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STC - SAB PROGRAM USERS MANUAL FOR

THE TURBULENT BOUNDARY LAYER AND TURBULENT SEPARATION PREDICTION METHODS EMPLOYED IN THE NASA LANGLEY STREAMTUBE CURVATURE COMPUTER PROGRAM

CASE FILE COPY

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16. Abstract

The Streamtube Curvature Program (STC) has been developed to predict the inviscid flow field and the pressure distribution about nacelles at transonic speeds. The effects of boundary layer are to displace the inviscid flow and effectively change the body shape. Thus, the body shape must be corrected by the displacement thickness in order to calculate the correct pressure distribution. This report describes the coupling of the Stratford and Beavers boundary layer solution with the inviscid STC analysis so that all nacelle pressure forces, friction drag, and incipient separation may be predicted. The usage of the coupled STC-SAB computer program is outlined and the program input and output are defined. Included in this manual are descriptions of the principal boundary layer tables and other revisions to the STC program. The use of the viscous option is controlled by the engineer during program input definition.

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1.0 INTRODUCTION

The Streamtube Curvature Program (STC) has been developed to predict the inviscid flow field and the pressure distribution about nacelles at transonic speeds. While this program is a basic tool for the calculation of the overall forces on nacelles, it is well understood that the effects of boundary layer friction drag and displacement of the inviscid flow must be included to obtain accurate performance predictions. The displacement of the inviscid flow effectively changes the body shape, thus altering the inviscid pressure distribution. The summation of pressure-area forces taken over the body can be seriously in error when this displacement effect is not included.

The coupling of a boundary layer solution with the inviscid STC analysis allows inclusion of displacement effects as well as a complete evaluation of all nacelle forces, including friction, and the prediction of boundary layer separation. The turbulent boundary layer method selected for use with the STC program is the integral method of Stratford and Beavers described in detail in References 1 and 2. This report is concerned with usage of the coupled STC-SAB (Stratford and Beavers) program. Included in this manual are descriptions of the principal boundary layer tables, and the revised program input and output.

2.0 PROGRAM DESCRIPTION

The Streamtube Curvature (STC) and the Stratford and Beavers Boundary Layer (SAB) routines have been combined as a composite program for evaluation of boundary layer displacement effects and friction drag, as well as solution of the inviscid problem. The following sections deal with the coupled STC-SAB solution procedure, including a description of the principal SAB routines and the storage regions for input and calculated boundary layer data.

2.1 Coupled STC-SAB Solution Procedure

The STC program and its use are described in References 2 and 3. The SAB section represents an extension of the current capabilities of the existing version of STC to include boundary layer effects, namely inviscid flow field displacement, friction losses, and turbulent boundary layer separation. The general calculation procedure for the coupled STC-SAB solution is as follows:

1.) Initially, the STC program is executed to obtain the pressure distribution on the solid boundaries at a given refinement or convergence level.

2.) Upon completion of the inviscid solution, the SAB routines are entered to calculate the boundary layer growth on specified solid surfaces and store the "least squares" smoothed displacement thickness information in the boundary layer tables. Boundary layer parameters such as momentum thickness, displacement thickness, and skin friction coefficient are printed immediately after the normal STC boundary output. If the boundary layer has separated, the location of the separation point is indicated.

3.) The STC solution may now be restarted using boundary information corrected for displacement effects. The adjusted inviscid pressure distribution is then used for another pass through the SAB boundary layer calculation routines.

4.) Steps 2.) and 3.) may be repeated until a desired level of convergence is attained. Note that no program control, such as weighting of consecutive δ^* values, is imposed on the coupled solution iteration. Continuation of the solution is entirely controlled by the user.

Normally, three (3) to four (4) consecutive passes through the coupled STC-SAB program should provide adequate convergence of the adjusted inviscid pressure distribution.

2.2 SAB Subroutines - STC Interface

The SAB control and calculation routines are located in the output overlay (2,2) and are called by subroutine WRIBDY after the inviscid boundary data are printed. The sequence of subroutine calls is as follows:

1.) Initially, WRIBDY calls LBDYBL (located in overlay (0,0)) to determine if a boundary layer is to be calculated for the given solid boundary. If yes, subroutine SAB is called with the boundary name given.

2.) Subroutine SAB determines the number of active points on the boundary using the information (surface distance SW) calculated in WRIBDY. Three types of situations may exist:

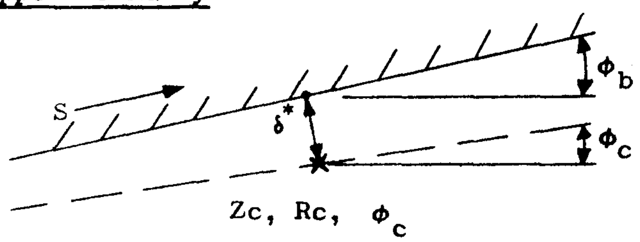
TYPE = 1	Boundary layer initiated at a stagnation point SW(1).
TYPE = 2	Axisymmetric spinner on the axis. Boundary layer is initiated at the last zero radius point, SW(NI).
TYPE = 3	Boundary layer is started at a stagnation point downstream of the start of the boundary. An initial "equivalent" flat plate distance must be supplied. The boundary layer history upstream of the stagnation point is ignored.

3.) Subroutine SABBL is called by SAB to calculate and print boundary layer information. The output quantities are described in detail in section 4. During the course of calculating the normal boundary layer parameters, the Stratford separation parameter F (described in Reference 2) is evaluated for all adverse pressure gradient regions. If the preceding parameter indicates a boundary layer separation, the calculation is terminated and the remaining locations in the δ^* table are filled with the displacement thickness at the point preceding the separation point. The output in this case includes only the data prior to and including separation.

4.) Subroutine SAB finally calls BLTBBL to store the smoothed displacement thicknesses and their derivatives in the boundary layer data table. In this process, the flow adjustment table and the station table are moved up in memory to accommodate the boundary layer data. If enough room in the TABLES storage area is not available, a comment to this effect is printed and the boundary layer input table is altered to reflect no boundary layer presence. Upon restart, no displacement thickness correction will be applied to this boundary. The above condition may be alleviated by providing additional storage in the TABLES area, as described in Reference 4.

5.) The interface with STC is provided on restart through subroutine BDYPTM, which determines the location of orthogonals intersecting the solid boundaries. Interpolated corrections are applied to the boundaries using the following relations:

Upper Boundary

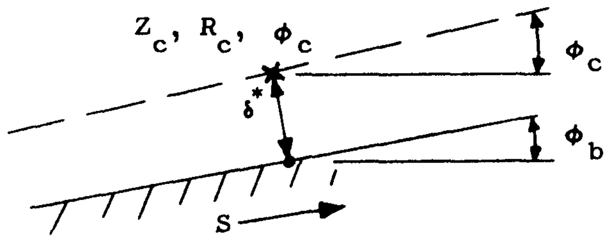


$$\phi_c = \phi_b - \frac{d\delta^*}{ds}$$

$$R_c = R_b - \delta^* \cos(\phi_c)$$

$$Z_c = Z_b + \delta^* \sin(\phi_c)$$

Lower Boundary



$$\phi_c = \phi_b + \frac{d\delta^*}{ds}$$

$$R_c = R_b + \delta^* \cos(\phi_c)$$

$$Z_c = Z_b - \delta^* \sin(\phi_c)$$

If the boundary layer on the solid surface is separated, a comment to this effect is printed each time the boundary is accessed to calculate an orthogonal intersection. When this situation is encountered, the user is advised to discontinue the calculation, since the displacement thickness information downstream of the separation point is in error.

Listings of the SAB subroutines and the STC routines altered for boundary layer capability are given in Appendix 8.1.

2.3 Program Nomenclature

Communication between the STC routines and the SAB routines is accomplished by the use of labeled common. The principal data storage areas utilized by both STC and SAB are the boundary layer input table and the boundary layer data tables. These regions are described in detail in this section. The remaining labeled commons are given alphabetically following the description of the main boundary layer tables. Within each block, variables are listed according to the position occupied in the block. Erasable temporary storage is used for communication between WRIBDY and the boundary layer subroutines. Variables listed in this block are the names used in SABBL. In all cases, the pertinent dimension and type information are included with the variable name (R ≡ Real, I ≡ Integer, L ≡ Logical). Variables normally containing BCD data are typed as H ≡ Hollerith, even though they may have real or integer names.

Boundary Layer Input Table

The boundary layer input table is stored in labeled common BLBDY. Input boundary layer information as supplied on page STC/Sheet-2 of the input sheets are read by routine RBD. The resulting table consists of the following three items stored serially for each boundary:

Variable Name	Type	Description
BLB(I)	H	Boundary name
BLB(I + 1)	I	Indicator designating whether a boundary layer calculation is to be performed. 0 - No 1 - Yes
BLB(I + 2)		Initial equivalent flat plate distance to first point on boundary.

The subscript I ranges from 1-58 and is incremented by 3 for each boundary. Information for a maximum of twenty (20) boundary layers may be stored; viz,

Common/BDBDY/BLB(60)

Boundary Layer Data Tables

The framework of the STC program is designed to allow flexibility as to the configuration to be analyzed. For example, very weak limits are placed on the number of flow boundaries and the number of channels into which the flow is split. To allow flexibility, the bulk of the calculation data is saved in singly dimensioned arrays. Within each array, the data are packed together to maximize storage efficiency. Information such as the boundary coordinates and flow properties is compactly stored in a single array, TABLES, so that only the total amount of information saved is limited by the array size. No limit is placed on the amount of information to be placed in any one Table of which there are currently six:

- o Channel input table
- o Boundary table
- o Table of convected properties
- o Table of wake displacement thickness
- o Flow adjustment table
- o Station table

Boundary layer data in the STC-SAB program are stored in the TABLES region immediately before the flow adjustment table. A subtable for each boundary layer is constructed and the information is stored in the following order:

Variable Name	Type	Description
BNAME	I	Boundary name
LBLNXT	I	Pointer to the next boundary layer table
NSEP	I	Index pointing to separation location (normally 0)
DUMMY		
SWREF	R	Reference distance for alteration of coordinates in the boundary layer table; viz, boundary origin
SIGN	R	Boundary type -1 Upper boundary +1 Lower boundary
SW(1)	R	Distance along surface
DSTAR(1)	R	Smoothed displacement thickness (δ^*)
DDSTAR(1)	R	Slope of smoothed displacement thickness ($d\delta^*/ds$)
SW(2)		
DSTAR(2)		
DDSTAR(2)		

The boundary layer data table is located between LDO and LDE in the tables region. The index limits LDO and LDO are stored in /IXORIG/ after LSE.

STC-SAB Labeled Commons

Common	Variable Name	Type	Description
BLDTA	BDNAME	I	Boundary name
	LOWER	L	T = Lower boundary F = Upper boundary
	IBTYPE	I	Initial condition indicator 1 = Boundary layer initiated at stagnation point SWBL(1) 2 = Axisymmetric spinner 3 = Boundary layer initiated at a mid-boundary stagnation point
	N1	I	Index of first point in SWBL table
	NI	I	Index of last point in SWBL table
	CAPX1	R	Equivalent flat plate distance from boundary layer origin to first calculated boundary layer point.
BLSEP	NSLOC	I	Index of separation point in SWBL array (normally 0)
CGRAV	CG	R	Gravitational conversion constant in consistent units
ERASE 2	DSTAR(100)	R	"Unsmoothed" displacement thickness δ^*
	SWBL(100)	R	Distance along surface
	ZW(100)	R	Axial coordinate (Z, X) on solid surface
	RW(100)	R	Radial (R) or normal (Y) coordinate on solid surface

Common	Variable Name	Type	
	DSTR(100)	R	"Smoothed" displacement thickness δ^*
	DDSTR(100)	R	Derivative of "Smoothed" displacement thickness ($d\delta^*/ds$)
	VE(100)	R	Velocity at edge of boundary layer
	MACH(100)	R	Mach number at edge of boundary layer
	MACHSQ(100)	R	Square of MACH
	CP(100)	R	Pressure Coefficient $C_p = 2(P-P_s)/\gamma P_s M_o^2 \quad M_o > .1$ $C_p = 0 \quad M_o < .1$
	PQPT(100)	R	Static to total pressure ratio
	PW(100)	R	Static pressure on surface
	REXP(100)	R	R ** $\left\| \begin{matrix} 1.2 \\ 1.25 \end{matrix} \right\|$ used in boundary layer calculation
	PR(100)	R	Boundary layer parameter $\left[\frac{MACH}{1+.2 * MACH}\right]^4 * REXP$
	CAPX(100)	R	Equivalent flat plate distance along surface
REBL	RESTBL	L	Boundary layer restart indicator F - Normal option T - Restart - restore tables
VISCOS	TREF	R	Reference temperature for dynamic viscosity calculation
	MUREF	R	Viscosity at reference temperature
	SCON	R	Sutherland constant for fluid; used in viscosity calculation

3.0 STC-SAB PROGRAM INPUT

Program input to the STC program is unchanged for the coupled STC-SAB version and is described in detail in Reference 3. The four (4) distinct card input sets read by the program are:

1.)	Input sheet 0	Identification information
2.)	Input sheet 1	Overall input data
3.)	Input sheet 2	Boundary coordinates
4.)	Input sheet 3	Channel flow properties

The above input sheets, revised for the STC-SAB program, are given in Appendix 8.2. Since the revised sheets are essentially identical to the original STC input sheets, only the changes applicable to the boundary layer calculation will be discussed.

