.00200
173	.86000	.86000	.00000	.99278	.00000	.00200
174	.86500	.86500	.00000	.98676	.00000	.00200
175	.87000	.87000	.00000	.98086	.00000	.00200
176	.87500	.87500	.00000	.97496	.00000	.00200
177	.88000	.88000	.00000	.96905	.00000	.00200
178	.88500	.88500	.00000	.96318	.00000	.00200
179	.89000	.89000	.00000	.95740	.00000	.00200
180	.89500	.89500	.00000	.95166	.00000	.00200
181	.90000	.90000	.00000	.94594	.00000	.00200
182	.90500	.90500	.00000	.94015	.00000	.00200
183	.91000	.91000	.00000	.93416	.00000	.00200
184	.91500	.91500	.00000	.92790	.00000	.00200
185	.92000	.92000	.00000	.92151	.00000	.00200
186	.92500	.92500	.00000	.91513	.00000	.00200
187	.93000	.93000	.00000	.90891	.00000	.00200
188	.93500	.93500	.00000	.90304	.00000	.00200
189	.94000	.94000	.00000	.89740	.00000	.00200
190	.94500	.94500	.00000	.89181	.00000	.00200
191	.95000	.95000	.00000	.88623	.00000	.00200
192	.95500	.95500	.00000	.88061	.00000	.00200
193	.96000	.96000	.00000	.87491	.00000	.00200
194	.96500	.96500	.00000	.86906	.00000	.00200
195	.97000	.97000	.00000	.86309	.00000	.00200
196	.97500	.97500	.00000	.85738	.00000	.00200
197	.98000	.97960	.00000	.85325	.00000	.00200
198	.98500	.97960	.00000	.85200	.00000	.00200
199	.99000	.97960	.00000	.85223	.00000	.00200

*** STREAMWISE LOCATIONS OF BOUNDARY LAYER CALCULATION, BODY RADIUS, FROM SUBROUTINE XBLGRD ***

M	S	XOCBL	RO
1	.50000100E+00	.50000100E+00	.10000000E+01
2	.50500000E+00	.50500000E+00	.10000000E+01
3	.51000000E+00	.51000000E+00	.10000000E+01
4	.51500000E+00	.51500000E+00	.10000000E+01
5	.52000000E+00	.52000000E+00	.10000000E+01
6	.52500000E+00	.52500000E+00	.10000000E+01
7	.53000000E+00	.53000000E+00	.10000000E+01
8	.53500000E+00	.53500000E+00	.10000000E+01
9	.54000000E+00	.54000000E+00	.10000000E+01
10	.54500000E+00	.54500000E+00	.10000000E+01
11	.55000000E+00	.55000000E+00	.10000000E+01
12	.55500000E+00	.55500000E+00	.10000000E+01
13	.56000000E+00	.56000000E+00	.10000000E+01
14	.56500000E+00	.56500000E+00	.10000000E+01
15	.57000000E+00	.57000000E+00	.10000000E+01
16	.57500000E+00	.57500000E+00	.10000000E+01
17	.58000000E+00	.58000000E+00	.10000000E+01
18	.58500000E+00	.58500000E+00	.10000000E+01
19	.59000000E+00	.59000000E+00	.10000000E+01
20	.59500000E+00	.59500000E+00	.10000000E+01
21	.60000000E+00	.60000000E+00	.10000000E+01
22	.60500000E+00	.60500000E+00	.10000000E+01
23	.61000000E+00	.61000000E+00	.10000000E+01
24	.61500000E+00	.61500000E+00	.10000000E+01
25	.62000000E+00	.62000000E+00	.10000000E+01
26	.62500000E+00	.62500000E+00	.10000000E+01
27	.63000000E+00	.63000000E+00	.10000000E+01
28	.63500000E+00	.63500000E+00	.10000000E+01
29	.64000000E+00	.64000000E+00	.10000000E+01
30	.64500000E+00	.64500000E+00	.10000000E+01
31	.65000000E+00	.65000000E+00	.10000000E+01
32	.65500000E+00	.65500000E+00	.10000000E+01
33	.66000000E+00	.66000000E+00	.10000000E+01
34	.66500000E+00	.66500000E+00	.10000000E+01
35	.67000000E+00	.67000000E+00	.10000000E+01
36	.67500000E+00	.67500000E+00	.10000000E+01
37	.68000000E+00	.68000000E+00	.10000000E+01
38	.68500000E+00	.68500000E+00	.10000000E+01
39	.69000000E+00	.69000000E+00	.10000000E+01
40	.69500000E+00	.69500000E+00	.10000000E+01
41	.70000000E+00	.70000000E+00	.10000000E+01
42	.70500000E+00	.70500000E+00	.10000000E+01
43	.71000000E+00	.71000000E+00	.10000000E+01
44	.71500000E+00	.71500000E+00	.10000000E+01
45	.72000000E+00	.72000000E+00	.10000000E+01
46	.72500000E+00	.72500000E+00	.10000000E+01
47	.73000000E+00	.73000000E+00	.10000000E+01
48	.73500000E+00	.73500000E+00	.10000000E+01
49	.74000000E+00	.74000000E+00	.10000000E+01
50	.74500000E+00	.74500000E+00	.10000000E+01
51	.75000000E+00	.75000000E+00	.10000000E+01
52	.75500000E+00	.75500000E+00	.10000000E+01
53	.76000000E+00	.76000000E+00	.10000000E+01
54	.76500000E+00	.76500000E+00	.10000000E+01
55	.77000000E+00	.77000000E+00	.10000000E+01
56	.77500000E+00	.77500000E+00	.10000000E+01
57	.78000000E+00	.78000000E+00	.10000000E+01

58	.78500000E+00	.78500000E+00	.10000000E+01
59	.79000000E+00	.79000000E+00	.10000000E+01
60	.79500000E+00	.79500000E+00	.10000000E+01
61	.80000000E+00	.80000000E+00	.10000000E+01
62	.80500000E+00	.80500000E+00	.10000000E+01
63	.81000000E+00	.81000000E+00	.10000000E+01
64	.81500000E+00	.81500000E+00	.10000000E+01
65	.82000000E+00	.82000000E+00	.10000000E+01
66	.82500000E+00	.82500000E+00	.10000000E+01
67	.83000000E+00	.83000000E+00	.10000000E+01
68	.83500000E+00	.83500000E+00	.10000000E+01
69	.84000000E+00	.84000000E+00	.10000000E+01
70	.84500000E+00	.84500000E+00	.10000000E+01
71	.85000000E+00	.85000000E+00	.10000000E+01
72	.85500000E+00	.85500000E+00	.10000000E+01
73	.86000000E+00	.86000000E+00	.10000000E+01
74	.86500000E+00	.86500000E+00	.10000000E+01
75	.87000000E+00	.87000000E+00	.10000000E+01
76	.87500000E+00	.87500000E+00	.10000000E+01
77	.88000000E+00	.88000000E+00	.10000000E+01
78	.88500000E+00	.88500000E+00	.10000000E+01
79	.89000000E+00	.89000000E+00	.10000000E+01
80	.89500000E+00	.89500000E+00	.10000000E+01
81	.90000000E+00	.90000000E+00	.10000000E+01
82	.90500000E+00	.90500000E+00	.10000000E+01
83	.91000000E+00	.91000000E+00	.10000000E+01
84	.91500000E+00	.91500000E+00	.10000000E+01
85	.92000000E+00	.92000000E+00	.10000000E+01
86	.92500000E+00	.92500000E+00	.10000000E+01
87	.93000000E+00	.93000000E+00	.10000000E+01
88	.93500000E+00	.93500000E+00	.10000000E+01
89	.94000000E+00	.94000000E+00	.10000000E+01
90	.94500000E+00	.94500000E+00	.10000000E+01
91	.95000000E+00	.95000000E+00	.10000000E+01
92	.95500000E+00	.95500000E+00	.10000000E+01
93	.96000000E+00	.96000000E+00	.10000000E+01
94	.96500000E+00	.96500000E+00	.10000000E+01
95	.97000000E+00	.97000000E+00	.10000000E+01
96	.97500000E+00	.97500000E+00	.10000000E+01
97	.98000000E+00	.97960000E+00	.10000000E+01
98	.98500000E+00	.97960000E+00	.10000000E+01
99	.99000000E+00	.97960000E+00	.10000000E+01

T(I),I=1,ISTOP ** TANGENTIAL SURFACE VELOCITY **

.20361118E-01	.42587502E+00	.69974665E+00	.84438338E+00	.92741105E+00	.97717037E+00	.10079155E+01	.10233201E+01
.10326985E+01	.10418054E+01	.10515865E+01	.10616646E+01	.10718227E+01	.10820591E+01	.10921312E+01	.11009306E+01
.11071978E+01	.11122086E+01	.11170772E+01	.11220551E+01	.11270912E+01	.11321336E+01	.11371735E+01	.11422303E+01
.11473275E+01	.11523902E+01	.11570372E+01	.11607504E+01	.11638072E+01	.11666916E+01	.11695964E+01	.11725311E+01
.11754740E+01	.11784156E+01	.11813564E+01	.11843038E+01	.11872670E+01	.11902215E+01	.11930290E+01	.11954789E+01
.11976296E+01	.11996843E+01	.12017419E+01	.12038129E+01	.12058880E+01	.12079620E+01	.12100365E+01	.12121230E+01
.12142348E+01	.12163270E+01	.12181662E+01	.12194251E+01	.12202554E+01	.12209657E+01	.12216866E+01	.12224271E+01
.12231732E+01	.12239169E+01	.12246563E+01	.12254010E+01	.12261896E+01	.12270632E+01	.12279789E+01	.12288992E+01
.12298158E+01	.12307304E+01	.12316450E+01	.12325609E+01	.12334778E+01	.12343887E+01	.12352755E+01	.12361266E+01
.12369616E+01	.12377951E+01	.12386300E+01	.12394658E+01	.12403025E+01	.12411409E+01	.12419783E+01	.12427992E+01
.12435795E+01	.12443252E+01	.12450596E+01	.12457942E+01	.12465304E+01	.12472671E+01	.12480036E+01	.12487402E+01
.12494784E+01	.12502202E+01	.12509602E+01	.12516671E+01	.12522913E+01	.12528432E+01	.12533712E+01	.12538994E+01
.12544307E+01	.12549623E+01	.12554938E+01	.12560301E+01	.12565830E+01	.12571569E+01	.12577395E+01	.12583225E+01
.12589045E+01	.12594873E+01	.12600737E+01	.12606620E+01	.12612270E+01	.12617113E+01	.12620882E+01	.12624186E+01
.12627456E+01	.12630774E+01	.12634115E+01	.12637458E+01	.12640778E+01	.12644054E+01	.12647356E+01	.12651067E+01
.12655760E+01	.12661366E+01	.12667675E+01	.12673255E+01	.12672454E+01	.12658707E+01	.12637881E+01	.12613663E+01
.12584187E+01	.12549316E+01	.12505079E+01	.12441069E+01	.12359210E+01	.12272409E+01	.12190825E+01	.12118356E+01