3.1 Overall Input Data

The normal option exercised in the STC program is to specify pressures and temperatures in dimensionless form normalized by the free stream ambient pressure and temperature. When the SAB boundary layer option is chosen, however, pressures and temperatures must be given in dimensional form. Also, several additional parameters must be specified to define the fluid viscosity and thermodynamic quantities.

Parameter	Description	Preset Value
TREF	Reference temperature for viscosity calculation	518.688 ^{o}R
MUREF	Reference viscosity at TREF	10^{-7} lbm/in sec.
SCON	Sutherland Constant for air	198.6 ^{o}R
CG	Gravitational conversion constant	32.174 ft-lbm/lb_f sec^2

Within the program, viscosities are calculated using the following Sutherland relation:

$$\mu = \mu_{ref} \left(\frac{T}{T_{ref}} \right)^{3/2} \left(\frac{T_{ref} + S}{T + S} \right)$$

Since length units of inches are normally used, no attempt has been made to preset necessary quantities to their metric MKS values. The units used must be consistent, and the gas constant RG and necessary pressures (PSO or PTO) and temperatures (TSO or TTO) must be given in the proper units. With the viscosity and CG specified as above, the proper values and units are:

	Units *
R, Z	inches
PTO, PSO	lb_f/in^2
TTO, TSO	^oR
RG	1716.2 ft lb_f/lb_m ^oR
VMG1	[100] ft/sec
VMG2	[100] ft/sec

3.2 Boundary Coordinates

Input to specify a boundary layer calculation is supplied in the $A namelist with the boundary coordinates. The preset option is to not calculate a boundary layer on the given surface. The necessary input to specify a boundary layer calculation is as follows:

Parameter	Description	Preset Value
BL	F - No boundary layer T - Boundary layer	F
CAPX1	Equivalent flat plate distance from boundary layer origin to the first calculated boundary layer point	0

The latter parameter CAPX1 may be calculated as follows:

$$CAPX1 = \frac{\pm 1}{Pr^a} \int_{S_{orig}}^{S_1} Pr^a ds$$

where a = 0 Planar flow
a = 1 Axisymmetric flow

$$P = \left[\frac{M}{1+.2M^2}\right]^4$$

* See Table I for other sets of consistent units

4.0 STC-SAB PROGRAM OUTPUT - SAMPLE CASES

The standard output from the STC program is divided into six sections:

1.) Card input and preliminary printout
2.) Input and calculated boundary coordinates and angles
3.) Solution history
4.) General input and output data
5.) Flow field data along orthogonal lines
6.) Calculated flow data along field boundaries and final channel momentum balances

Output from the SAB portion of the STC-SAB program appears after the inviscid boundary data for each solid surface with a boundary layer. The designation of BL = T or BL = F appears with the above printout of the "input and calculated boundary coordinates and angles". Additional related boundary layer output will be printed by BLTBBL if the TABLES area will not accommodate additional boundary layer data. Also, on restart, printout will be produced by BDYPTM if a separated boundary layer is present on the pertinent boundary being accessed.

4.1 Standard SAB Boundary Layer Output

The standard output from the SAB portion of STC consists of the boundary layer parameters at each orthogonal intersection of the boundary. The initial output consists of a bold heading specifying BOUNDARY LAYER. This is followed by the boundary layer parameters.

Variable	Description
XW	Axial coordinate
THETA	Momentum thickness $\theta = \int_0^{\delta} \frac{\rho V}{\rho_e V_e} \left(1 - \frac{V}{V_e}\right) dn$
DSTAR	Displacement thickness $\delta^* = \int_0^{\delta} \left(1 - \frac{\rho V}{\rho_e V_e}\right) dn$
DELTA	Boundary layer thickness δ
REX	Local Reynolds Number $R_{e_x} = \frac{\rho_e V_e S}{\mu_e}$

Variable

CAPX	Equivalent flat plate distance along surface $$X = \frac{1}{\hat{P}r^a} \int_{S_1}^{S} \hat{P}r^a \, ds$$ where $\hat{P} = \left[\frac{M}{1 + .2M^2}\right]^4$ a = 0 Planar flow a = 1 Axisymmetric flow
CF	Skin friction coefficient $$C_f = \frac{\tau_w}{1/2 \; \rho_e V_e^{\,2}}$$ τ_w = Shear stress at solid surface
SW	Distance along surface
DSTR	"Smoothed" displacement thickness δ^*
DDSTR	Derivative of DSTR ($d\delta^*/ds$) used for correcting the local flow angle
SEP	Separation flag. Normally blank, appears as SEP if the boundary layer has separated
F	Stratford separation parameter

The Stratford separation parameter is defined as follows:

$$F = \bar{C}_p \left[s \frac{d\bar{C}_p}{ds} \right]^{1/2} \left[10^{-6} \, Re_x \right]^{-0.1}$$

$$\bar{C}_p = 1 - \frac{M^2}{M_1^{\,2}}$$

This parameter is only calculated in an adverse pressure gradient ($dP_w/ds > 0$) and appears as 0.0 in regions of favorable ($dP_w/ds < 0$) or zero pressure gradient. The distance along the surface S is taken as the distance from the beginning of the adverse pressure gradient region. Also, M_1 is the Mach number at the minimum pressure point. For practical purposes, separation is assumed to occur if F attains a value of 0.5 or greater. When separation occurs, the boundary layer calculation is terminated and printout only appears up to the separation point. The integrated friction drag for the surface is printed below the tabular data and is not calculated for a separated boundary layer.

4.2 Related Boundary Layer Output

The boundary layer data tables are built by subroutine BLTBBL at the end of the problem. If a boundary layer on a given surface is specified in the boundary layer input table and there is insufficient storage in the TABLES region to accommodate all the data, the following output will occur:

TABLE SPACE EXHAUSTED--BOUNDARY LAYER DATA
FOR {UPPER / LOWER} BOUNDARY "boundary name" NOT SAVED

The above comment serves as a warning to the user to increase the available size of the TABLES area. Following the printing of this comment, the calculation switch in the input table is turned off.

If subroutine BDYPTM detects a separated boundary layer in the course of interpolation for the displacement correction, the following comment with boundary name and separation location appears each time the boundary is accessed:

** W A R N I N G ** SEPARATED BOUNDARY LAYER, BOUNDARY = "boundary name"
SW = XXXXX

Since displacement thicknesses downstream of the separation point are in error, the user is advised to terminate the problem at this stage.

Intermediate diagnostic printout of the boundary layer data table and the interpolated displacement data may be obtained by setting PDUM(15) ≠ 0, however, this printout is seldom useful to the normal user.

4.3 Sample Cases

Two sample cases have been selected to illustrate the input/output for the STC-SAB program. The first case consists of the unseparated boundary layers on the inlet and cowl surfaces of a NASA Inlet No. 8 operating at M_o = .8 with a mass flow ratio of 0.8093. This example case is identical to the one given in the STC users manual (Reference 3) with exception of the presence of the boundary layers. The input and output for this problem is given in Figure 1. Three (3) passes through each program are shown with MAXIT = 8. On the third pass, the STC tolerance was reduced from 1. to .001 to obtain more accuracy in the inviscid solution.

The second case illustrates the boundary layer on a 2-D circular arc in a wind tunnel at M_o = .663. The input/output is given in Figure 2. As indicated in the output, boundary layer separation occurred at SW = 19.876. Upon restart, the previously described warning comment is printed each time the boundary is accessed. Figure 3 shows the comparison of the STC-SAB results with test data, and illustrates good agreement with the separation location. Discrepancies in the pressure distribution may be accounted for by the presence of upstream boundary layer fences and bleed parts which caused the flow in this region to be three dimensional.

5.0 GENERAL OPERATING PROCEDURES

The STC-SAB program described herein may be run on any Control Data 6400/6600 machine operating under SCOPE 3.0 or a higher level operating system. In general, operating procedures will differ from site to site. The following comments on deck set-up and operating instructions are restricted to the program as installed at the NASA Langley Research Center. Minimal changes should be necessary for successful installation at other CDC sites.

A large version of STC-SAB resides in source and absolute binary form on permanent (data cell) disc storage. This version is capable of handling 768 field points and has a TABLES storage region 2200 locations in length. Should this space be inadequate, the length of this latter region may be changed using the procedures given in Reference 3. The installed version will execute from the absolute binary file using a field length of 106K.

As indicated in Reference 4, a partially completed STC problem may be restarted using the output data from a previous STC execution. When used for a boundary layer run, the output tape also contains the boundary layer data from the previous run. If TAPOT and TAPIN are specified as T and TAPE2 and/or TAPE1 are not assigned to a tape file, the system will assign them to disc. Hence, consecutive boundary layer restart cases may be run by simply setting TAPIN and TAPOT to T on all cases after the first. The general procedure for carrying out a boundary layer iteration would be to run a given STC problem to a specified refinement/or convergence level and then run successive restart cases at the same level to converge the combined inviscid - boundary layer problem. For example,

```
 2  4                14         24
1   STC              F          T
$A
:
MAXIT = 8,
$
```

original STC input

```
BL         1   STC              T          T
iteration  $A
1          MAXIT = 8,
           $
```

```
BL         1   STC              T          T
iteration  $A
2          MAXIT = 8,
           $
```

6.0 REFERENCES

1. Stratford, B.S. and Beavers, G.S., "The Calculation of the Compressible Turbulent Boundary Layer in an Arbitrary Pressure Gradient - A Correlation of Certain Previous Methods", ARC R&M No. 3207, September, 1959.

2. Keith, J.S.; Ferguson, D.R.; Merkle, C.L.; Heck, P.H., and Lahti, D.J., "Analytical Method for Predicting the Pressure Distribution about a Nacelle at Transonic Speeds", Final Report, NASA CR-2217, General Electric Company.

3. Keith, J.S.; Ferguson, D.R., and Heck, P.H., "Users Manual for Streamtube Curvature Analysis - Analytical Method for Predicting the Pressure Distribution about a Nacelle at Transonic Speeds", NASA CR-112239, General Electric Company.

TABLE I

CONSISTENT UNITS FOR STC/STC-SAB PROGRAMS

Parameter	Dimensionless (STC)	Units: Eng. Grav. (in.)	Eng. Grav. (ft.)	CGS	MKS
L	any	in.	ft.	Cm	m
PSO, PTO	*atm	psia	psfa	dynes/Cm^2	N/m^2
TSO, TTO	*atm	^oR	^oR	^oK	^oK
TREF	--	^oR	^oR	^oK	^oK
MUREF	--	lbm/in. sec.	lbm/ft. sec.	g/Cm. sec.	Kg/m. sec.
SCON	--	^oR	^oR	^oK	^oK
RG	1	$ft^2/sec.^2$ ^oR	$ft^2/sec.^2$ ^oR	ergs/^{o}K-gm	J/^{o}K-Kg
CG	--	ft-lbm/lbf $sec.^2$	ft-lbm/lbf $sec.^2$	(unity)	(unity)
VMG1, VMG2	**	ft/sec.	ft/sec.	Cm/sec.	m/sec.

* m - Normalized by ambient conditions

** - Dimensionless (values are approximately equal to a Mach number difference)

```
NAME= D A V E    F E R G U S O N
ADDRESS= E V E N D A L E
IDENT=  NASA INLET CONFIGURATION NO. 8
1 STC        F          T
$A
MACH0=.8,
TS0=518.688,PS0=14.69594,RG=1716.20,VMG1=100.,VMG2=100.,SCON=198.6,
MAXIT=8,
NGR=5,
GR(1)=0.,7.,8.5,10.,20.,
SGR(1)=3.,1.,1.,3.,12.,
NGZ=6,
GZ(1)=-15.,-7.,-2.,2.,7.,15.,
SGZ(1)=12.,5.,1.,1.,5.,12.,
TOLES2=1,
RHL=7.682,RM=9.,
PRFRN=-1,
$
2 BDY        CNTLN     W2
$A
UPPER=F,
B(1)=-30.,0.,0.,
18.,0.,0.,
$
2 BDY        NACA1     W2
$A
UPPER=T,
BL=T,
B(1)=0.,7.682,-90.,
.01721,7.6100,-64.068,
.03790,7.57593,-53.751,
.05404,7.55603,-48.309,
.08320,7.52723,-41.353,
.11560,7.50136,-36.031,
.1980,7.45181,-26.448,
.3830,7.38728,-13.081,
.5340,7.36163,-6.630,
.7610,7.3480,-0.831,
2.500,7.378,0.995,
4.500,7.413,1.010,
6.300,7.44856,1.852,
8.100,7.52971,3.320,
10.800,7.73329,5.172,
14.400,8.09178,5.742,
16.200,8.26233,4.956,
18.00,8.400,3.791,
$
2 BDY        CLEX      EXT
$A
UPPER=F,
BL=T,
ZRONLY=T,
B(1)=991.,1.,0.,7.682,18.,9.,18.,9.,27.5,9.,
$
2 BDY        FF        EXT
$A
UPPER=T,
B(1)=-30.,60.,0.,28.,60.,0.,
$
3 CHN        W2
$A
```

Figure 1

```
AO=.8093,
$
1 STC        T          T
$A
MAXIT=8,
$
1 STC        T          T
$A
MAXIT=8,TOLES2=.001,PRPRN=-1,
$
```

Figure 1

EXECUTING PROGM=STC
TAPIN= F   TAPOT= T

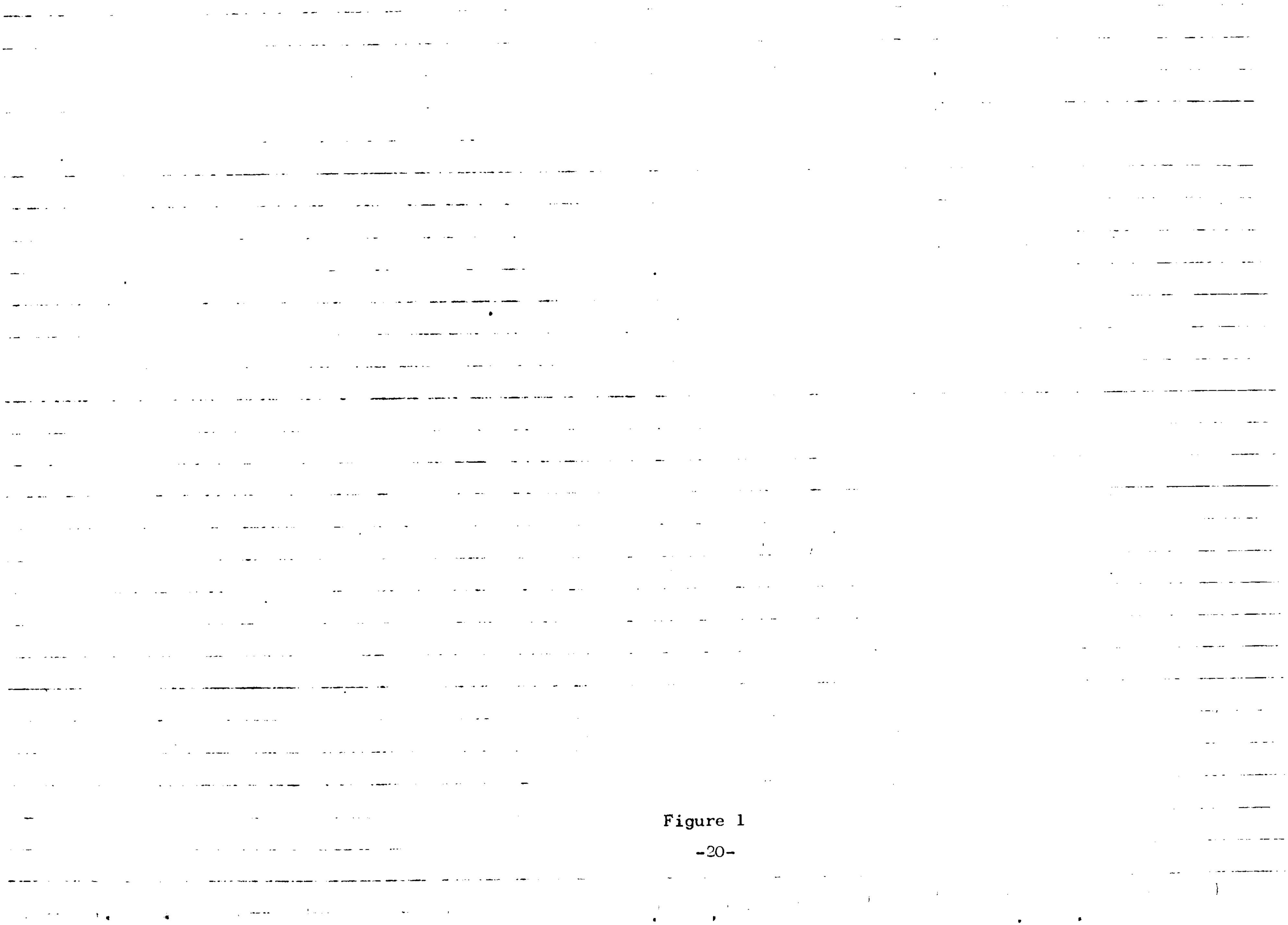


Figure 1

STREAMTUBE CURVATURE PROGRAM

IDENT= NASA INLET CONFIGURATION NO. 8

B O U N D A R Y   C O O R D I N A T E S, BDY=CNTLN   CHN=W2   UPPER= F   BL= F

I	X,Z	Y,R	ANGD	CURV-	CURV+
1	-30.00000	0.00000	0.000	0.0000	0.0000
2	18.00000	0.00000	0.000	0.0000	0.0000

B O U N D A R Y   C O O R D I N A T E S, BDY=NACA1   CHN=W2   UPPER= T   BL= T

I	X,Z	Y,R	ANGD	CURV-	CURV+
1	0.00000	7.68200	-90.000	0.0000	-6.2709
2	.01721	7.61000	-64.068	-5.0772	-4.9234
3	.03790	7.57593	-53.751	-4.0020	-3.9950
4	.05404	7.55603	-48.309	-3.3938	-3.4187
5	.08320	7.52723	-41.353	-2.4725	-2.4495
6	.11560	7.50136	-36.031	-2.0166	-1.9562
7	.19800	7.45181	-26.448	-1.4862	-1.4424
8	.38300	7.38728	-13.081	-.8893	-.8772
9	.53400	7.36163	-6.630	-.5858	-.5779
10	.76100	7.34800	-.831	-.3086	-.0728
11	2.50000	7.37800	.995	.0362	-.0001
12	4.50000	7.41300	1.010	-.0001	.0092
13	6.30000	7.44856	1.852	-.0256	-.0139
14	8.10000	7.52971	3.320	-.0145	-.0145
15	10.80000	7.73329	5.172	-.0094	-.0094
16	14.40000	8.09178	5.742	.0039	.0039
17	16.20000	8.26233	4.956	.0113	.0113
18	18.00000	8.40000	3.791	.0113	0.0000

Figure 1

```
IDENT=  NASA INLET CONFIGURATION NO. 8

SEGMENT  2  OF BDY=CLEX
-------------------------
      * A CURVE HAS BEEN FITTED TO GIVEN X,Y POINTS *

   END CONDITIONS -  FENDA(1)=  0.00000        FENDA(2)=  0.00000
                                                                    APPLIED     ARC
   INPUT COORDINATES                    ADJUSTED COORDINATES        FORCES     LENGTH
     XA.ZA       YA.RA     DEVI   DEV      X,Z         Y,R      ANGD     CURV       FQK         S
                                 *1000                         DEGREES
   18.00000    9.00000    0.00   0.00   18.00000    9.00000    0.000  0.000000   0.00000   0.00000
   27.50000    9.00000    0.00   0.00   27.50000    9.00000    0.000  0.000000   0.00000   9.50000

SEGMENT  1  OF BDY=CLEX
-------------------------
```

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

* NACA SERIES-1 COWL CONTOUR *

INPUT DATA, X1= 0.00000 Y1= 7.68200
X2= 18.00000 Y2= 9.00000 A= 1.000

COORDINATE DATA-

					----- BEAM	CALCULATED	-----
X/X	Y/Y	Z	R	ANGD	ANGB	CURV	S
0.000000	0.00000	0.00000	7.68200	90.000	90.000	17.500104	0.00000
.000106	.01120	.00191	7.69676	75.425	75.462	15.857660	.01492
.000306	.01900	.00551	7.70704	66.085	66.093	13.864206	.02583
.000646	.02750	.01163	7.71824	57.017	56.980	10.807238	.03861
.001300	.03880	.02340	7.73314	47.103	47.026	7.307785	.05761
.002003	.04797	.03606	7.74522	40.627	40.613	5.393196	.07512
.003966	.06671	.07140	7.76992	30.349	30.337	2.832944	.11830
.006002	.08117	.10804	7.78898	25.099	25.143	1.544224	.15961
.008000	.09312	.14400	7.80473	22.362	22.394	.897495	.19888
.010000	.10386	.18000	7.81889	20.601	20.612	.709490	.23756
.015000	.12727	.27000	7.84974	17.511	17.483	.437455	.33272
.020000	.14746	.36000	7.87635	15.633	15.619	.255594	.42657
.025000	.16579	.45000	7.90051	14.505	14.518	.156608	.51976
.030000	.18298	.54000	7.92316	13.753	13.772	.123801	.61257
.035000	.19930	.63000	7.94468	13.120	13.124	.120739	.70510
.040000	.21483	.72000	7.96514	12.509	12.497	.116369	.79740
.045000	.22959	.81000	7.98460	11.927	11.915	.104142	.88948
.050000	.24368	.90000	8.00317	11.406	11.403	.090636	.98138
.060000	.27013	1.08000	8.03804	10.557	10.563	.069178	1.16473
.070000	.29478	1.26000	8.07052	9.922	9.924	.052815	1.34763
.080000	.31804	1.44000	8.10118	9.431	9.426	.042313	1.53023
.090000	.34020	1.62000	8.13038	9.012	9.012	.037041	1.71258
.100000	.36138	1.80000	8.15830	8.611	8.622	.037599	1.89473
.120000	.40087	2.16000	8.21035	7.818	7.827	.038750	2.25848
.140000	.43654	2.52000	8.25736	7.085	7.071	.033938	2.62154
.160000	.46888	2.88000	8.29999	6.486	6.470	.023849	2.98405
.180000	.49879	3.24000	8.33940	6.045	6.051	.016564	3.34621
.200000	.52696	3.60000	8.37653	5.721	5.735	.013928	3.70812
.220000	.55371	3.96000	8.41180	5.453	5.458	.012829	4.06984
.250000	.59148	4.50000	8.46158	5.093	5.085	.011162	4.61213
.300000	.64899	5.40000	8.53737	4.565	4.561	.009082	5.51532
.350000	.70076	6.30000	8.60560	4.111	4.117	.008081	6.41790
.400000	.74746	7.20000	8.66715	3.708	3.712	.007612	7.32001
.450000	.78948	8.10000	8.72253	3.341	3.337	.006913	8.22171
.500000	.82721	9.00000	8.77226	2.999	2.993	.006395	9.12309
.600000	.89087	10.80000	8.85617	2.350	2.351	.006045	10.92505
.700000	.93955	12.60000	8.92033	1.730	1.735	.005886	12.72620
.800000	.97372	14.40000	8.96536	1.128	1.132	.005806	14.52677
.900000	.99365	16.20000	8.99163	.548	.544	.005596	16.32697
1.000000	1.00000	18.00000	9.00000	0.000	.000	.004952	18.12700