.12049893E+01	.11981644E+01	.11913973E+01	.11850243E+01	.11792827E+01	.11738360E+01	.11684112E+01	.11629067E+01
.11572793E+01	.11515855E+01	.11458577E+01	.11400624E+01	.11341824E+01	.11282649E+01	.11223511E+01	.11164763E+01
.11106654E+01	.11048784E+01	.10990885E+01	.10933362E+01	.10877476E+01	.10824060E+01	.10771816E+01	.10719585E+01
.10666475E+01	.10611719E+01	.10556068E+01	.10500030E+01	.10443102E+01	.10384810E+01	.10325951E+01	.10266140E+01
.10202646E+01	.10133428E+01	.10061831E+01	.99921421E+00	.99277769E+00	.98675889E+00	.98086357E+00	.97495857E+00
.96904543E+00	.96317772E+00	.95739597E+00	.95166285E+00	.94593812E+00	.94015169E+00	.93416163E+00	.92790154E+00
.92151407E+00	.91513169E+00	.90891310E+00	.90303803E+00	.89739503E+00	.89181324E+00	.88622597E+00	.88060782E+00
.87490564E+00	.86906174E+00	.86308678E+00	.85737531E+0C	.85325028E+00	.85200245E+00	.85222938E+00	

INITIAL GUESS ON PMF

.11667000E+01	.12978000E+01	.12978000E+01

SPMF

.60000000E+00	.80000000E+00	.10000000E+01

INTERPOLATED PMF DISTRIBUTION FROM INITIAL GUESS ONTO COMPUTATIONAL MESH

.11667000E+01	.11044275E+01	.11077050E+01	.11109825E+01	.11142600E+01	.11175375E+01	.11208150E+01	.11240925E+01
.11273700E+01	.11306475E+01	.11339250E+01	.11372025E+01	.11404800E+01	.11437575E+01	.11470350E+01	.11503125E+01
.11535900E+01	.11568675E+01	.11601450E+01	.11634225E+01	.11667000E+01	.11699775E+01	.11732550E+01	.11765325E+01
.11798100E+01	.11830875E+01	.11863650E+01	.11896425E+01	.11929200E+01	.11961975E+01	.11994750E+01	.12027525E+01
.12060300E+01	.12093075E+01	.12125850E+01	.12158625E+01	.12191400E+01	.12224175E+01	.12256950E+01	.12289725E+01
.12322500E+01	.12355275E+01	.12388050E+01	.12420825E+01	.12453600E+01	.12486375E+01	.12519150E+01	.12551925E+01
.12584700E+01	.12617475E+01	.12650250E+01	.12683025E+01	.12715800E+01	.12748575E+01	.12781350E+01	.12814125E+01
.12846900E+01	.12879675E+01	.12912450E+01	.12945225E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01
.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01
.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01
.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01
.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01	.12978000E+01
.12978000E+01	.12978000E+01	.12978000E+01					

*** INITIAL PROFILES ***

N	ETA(N)	F1(N)	SF1(N)	G1(N)	T(N)
1	.00000E+00	.00000E+00	.00000E+00	1.00000E+00	1.00051E+00
2	9.26311E-04	5.77794E-04	6.23002E-04	1.00000E+00	1.00051E+00
3	1.93599E-03	1.20750E-03	1.30132E-03	1.00000E+00	1.00051E+00
4	3.03654E-03	1.89376E-03	2.03978E-03	1.00000E+00	1.00051E+00
5	4.23614E-03	2.64166E-03	2.84364E-03	1.00000E+00	1.00051E+00
6	5.54370E-03	3.45672E-03	3.71857E-03	1.00000E+00	1.00051E+00
7	6.96895E-03	4.34494E-03	4.67074E-03	1.00000E+00	1.00051E+00
8	8.52246E-03	5.31289E-03	5.70681E-03	1.00000E+00	1.00051E+00
9	1.02158E-02	6.36769E-03	6.83401E-03	1.00000E+00	1.00051E+00
10	1.20615E-02	7.51712E-03	8.06012E-03	1.00000E+00	1.00051E+00
11	1.40734E-02	8.76963E-03	9.39359E-03	9.99999E-01	1.00051E+00
12	1.62663E-02	1.01344E-02	1.08435E-02	9.99999E-01	1.00051E+00
13	1.86566E-02	1.16216E-02	1.24197E-02	9.99999E-01	1.00051E+00
14	2.12620E-02	1.32419E-02	1.41327E-02	9.99999E-01	1.00050E+00
15	2.41019E-02	1.50073E-02	1.59940E-02	9.99999E-01	1.00050E+00
16	2.71973E-02	1.69308E-02	1.80156E-02	9.99999E-01	1.00050E+00
17	3.05714E-02	1.90264E-02	2.02108E-02	9.99999E-01	1.00050E+00
18	3.42491E-02	2.13093E-02	2.25937E-02	9.99999E-01	1.00050E+00
19	3.82579E-02	2.37962E-02	2.51791E-02	9.99999E-01	1.00050E+00
20	4.26274E-02	2.65053E-02	2.79832E-02	9.99998E-01	1.00050E+00
21	4.73902E-02	2.94561E-02	3.10229E-02	9.99998E-01	1.00050E+00
22	5.25816E-02	3.26700E-02	3.43165E-02	9.99998E-01	1.00050E+00
23	5.82402E-02	3.61702E-02	3.78830E-02	9.99998E-01	1.00050E+00
24	6.44082E-02	3.99820E-02	4.17426E-02	9.99998E-01	1.00050E+00
25	7.11312E-02	4.41328E-02	4.59165E-02	9.99997E-01	1.00050E+00
26	7.84593E-02	4.86522E-02	5.04269E-02	9.99997E-01	1.00050E+00
27	8.64470E-02	5.35726E-02	5.52968E-02	9.99997E-01	1.00050E+00
28	9.51535E-02	5.89288E-02	6.05497E-02	9.99997E-01	1.00050E+00
29	1.04644E-01	6.47589E-02	6.62101E-02	9.99996E-01	1.00050E+00
30	1.14988E-01	7.11037E-02	7.23024E-02	9.99996E-01	1.00050E+00
31	1.26263E-01	7.80078E-02	7.88511E-02	9.99996E-01	1.00050E+00
32	1.38553E-01	8.55193E-02	8.58803E-02	9.99996E-01	1.00050E+00
33	1.51949E-01	9.36899E-02	9.34132E-02	9.99995E-01	1.00050E+00
34	1.66551E-01	1.02576E-01	1.01471E-01	9.99995E-01	1.00050E+00
35	1.82467E-01	1.12237E-01	1.10073E-01	9.99995E-01	1.00049E+00
36	1.99815E-01	1.22740E-01	1.19235E-01	9.99994E-01	1.00049E+00
37	2.18725E-01	1.34152E-01	1.28968E-01	9.99994E-01	1.00049E+00
38	2.39336E-01	1.46550E-01	1.39277E-01	9.99994E-01	1.00049E+00
39	2.61803E-01	1.60013E-01	1.50158E-01	9.99993E-01	1.00049E+00
40	2.86292E-01	1.74626E-01	1.61599E-01	9.99993E-01	1.00048E+00
41	3.12984E-01	1.90480E-01	1.73573E-01	9.99993E-01	1.00048E+00
42	3.42079E-01	2.07669E-01	1.86037E-01	9.99993E-01	1.00048E+00
43	3.73792E-01	2.26293E-01	1.98932E-01	9.99992E-01	1.00047E+00
44	4.08360E-01	2.46457E-01	2.12170E-01	9.99992E-01	1.00047E+00
45	4.46039E-01	2.68264E-01	2.25637E-01	9.99993E-01	1.00046E+00
46	4.87109E-01	2.91822E-01	2.39185E-01	9.99993E-01	1.00046E+00
47	5.31875E-01	3.17235E-01	2.52621E-01	9.99993E-01	1.00045E+00
48	5.80670E-01	3.44603E-01	2.65709E-01	9.99994E-01	1.00044E+00
49	6.33856E-01	3.74012E-01	2.78154E-01	9.99995E-01	1.00043E+00
50	6.91830E-01	4.05535E-01	2.89602E-01	9.99996E-01	1.00042E+00
51	7.55021E-01	4.39216E-01	2.99631E-01	9.99997E-01	1.00041E+00
52	8.23899E-01	4.75062E-01	3.07750E-01	9.99999E-01	1.00039E+00
53	8.98976E-01	5.13027E-01	3.13398E-01	1.00000E+00	1.00037E+00
54	9.80810E-01	5.52996E-01	3.15959E-01	1.00000E+00	1.00036E+00
55	1.07001E+00	5.94762E-01	3.14780E-01	1.00001E+00	1.00033E+00
56	1.16724E+00	6.38001E-01	3.09208E-01	1.00001E+00	1.00031E+00
57	1.27321E+00	6.82247E-01	2.98653E-01	1.00001E+00	1.00028E+00

58	1.38873E+00	7.26869E-01	2.82674E-01	1.00002E+00	1.00026E+00
59	1.51464E+00	7.71056E-01	2.61091E-01	1.00002E+00	1.00023E+00
60	1.65189E+00	8.13824E-01	2.34128E-01	1.00002E+00	1.00019E+00
61	1.80148E+00	8.54050E-01	2.02537E-01	1.00003E+00	1.00016E+00
62	1.96454E+00	8.90560E-01	1.67705E-01	1.00003E+00	1.00013E+00
63	2.14228E+00	9.22255E-01	1.31635E-01	1.00003E+00	1.00010E+00
64	2.33601E+00	9.48295E-01	9.67800E-02	1.00002E+00	1.00007E+00
65	2.54717E+00	9.68280E-01	6.56618E-02	1.00002E+00	1.00005E+00
66	2.77735E+00	9.82381E-01	4.03469E-02	1.00002E+00	1.00003E+00
67	3.02823E+00	9.91348E-01	2.19190E-02	1.00001E+00	1.00002E+00
68	3.30170E+00	9.96362E-01	1.01972E-02	1.00001E+00	1.00001E+00
69	3.59978E+00	9.98747E-01	3.88542E-03	1.00000E+00	1.00000E+00
70	3.92469E+00	9.99669E-01	1.13344E-03	1.00000E+00	1.00000E+00
71	4.27884E+00	9.99941E-01	2.25148E-04	1.00000E+00	1.00000E+00
72	4.66486E+00	9.99994E-01	2.32875E-05	1.00000E+00	1.00000E+00
73	5.08562E+00	1.00000E+00	1.84757E-07	1.00000E+00	1.00000E+00
74	5.54425E+00	1.00000E+00	-1.50122E-08	1.00000E+00	1.00000E+00
75	6.04416E+00	1.00000E+00	2.90561E-09	1.00000E+00	1.00000E+00
76	6.58906E+00	1.00000E+00	-1.13542E-09	1.00000E+00	1.00000E+00
77	7.18300E+00	1.00000E+00	-5.53753E-11	1.00000E+00	1.00000E+00
78	7.83040E+00	1.00000E+00	-3.32677E-10	1.00000E+00	1.00000E+00
79	8.53606E+00	1.00000E+00	-2.72162E-10	1.00000E+00	1.00000E+00
80	9.30524E+00	1.00000E+00	-2.78421E-10	1.00000E+00	1.00000E+00
81	1.01436E+01	1.00000E+00	-2.83120E-10	1.00000E+00	1.00000E+00
82	1.10575E+01	1.00000E+00	-2.78171E-10	1.00000E+00	1.00000E+00
83	1.20536E+01	1.00000E+00	-2.80746E-10	1.00000E+00	1.00000E+00
84	1.31393E+01	1.00000E+00	-2.80964E-10	1.00000E+00	1.00000E+00
85	1.43228E+01	1.00000E+00	-2.78622E-10	1.00000E+00	1.00000E+00
86	1.56128E+01	1.00000E+00	-2.83407E-10	1.00000E+00	1.00000E+00
87	1.70189E+01	1.00000E+00	-2.77132E-10	1.00000E+00	1.00000E+00
88	1.85515E+01	1.00000E+00	-2.83190E-10	1.00000E+00	1.00000E+00
89	2.02220E+01	1.00000E+00	-2.77933E-10	1.00000E+00	1.00000E+00
90	2.20430E+01	1.00000E+00	-2.82266E-10	1.00000E+00	1.00000E+00
91	2.40277E+01	1.00000E+00	-2.80140E-10	1.00000E+00	1.00000E+00
92	2.61912E+01	1.00000E+00	-2.81208E-10	1.00000E+00	1.00000E+00
93	2.85493E+01	1.00000E+00	-2.83951E-10	1.00000E+00	1.00000E+00
94	3.11197E+01	1.00000E+00	-2.78758E-10	1.00000E+00	1.00000E+00
95	3.39214E+01	1.00000E+00	-2.85528E-10	1.00000E+00	1.00000E+00
96	3.69752E+01	1.00000E+00	-2.79979E-10	1.00000E+00	1.00000E+00
97	4.03039E+01	1.00000E+00	-2.87555E-10	1.00000E+00	1.00000E+00
98	4.39322E+01	1.00000E+00	-2.84034E-10	1.00000E+00	1.00000E+00
99	4.78870E+01	1.00000E+00	-2.90819E-10	1.00000E+00	1.00000E+00
100	5.21978E+01	1.00000E+00	.00000E+00	1.00000E+00	1.00000E+00

*** SUMMARY OF CONVERGENCE HISTORY ***

INTRAC	DDTMAX	RMSDT	SMDT	DUEMAX	RMSUE	SMUE	DSFMAX	DFMAX	DGMAX
2	-.71076E+00	.24873E-01	.99000E+00	.97713E-01	.60667E-02	.70000E+00	.15504E+01	-.28723E+00	-.17674E-04

*** SUMMARY OF CONVERGENCE HISTORY ***

INTRAC	DDTMAX	RMSDT	SMDT	DUEMAX	RMSUE	SMUE	DSFMAX	DFMAX	DGMAX
3	-.27173E+00	.95139E-02	.99000E+00	-.45837E-01	.25718E-02	.99000E+00	.56745E+00	.12014E+00	-.89486E-05

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 EDGE QUANTITIES IN VISMFK AT STATION M= 44
MREF    =      .04000      TREFD  =  530.00000      TREF    =1562.50000
REYREF  = 2000000.0        ME2    =     .04870      UE2     =   1.21747
TE2     =1562.25889        RHOE2  =     .99961      TU2     =    .00200
RO2     =    1.00000       QE2    =     .00346      MUE2    =    .99988
ME1     =     .04880       UE1    =    1.21979      TE1     =1562.25605
RHOE1   =     .99961       RO1    =    1.00000      QE1     =    .00346

 MFK QUANTITIES IN VISMFK AT STATION M= 44
ACLINF  =    2.12629       ALINFN =     .15269      ALINFO  =    .09019
A1MFKN  =     .12000       A1MFKO =     .12000      A2MFK   =    .50000
A3MFK   =     .20000       BLTHK  =    6.44983      DELIN   =   4.39527
DELTU2  =    6.44983       DELTU1 =    6.45033      DTINC2  =   3.73176
DTINC1  =    3.81392       VEDGE  =    -.01328      NDELTU  =        61
NINNER  =         57       PSI11N =     .11757      PSI12N  =    .00000
PDI110  =     .12668       PSI12O =     .00000      PSI21N  =    .06090
PSI31N  =     .57419       PSI32N =     .00000      EMFK    =    .00011
RTAU    =    6.45525       RTHEAT = 251.29068       A2MA3N  =    .30000
44  .71500E+0C 11  .45421E+01  .45421E+01 -.31380E+00 -.31371E+00  .12175E+01  .48702E-01  .55330E-03 -.43160E-03***   910.651
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PROFILES AT M= 44 S(M)=R 7.15000E-01 INVRSE= 1 PMF(M)= 4.54211E+00 BETA(M)= -3.13798E-01

N	ETA(N)	YBL(N)	F2(N)	SF2(N)	G2(N)	EPSBAR(N)	RHOMUR(N)	T(N)
1	.00000E+00	.00000E+00	.00000E+00	.00000E+00	1.00000E+00	1.00000E+00	9.99892E-01	1.00047E+00
2	9.26311E-04	2.44577E-06	-8.64058E-04	-3.00618E-03	1.00000E+00	1.00000E+00	9.99892E-01	1.00047E+00
3	1.93599E-03	5.11166E-06	-1.79956E-03	-6.25775E-03	1.00000E+00	1.00001E+00	9.99892E-01	1.00047E+00
4	3.03654E-03	8.01748E-06	-2.81174E-03	-9.77214E-03	1.00000E+00	1.00002E+00	9.99892E-01	1.00047E+00
5	4.23614E-03	1.11848E-05	-3.90609E-03	-1.35675E-02	1.00000E+00	1.00004E+00	9.99892E-01	1.00047E+00
6	5.54370E-03	1.46372E-05	-5.08836E-03	-1.76625E-02	1.00000E+00	1.00008E+00	9.99892E-01	1.00047E+00
7	6.96895E-03	1.84004E-05	-6.36448E-03	-2.20766E-02	1.00000E+00	1.00013E+00	9.99892E-01	1.00047E+00
8	8.52246E-03	2.25022E-05	-7.74056E-03	-2.68292E-02	1.00000E+00	1.00020E+00	9.99892E-01	1.00047E+00
9	1.02158E-02	2.69731E-05	-9.22285E-03	-3.19404E-02	1.00000E+00	1.00029E+00	9.99892E-01	1.00047E+00
10	1.20615E-02	3.18465E-05	-1.08176E-02	-3.74296E-02	1.00000E+00	1.00042E+00	9.99892E-01	1.00047E+00
11	1.40734E-02	3.71584E-05	-1.25313E-02	-4.33163E-02	1.00000E+00	1.00060E+00	9.99892E-01	1.00047E+00
12	1.62663E-02	4.29485E-05	-1.43699E-02	-4.96189E-02	1.00000E+00	1.00083E+00	9.99892E-01	1.00047E+00
13	1.86566E-02	4.92596E-05	-1.63394E-02	-5.63547E-02	1.00000E+00	1.00113E+00	9.99892E-01	1.00047E+00
14	2.12620E-02	5.61387E-05	-1.84456E-02	-6.35392E-02	1.00000E+00	1.00153E+00	9.99892E-01	1.00047E+00
15	2.41019E-02	6.36370E-05	-2.06933E-02	-7.11855E-02	1.00000E+00	1.00204E+00	9.99892E-01	1.00047E+00
16	2.71973E-02	7.18101E-05	-2.30870E-02	-7.93035E-02	1.00000E+00	1.00270E+00	9.99892E-01	1.00047E+00
17	3.05714E-02	8.07187E-05	-2.56300E-02	-8.78993E-02	1.00000E+00	1.00353E+00	9.99892E-01	1.00047E+00
18	3.42491E-02	9.04292E-05	-2.83245E-02	-9.69740E-02	1.00000E+00	1.00460E+00	9.99892E-01	1.00047E+00
19	3.82579E-02	1.01014E-04	-3.11712E-02	-1.06523E-01	1.00000E+00	1.00593E+00	9.99892E-01	1.00047E+00
20	4.26274E-02	1.12551E-04	-3.41691E-02	-1.16536E-01	1.00000E+00	1.00757E+00	9.99892E-01	1.00047E+00
21	4.73902E-02	1.25126E-04	-3.73150E-02	-1.26993E-01	1.00000E+00	1.00959E+00	9.99892E-01	1.00047E+00
22	5.25816E-02	1.38833E-04	-4.06035E-02	-1.37867E-01	1.00000E+00	1.01201E+00	9.99892E-01	1.00047E+00
23	5.82402E-02	1.53774E-04	-4.40265E-02	-1.49121E-01	1.00000E+00	1.01488E+00	9.99892E-01	1.00047E+00
24	6.44082E-02	1.70059E-04	-4.75733E-02	-1.60709E-01	1.00000E+00	1.01820E+00	9.99892E-01	1.00047E+00
25	7.11312E-02	1.87810E-04	-5.12298E-02	-1.72574E-01	1.00000E+00	1.02195E+00	9.99892E-01	1.00047E+00
26	7.84593E-02	2.07159E-04	-5.49791E-02	-1.84647E-01	1.00000E+00	1.02605E+00	9.99892E-01	1.00047E+00
27	8.64470E-02	2.28249E-04	-5.88004E-02	-1.96851E-01	1.00000E+00	1.03036E+00	9.99893E-01	1.00047E+00
28	9.51535E-02	2.51237E-04	-6.26697E-02	-2.09095E-01	1.00000E+00	1.03467E+00	9.99893E-01	1.00047E+00
29	1.04644E-01	2.76294E-04	-6.65582E-02	-2.21277E-01	1.00000E+00	1.03867E+00	9.99893E-01	1.00047E+00
30	1.14988E-01	3.03606E-04	-7.04317E-02	-2.33279E-01	1.00000E+00	1.04196E+00	9.99893E-01	1.00047E+00
31	1.26263E-01	3.33377E-04	-7.42479E-02	-2.44959E-01	1.00000E+00	1.04402E+00	9.99893E-01	1.00047E+00
32	1.38553E-01	3.65826E-04	-7.79516E-02	-2.56143E-01	1.00000E+00	1.04417E+00	9.99893E-01	1.00047E+00
33	1.51949E-01	4.01196E-04	-8.14662E-02	-2.66598E-01	1.00000E+00	1.04158E+00	9.99893E-01	1.00047E+00
34	1.66551E-01	4.39750E-04	-8.46726E-02	-2.75980E-01	1.00000E+00	1.03634E+00	9.99893E-01	1.00047E+00
35	1.82467E-01	4.81773E-04	-8.73688E-02	-2.83726E-01	1.00000E+00	1.02901E+00	9.99893E-01	1.00047E+00
36	1.99815E-01	5.27578E-04	-8.91858E-02	-2.88842E-01	1.00000E+00	1.01842E+00	9.99893E-01	1.00047E+00