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

STREAMTUBE CURVATURE PROGRAM

CONSOLIDATED OUTPUT DATA

I	S	X,Z	Y,R	ANGD DEGREES	CURV	FQK
1	0.00000	0.00000	7.68200	90.000	17.500104	115.06761
2	.01492	.00191	7.69676	75.425	15.857660	70.93651
3	.02583	.00551	7.70704	66.085	13.864206	57.23452
4	.03861	.01163	7.71824	57.017	10.807238	-55.33965
5	.05761	.02340	7.73314	47.103	7.307785	-77.68618
6	.07512	.03606	7.74522	40.627	5.393196	-49.61809
7	.11830	.07140	7.76992	30.349	2.832944	-29.23370
8	.15961	.10804	7.78898	25.099	1.544224	-14.86643
9	.19888	.14400	7.80473	22.362	.897495	-11.63365
10	.23756	.18000	7.81889	20.601	.709490	-1.99834
11	.33272	.27000	7.84974	17.511	.437455	-.92552
12	.42657	.36000	7.87635	15.633	.255594	-.87657
13	.51976	.45000	7.90051	14.505	.156608	-.70897
14	.61257	.54000	7.92316	13.753	.123801	-.32044
15	.70510	.63000	7.94468	13.120	.120739	.01427
16	.79740	.72000	7.96514	12.509	.116369	.08543
17	.88948	.81000	7.98460	11.927	.104142	.01420
18	.98138	.90000	8.00317	11.406	.090636	-.02993
19	1.16473	1.08000	8.03804	10.557	.069178	-.02758
20	1.34763	1.26000	8.07052	9.922	.052815	-.03195
21	1.53023	1.44000	8.10118	9.431	.042313	-.02861
22	1.71258	1.62000	8.13038	9.012	.037041	-.03197
23	1.89473	1.80000	8.15830	8.611	.037599	-.00010
24	2.25848	2.16000	8.21035	7.818	.038750	.01642
25	2.62154	2.52000	8.25736	7.085	.033938	.01458
26	2.98405	2.88000	8.29999	6.486	.023849	-.00772
27	3.34621	3.24000	8.33940	6.045	.016564	-.01283
28	3.70812	3.60000	8.37653	5.721	.013928	-.00424
29	4.06984	3.96000	8.41180	5.453	.012829	.00004
30	4.61213	4.50000	8.46158	5.093	.011162	-.00077
31	5.51532	5.40000	8.53737	4.565	.009082	-.00119
32	6.41790	6.30000	8.60560	4.111	.008081	-.00059
33	7.32001	7.20000	8.66715	3.708	.007612	.00025
34	8.22171	8.10000	8.72253	3.341	.006913	-.00020
35	9.12309	9.00000	8.77226	2.999	.006395	-.00038
36	10.92505	10.80000	8.85617	2.350	.006045	-.00011
37	12.72620	12.60000	8.92033	1.730	.005886	-.00004
38	14.52677	14.40000	8.96536	1.128	.005806	.00007
39	16.32697	16.20000	8.99163	.548	.005596	.00024
40	18.12700	18.00000	9.00000	0.000	.004952	-.00036
41	18.12700	18.00000	9.00000	0.000	0.000000	0.00000
42	27.62700	27.50000	9.00000	0.000	0.000000	0.00000

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

B O U N D A R Y   C O O R D I N A T E S, BDY=CLEX   CHN=EXT   UPPER= F   BL= T

DOUBLE POINTS WITH ANGLE DIFFERENCES LESS THAN .010 ARE ELIMINATED (DBLPTS= .010).

I	X,Z	Y,R	ANGD	CURV-	CURV+
1	0.00000	7.68200	90.000	0.0000	17.2095
2	.00191	7.69676	75.425	16.1600	15.5005
3	.00551	7.70704	66.085	14.1340	13.8217
4	.01163	7.71824	57.017	10.7423	11.0169
5	.02340	7.73314	47.103	7.0051	7.5860
6	.03606	7.74522	40.627	5.2668	5.3943
7	.07140	7.76992	30.349	2.8203	2.8129
8	.10804	7.78898	25.099	1.6094	1.4377
9	.14400	7.80473	22.362	.9940	.8288
10	.18000	7.81889	20.601	.7591	.7116
11	.27000	7.84974	17.511	.4208	.4638
12	.36000	7.87635	15.633	.2346	.2613
13	.45000	7.90051	14.505	.1610	.1395
14	.54000	7.92316	13.753	.1436	.1073
15	.63000	7.94468	13.120	.1313	.1221
16	.72000	7.96514	12.509	.1091	.1296
17	.81000	7.98460	11.927	.0908	.1144
18	.90000	8.00317	11.406	.0835	.0908
19	1.08000	8.03804	10.557	.0707	.0666
20	1.26000	8.07052	9.922	.0547	.0529
21	1.44000	8.10118	9.431	.0409	.0441
22	1.62000	8.13038	9.012	.0361	.0349
23	1.80000	8.15830	8.611	.0419	.0346
24	2.16000	8.21035	7.818	.0415	.0385
25	2.52000	8.25736	7.085	.0319	.0383
26	2.88000	8.29999	6.486	.0195	.0262
27	3.24000	8.33940	6.045	.0163	.0139
28	3.60000	8.37653	5.721	.0173	.0107
29	3.96000	8.41180	5.453	.0151	.0128
30	4.50000	8.46158	5.093	.0104	.0120
31	5.40000	8.53737	4.565	.0084	.0091
32	6.30000	8.60560	4.111	.0084	.0074
33	7.20000	8.66715	3.708	.0082	.0075
34	8.10000	8.72253	3.341	.0067	.0075
35	9.00000	8.77226	2.999	.0058	.0066
36	10.80000	8.85617	2.350	.0060	.0059
37	12.60000	8.92033	1.730	.0061	.0056
38	14.40000	8.96536	1.128	.0060	.0057
39	16.20000	8.99163	.548	.0055	.0058
40	18.00000	9.00000	0.000	.0049	-.0000
41	27.50000	9.00000	0.000	.0000	0.0000

Figure 1

```
IDENT=  NASA INLET CONFIGURATION NO. 8

B O U N D A R Y   C O O R D I N A T E S,  BDY=FF        CHN=EXT        UPPER= T       BL= F

         I    X,Z          Y,R         ANGD      CURV-      CURV+
         1 -30.00000   60.00000      0.000     0.0000     0.0000
         2  28.00000   60.00000      0.000     0.0000     0.0000

 THE FAR FIELD INTERFACE BOUNDARY IS AT R=   60.000 BETWEEN Z=  -30.000 AND   28.000.   (BDY=FF     )

      *EXTENDED FAR FIELD BOUNDARY*
       Z=    -44.500    R=     60.000
       Z=     42.500    R=     60.276
```

Figure 1

*** SOLUTION HISTORY ***

GRID REFINEMENT		INNER ITERATIONS		ORTHOGONALIZATION			FLOW BALANCE		MATRIX SOLUTION		TIME
NREFIN	GRID PTS	INRCTR	CNVF	RMS-DS1 (BEFORE	MAX-DS1 DAMPING)	MAX-DS1 (AFTER)	LIM-ES2	MAX-ES2	MAX-DS2	NSWEEPS	(SEC)
1	50	0	1.00	.339288	.950116	.950116	1.111143	.448546	0.000000	0	3.598
1	50	1	1.00	.116128	.290649	.285712	1.111143	.085578	.309104	10	4.014
2	113	0	1.00	.047688	.126851	.125906	.571258	.271098	0.000000	0	5.079
2	113	1	1.00	.077651	.222160	.202396	.571258	.031976	.173140	10	5.996
3	178	0	1.00	.037566	.121604	.115558	.287101	.198591	0.000000	0	7.651
3	178	1	1.00	.038743	.134626	.125314	.287101	.014362	.096257	12	9.231
4	232	0	1.00	.023140	.108238	.102177	.177647	.135744	0.000000	0	11.002
4	232	1	1.00	.019188	.078327	.073200	.177647	.028386	.052953	14	13.150
5	346	0	1.00	.030447	.149021	.131012	.137595	.339660	0.000000	0	16.352
5	346	1	1.00	.017671	.080028	.075930	.137595	.056824	.053892	16	21.716
6	467	0	1.00	.026665	.114446	.106157	.086171	.296103	0.000000	0	28.937
6	467	1	1.00	.013198	.077797	.073387	.086171	.155566	.022212	18	33.932
6	467	2	1.00	.006707	.055648	.053373	.086171	.028348	.009063	18	38.888
7	548	0	1.00	.019053	.092017	.085880	.061596	.188001	0.000000	0	46.620
7	548	1	1.00	.009332	.057217	.053882	.061596	.024415	.025395	18	52.684
8	600	0	1.00	.006346	.043728	.041766	.051372	.082061	0.000000	0	58.102
8	600	1	1.00	.011821	.047981	.041247	.051372	.035195	.019538	20	65.312

Figure 1

```
IDENT=  NASA INLET CONFIGURATION NO. 8

GENERAL INPUT-
                                                MACHO =    .8000
     AXI    =        T                          TSO   =   518.69
     RG     = 1716.20                           PSO   =   14.696
     GAM    =   1.4000                          PTO   =    22.40
     TTE    =   0.000                           TTO   =  585.080
     CHOTST=         T

STREAMLINE END CONDITIONS-
     NBCIN  =        2         2
     ACF    =    0.000     0.000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
     SSFML  =        1    (FORMULA NUMBER)
     SSFEND=      .750    (DOWNSTREAM END CONDITION, SSFML=2 ONLY)
     SSFND1=      .750    (UPSTREAM END CONDITION, SSFML=2 ONLY)
     SSEANG=     0.000    (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
     SSEF   =        F    (SUPERSONIC ENTERING FLOW, T OR F)
     SSDF   =        F    (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)
     SSDLE  =        F    (SUPERSONIC FLOW BELOW AND AFT OF A L.E. POINT, T OR F)

GRID SIZE CRITERIA-
     NGR/GR=      0.00      7.00      8.50     10.00     20.00
     SGR    =     3.00      1.00      1.00      3.00     12.00

     NGZ/GZ=    -15.00     -7.00     -2.00      2.00      7.00     15.00
     SGZ    =    12.00      5.00      1.00      1.00      5.00     12.00

     VMG1   =   100.00                          VMG2  =   100.00

     CRX    =     .375      .375      .125     0.000     0.000     0.000

MEMORY UTILIZATION-
                               USED     AVAILABLE
     GRID POINTS                600        768
     TABLES                    1209       2200
     STREAMLINES                 30        128

CONVERGENCE DATA-
     MAXIT  =        8    (MAXIMUM ITERATIONS)
     NREFIN=         8  - NUMBER OF REFINEMENT ITERATIONS
     INRCTR=         1  - NUMBER OF ADDITIONAL ITERATIONS AFTER LAST REFINEMENT

     TOLINR= 5.0E-02      (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
     TOLES2= 1.0E+00      (FINAL TOLERANCE ON S.L. MOVEMENT)
     CLEN   =    5.091  - CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
                5.1E+00 - ABSOLUTE TOLERANCE ON S.L. MOVEMENT
     MAXES2= 3.5E-02    - LARGEST S.L. MOVEMENT ON LAST ITERATION

     DS1DMP=      .020    (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
     NODENS=         0    (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
```