37	2.18725E-01	5.77506E-04	-8.93846E-02	-2.89388E-01	9.99999E-01	1.00188E+00	9.99893E-01	1.00047E+00
38	2.39336E-01	6.31927E-04	-8.64654E-02	-2.81556E-01	9.99999E-01	1.06579E+00	9.99893E-01	1.00047E+00
39	2.61803E-01	6.91246E-04	-7.93817E-02	-2.63081E-01	9.99999E-01	1.52142E+00	9.99893E-01	1.00047E+00
40	2.86292E-01	7.55904E-04	-7.07408E-02	-2.41251E-01	9.99998E-01	2.84557E+00	9.99893E-01	1.00047E+00
41	3.12984E-01	8.26381E-04	-6.14452E-02	-2.18596E-01	9.99998E-01	4.03030E+00	9.99893E-01	1.00047E+00
42	3.42079E-01	9.03201E-04	-5.05550E-02	-1.93112E-01	9.99997E-01	4.89872E+00	9.99893E-01	1.00047E+00
43	3.73792E-01	9.86934E-04	-3.70864E-02	-1.63021E-01	9.99997E-01	5.54904E+00	9.99893E-01	1.00047E+00
44	4.08360E-01	1.07820E-03	-2.01766E-02	-1.27193E-01	9.99996E-01	6.24939E+00	9.99893E-01	1.00047E+00
45	4.46039E-01	1.17769E-03	7.27095E-04	-8.55329E-02	9.99995E-01	6.95589E+00	9.99893E-01	1.00047E+00
46	4.87109E-01	1.28613E-03	2.62289E-02	-3.82060E-02	9.99995E-01	7.66735E+00	9.99893E-01	1.00047E+00
47	5.31875E-01	1.40432E-03	5.72639E-02	1.47507E-02	9.99994E-01	8.44469E+00	9.99894E-01	1.00047E+00
48	5.80670E-01	1.53316E-03	9.49270E-02	7.28814E-02	9.99993E-01	9.28905E+00	9.99895E-01	1.00046E+00
49	6.33856E-01	1.67358E-03	1.40548E-01	1.35193E-01	9.99993E-01	1.02116E+01	9.99896E-01	1.00046E+00
50	6.91830E-01	1.82665E-03	1.95612E-01	1.99744E-01	9.99992E-01	1.12007E+01	9.99898E-01	1.00045E+00
51	7.55021E-01	1.99349E-03	2.61598E-01	2.63175E-01	9.99993E-01	1.22149E+01	9.99901E-01	1.00044E+00
52	8.23899E-01	2.17534E-03	3.39607E-01	3.20225E-01	9.99995E-01	1.31644E+01	9.99906E-01	1.00041E+00
53	8.98976E-01	2.37356E-03	4.29741E-01	3.63547E-01	9.99999E-01	1.38956E+01	9.99912E-01	1.00039E+00
54	9.80810E-01	2.58960E-03	5.30231E-01	3.84389E-01	1.00000E+00	1.41915E+01	9.99921E-01	1.00035E+00
55	1.07001E+00	2.82508E-03	6.36573E-01	3.74774E-01	1.00001E+00	1.38088E+01	9.99933E-01	1.00029E+00
56	1.16724E+00	3.08174E-03	7.41248E-01	3.31328E-01	1.00002E+00	1.25690E+01	9.99947E-01	1.00023E+00
57	1.27321E+00	3.36148E-03	8.34760E-01	2.59426E-01	1.00002E+00	1.04835E+01	9.99962E-01	1.00017E+00
58	1.38873E+00	3.66638E-03	9.08315E-01	1.74500E-01	1.00002E+00	7.84475E+00	9.99976E-01	1.00011E+00
59	1.51464E+00	3.99870E-03	9.57424E-01	9.71536E-02	1.00002E+00	5.19317E+00	9.99986E-01	1.00006E+00
60	1.65189E+00	4.36091E-03	9.84190E-01	4.27312E-02	1.00001E+00	3.09693E+00	9.99994E-01	1.00003E+00
61	1.80148E+00	4.75572E-03	9.95670E-01	1.36555E-02	1.00001E+00	1.82515E+00	9.99997E-01	1.00001E+00
62	1.96454E+00	5.18605E-03	9.99334E-01	2.37940E-03	1.00000E+00	1.24165E+00	9.99999E-01	1.00000E+00
63	2.14228E+00	5.65511E-03	1.00005E+00	-2.59697E-04	1.00000E+00	1.04350E+00	1.00000E+00	1.00000E+00
64	2.33601E+00	6.16638E-03	1.00005E+00	-2.33440E-04	1.00000E+00	1.00034E+00	1.00000E+00	1.00000E+00
65	2.54717E+00	6.72367E-03	9.99999E-01	8.20406E-06	1.00000E+00	1.00245E+00	1.00000E+00	1.00000E+00
66	2.77735E+00	7.33111E-03	9.99995E-01	3.38101E-05	1.00000E+00	1.00021E+00	1.00000E+00	1.00000E+00
67	3.02823E+00	7.99322E-03	1.00000E+00	-1.43569E-06	1.00000E+00	1.00023E+00	1.00000E+00	1.00000E+00
68	3.30170E+00	8.71493E-03	1.00000E+00	-6.37242E-06	1.00000E+00	1.00003E+00	1.00000E+00	1.00000E+00
69	3.59978E+00	9.50158E-03	1.00000E+00	1.04511E-06	1.00000E+00	1.00003E+00	1.00000E+00	1.00000E+00
70	3.92469E+00	1.03590E-02	1.00000E+00	1.21272E-06	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
71	4.27884E+00	1.12937E-02	1.00000E+00	-7.19485E-07	1.00000E+00	1.00001E+00	1.00000E+00	1.00000E+00
72	4.66486E+00	1.23124E-02	1.00000E+00	-2.39006E-07	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
73	5.08562E+00	1.34228E-02	1.00000E+00	1.97365E-07	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
74	5.54425E+00	1.46332E-02	1.00000E+00	-1.50460E-07	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
75	6.04416E+00	1.59525E-02	1.00000E+00	-1.39239E-07	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
76	6.58906E+00	1.73905E-02	1.00000E+00	-6.12036E-09	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
77	7.18300E+00	1.89580E-02	1.00000E+00	-9.80081E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
78	7.83040E+00	2.06665E-02	1.00000E+00	-9.27356E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
79	8.53606E+00	2.25288E-02	1.00000E+00	-4.98450E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
80	9.30524E+00	2.45588E-02	1.00000E+00	-9.43845E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
81	1.01436E+01	2.67714E-02	1.00000E+00	-7.03110E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
82	1.10575E+01	2.91831E-02	1.00000E+00	-7.39964E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
83	1.20536E+01	3.18119E-02	1.00000E+00	-8.15067E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
84	1.31393E+01	3.46773E-02	1.00000E+00	-7.12717E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
85	1.43228E+01	3.78005E-02	1.00000E+00	-8.00130E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
86	1.56128E+01	4.12049E-02	1.00000E+00	-7.33403E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
87	1.70189E+01	4.49156E-02	1.00000E+00	-7.90912E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
88	1.85515E+01	4.89604E-02	1.00000E+00	-7.29716E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
89	2.02220E+01	5.33691E-02	1.00000E+00	-8.01457E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
90	2.20430E+01	5.81746E-02	1.00000E+00	-7.19279E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
91	2.40277E+01	6.34127E-02	1.00000E+00	-8.07270E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
92	2.61912E+01	6.91221E-02	1.00000E+00	-7.19720E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
93	2.85493E+01	7.53454E-02	1.00000E+00	-8.01338E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
94	3.11197E+01	8.21288E-02	1.00000E+00	-7.29612E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
95	3.39214E+01	8.95228E-02	1.00000E+00	-7.89910E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
96	3.69752E+01	9.75821E-02	1.00000E+00	-7.41798E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
97	4.03039E+01	1.06367E-01	1.00000E+00	-7.79696E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00

98	4.39322E+01	1.15942E-01	1.00000E+00	-7.52281E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
99	4.78870E+01	1.26379E-01	1.00000E+00	-7.74104E-08	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00
100	5.21978E+01	1.37756E-01	1.00000E+00	.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00	1.00000E+00

N	YN(N)	YPLUS(N)	DUDY(N)	TAU(N)	DAMP(N)	FUN(N)	FMFK(N)	EPSBAR(N)
1	.00000E+00	.00000E+00	2.50733E-01	3.05334E-01	2.01996E-03	.00000E+00	.00000E+00	1.00000E+00
2	3.45884E-03	7.15787E-02	2.49009E-01	3.03235E-01	2.07795E-03	9.48546E-05	.00000E+00	1.00000E+00
3	7.22898E-03	1.49073E-01	2.47259E-01	3.01106E-01	2.14242E-03	4.14246E-04	.00000E+00	1.00001E+00
4	1.13384E-02	2.32916E-01	2.45353E-01	2.98789E-01	2.21422E-03	1.01867E-03	.00000E+00	1.00002E+00
5	1.58177E-02	3.23557E-01	2.43277E-01	2.96268E-01	2.29428E-03	1.98125E-03	.00000E+00	1.00004E+00
6	2.07002E-02	4.21465E-01	2.41018E-01	2.93527E-01	2.38370E-03	3.38992E-03	.00000E+00	1.00008E+00
7	2.60220E-02	5.27124E-01	2.38560E-01	2.90547E-01	2.48373E-03	5.35001E-03	.00000E+00	1.00013E+00
8	3.18229E-02	6.41031E-01	2.35887E-01	2.87312E-01	2.59581E-03	7.98697E-03	.00000E+00	1.00020E+00
9	3.81458E-02	7.63687E-01	2.32981E-01	2.83800E-01	2.72158E-03	1.14495E-02	.00000E+00	1.00029E+00
10	4.50377E-02	8.95598E-01	2.29826E-01	2.79992E-01	2.86296E-03	1.59125E-02	.00000E+00	1.00042E+00
11	5.25499E-02	1.03726E+00	2.26402E-01	2.75869E-01	3.02214E-03	2.15805E-02	.00000E+00	1.00060E+00
12	6.07383E-02	1.18915E+00	2.22690E-01	2.71409E-01	3.20164E-03	2.86905E-02	.00000E+00	1.00083E+00
13	6.96636E-02	1.35174E+00	2.18671E-01	2.66591E-01	3.40435E-03	3.75140E-02	.00000E+00	1.00113E+00
14	7.93921E-02	1.52543E+00	2.14326E-01	2.61397E-01	3.63358E-03	4.83588E-02	.00000E+00	1.00153E+00
15	8.99963E-02	1.71058E+00	2.09636E-01	2.55807E-01	3.89311E-03	6.15678E-02	.00000E+00	1.00204E+00
16	1.01555E-01	1.90750E+00	2.04582E-01	2.49805E-01	4.18722E-03	7.75158E-02	.00000E+00	1.00270E+00
17	1.14154E-01	2.11637E+00	1.99150E-01	2.43375E-01	4.52077E-03	9.66026E-02	.00000E+00	1.00353E+00
18	1.27886E-01	2.33727E+00	1.93325E-01	2.36506E-01	4.89916E-03	1.19240E-01	.00000E+00	1.00460E+00
19	1.42855E-01	2.57014E+00	1.87098E-01	2.29191E-01	5.32839E-03	1.45833E-01	.00000E+00	1.00593E+00
20	1.59171E-01	2.81476E+00	1.80464E-01	2.21426E-01	5.81495E-03	1.76754E-01	.00000E+00	1.00757E+00
21	1.76955E-01	3.07068E+00	1.73424E-01	2.13215E-01	6.36582E-03	2.12304E-01	.00000E+00	1.00959E+00
22	1.96339E-01	3.33722E+00	1.65989E-01	2.04563E-01	6.98818E-03	2.52672E-01	.00000E+00	1.01201E+00
23	2.17469E-01	3.61342E+00	1.58175E-01	1.95485E-01	7.68914E-03	2.97885E-01	.00000E+00	1.01488E+00
24	2.40500E-01	3.89793E+00	1.50008E-01	1.85999E-01	8.47520E-03	3.47754E-01	.00000E+00	1.01820E+00
25	2.65604E-01	4.18897E+00	1.41523E-01	1.76124E-01	9.35143E-03	4.01826E-01	.00000E+00	1.02195E+00
26	2.92967E-01	4.48418E+00	1.32762E-01	1.65883E-01	1.03202E-02	4.59356E-01	.00000E+00	1.02605E+00
27	3.22793E-01	4.78039E+00	1.23766E-01	1.55293E-01	1.13790E-02	5.19299E-01	.00000E+00	1.03036E+00
28	3.55303E-01	5.07328E+00	1.14575E-01	1.44362E-01	1.25175E-02	5.80336E-01	.00000E+00	1.03467E+00
29	3.90739E-01	5.35677E+00	1.05212E-01	1.33077E-01	1.37122E-02	6.40953E-01	.00000E+00	1.03867E+00
30	4.29364E-01	5.62193E+00	9.56703E-02	1.21392E-01	1.49173E-02	6.99547E-01	.00000E+00	1.04196E+00
31	4.71466E-01	5.85488E+00	8.58889E-02	1.09196E-01	1.60501E-02	7.54567E-01	.00000E+00	1.04402E+00
32	5.17356E-01	6.03251E+00	7.57099E-02	9.62688E-02	1.69627E-02	8.04664E-01	.00000E+00	1.04417E+00
33	5.67377E-01	6.11209E+00	6.47817E-02	8.21684E-02	1.73858E-02	8.48822E-01	.00000E+00	1.04158E+00
34	6.21900E-01	6.00884E+00	5.23775E-02	6.61013E-02	1.73858E-02	8.86442E-01	.00000E+00	1.03634E+00
35	6.81330E-01	5.51945E+00	3.70819E-02	4.64671E-02	1.73858E-02	9.17374E-01	.00000E+00	1.02901E+00
36	7.46108E-01	3.94680E+00	1.59759E-02	1.98133E-02	1.73859E-02	9.41883E-01	.00000E+00	1.01842E+00
37	8.16716E-01	4.37856E+00	1.66804E-02	2.03511E-02	1.73858E-02	9.60571E-01	.00000E+00	1.00188E+00
38	8.93680E-01	9.38607E+00	6.01834E-02	7.81039E-02	4.44005E-02	9.74259E-01	.00000E+00	1.06579E+00
39	9.77569E-01	1.49291E+01	8.92527E-02	1.65135E-01	1.56517E-01	9.83873E-01	.00000E+00	1.52142E+00
40	1.06901E+00	2.28355E+01	9.39080E-02	3.23092E-01	4.91797E-01	9.90332E-01	.00000E+00	2.84557E+00
41	1.16868E+00	3.01652E+01	9.66024E-02	4.71725E-01	8.14781E-01	9.94473E-01	.00000E+00	4.03030E+00
42	1.27732E+00	3.83948E+01	1.06699E-01	6.39758E-01	9.72846E-01	9.96999E-01	.00000E+00	4.89872E+00
43	1.39574E+00	4.76247E+01	1.22001E-01	8.24379E-01	9.98958E-01	9.98458E-01	.00000E+00	5.54904E+00
44	1.52481E+00	5.89999E+01	1.39415E-01	1.06008E+00	9.99997E-01	9.99254E-01	.00000E+00	6.24939E+00
45	1.66550E+00	7.21964E+01	1.57055E-01	1.33048E+00	1.00000E+00	9.99662E-01	.00000E+00	6.95589E+00
46	1.81886E+00	8.75177E+01	1.75563E-01	1.63931E+00	1.00000E+00	9.99858E-01	.00000E+00	7.66735E+00
47	1.98601E+00	1.05890E+02	1.95737E-01	2.01286E+00	1.00000E+00	9.99944E-01	.00000E+00	8.44469E+00
48	2.16821E+00	1.27874E+02	2.17720E-01	2.46275E+00	1.00000E+00	9.99980E-01	.00000E+00	9.28905E+00
49	2.36681E+00	1.54146E+02	2.41516E-01	3.00325E+00	1.00000E+00	9.99993E-01	.00000E+00	1.02116E+01
50	2.58327E+00	1.85087E+02	2.66475E-01	3.63460E+00	1.00000E+00	9.99998E-01	.00000E+00	1.12007E+01
51	2.81922E+00	2.20430E+02	2.90985E-01	4.32824E+00	1.00000E+00	9.99999E-01	.00000E+00	1.22149E+01
52	3.07640E+00	2.58594E+02	3.12043E-01	5.00216E+00	1.00000E+00	1.00000E+00	.00000E+00	1.31644E+01
53	3.35672E+00	2.95880E+02	3.25062E-01	5.50017E+00	1.00000E+00	1.00000E+00	.00000E+00	1.38956E+01
54	3.66225E+00	3.25868E+02	3.24318E-01	5.60427E+00	1.00000E+00	1.00000E+00	.00000E+00	1.41915E+01
55	3.99527E+00	3.39819E+02	3.04522E-01	5.12009E+00	1.00000E+00	1.00000E+00	.00000E+00	1.38088E+01
56	4.35824E+00	3.28994E+02	2.63499E-01	4.03237E+00	1.00000E+00	1.00000E+00	.00000E+00	1.25690E+01