Figure 1

```
                                                                        STREAMTUBE CURVATURE PROGRAM
IDENT=  NASA INLET CONFIGURATION NO. 8

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM  =        0    (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
     RHORAS=     .500    (ACCELERATION FACTOR, BASE LEVEL)
     RHOAMP=     .500    (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
     TOLRL = 1.0E-03     (TOLERANCE RELATIVE TO MAXDS2)


     HIGHLIGHT RADIUS=   7.682    HIGHLIGHT AREA= 185.395
     MAX. BODY RADIUS=   9.000    MAX. BODY AREA= 254.469

CONTENTS OF CHANNEL TABLE-

     CHN    =  W2           WTFLOW=  1.0000E+15
     TTO    =*0000.00       PTO    =*000.000      TSO    =*0000.00      PSO    =*000.000
     MACHO  =*00.0000       AO     =  8.0930E-01  VARY   =        T
     RG     =*0000.00       GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

                SPECIFIED     ADJUSTED        PT/PSO       TT/TSO
     W2            2.2122       2.2122       22.4016     585.0801
     EXT         164.5381     164.5381       22.4016     585.0801
```

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=W2 , STREAMLINE COORDINATE, XI2= 0.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-29.99564	0.00000	0.000	0.00000	1.002	.005	.657	.7979	0.0000	1.000	1.000
4.000	7.517	-22.47911	0.00000	0.000	0.00000	1.010	.022	.662	.7902	0.0000	1.000	1.000
8.000	15.043	-14.95229	0.00000	0.000	0.00000	1.024	.054	.672	.7755	0.0000	1.000	1.000
10.000	18.815	-11.18027	0.00000	0.000	0.00000	1.041	.091	.683	.7587	0.0000	1.000	1.000
12.000	22.623	-7.37267	0.00000	0.000	0.00000	1.072	.161	.703	.7275	0.0000	1.000	1.000
13.000	24.542	-5.45352	0.00000	0.000	0.00000	1.099	.221	.721	.7000	0.0000	1.000	1.000
13.500	25.509	-4.48650	0.00000	0.000	0.00000	1.114	.255	.731	.6844	0.0000	1.000	1.000
14.000	26.482	-3.51351	0.00000	0.000	0.00000	1.130	.291	.742	.6678	0.0000	1.000	1.000
14.500	27.450	-2.54566	0.00000	0.000	0.00000	1.146	.327	.752	.6513	0.0000	1.000	1.000
14.750	27.931	-2.06486	0.00000	0.000	0.00000	1.153	.341	.756	.6446	0.0000	1.000	1.000
15.000	28.403	-1.59232	0.00000	0.000	0.00000	1.161	.360	.762	.6357	0.0000	1.000	1.000
15.250	28.868	-1.12799	0.00000	0.000	0.00000	1.167	.374	.766	.6293	0.0000	1.000	1.000
15.500	29.312	-.68342	0.00000	0.000	0.00000	1.174	.388	.770	.6225	0.0000	1.000	1.000
15.750	29.726	-.26949	0.00000	0.000	0.00000	1.189	.423	.780	.6061	0.0000	1.000	1.000
16.000	30.006	.01077	0.00000	0.000	0.00000	1.180	.402	.774	.6157	0.0000	1.000	1.000
16.250	30.454	.45790	0.00000	0.000	0.00000	1.182	.407	.776	.6137	0.0000	1.000	1.000
16.500	31.063	1.06738	0.00000	0.000	0.00000	1.186	.415	.778	.6098	0.0000	1.000	1.000
16.750	31.641	1.64490	0.00000	0.000	0.00000	1.189	.422	.780	.6062	0.0000	1.000	1.000
17.000	32.204	2.20817	0.00000	0.000	0.00000	1.192	.429	.782	.6032	0.0000	1.000	1.000
17.500	33.318	3.32220	0.00000	0.000	0.00000	1.198	.442	.786	.5970	0.0000	1.000	1.000
18.000	34.433	4.43755	0.00000	0.000	0.00000	1.204	.456	.790	.5902	0.0000	1.000	1.000
19.000	36.706	6.70992	0.00000	0.000	0.00000	1.222	.495	.802	.5712	0.0000	1.000	1.000
20.000	39.005	9.00954	0.00000	0.000	0.00000	1.245	.547	.817	.5454	0.0000	1.000	1.000
21.000	41.302	11.30685	0.00000	0.000	0.00000	1.275	.615	.837	.5113	0.0000	1.000	1.000
22.000	43.536	13.54004	0.00000	0.000	0.00000	1.303	.677	.855	.4785	0.0000	1.000	1.000
24.000	47.943	17.94686	0.00000	0.000	0.00000	1.349	.778	.885	.4219	0.0000	1.000	1.000

TT/TTO = 1.000

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.00007	6.91374	.075	0.00000	1.002	.005	.657	.7979	0.0000	.410	1.000
4.000	7.515	-22.48508	6.92450	.097	-.00010	1.009	.021	.662	.7905	.0000	.408	1.000
8.000	15.030	-14.97012	6.94607	.277	-.00073	1.023	.050	.671	.7773	.0002	.404	1.000
10.000	18.787	-11.21272	6.97080	.498	-.00132	1.036	.081	.680	.7635	.0004	.400	1.000
12.000	22.545	-7.45560	7.02220	1.214	-.00534	1.060	.134	.695	.7396	.0014	.391	1.000
13.000	24.424	-5.57754	7.07234	1.872	-.00689	1.079	.177	.708	.7200	.0027	.382	1.000
13.500	25.363	-4.63879	7.10642	2.308	-.00933	1.091	.204	.716	.7077	.0039	.377	1.000
14.000	26.302	-3.70041	7.14960	3.036	-.01768	1.107	.238	.726	.6920	.0056	.369	1.000
14.500	27.242	-2.76284	7.20752	4.058	-.02035	1.127	.283	.739	.6713	.0082	.359	1.000
14.750	27.712	-2.29452	7.24326	4.703	-.02757	1.141	.316	.749	.6563	.0101	.352	1.000
15.000	28.181	-1.82668	7.28490	5.482	-.03051	1.159	.355	.760	.6379	.0127	.345	1.000
15.250	28.651	-1.35956	7.33382	6.562	-.04979	1.182	.407	.775	.6138	.0160	.336	1.000
15.500	29.121	-.89373	7.39383	8.225	-.07450	1.223	.497	.802	.5701	.0209	.325	1.000
15.625	29.355	-.66168	7.42997	9.604	-.12995	1.247	.552	.818	.5429	.0244	.318	1.000
15.750	29.590	-.43080	7.47294	11.549	-.16349	1.298	.665	.851	.4848	.0292	.311	1.000
15.875	29.825	-.20246	7.52764	16.228	-.52881	1.396	.884	.916	.3565	.0371	.300	1.000
16.000	30.060	.01708	7.61028	-14.125	5.08732	1.524	1.170	1.000	0.0000	.0529	.285	1.000

TT/TTO = 1.000

ADDITIVE DRAG = .0529

Figure 1

STREAMTUBE CURVATURE PROGRAM

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 • STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	COP1	(AMAX-A)/AMAX	PT/PTO
16.000	0.000	.01708	7.61028	-14.125	5.08732	1.524	1.170	1.000	0.0000	.0529	.285	1.000
16.125	.276	.22798	7.43779	-23.753	-1.36782	1.247	.552	.818	.5428	.0253	.317	1.000
16.187	.414	.35845	7.39330	-14.438	-.96800	1.135	.302	.745	.6628	.0219	.325	1.000
16.250	.552	.49389	7.36680	-8.082	-.66498	1.087	.194	.713	.7124	.0207	.330	1.000
16.375	.828	.76922	7.34788	-.797	-.07227	1.130	.289	.741	.6685	.0198	.333	1.000
16.500	1.104	1.04535	7.34658	.211	-.05504	1.147	.328	.753	.6505	.0198	.334	1.000
16.750	1.656	1.59756	7.35525	1.405	-.02040	1.168	.376	.767	.6282	.0203	.332	1.000
17.000	2.209	2.14964	7.37014	1.502	.01425	1.187	.418	.779	.6081	.0214	.329	1.000
17.500	3.313	3.25460	7.39113	1.001	-.00013	1.193	.431	.783	.6022	.0230	.326	1.000
18.000	4.418	4.35839	7.41050	1.009	-.00013	1.197	.440	.785	.5976	.0246	.322	1.000
19.000	6.627	6.56696	7.45769	2.066	-.01403	1.197	.441	.785	.5976	.0284	.313	1.000
20.000	8.836	8.77298	7.57195	3.855	-.01322	1.227	.506	.805	.5658	.0384	.292	1.000
21.000	11.045	10.97487	7.74926	5.263	-.00876	1.263	.588	.829	.5248	.0568	.259	1.000
22.000	13.254	13.17321	7.96659	5.857	-.00063	1.303	.677	.855	.4785	.0834	.216	1.000
24.000	17.672	17.57273	8.37065	4.068	.01127	1.352	.786	.887	.4174	.1430	.135	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0171	0.00000	0.00000	0.00000	0	0.0000	0.00000	0.0000	0.00000	.00316		0.000000
2	.2280	.00056	.00080	.00583	370574	.1378	.00707	.2756	.00074	.00221		0.000000
3	.3584	.00064	.00097	.00682	426056	.1735	.00565	.4137	.00101	.00267		0.000000
4	.4939	.00088	.00135	.00937	445385	.2609	.00536	.5518	.00148	.00371		0.000000
5	.7692	.00181	.00272	.01916	428368	.6320	.00467	.8279	.00269	.00427		.055684
6	1.0453	.00259	.00387	.02737	420899	.9824	.00427	1.1040	.00383	.00408		.061503
7	1.5976	.00402	.00595	.04244	411308	1.6904	.00386	1.6563	.00604	.00366		.084869
8	2.1496	.00546	.00804	.05773	402267	2.4695	.00359	2.2086	.00788	.00317		.086880
9	3.2540	.00753	.01103	.07930	399546	3.6666	.00331	3.3132	.01105	.00249		.051667
10	4.3584	.00946	.01383	.09962	397427	4.8694	.00313	4.4177	.01337	.00221		.040159
11	6.5670	.01269	.01856	.13369	397393	7.0338	.00294	6.6268	.01869	.00283		.087444
12	8.7730	.01803	.02604	.18945	382131	10.7685	.00282	8.8359	.02587	.00408		.182966
13	10.9749	.02532	.03599	.26519	361211	16.1672	.00274	11.0450	.03671	.00554		.264041
14	13.1732	.03584	.05010	.37423	335888	24.4187	.00245	13.2541	.05033	.00637		.309629
15	17.5727	.05854	.08019	.60900	300025	43.6328	.00329	17.6721	.08019	.00715		.362412

TOTAL FRICTION DRAG= 9.87219

INTEGRAL MOMENTUM BALANCE, CHN=W2 (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	1975.6665
LOWER BOUNDARY PRESSURE FORCE	=	0.0000
UPPER BOUNDARY PRESSURE FORCE	=	239.6406
SUM OF ABOVE		2215.3072
LEAVING MOMENTUM	=	2213.7975
ERROR	=	1.5097

Figure 1

DENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.00007	6.91374	.075	0.00000	1.002	.005	.657	.7979	0.0000	.410	1.000
4.000	7.515	-22.48508	6.92450	.097	-.00010	1.009	.021	.662	.7905	-.0000	.408	1.000
8.000	15.030	-14.97012	6.94607	.277	-.00073	1.023	.050	.671	.7773	-.0002	.404	1.000
10.000	16.787	-11.21272	6.97080	.498	-.00132	1.036	.081	.680	.7635	-.0004	.400	1.000
12.000	22.545	-7.45560	7.02220	1.214	-.00534	1.060	.134	.695	.7396	-.0014	.391	1.000
13.000	24.424	-5.57754	7.07234	1.872	-.00689	1.079	.177	.708	.7200	-.0027	.382	1.000
13.500	25.363	-4.63879	7.10642	2.308	-.00933	1.091	.204	.716	.7077	-.0039	.377	1.000
14.000	26.302	-3.70041	7.14960	3.036	-.01768	1.107	.238	.726	.6920	-.0056	.369	1.000
14.500	27.242	-2.76284	7.20752	4.058	-.02035	1.127	.283	.739	.6713	-.0082	.359	1.000
14.750	27.712	-2.29452	7.24326	4.763	-.02757	1.141	.316	.749	.6563	-.0101	.352	1.000
15.000	28.181	-1.82668	7.28490	5.482	-.03051	1.159	.355	.760	.6379	-.0127	.345	1.000
15.250	28.651	-1.35956	7.33382	6.562	-.04979	1.182	.407	.775	.6138	-.0160	.336	1.000
15.500	29.121	-.89373	7.39383	8.225	-.07450	1.223	.497	.802	.5701	-.0209	.325	1.000
15.625	29.355	-.66168	7.42997	9.604	-.12995	1.247	.552	.818	.5429	-.0244	.318	1.000
15.750	29.590	-.43080	7.47294	11.549	-.16349	1.298	.665	.851	.4848	-.0292	.311	1.000
15.875	29.825	-.20246	7.52764	16.228	-.52881	1.396	.884	.916	.3565	-.0371	.300	1.000
16.000	30.060	.01708	7.61028	57.191	5.08732	1.524	1.170	1.000	0.0000	-.0529	.285	1.000