57	4.75385E+00	2.89020E+02	2.04895E-01	2.61516E+00	1.00000E+00	1.00000E+00	.00000E+00	1.04835E+01
58	5.18504E+00	2.24582E+02	1.38961E-01	1.32713E+00	1.00000E+00	1.00000E+00	.00000E+00	7.84475E+00
59	5.65501E+00	1.50741E+02	7.94973E-02	5.02584E-01	1.00000E+00	1.00000E+00	.00000E+00	5.19317E+00
60	6.16726E+00	8.67153E+01	3.70889E-02	1.39826E-01	1.00000E+00	1.00000E+00	.00000E+00	3.09693E+00
61	6.72560E+00	4.39682E+01	1.36041E-02	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.82515E+00
62	7.33418E+00	4.79473E+01	3.65887E-03	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.24165E+00
63	7.99753E+00	5.22841E+01	5.61243E-04	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.04350E+00
64	8.72058E+00	5.70111E+01	3.35954E-05	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00034E+00
65	9.50870E+00	6.21635E+01	3.43003E-05	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00245E+00
66	1.03678E+01	6.77796E+01	3.25751E-08	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00021E+00
67	1.13041E+01	7.39011E+01	3.26834E-06	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00023E+00
68	1.23248E+01	8.05736E+01	3.92039E-08	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00003E+00
69	1.34373E+01	8.78466E+01	4.14188E-07	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00003E+00
70	1.46499E+01	9.57742E+01	5.72454E-08	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
71	1.59717E+01	1.04415E+02	5.73687E-08	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00001E+00
72	1.74124E+01	1.13834E+02	2.42322E-08	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
73	1.89828E+01	1.24100E+02	4.26732E-09	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
74	2.06945E+01	1.35291E+02	6.87889E-09	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
75	2.25603E+01	1.47488E+02	1.87910E-09	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
76	2.45939E+01	1.60784E+02	8.76048E-10	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
77	2.68107E+01	1.75276E+02	1.00843E-09	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
78	2.92269E+01	1.91072E+02	3.61663E-10	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
79	3.18606E+01	2.08290E+02	7.03837E-11	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
80	3.47313E+01	2.27057E+02	1.72169E-10	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
81	3.78604E+01	2.47514E+02	1.16584E-10	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
82	4.12711E+01	2.69811E+02	4.31455E-11	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
83	4.49888E+01	2.94116E+02	1.26455E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
84	4.90411E+01	3.20608E+02	1.12593E-11	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
85	5.34580E+01	3.49484E+02	9.64632E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
86	5.82725E+01	3.80959E+02	5.02858E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
87	6.35203E+01	4.15266E+02	1.95789E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
88	6.92404E+01	4.52662E+02	9.46575E-13	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
89	7.54753E+01	4.93423E+02	1.11925E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
90	8.22714E+01	5.37852E+02	1.58862E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
91	8.96791E+01	5.86280E+02	1.89359E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
92	9.77535E+01	6.39067E+02	1.90321E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
93	1.06555E+02	6.96604E+02	1.70387E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
94	1.16148E+02	7.59320E+02	1.36952E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
95	1.26604E+02	8.27680E+02	1.05595E-12	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
96	1.38002E+02	9.02193E+02	7.21820E-13	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
97	1.50425E+02	9.83412E+02	5.37181E-13	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
98	1.63967E+02	1.07194E+03	2.84895E-13	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
99	1.78727E+02	1.16844E+03	2.74865E-13	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00
100	1.94816E+02	1.27362E+03	.00000E+00	3.02258E-02	1.00000E+00	1.00000E+00	.00000E+00	1.00000E+00

```
 MFK QUANTITIES IN VISMFK AT STATION M= 98
ACLINF =    3.02966     ALINFN =    3.01908     ALINFO =    2.97758
A1MFKN =     .12000     A1MFKO =     .12000     A2MFK  =     .50000
A3MFK  =     .20000     BLTHK  =   27.36673     DELIN  =    1.18870
DELTU2 =   27.36673     DELTU1 =   27.07989     DTINC2 =    5.56567
DTINC1 =    5.51352     VEDGE  =     .01297     NDELTU =         73
NINNER =         37     PSI11N =     .00426     PSI12N =     .00000
PDI110 =     .00433     PSI120 =     .00000     PSI21N =     .00000
PSI31N =    -.00223     PSI32N =     .00000     EMFK   =     .00018
RTAU   =  133.57505     RTHEAT =8503.50291      A2MA3N =     .30000
98  .97960E+00  5  .47195E+01  .47194E+01 -.60510E+00 -.58989E+00  .84751E+00  .33899E-01  .40399E-03  .16068E-02***  4490.037

 EDGE QUANTITIES IN VISMFK AT STATION M= 99
MREF   =     .04000     TREFD  = 530.00000      TREF   =1562.50000
REYREF = 2000000.0      ME2    =     .03378     UE2    =     .84462
TE2    =1562.64331      RHOE2  =    1.00023     TU2    =     .00200
RO2    =    1.00000     QE2    =     .00346     MUE2   =    1.00007
ME1    =     .03390     UE1    =     .84751     TE1    =1562.64086
RHOE1  =    1.00023     RO1    =    1.00000     QE1    =     .00346

 MFK QUANTITIES IN VISMFK AT STATION M= 99
ACLINF =    3.06774     ALINFN =    3.05373     ALINFO =    3.01908
A1MFKN =     .12000     A1MFKO =     .12000     A2MFK  =     .50000
A3MFK  =     .20000     BLTHK  =   27.71125     DELIN  =    1.19687
DELTU2 =   27.71125     DELTU1 =   27.36673     DTINC2 =    5.64454
DTINC1 =    5.56567     VEDGE  =     .01846     NDELTU =         73
NINNER =         37     PSI11N =     .00421     PSI12N =     .00000
PDI110 =     .00426     PSI120 =     .00000     PSI21N =     .00000
PSI31N =    -.00301     PSI32N =     .00000     EMFK   =     .00019
RTAU   =  133.82633     RTHEAT =8520.65502      A2MA3N =     .30000
99  .97960E+00  8  .47701E+01  .47699E+01 -.80755E+00 -.79303E+00  .84462E+00  .33783E-01  .40117E-03  .15770E-02***  4537.856

XC(M),M=1,MMAX (LEVY-LEES STREAMWISE COORDINATE)
 .58400446E+00  .59027671E+00  .59654243E+00  .60280417E+00  .60906308E+00  .61532032E+00  .62157658E+00  .62783236E+00
 .63408793E+00  .64034338E+00  .64659860E+00  .65285341E+00  .65910768E+00  .66536129E+00  .67161409E+00  .67786593E+00
 .68411658E+00  .69036579E+00  .69661321E+0C  .70285846E+00  .70910111E+00  .71534060E+00  .72157612E+00  .72780638E+00
 .73402939E+00  .74024223E+00  .74644203E+0C  .75262698E+00  .75879636E+00  .76495067E+00  .77109164E+00  .77722187E+00
 .78334410E+00  .78946053E+00  .79557268E+0C  .80168150E+0C  .80778763E+00  .81389148E+00  .81999331E+00  .82609328E+00
 .83219143E+00  .83828762E+00  .84438097E+00  .85046638E+0C  .85651586E+00  .86243696E+00  .86815526E+00  .87371792E+00
 .87920969E+00  .88467322E+00  .89012138E+0C  .89555598E+0C  .90097546E+00  .90637769E+00  .91176067E+00  .91712280E+00
 .92246307E+00  .92778107E+00  .93307654E+00  .93834903E+0C  .94359784E+00  .94882211E+00  .95402098E+00  .95919384E+00
 .96434011E+00  .96945908E+00  .97455013E+00  .97961265E+00  .98464570E+00  .98964778E+00  .99461769E+00  .99955534E+00
 .10044617E+01  .10093381E+01  .10141853E+01  .10190037E+01  .10237935E+01  .10285548E+01  .10332878E+01  .10379927E+01
 .10426697E+01  .10473187E+01  .10519394E+01  .10565314E+01  .10610944E+01  .10656284E+01  .10701339E+01  .10746117E+01
 .10790627E+01  .10834875E+01  .10878866E+01  .10922605E+01  .10966094E+01  .11009339E+01  .11052346E+01  .11095128E+01
 .11137709E+01  .11180144E+01  .11222452E+01
```

*** INVERSE B.L. CALCULATIONS - SUMMARY CHART NO. 2 ***

M	XLE	S	DT*	THETA*	CPBL	UEP	QW	STAN	STRINT	CFX
2	.50500	.50500	.97191	.37682	-.57331	1.25437	.08287	.00077	.00000	1.31097
3	.51000	.51000	.98169	.38021	-.57112	1.25349	.08330	.00078	.00000	1.36654

4	.51500	.51500	.99211	.38338	-.56932	1.25278	.08252	.00077	.00000	1.35989
5	.52000	.52000	.99852	.38615	-.56829	1.25236	.08245	.00077	.00000	1.37872
6	.52500	.52500	1.00419	.38873	-.56764	1.25211	.08229	.00077	.00000	1.38970
7	.53000	.53000	1.00920	.39116	-.56730	1.25197	.08216	.00077	.00000	1.39932
8	.53500	.53500	1.01405	.39348	-.56715	1.25191	.08197	.00077	.00000	1.40490
9	.54000	.54000	1.01906	.39576	-.56709	1.25189	.08170	.00076	.00000	1.40605
10	.54500	.54500	1.02463	.39803	-.56702	1.25186	.08130	.00076	.00000	1.40079
11	.55000	.55000	1.03095	.40034	-.56685	1.25179	.08075	.00075	.00000	1.38952
12	.55500	.55500	1.03764	.40268	-.56661	1.25170	.08015	.00075	.00000	1.37666
13	.56000	.56000	1.04453	.40503	-.56631	1.25157	.07955	.00074	.00000	1.36354
14	.56500	.56500	1.05160	.40740	-.56595	1.25143	.07893	.00074	.00000	1.34983
15	.57000	.57000	1.05892	.40979	-.56551	1.25126	.07828	.00073	.00000	1.33496
16	.57500	.57500	1.06659	.41221	-.56499	1.25105	.07759	.00072	.00000	1.31841
17	.58000	.58000	1.07471	.41468	-.56434	1.25079	.07684	.00072	.00000	1.29965
18	.58500	.58500	1.08342	.41721	-.56355	1.25047	.07601	.00071	.00000	1.27810
19	.59000	.59000	1.09286	.41981	-.56258	1.25008	.07510	.00070	.00000	1.25333
20	.59500	.59500	1.10311	.42251	-.56141	1.24961	.07410	.00069	.00000	1.22554
21	.60000	.60000	1.11423	.42530	-.56002	1.24906	.07301	.00068	.00000	1.19473
22	.60500	.60500	1.12700	.42825	-.55830	1.24837	.07171	.00067	.00000	1.15602
23	.61000	.61000	1.14257	.43145	-.55610	1.24749	.07006	.00065	.00000	1.10394
24	.61500	.61500	1.16315	.43507	-.55315	1.24630	.06780	.00063	.00000	1.02858
25	.62000	.62000	1.19342	.43942	-.54898	1.24463	.06441	.00060	.00000	.91062
26	.62500	.62500	1.24019	.44489	-.54319	1.24230	.05940	.00055	.00000	.73524
27	.63000	.63000	1.30190	.45123	-.53625	1.23950	.05378	.00050	.00000	.54716
28	.63500	.63500	1.37967	.45821	-.52874	1.23647	.04788	.00045	.00000	.36190
29	.64000	.64000	1.47900	.46564	-.52119	1.23341	.04164	.00039	.00000	.18428
30	.64500	.64500	1.60367	.47322	-.51425	1.23059	.03536	.00033	.00000	.03322
31	.65000	.65000	1.75840	.48064	-.50841	1.22822	.02927	.00027	.00000	-.07820
32	.65500	.65500	1.95162	.48781	-.50395	1.22640	.02348	.00022	.00000	-.14433
33	.66000	.66000	2.17750	.49437	-.50070	1.22507	.01876	.00018	.00000	-.16998
34	.66500	.66500	2.41920	.49992	-.49833	1.22410	.01539	.00014	.00000	-.17390
35	.67000	.67000	2.66191	.50436	-.49652	1.22336	.01306	.00012	.00000	-.16949
36	.67500	.67500	2.89443	.50777	-.49508	1.22277	.01145	.00011	.00000	-.16339
37	.68000	.68000	3.11439	.51041	-.49389	1.22229	.01029	.00010	.00000	-.15716
38	.68500	.68500	3.31800	.51245	-.49286	1.22187	.00944	.00009	.00000	-.15199
39	.69000	.69000	3.49881	.51402	-.49196	1.22150	.00884	.00008	.00000	-.14875
40	.69500	.69500	3.64759	.51522	-.49111	1.22115	.00841	.00011	.16973	-.14845
41	.70000	.70000	3.75484	.51619	-.49029	1.22081	.00763	.00007	.89756	-.15347
42	.70500	.70500	3.81321	.51718	-.48938	1.22044	.00574	.00005	.99876	-.17396
43	.71000	.71000	3.81437	.51937	-.48780	1.21979	.00304	.00003	1.00000	-.25870
44	.71500	.71500	3.73223	.52905	-.48213	1.21747	.00393	.00004	1.00000	-.61038
45	.72000	.72000	3.56285	.57763	-.45390	1.20581	.01186	.00011	1.00000	-1.79600
46	.72500	.72500	3.17802	.76223	-.36165	1.16692	.00037	.00000	1.00000	-3.32501
47	.73000	.73000	2.74561	1.00246	-.26491	1.12469	-.03428	-.00032	1.00000	-1.95583
48	.73500	.73500	2.43899	1.13619	-.21798	1.10363	-.03581	-.00033	1.00000	.38382
49	.74000	.74000	2.23716	1.19558	-.20021	1.09555	-.01946	-.00018	1.00000	1.96497
50	.74500	.74500	2.11614	1.22674	-.19211	1.09184	-.00181	-.00002	1.00000	2.94961
51	.75000	.75000	2.04719	1.25012	-.18616	1.08911	.01271	.00012	1.00000	3.59295
52	.75500	.75500	2.01200	1.27289	-.17988	1.08623	.02382	.00022	1.00000	4.02929
53	.76000	.76000	1.99895	1.29712	-.17275	1.08294	.03208	.00030	1.00000	4.32985
54	.76500	.76500	2.00119	1.32335	-.16472	1.07923	.03818	.00036	1.00000	4.53771
55	.77000	.77000	2.01453	1.35151	-.15596	1.07516	.04260	.00040	1.00000	4.67798
56	.77500	.77500	2.03583	1.38135	-.14665	1.07082	.04577	.00043	1.00000	4.77071
57	.78000	.78000	2.06260	1.41236	-.13711	1.06636	.04804	.00045	1.00000	4.83073
58	.78500	.78500	2.09311	1.44412	-.12753	1.06186	.04973	.00046	1.00000	4.86925
59	.79000	.79000	2.12733	1.47677	-.11787	1.05729	.05081	.00047	1.00000	4.88418
60	.79500	.79500	2.16516	1.51062	-.10800	1.05262	.05131	.00048	1.00000	4.87945
61	.80000	.80000	2.20668	1.54588	-.09784	1.04778	.05130	.00048	1.00000	4.85625
62	.80500	.80500	2.25210	1.58279	-.08733	1.04275	.05081	.00047	1.00000	4.81651
63	.81000	.81000	2.30081	1.62119	-.07657	1.03758	.05000	.00047	1.00000	4.76849
64	.81500	.81500	2.35248	1.66093	-.06565	1.03231	.04894	.00046	1.00000	4.71120

65	.82000	.82000	2.40732	1.70218	-.05453	1.02690	.04764	.00044	1.00000	4.64481
66	.82500	.82500	2.46563	1.74516	-.04316	1.02135	.04610	.00043	1.00000	4.56966
67	.83000	.83000	2.52702	1.78969	-.03163	1.01569	.04442	.00041	1.00000	4.49011
68	.83500	.83500	2.59183	1.83599	-.01991	1.00990	.04259	.00040	1.00000	4.40435
69	.84000	.84000	2.66171	1.88496	-.00774	1.00386	.04047	.00038	1.00000	4.30577
70	.84500	.84500	2.73803	1.93736	.00504	.99748	.03804	.00036	1.00000	4.19376
71	.85000	.85000	2.81854	1.99205	.01801	.99095	.03562	.00033	1.00000	4.08643
72	.85500	.85500	2.90048	2.04747	.03070	.98453	.03342	.00031	1.00000	3.98701
73	.86000	.86000	2.98121	2.10223	.04273	.97840	.03161	.00030	1.00000	3.90370
74	.86500	.86500	3.06128	2.15657	.05423	.97251	.03001	.00028	1.00000	3.82565
75	.87000	.87000	3.14255	2.21147	.06546	.96672	.02843	.00027	1.00000	3.74667
76	.87500	.87500	3.22604	2.26745	.07657	.96096	.02684	.00025	1.00000	3.66418
77	.88000	.88000	3.31187	2.32459	.08755	.95522	.02524	.00024	1.00000	3.58111
78	.88500	.88500	3.39981	2.38278	.09840	.94953	.02369	.00022	1.00000	3.49918
79	.89000	.89000	3.48962	2.44196	.10909	.94389	.02218	.00021	1.00000	3.41806
80	.89500	.89500	3.58176	2.50232	.11965	.93827	.02070	.00019	1.00000	3.33824
81	.90000	.90000	3.67675	2.56408	.13013	.93267	.01924	.00018	1.00000	3.25742
82	.90500	.90500	3.77530	2.62760	.14059	.92705	.01776	.00017	1.00000	3.17467
83	.91000	.91000	3.87870	2.69356	.15114	.92134	.01622	.00015	1.00000	3.08791
84	.91500	.91500	3.98761	2.76226	.16180	.91554	.01464	.00014	1.00000	2.99801
85	.92000	.92000	4.10075	2.83305	.17244	.90971	.01311	.00012	1.00000	2.91058
86	.92500	.92500	4.21680	2.90525	.18292	.90393	.01167	.00011	1.00000	2.82749
87	.93000	.93000	4.33416	2.97802	.19312	.89827	.01038	.00010	1.00000	2.75078
88	.93500	.93500	4.45078	3.05035	.20289	.89282	.00927	.00009	1.00000	2.68269
89	.94000	.94000	4.56746	3.12258	.21231	.88753	.00827	.00008	1.00000	2.61764
90	.94500	.94500	4.68549	3.19535	.22149	.88234	.00732	.00007	1.00000	2.55299
91	.95000	.95000	4.80532	3.26895	.23048	.87723	.00641	.00006	1.00000	2.48852
92	.95500	.95500	4.92699	3.34335	.23928	.87220	.00554	.00005	1.00000	2.42696
93	.96000	.96000	5.05047	3.41849	.24789	.86726	.00471	.00004	1.00000	2.36685
94	.96500	.96500	5.17512	3.49408	.25628	.86241	.00395	.00004	1.00000	2.30968
95	.97000	.97000	5.29918	3.56929	.26435	.85772	.00328	.00003	1.00000	2.25806
96	.97500	.97500	5.41586	3.64094	.27177	.85338	.00286	.00003	1.00000	2.22265
97	.97960	.98000	5.51507	3.70432	.27806	.84969	.00286	.00003	1.00000	2.21356
98	.97960	.98500	5.56723	3.74560	.28176	.84751	.00385	.00004	1.00000	2.27237
99	.97960	.99000	5.64611	3.79843	.28665	.84462	.00382	.00004	1.00000	2.23015

INTRAC=40DT(M),M=1,MMAX

.65683177E-03	.68724676E-03	.69415870E-03	.70152512E-03	.70605941E-03	.71007281E-03	.71360929E-03	.71704370E-03
.72058329E-03	.72452408E-03	.72898921E-03	.73372409E-03	.73859319E-03	.74359262E-03	.74877030E-03	.75419029E-03
.75993209E-03	.76609372E-03	.77277158E-03	.780C1455E-03	.78787939E-03	.79690987E-03	.80792149E-03	.82247022E-03
.84387707E-03	.87694899E-03	.92058103E-03	.97557254E-03	.10458102E-02	.11339643E-02	.12433745E-02	.13800014E-02
.15397233E-02	.17106354E-02	.18822551E-02	.20466744E-02	.22022091E-02	.23461782E-02	.24740340E-02	.25792376E-02
.26550717E-02	.26963496E-02	.26971662E-02	.26390836E-02	.25193131E-02	.22471983E-02	.19414402E-02	.17246289E-02
.15819082E-02	.14963387E-02	.14475843E-02	.14226979E-02	.14134733E-02	.14150524E-02	.14244891E-02	.14395478E-02
.14584780E-02	.14800542E-02	.15042521E-02	.15309965E-02	.15603598E-02	.15924740E-02	.16269186E-02	.16634572E-02
.17022332E-02	.17434635E-02	.17868744E-02	.18326995E-02	.18821151E-02	.19360827E-02	.19930079E-02	.20509500E-02
.21080332E-02	.21646495E-02	.22221207E-02	.22811545E-02	.23418435E-02	.24040298E-02	.24675314E-02	.25326889E-02
.25998520E-02	.26695383E-02	.27426523E-02	.28196696E-02	.28996697E-02	.29817308E-02	.30647106E-02	.31471794E-02
.32296799E-02	.33131440E-02	.33978774E-02	.34839055E-02	.35712207E-02	.36593596E-02	.37470837E-02	.38295899E-02
.38997462E-02	.39366261E-02	.39924035E-02					

OUTPUT QUANTITIES FROM SUBROUTINES INV1 & PMFNEW

VT DISTRIBUTION ON INVISCID MESH AT INTRAC= 40

.20361118E-01	.40332743E+00	.67977286E+00	.82561002E+00	.90943079E+00	.95978430E+00	.99100538E+00	.10068074E+01
.10165274E+01	.10259340E+01	.10359824E+01	.10463018E+01	.10566801E+01	.10671190E+01	.10773787E+01	.10863529E+01
.10927839E+01	.10979488E+01	.11029631E+C1	.11080791E+01	.11132467E+01	.11184145E+01	.11235743E+01	.11287461E+01
.11339538E+01	.11391229E+01	.11438725E+C1	.11476849E+C1	.11508377E+01	.11538151E+01	.11568103E+01	.11598328E+01
.11628612E+C1	.11658861E+01	.11689082E+C1	.11719349E+C1	.11749757E+01	.11780061E+01	.11808880E+01	.11834109E+01

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.12523104E+01   .12520514E+01   .12519143E+01   .12518521E+01   .12518283E+01   .12517990E+01   .12517326E+01   .12516344E+01
.12515116E+01   .12513641E+01   .12511867E+01   .12509716E+01   .12507085E+01   .12503851E+01   .12499884E+01   .12495090E+01
.12489383E+01   .12482344E+01   .12473315E+01   .12461192E+01   .12444093E+01   .12420296E+01   .12391747E+01   .12360683E+01
.12329343E+01   .12300407E+01   .12276072E+01   .12257528E+01   .12244160E+01   .12234425E+01   .12227047E+01   .12221158E+01
.12216271E+01   .12212052E+01   .12208249E+01   .12204641E+01   .12201018E+01   .12196886E+01   .12189804E+01   .12165565E+01
.12047805E+01   .11655115E+01   .11234099E+01   .11025025E+01   .10946080E+01   .10910505E+01   .10884292E+01   .10856229E+01
.10823940E+01   .10787247E+01   .10746895E+01   .10703814E+01   .10659361E+01   .10614563E+01   .10569109E+01   .10522459E+01
.10474237E+01   .10424072E+01   .10372463E+01   .10319795E+01   .10265862E+01   .10210418E+01   .10153898E+01   .10096107E+01
.10035763E+01   .99719818E+00   .99068210E+00   .98426658E+00   .97813990E+00   .97225331E+00   .96646503E+00   .96071028E+00
.95498031E+00   .94929135E+00   .94365225E+00   .93804425E+00   .93244638E+00   .92682493E+00   .92112331E+00   .91532273E+00
.90949957E+00   .90372351E+00   .89806906E+00   .89261713E+00   .88732842E+00   .88214430E+00   .87703842E+00   .87201177E+00
.86706637E+00   .86222153E+00   .85753023E+00   .85319620E+00   .84950662E+00   .84732821E+00   .84443449E+00

INTRAC= 40   PMF(M),M=1,MMAX
.11667000E+01   .12186841E+01   .12301037E+01   .12424650E+01   .12500909E+01   .12569419E+01   .12630652E+01   .12690819E+01
.12753236E+01   .12822706E+01   .12901086E+01   .12983921E+01   .13068884E+01   .13155901E+01   .13245766E+01   .13339525E+01
.13438474E+01   .13544208E+01   .13658284E+01   .13781455E+01   .13914622E+01   .14066912E+01   .14251944E+01   .14495792E+01
.14854446E+01   .15409521E+01   .16142275E+01   .17067762E+01   .18255005E+01   .19752382E+01   .21619918E+01   .23962501E+01
.26708310E+01   .29649882E+01   .32604884E+01   .35436004E+01   .38113951E+01   .40592306E+01   .42792444E+01   .44601391E+01
.45903181E+01   .46607361E+01   .46603806E+01   .45526207E+01   .43066010E+01   .37228342E+01   .30988739E+01   .27001236E+01
.24577244E+01   .23165016E+01   .22351731E+01   .21907537E+01   .21698093E+01   .21646311E+01   .21706868E+01   .21846187E+01
.22039405E+01   .22269407E+01   .22534582E+01   .22832051E+01   .23161405E+01   .23523017E+01   .23911025E+01   .24322164E+01
.24757387E+01   .25218496E+01   .25701822E+01   .26209474E+01   .26753886E+01   .27344746E+01   .27963513E+01   .28588954E+01
.29200704E+01   .29803568E+01   .30411842E+01   .31033078E+01   .31667936E+01   .32314510E+01   .32970417E+01   .33639333E+01
.34324784E+01   .35031835E+01   .35769405E+01   .36541826E+01   .37339105E+01   .38151580E+01   .38967628E+01   .39773001E+01
.40573541E+01   .41378694E+01   .42191138E+01   .43011249E+01   .43839045E+01   .44669904E+01   .45491820E+01   .46258499E+01
.46902391E+01   .47224697E+01   .47731201E+01