TT/TTO = 1.000

ADDITIVE DRAG = -.0529

Figure I

STREAMTUBE CURVATURE PROGRAM

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	0.000	.01708	7.61028	57.191	5.08732	1.524	1.170	1.000	0.0000	-.0529	.285	1.000
16.187	.217	.11630	7.79279	24.376	1.33560	.684	-.706	.449	1.1344	-.0610	.250	1.000
16.281	.325	.21676	7.83216	19.139	.59280	.765	-.524	.502	1.0432	-.0563	.243	1.000
16.375	.433	.31982	7.86486	16.317	.33679	.802	-.442	.526	1.0037	-.0533	.236	1.000
16.563	.649	.52874	7.92040	13.848	.14307	.847	-.341	.556	.9559	-.0490	.226	1.000
16.750	.865	.73931	7.96940	12.367	.12131	.865	-.301	.567	.9374	-.0459	.216	1.000
17.125	1.298	1.16347	8.05336	10.247	.06106	.882	-.264	.579	.9199	-.0413	.199	1.000
17.500	1.730	1.58980	8.12557	9.076	.03744	.894	-.237	.587	.9074	-.0376	.185	1.000
18.250	2.595	2.44587	8.24805	7.225	.03330	.903	-.216	.592	.8981	-.0320	.160	1.000
19.000	3.460	3.30508	8.34626	5.991	.01456	.919	-.180	.603	.8815	-.0281	.140	1.000
20.500	5.189	5.02721	8.50698	4.762	.00990	.936	-.144	.614	.8650	-.0226	.107	1.000
22.000	6.919	6.75193	8.63730	3.913	.00779	.942	-.130	.618	.8590	-.0189	.079	1.000
25.000	10.378	10.20575	8.83071	2.557	.00618	.945	-.122	.620	.8552	-.0136	.037	1.000
28.000	13.838	13.66297	8.94921	1.380	.00587	.949	-.114	.623	.8514	-.0105	.011	1.000
34.000	20.756	20.58129	9.00000	.000	-.00000	.984	-.035	.646	.8157	-.0097	.000	1.000
40.000	27.675	27.50000	9.00000	.000	.00000	.998	-.005	.654	.8024	-.0097	.000	1.000

TT/TTO = 1.000

B O U N D A R Y L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0171	0.00000	0.00000	0.00000	0	0.0000	0.00000	0.0000	0.00000	.00295		0.000000
2	.1163	.00040	.00076	.00448	529037	.1083	.00665	.2165	.00084	.00478		0.000000
3	.2168	.00080	.00145	.00884	522172	.2524	.00506	.3246	.00140	.00552		.089521
4	.3198	.00114	.00203	.01257	517458	.3913	.00469	.4327	.00203	.00545		.100172
5	.5287	.00178	.00308	.01946	510256	.6731	.00424	.6489	.00306	.00440		.116611
6	.7393	.00231	.00395	.02516	506994	.9268	.00400	.8652	.00393	.00390		.092269
7	1.1635	.00323	.00549	.03517	503687	1.4058	.00369	1.2976	.00549	.00337		.087580
8	1.5898	.00410	.00691	.04449	501172	1.8841	.00349	1.7300	.00685	.00309		.078445
9	2.4459	.00559	.00939	.06069	499222	2.7744	.00324	2.5948	.00945	.00293		.083196
10	3.3051	.00717	.01194	.07765	495554	3.7690	.00305	3.4596	.01192	.00276		.097012
11	5.0272	.00994	.01643	.10749	491707	5.6478	.00283	5.1893	.01635	.00240		.080764
12	6.7519	.01234	.02033	.13334	490247	7.3886	.00268	6.9189	.02023	.00215		.054579
13	10.2057	.01663	.02735	.17960	489317	10.7159	.00249	10.3782	.02706	.00211		.044882
14	13.6630	.02077	.03409	.22420	488370	14.1329	.00236	13.8376	.03484	.00222		.085362
15	20.5813	.03128	.05045	.33629	478874	23.3452	.00215	20.7562	.04991	.00212		.117793
16	27.5000	.04003	.06414	.42975	475060	31.6558	.00207	27.6749	.06414	.00200		.099826

TOTAL FRICTION DRAG= 27.29046

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 16.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.17316	60.02524	.163	-.00000	1.002	.005	.657	.7979	0.0000	-43.482	1.000
4.000	7.483	-22.69044	60.04722	.179	-.00007	1.002	.004	.657	.7983	.0001	-43.514	1.000
8.000	14.872	-15.30102	60.07234	.211	-.00008	1.001	.003	.657	.7986	.0003	-43.552	1.000
10.000	18.512	-11.66105	60.08625	.227	-.00008	1.001	.003	.657	.7988	.0003	-43.572	1.000
12.000	22.065	-8.10844	60.10081	.242	-.00007	1.001	.002	.657	.7990	.0004	-43.594	1.000
14.000	25.475	-4.69872	60.11556	.253	-.00005	1.001	.001	.656	.7994	.0004	-43.616	1.000
16.000	28.377	-1.79676	60.12858	.260	-.00003	1.000	.001	.656	.7997	.0004	-43.635	1.000
19.000	32.277	2.10363	60.14641	.263	-.00000	1.000	-.000	.656	.8001	.0004	-43.662	1.000
22.000	35.995	5.82143	60.16341	.260	.00003	1.000	-.001	.656	.8005	.0004	-43.687	1.000
25.000	39.672	9.49849	60.17981	.251	.00005	.999	-.002	.655	.8009	.0004	-43.711	1.000
28.000	43.328	13.15496	60.19547	.240	.00006	.999	-.003	.655	.8012	.0003	-43.734	1.000
34.000	50.490	20.31694	60.22379	.212	.00008	.998	-.004	.655	.8017	.0002	-43.777	1.000
40.000	57.462	27.28844	60.24839	.197	.00000	.998	-.005	.654	.8023	.0000	-43.813	1.000

TT/TTO = 1.000

```
INTEGRAL MOMENTUM BALANCE,  CHN=EXT      (AXIAL FORCES ONLY)
    ENTERING MOMENTUM                   =146945.2295
    LOWER BOUNDARY PRESSURE FORCE =       -16.2523
    UPPER BOUNDARY PRESSURE FORCE =          .0769
         SUM OF ABOVE                   146929.0542
    LEAVING MOMENTUM                    =146944.6743
         ERROR                          =    -15.6202
```

Figure 1

```
   EXECUTING PROGM=STC
  TAPIN= T     TAPOT= T

THE FAR FIELD INTERFACE BOUNDARY IS AT R=   60.000 BETWEEN Z=  -30.000 AND   28.000.   (BDY=FF     )

 *EXTENDED FAR FIELD BOUNDARY*
  Z=   -44.500   R=    60.000
  Z=    42.500   R=    60.276
```

Figure 1

*** SOLUTION HISTORY ***

GRID REFINEMENT		INNER ITERATIONS		ORTHOGONALIZATION			FLOW BALANCE		MATRIX SOLUTION		TIME
NREFIN	GRID PTS	INRCTR	CNVF	RMS-DS1 (BEFORE	MAX-DS1 DAMPING)	MAX-DS1 (AFTER)	LIM-ES2	MAX-ES2	MAX-DS2	NSWEEPS	(SEC)
8	600	1	1.00	.002715	.017757	.016790	.051372	.034978	.019538	20	72.364

Figure 1

```
IDENT=  NASA INLET CONFIGURATION NO. 8

GENERAL INPUT-
                                              MACHO  =    .8000
     AXI    =         T                       TSO    =  518.69
     RG     = 1716.20                         PSO    =   14.696
     GAM    =  1.4000                         PTO    =   22.40
     TTE    =   0.000                         TTO    = 585.080
     CHOTST=          T

STREAMLINE END CONDITIONS-
     NBCIN  =        2        2
     ACF    =    0.000    0.000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
     SSFML  =        1   (FORMULA NUMBER)
     SSFEND=      .750   (DOWNSTREAM END CONDITION, SSFML=2 ONLY)
     SSFND1=      .750   (UPSTREAM END CONDITION, SSFML=2 ONLY)
     SSEANG=     0.000   (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
     SSEF   =        F   (SUPERSONIC ENTERING FLOW, T OR F)
     SSDF   =        F   (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)
     SSDLE  =        F   (SUPERSONIC FLOW BELOW AND AFT OF A L.E. POINT, T OR F)

GRID SIZE CRITERIA-
     NGR/GR=      0.00     7.00     8.50    10.00    20.00
     SGR    =     3.00     1.00     1.00     3.00    12.00

     NGZ/GZ=    -15.00    -7.00    -2.00     2.00     7.00    15.00
     SGZ    =    12.00     5.00     1.00     1.00     5.00    12.00

     VMG1   =   100.00                            VMG2   =   100.00

     CRX    =     .375     .375     .125    0.000    0.000    0.000

MEMORY UTILIZATION-
                          USED    AVAILABLE
     GRID POINTS           600       768
     TABLES               1314      2200
     STREAMLINES            30       128

CONVERGENCE DATA-
     MAXIT  =          8   (MAXIMUM ITERATIONS)
     NREFIN=           8 - NUMBER OF REFINEMENT ITERATIONS
     INRCTR=           1 - NUMBER OF ADDITIONAL ITERATIONS AFTER LAST REFINEMENT

     TOLINR= 5.0E-02   (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
     TOLES2= 1.0E+00   (FINAL TOLERANCE ON S.L. MOVEMENT)
     CLEN   =    5.091 - CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
               5.1E+00 - ABSOLUTE TOLERANCE ON S.L. MOVEMENT
     MAXES2= 3.5E-02 - LARGEST S.L. MOVEMENT ON LAST ITERATION

     DSIDMP=      .020   (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
     NODENS=         0   (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
```

Figure 1

```
IDENT=  NASA INLET CONFIGURATION NO. 8

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM   =       0    (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
     RHOBAS=     .500    (ACCELERATION FACTOR, BASE LEVEL)
     RHOAMP=     .500    (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
     TOLPL = 1.0E-03     (TOLERANCE RELATIVE TO MAXDS2)

     HIGHLIGHT RADIUS=   7.682    HIGHLIGHT AREA= 185.395
     MAX. BODY RADIUS=   9.000    MAX. BODY AREA= 254.469

CONTENTS OF CHANNEL TABLE-

     CHN   =  W2          WTFLOW=  1.0000E+15
     TTO   =*0000.00      PTO   =*000.000       TSO   =*0000.00      PSO   =*000.000
     MACHO =*00.0000      AO    =  8.0930E-01   VARY  =        T
     RG    =*0000.00      GAM   =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

             SPECIFIED     ADJUSTED      PT/PSO       TT/TSO
     W2         2.2122       2.2122     22.4016     585.0801
     EXT      164.5381     164.5381     22.4016     585.0801
```

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER ROUNDARY TO CHN=W2 , STREAMLINE COORDINATE, XI2= 0.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	COPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-29.99564	0.00000	0.000	0.00000	1.002	.005	.657	.7979	0.0000	1.000	1.000
4.000	7.517	-22.47911	0.00000	0.000	0.00000	1.010	.022	.662	.7902	0.0000	1.000	1.000
8.000	15.043	-14.95227	0.00000	0.000	0.00000	1.024	.054	.672	.7755	0.0000	1.000	1.000
10.000	18.815	-11.18022	0.00000	0.000	0.00000	1.041	.091	.683	.7588	0.0000	1.000	1.000
12.000	22.623	-7.37259	0.00000	0.000	0.00000	1.072	.160	.703	.7275	0.0000	1.000	1.000
13.000	24.542	-5.45343	0.00000	0.000	0.00000	1.099	.221	.721	.7000	0.0000	1.000	1.000
13.500	25.509	-4.48644	0.00000	0.000	0.00000	1.114	.255	.731	.6844	0.0000	1.000	1.000
14.000	26.482	-3.51346	0.00000	0.000	0.00000	1.130	.291	.742	.6678	0.0000	1.000	1.000
14.500	27.450	-2.54552	0.00000	0.000	0.00000	1.146	.327	.752	.6512	0.0000	1.000	1.000
14.750	27.931	-2.06466	0.00000	0.000	0.00000	1.153	.341	.756	.6445	0.0000	1.000	1.000
15.000	28.404	-1.59195	0.00000	0.000	0.00000	1.161	.360	.762	.6357	0.0000	1.000	1.000
15.250	28.868	-1.12775	0.00000	0.000	0.00000	1.168	.374	.766	.6291	0.0000	1.000	1.000
15.500	29.312	-.68370	0.00000	0.000	0.00000	1.174	.388	.770	.6224	0.0000	1.000	1.000
15.750	29.725	-.27057	0.00000	0.000	0.00000	1.189	.423	.780	.6060	0.0000	1.000	1.000
16.000	29.998	.00204	0.00000	0.000	0.00000	1.179	.400	.773	.6171	0.0000	1.000	1.000
16.250	30.456	.46078	0.00000	0.000	0.00000	1.182	.406	.775	.6141	0.0000	1.000	1.000
16.500	31.064	1.06876	0.00000	0.000	0.00000	1.186	.415	.778	.6098	0.0000	1.000	1.000
16.750	31.642	1.64600	0.00000	0.000	0.00000	1.189	.423	.780	.6062	0.0000	1.000	1.000
17.000	32.205	2.20899	0.00000	0.000	0.00000	1.192	.429	.782	.6031	0.0000	1.000	1.000
17.500	33.318	3.32276	0.00000	0.000	0.00000	1.198	.442	.786	.5970	0.0000	1.000	1.000
18.000	34.434	4.43818	0.00000	0.000	0.00000	1.204	.456	.790	.5902	0.0000	1.000	1.000
19.000	36.706	6.71053	0.00000	0.000	0.00000	1.222	.495	.801	.5713	0.0000	1.000	1.000
20.000	39.006	9.00998	0.00000	0.000	0.00000	1.245	.547	.817	.5457	0.0000	1.000	1.000
21.000	41.303	11.30713	0.00000	0.000	0.00000	1.275	.613	.836	.5120	0.0000	1.000	1.000
22.000	43.536	13.54014	0.00000	0.000	0.00000	1.303	.675	.854	.4793	0.0000	1.000	1.000
24.000	47.942	17.94684	0.00000	0.000	0.00000	1.348	.776	.884	.4230	0.0000	1.000	1.000

TT/TTO = 1.000

Figure 1

STREAMTUBE CURVATURE PROGRAM

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.00007	6.91374	.075	0.00000	1.002	.005	.657	.7979	0.0000	.410	1.000
4.000	7.515	-22.48508	6.92450	.097	-.00010	1.009	.021	.662	.7905	.0000	.408	1.000
8.000	15.030	-14.97011	6.94607	.277	-.00073	1.023	.050	.671	.7773	.0002	.404	1.000
10.000	18.788	-11.21269	6.97080	.498	-.00131	1.036	.081	.680	.7635	.0004	.400	1.000
12.000	22.545	-7.45556	7.02220	1.214	-.00534	1.060	.134	.695	.7396	.0014	.391	1.000
13.000	24.424	-5.57749	7.07234	1.872	-.00689	1.079	.177	.708	.7200	.0027	.382	1.000
13.500	25.363	-4.63874	7.10643	2.308	-.00933	1.091	.204	.716	.7077	.0039	.377	1.000
14.000	26.303	-3.70036	7.14960	3.035	-.01768	1.107	.236	.726	.6921	.0056	.369	1.000
14.500	27.242	-2.76278	7.20752	4.058	-.02032	1.127	.283	.739	.6713	.0082	.359	1.000
14.750	27.712	-2.29446	7.24326	4.703	-.02757	1.142	.316	.749	.6563	.0101	.352	1.000
15.000	28.181	-1.82662	7.28490	5.483	-.03046	1.159	.355	.760	.6379	.0127	.345	1.000
15.250	28.651	-1.35950	7.33383	6.562	-.04968	1.182	.407	.776	.6137	.0160	.336	1.000
15.500	29.121	-.89368	7.39384	8.229	-.07419	1.223	.497	.802	.5701	.0209	.325	1.000
15.625	29.355	-.66164	7.42997	9.600	-.12962	1.247	.552	.818	.5432	.0244	.318	1.000
15.750	29.590	-.43077	7.47295	11.559	-.16142	1.299	.666	.852	.4841	.0292	.311	1.000
15.875	29.825	-.20245	7.52765	16.223	-.52862	1.398	.888	.917	.3537	.0371	.300	1.000
16.000	30.060	.01708	7.61026	-13.916	5.08688	1.524	1.170	1.000	0.0000	.0530	.285	1.000

TT/TTO = 1.000

ADDITIVE DRAG = .0530

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	0.000	.01708	7.61026	-13.916	5.08688	1.524	1.170	1.000	0.0000	.0530	.285	1.000
16.125	.276	.22825	7.43670	-23.840	-1.36615	1.247	.551	.818	.5434	.0252	.317	1.000
16.187	.414	.35882	7.39109	-14.585	-.96577	1.129	.289	.741	.6688	.0218	.325	1.000
16.250	.552	.49432	7.36490	-8.277	-.66362	1.085	.190	.712	.7140	.0206	.330	1.000
16.375	.828	.76984	7.34486	-1.036	-.07223	1.129	.287	.740	.6696	.0198	.334	1.000
16.500	1.104	1.04601	7.34244	-.018	-.05500	1.147	.329	.753	.6503	.0196	.334	1.000
16.750	1.657	1.59831	7.34897	1.199	-.02036	1.169	.376	.767	.6281	.0200	.333	1.000
17.000	2.209	2.15041	7.36205	1.322	.01429	1.187	.418	.779	.6082	.0210	.331	1.000
17.500	3.313	3.25468	7.37994	.859	-.00013	1.193	.431	.783	.6022	.0224	.328	1.000
18.000	4.418	4.35905	7.39696	.881	-.00013	1.197	.440	.785	.5977	.0237	.325	1.000
19.000	6.627	6.56792	7.43878	1.902	-.01403	1.197	.440	.785	.5978	.0271	.317	1.000
20.000	8.836	8.77488	7.54577	3.619	-.01322	1.226	.506	.805	.5681	.0364	.297	1.000
21.000	11.045	10.97823	7.71224	4.945	-.00875	1.263	.587	.828	.5256	.0536	.266	1.000
22.000	13.254	13.17816	7.91599	5.492	-.00063	1.303	.675	.854	.4793	.0784	.226	1.000
24.000	17.672	17.57785	8.29063	3.658	.01127	1.351	.784	.886	.4185	.1331	.151	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0171	0.00000	0.00000	0.00000	0	0.0000	0.00000	0.0000	0.00000	.00313		0.000000
2	.2282	.00056	.00080	.00584	370879	.1381	.00712	.2761	.00074	.00221		0.000000
3	.3588	.00064	.00096	.00673	428483	.1709	.00563	.4142	.00101	.00268		0.000000
4	.4943	.00089	.00136	.00943	445957	.2632	.00537	.5522	.00148	.00375		0.000000
5	.7698	.00182	.00274	.01925	428610	.6358	.00466	.8284	.00271	.00431		.056926
6	1.0460	.00261	.00390	.02759	420815	.9923	.00427	1.1045	.00386	.00410		.064319
7	1.5983	.00404	.00598	.04266	411264	1.7012	.00386	1.6567	.00607	.00367		.085878
8	2.1504	.00549	.00807	.05793	402295	2.4802	.00359	2.2096	.00791	.00318		.087407
9	3.2547	.00755	.01106	.07953	399568	3.6795	.00330	3.3135	.01106	.00249		.052053
10	4.3590	.00948	.01386	.09984	397467	4.8833	.00313	4.4180	.01340	.00221		.056772
11	6.5679	.01271	.01860	.13391	397487	7.0487	.00294	6.6270	.01873	.00283		0.000000
12	8.7749	.01806	.02608	.18976	382266	10.7922	.00281	8.8360	.02590	.00407		.062747
13	10.9782	.02532	.03600	.26520	361597	16.1724	.00274	11.0449	.03673	.00554		.159785
14	13.1782	.03584	.05012	.37431	336379	24.4337	.00245	13.2539	.05036	.00637		.244967
15	17.5778	.05858	.08026	.60940	300695	43.6922	.00328	17.6719	.08026	.00717		.340395

TOTAL FRICTION DRAG= 9.84877

INTEGRAL MOMENTUM BALANCE, CHN=W2 (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	1975.6665
LOWER BOUNDARY PRESSURE FORCE	=	0.0000
UPPER BOUNDARY PRESSURE FORCE	=	222.9385
SUM OF ABOVE		2198.6050
LEAVING MOMENTUM	=	2211.6435
ERROR	=	-13.0385

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.00007	6.91374	.075	0.00000	1.002	.005	.657	.7979	0.0000	.410	1.000
4.000	7.515	-22.48508	6.92450	.097	-.00010	1.009	.021	.662	.7905	-.0000	.408	1.000
8.000	15.030	-14.97011	6.94607	.277	-.00073	1.023	.050	.671	.7773	-.0002	.404	1.000
10.000	18.788	-11.21269	6.97080	.498	-.00131	1.036	.081	.680	.7635	-.0004	.400	1.000
12.000	22.545	-7.45556	7.02220	1.214	-.00534	1.060	.134	.695	.7396	-.0014	.391	1.000
13.000	24.424	-5.57749	7.07234	1.872	-.00689	1.079	.177	.708	.7200	-.0027	.382	1.000
13.500	25.363	-4.63674	7.10643	2.308	-.00933	1.091	.204	.716	.7077	-.0039	.377	1.000
14.000	26.303	-3.70036	7.14960	3.035	-.01768	1.107	.238	.725	.6921	-.0056	.369	1.000
14.500	27.242	-2.76278	7.20752	4.058	-.02032	1.127	.283	.739	.6713	-.0082	.359	1.000
14.750	27.712	-2.29446	7.24326	4.703	-.02757	1.142	.316	.749	.6563	-.0101	.352	1.000
15.000	28.181	-1.82662	7.28490	5.483	-.03046	1.159	.355	.760	.6379	-.0127	.345	1.000
15.250	28.651	-1.35950	7.33383	6.562	-.04968	1.182	.407	.776	.6137	-.0160	.336	1.000
15.500	29.121	-.89368	7.39384	8.229	-.07419	1.223	.497	.802	.5701	-.0209	.325	1.000
15.625	29.355	-.66164	7.42997	9.600	-.12962	1.247	.552	.818	.5432	-.0244	.318	1.000
15.750	29.590	-.43077	7.47295	11.559	-.16142	1.299	.666	.852	.4841	-.0292	.311	1.000
15.875	29.825	-.20245	7.52765	16.223	-.52862	1.398	.888	.917	.3537	-.0371	.300	1.000
16.000	30.060	.01708	7.61026	58.273	5.08688	1.524	1.170	1.000	0.0000	-.0530	.285	1.000