INTRAC= 40 RHOUE(M),M=1,MMAX
.00000000E+00   .12537929E+01   .12529217E+01   .12522046E+01   .12517943E+01   .12515377E+01   .12514017E+01   .12513403E+01
.12513173E+01   .12512890E+01   .12512241E+01   .12511279E+01   .12510077E+01   .12508634E+01   .12506901E+01   .12504799E+01
.12502230E+01   .12499072E+01   .12495199E+01   .12490523E+01   .12484963E+01   .12478112E+01   .12469325E+01   .12457520E+01
.12440838E+01   .12417590E+01   .12389721E+01   .12359451E+01   .12328962E+01   .12300836E+01   .12277159E+01   .12259018E+01
.12245827E+01   .12236145E+01   .12228775E+01   .12222895E+01   .12218031E+01   .12213865E+01   .12210160E+01   .12206718E+01
.12203361E+01   .12199637E+01   .12193156E+01   .12169960E+01   .12053720E+01   .11665834E+01   .11244547E+01   .11034366E+01
.10953728E+01   .10916771E+01   .10889522E+01   .10860726E+01   .10827921E+01   .10790862E+01   .10750247E+01   .10706976E+01
.10662383E+01   .10617483E+01   .10571953E+01   .10525248E+01   .10476988E+01   .10426800E+01   .10375179E+01   .10322509E+01
.10268581E+01   .10213150E+01   .10156647E+01   .10098879E+01   .10038562E+01   .99748139E+00   .99096888E+00   .98455701E+00
.97843393E+00   .97255087E+00   .96676614E+00   .96101495E+00   .95528854E+00   .94960315E+00   .94396757E+00   .93836312E+00
.93276878E+00   .92715087E+00   .92145279E+00   .91565574E+00   .90983609E+00   .90406348E+00   .89841239E+00   .89296372E+00
.88767817E+00   .88249714E+00   .87739425E+00   .87237054E+00   .86742802E+00   .86258598E+00   .85789746E+00   .85356609E+00
.84987955E+00   .84770310E+00   .84481575E+00
```

*** SUMMARY OF CONVERGENCE HISTORY ***

INTRAC	DDTMAX	RMSDT	SMDT	DUEMAX	RMSUE	SMUE	DSFMAX	DFMAX	DGMAX
40	.44969E-02	.13448E-03	.72500E+00	.14095E-02	.45920E-04	.72500E+00	.17686E-02	-.65451E-03	-.64283E-07

*** SUMMARY OF CONVERGENCE HISTORY ***

INTRAC	DDTMAX	RMSDT	SMDT	DUEMAX	RMSUE	SMUE	DSFMAX	DFMAX	DGMAX
1	.35913E+01	.11701E+00	.99000E+00	.70411E+00	.30850E-01	.99000E+00			
2	-.71076E+00	.24873E-01	.99000E+00	.97713E-01	.60667E-02	.70000E+00	.15504E+01	-.28723E+00	-.17674E-04
3	-.27173E+00	.95139E-02	.99000E+00	-.45837E-01	.25718E-02	.99000E+00	.56745E+00	.12014E+00	-.89486E-05
4	-.56569E-01	.18364E-02	.99000E+00	.20625E-01	.83977E-03	.70000E+00	.16098E+00	.34229E-01	-.37457E-05

5	-.37189E-01	.13632E-02	.99000E+00	.15247E-01	.71776E-03	.69500E+00	.39683E-01	-.18200E-01	-.19607E-05
6	.35854E-01	.11859E-02	.70000E+00	.14411E-01	.62002E-03	.69500E+00	.36739E-01	-.13803E-01	-.13918E-05
7	.37338E-01	.12174E-02	.70000E+00	.14568E-01	.57539E-03	.69500E+00	.31468E-01	-.12110E-01	-.12308E-05
8	.37931E-01	.13132E-02	.70000E+00	.14408E-01	.57463E-03	.69000E+00	.19642E-01	-.11227E-01	-.11835E-05
9	.36763E-01	.13124E-02	.70000E+00	.13543E-01	.55539E-03	.69000E+00	-.17521E-01	-.10329E-01	-.11267E-05
10	.34362E-01	.12904E-02	.70000E+00	.12309E-01	.53011E-03	.71500E+00	-.15959E-01	-.92950E-02	-.10419E-05
11	.32601E-01	.12370E-02	.71500E+00	.11606E-01	.49871E-03	.72000E+00	-.14199E-01	-.82224E-02	-.93521E-06
12	.30846E-01	.11607E-02	.71500E+00	.11272E-01	.45899E-03	.72000E+00	.12698E-01	-.72150E-02	-.82555E-06
13	.28753E-01	.10808E-02	.71500E+00	.10797E-01	.42061E-03	.72000E+00	.12454E-01	-.63217E-02	-.73701E-06
14	.27811E-01	.10097E-02	.72000E+00	.10195E-01	.38668E-03	.72000E+00	.11888E-01	-.55837E-02	-.65829E-06
15	.26834E-01	.94115E-03	.72000E+00	.95929E-02	.35684E-03	.72000E+00	.11046E-01	-.50729E-02	-.58908E-06
16	.25518E-01	.88249E-03	.72000E+00	.89118E-02	.32869E-03	.72000E+00	.11266E-01	-.46236E-02	-.52969E-06
17	.24144E-01	.81540E-03	.72000E+00	.82517E-02	.30262E-03	.72000E+00	.10800E-01	-.42768E-02	-.47811E-06
18	.22876E-01	.75540E-03	.72000E+00	.76635E-02	.27832E-03	.72000E+00	.96507E-02	-.39384E-02	-.43234E-06
19	.21520E-01	.70657E-03	.72000E+00	.70771E-02	.25811E-03	.72000E+00	.86351E-02	-.36242E-02	-.39763E-06
20	.20079E-01	.66051E-03	.72000E+00	.65114E-02	.23938E-03	.72500E+00	.80968E-02	-.33412E-02	-.36725E-06
21	.18670E-01	.61709E-03	.72000E+00	.61158E-02	.22284E-03	.72500E+00	.71532E-02	-.30799E-02	-.33911E-06
22	.17102E-01	.56734E-03	.72000E+00	.56481E-02	.20331E-03	.72500E+00	.74374E-02	-.28243E-02	-.31257E-06
23	.15729E-01	.53562E-03	.72000E+00	.51653E-02	.18857E-03	.72500E+00	.77529E-02	-.25995E-02	-.28732E-06
24	.14475E-01	.48719E-03	.72000E+00	.48521E-02	.17264E-03	.72500E+00	.66125E-02	-.23813E-02	-.26313E-06
25	.13247E-01	.44865E-03	.72000E+00	.45232E-02	.15824E-03	.72500E+00	.56307E-02	-.21597E-02	-.24061E-06
26	.12280E-01	.41280E-03	.72500E+00	.42223E-02	.14514E-03	.72500E+00	.51374E-02	-.19829E-02	-.21966E-06
27	.11568E-01	.38134E-03	.72500E+00	.39358E-02	.13338E-03	.72500E+00	.46418E-02	-.18097E-02	-.20056E-06
28	.10842E-01	.35872E-03	.72500E+00	.36530E-02	.12470E-03	.72500E+00	.42247E-02	-.16550E-02	-.18333E-06
29	.98367E-02	.33623E-03	.72500E+00	.32849E-02	.11549E-03	.72500E+00	.51801E-02	-.15167E-02	-.16781E-06
30	.91480E-02	.30044E-03	.72500E+00	.30302E-02	.10433E-03	.72500E+00	.42259E-02	-.13856E-02	-.15358E-06
31	.85574E-02	.27128E-03	.72500E+00	.28134E-02	.94150E-04	.72500E+00	.37165E-02	-.12502E-02	-.13986E-06
32	.81339E-02	.24926E-03	.72500E+00	.26553E-02	.86780E-04	.72500E+00	.26145E-02	-.13246E-02	-.12699E-06
33	.75886E-02	.23308E-03	.72500E+00	.24611E-02	.80134E-04	.72500E+00	.30114E-02	-.10457E-02	-.11574E-06
34	.70868E-02	.21603E-03	.72500E+00	.22844E-02	.74176E-04	.72500E+00	.26354E-02	-.96796E-03	-.10607E-06
35	.65908E-02	.20105E-03	.72500E+00	.21126E-02	.68885E-04	.72500E+00	.24816E-02	-.88408E-03	-.97452E-07
36	.61362E-02	.18479E-03	.72500E+00	.19566E-02	.63367E-04	.72500E+00	.24263E-02	-.83048E-03	-.89640E-07
37	.57149E-02	.17140E-03	.72500E+00	.18135E-02	.58632E-04	.72500E+00	.23070E-02	-.77849E-03	-.82478E-07
38	.53196E-02	.15876E-03	.72500E+00	.16805E-02	.54246E-04	.72500E+00	.20079E-02	-.75394E-03	-.75880E-07
39	.48401E-02	.14969E-03	.72500E+00	.15228E-02	.50772E-04	.72500E+00	.19500E-02	-.64088E-03	-.69885E-07
40	.44969E-02	.13448E-03	.72500E+00	.14095E-02	.45920E-04	.72500E+00	.17686E-02	-.65451E-03	-.64283E-07

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Langley Technical Monitor: Joel L. Everhart

16. Abstract

A program called ALESEP is presented for the analysis of the inviscid-viscous interaction which occurs due to the presence of a closed laminar-transitional separation bubble on an airfoil. The ALESEP code provides a iterative solution of the boundary layer equations expressed in an inverse formulation coupled to a Cauchy integral representation of the inviscid flow. This interaction analysis is treated as a local perturbation to a known solution obtained from a global airfoil analysis; hence, part of the required input to the ALESEP code are the reference displacement thickness and tangential velocity distributions. Special windward differencing may be used in the reversed flow regions of the separation bubble to accurately account for the flow direction in the discretization of the streamwise convection of momentum. The ALESEP code contains both a forced transition model based on a streamwise intermittency function and a natural transition model based on a solution of the integral form of the turbulent kinetic energy equation. Instructions for the input, output, and program usage are given herein along with a sample case.

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