TT/TTO = 1.000

ADDITIVE DRAG = -.0530

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 8.000,

XI1	SI#	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	0.000	.01708	7.61026	58.273	5.08688	1.524	1.170	1.000	0.0000	-.0530	.285	1.000
16.187	.216	.11389	7.79240	24.807	1.36219	.669	-.693	.452	1.1280	-.0613	.250	1.000
16.281	.324	.21417	7.83246	19.516	.60000	.744	-.571	.488	1.0661	-.0564	.243	1.000
16.375	.432	.31707	7.86587	16.677	.34252	.804	-.436	.528	1.0009	-.0531	.236	1.000
16.563	.649	.52579	7.92257	14.133	.14297	.846	-.343	.555	.9569	-.0488	.225	1.000
16.750	.865	.73625	7.97255	12.613	.12228	.865	-.301	.568	.9372	-.0456	.215	1.000
17.125	1.297	1.16028	8.05818	10.452	.06121	.882	-.264	.578	.9200	-.0409	.198	1.000
17.500	1.730	1.58653	8.13182	9.260	.03754	.894	-.236	.587	.9073	-.0372	.184	1.000
18.250	2.595	2.44255	8.25701	7.398	.03333	.903	-.216	.592	.8982	-.0314	.158	1.000
19.000	3.460	3.30177	8.35776	6.152	.01454	.919	-.180	.603	.8814	-.0273	.138	1.000
20.500	5.189	5.02394	8.52299	4.901	.00991	.936	-.144	.614	.8650	-.0218	.103	1.000
22.000	6.919	6.74878	8.65726	4.038	.00779	.942	-.130	.618	.8590	-.0179	.075	1.000
25.000	10.379	10.20307	8.85759	2.678	.00618	.945	-.122	.620	.8552	-.0124	.031	1.000
28.000	13.839	13.66094	8.98390	1.508	.00587	.949	-.114	.623	.8514	-.0091	.004	1.000
34.000	20.758	20.58064	9.04981	.121	-.00000	.984	-.035	.646	.8157	-.0080	-.011	1.000
40.000	27.677	27.49987	9.06404	.114	.00000	.998	-.005	.654	.8023	-.0080	-.014	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0171	0.00000	0.00000	0.00000	0	0.0000	0.00000	0.0000	0.00000	.00284		0.000000
2	.1139	.00040	.00076	.00447	528728	.1081	.00659	.2162	.00082	.00477		0.000000
3	.2142	.00076	.00140	.00845	524413	.2391	.00518	.3244	.00139	.00557		.061180
4	.3171	.00116	.00205	.01273	517078	.3975	.00462	.4325	.00203	.00553		.116482
5	.5258	.00178	.00308	.01948	510412	.6742	.00424	.6487	.00307	.00443		.111047
6	.7362	.00232	.00397	.02525	506959	.9306	.00399	.8649	.00394	.00390		.092246
7	1.1603	.00324	.00550	.03522	503699	1.4085	.00369	1.2974	.00550	.00337		.085976
8	1.5865	.00410	.00692	.04456	501152	1.8875	.00349	1.7298	.00685	.00309		.077486
9	2.4425	.00559	.00940	.06071	499239	2.7757	.00324	2.5947	.00946	.00293		.081911
10	3.3018	.00717	.01195	.07767	495549	3.7702	.00305	3.4596	.01192	.00275		.096053
11	5.0239	.00994	.01642	.10746	491704	5.6461	.00283	5.1895	.01635	.00240		.079918
12	6.7488	.01234	.02032	.13327	490245	7.3835	.00268	6.9193	.02022	.00215		.054024
13	10.2031	.01662	.02732	.17942	489316	10.7027	.00249	10.3789	.02704	.00210		.044363
14	13.6609	.02074	.03404	.22386	488374	14.1065	.00236	13.8385	.03479	.00222		.084559
15	20.5806	.03120	.05033	.33549	478874	23.2761	.00215	20.7578	.04979	.00211		.117034
16	27.4999	.03990	.06394	.42837	475060	31.5285	.00207	27.6770	.06394	.00198		.099250

TOTAL FRICTION DRAG= 27.39400

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 16.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.17312	60.02524	.163	-.00000	1.002	.005	.657	.7979	0.0000	-43.482	1.000
4.000	7.483	-22.69043	60.04722	.179	-.00007	1.002	.004	.657	.7983	.0001	-43.514	1.000
8.000	14.872	-15.30107	60.07234	.211	-.00008	1.001	.003	.657	.7986	.0003	-43.552	1.000
10.000	18.512	-11.66122	60.08625	.227	-.00008	1.001	.003	.657	.7988	.0003	-43.572	1.000
12.000	22.064	-8.10879	60.10081	.242	-.00007	1.001	.002	.657	.7990	.0004	-43.594	1.000
14.000	25.474	-4.69949	60.11556	.253	-.00005	1.001	.001	.656	.7994	.0004	-43.616	1.000
16.000	28.373	-1.79965	60.12857	.260	-.00003	1.000	.001	.656	.7997	.0004	-43.635	1.000
19.000	32.274	2.10042	60.14640	.263	-.00000	1.000	-.000	.656	.8001	.0004	-43.662	1.000
22.000	35.992	5.81896	60.16340	.260	.00003	1.000	-.001	.656	.8005	.0004	-43.687	1.000
25.000	39.670	9.49657	60.17980	.251	.00005	.999	-.002	.655	.8009	.0004	-43.711	1.000
28.000	43.327	13.15354	60.19546	.240	.00006	.999	-.003	.655	.8012	.0003	-43.734	1.000
34.000	50.490	20.31633	60.22379	.212	.00008	.998	-.004	.655	.8017	.0002	-43.777	1.000
40.000	57.462	27.28846	60.24839	.197	-.00000	.998	-.005	.654	.8023	.0000	-43.813	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=EXT (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=146945.2295
LOWER BOUNDARY PRESSURE FORCE	= -13.3733
UPPER BOUNDARY PRESSURE FORCE	= .0769
SUM OF ABOVE	146931.9331
LEAVING MOMENTUM	=146944.6734
ERROR	= -12.7403

Figure 1

```
 EXECUTING PROGM=STC
TAPIN= T     TAPOT= T

THE FAR FIELD INTERFACE BOUNDARY IS AT R=   60.000 BETWEEN Z=  -30.000 AND  28.000.   (BDY=FF     )

*EXTENDED FAR FIELD BOUNDARY*
 Z=   -44.500   R=    60.000
 Z=    42.500   R=    60.286
```

Figure 1

*** SOLUTION HISTORY ***

GRID REFINEMENT		INNER ITERATIONS		ORTHOGONALIZATION			FLOW BALANCE		MATRIX SOLUTION		TIME
NREFIN	GRID PTS	INRCTR	CNVF	RMS-DS1 (BEFORE	MAX-DS1 DAMPING)	MAX-DS1 (AFTER)	LIM-ES2	MAX-ES2	MAX-DS2	NSWEEPS	(SEC)
8	600	1	1.00	.001679	.007905	.007710	.051372	.056023	.019538	20	79.425
8	600	2	1.00	.008317	.030686	.027857	.051372	.015570	.056023	16	86.013
8	600	3	1.00	.004965	.039009	.034496	.051372	.010912	.003304	18	92.950
8	600	4	1.00	.001111	.006494	.006363	.051372	.014120	.001026	22	100.581
8	600	5	1.00	.002531	.012743	.012241	.051372	.004963	.006262	20	107.857

Figure 1

```
                                                              STREAMTUBE CURVATURE PROGRAM

IDENT=  NASA INLET CONFIGURATION NO. 8

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM   =      0   (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
     RHOBAS=    .500   (ACCELERATION FACTOR, BASE LEVEL)
     RHOAMP=    .500   (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
     TOLRL = 1.0E-03   (TOLERANCE RELATIVE TO MAXDS2)


     HIGHLIGHT RADIUS=   7.682    HIGHLIGHT AREA= 185.395
     MAX. BODY RADIUS=   9.000    MAX. BODY AREA= 254.469

CONTENTS OF CHANNEL TABLE-

     CHN   =  W2          WTFLOW=  1.0000E+15
     TTO   =*0000.00      PTO    =*000.000      TSO   =*0000.00     PSO    =*000.000
     MACHO =*00.0000      AO     =  8.0930E-01  VARY  =          T
     RG    =*0000.00      GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

                SPECIFIED     ADJUSTED       PT/PSO       TT/TSO
     W2            2.2122       2.2122      22.4016     585.0801
     EXT         164.5381     164.5381      22.4016     585.0801
```

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=W2 , STREAMLINE COORDINATE, XI2= 0.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-29.99553	0.00000	0.000	0.00000	1.002	.005	.657	.7978	0.0000	1.000	1.000
4.000	7.517	-22.47870	0.00000	0.000	0.00000	1.010	.022	.663	.7900	0.0000	1.000	1.000
8.000	15.044	-14.95146	0.00000	0.000	0.00000	1.025	.055	.672	.7751	0.0000	1.000	1.000
10.000	18.816	-11.17915	0.00000	0.000	0.00000	1.041	.093	.683	.7582	0.0000	1.000	1.000
12.000	22.624	-7.37135	0.00000	0.000	0.00000	1.073	.162	.704	.7268	0.0000	1.000	1.000
13.000	24.543	-5.45232	0.00000	0.000	0.00000	1.100	.223	.721	.6992	0.0000	1.000	1.000
13.500	25.510	-4.48564	0.00000	0.000	0.00000	1.115	.256	.731	.6838	0.0000	1.000	1.000
14.000	26.482	-3.51323	0.00000	0.000	0.00000	1.131	.293	.742	.6671	0.0000	1.000	1.000
14.500	27.450	-2.54596	0.00000	0.000	0.00000	1.146	.327	.752	.6513	0.0000	1.000	1.000
14.750	27.930	-2.06535	0.00000	0.000	0.00000	1.153	.342	.757	.6440	0.0000	1.000	1.000
15.000	28.403	-1.59285	0.00000	0.000	0.00000	1.160	.358	.761	.6368	0.0000	1.000	1.000
15.250	28.865	-1.13030	0.00000	0.000	0.00000	1.165	.369	.765	.6313	0.0000	1.000	1.000
15.500	29.309	-.68695	0.00000	0.000	0.00000	1.170	.381	.768	.6261	0.0000	1.000	1.000
15.750	29.719	-.27667	0.00000	0.000	0.00000	1.173	.385	.769	.6238	0.0000	1.000	1.000
16.000	29.993	-.00216	0.00000	0.000	0.00000	1.177	.395	.772	.6191	0.0000	1.000	1.000
16.250	30.453	.45742	0.00000	0.000	0.00000	1.181	.403	.774	.6155	0.0000	1.000	1.000
16.500	31.058	1.06216	0.00000	0.000	0.00000	1.184	.412	.777	.6114	0.0000	1.000	1.000
16.750	31.635	1.63934	0.00000	0.000	0.00000	1.187	.418	.779	.6082	0.0000	1.000	1.000
17.000	32.198	2.20210	0.00000	0.000	0.00000	1.190	.424	.781	.6054	0.0000	1.000	1.000
17.500	33.312	3.31605	0.00000	0.000	0.00000	1.195	.435	.784	.6000	0.0000	1.000	1.000
18.000	34.427	4.43161	0.00000	0.000	0.00000	1.201	.448	.788	.5939	0.0000	1.000	1.000
19.000	36.697	6.70139	0.00000	0.000	0.00000	1.217	.485	.798	.5763	0.0000	1.000	1.000
20.000	38.992	8.99656	0.00000	0.000	0.00000	1.239	.535	.813	.5518	0.0000	1.000	1.000
21.000	41.283	11.28762	0.00000	0.000	0.00000	1.269	.600	.832	.5190	0.0000	1.000	1.000
22.000	43.513	13.51700	0.00000	0.000	0.00000	1.296	.660	.850	.4873	0.0000	1.000	1.000
24.000	47.916	17.92090	0.00000	0.000	0.00000	1.340	.760	.879	.4325	0.0000	1.000	1.000

TT/TTO = 1.000

Figure 1

STREAMTUBE CURVATURE PROGRAM

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 . STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.00007	6.91382	.076	0.00000	1.002	.005	.657	.7978	0.0000	.410	1.000
4.000	7.515	-22.48477	6.92476	.098	-.00010	1.010	.021	.662	.7904	.0000	.408	1.000
8.000	15.031	-14.96950	6.94661	.280	-.00074	1.023	.051	.671	.7769	.0002	.404	1.000
10.000	18.788	-11.21193	6.97160	.503	-.00132	1.037	.082	.680	.7630	.0004	.400	1.000
12.000	22.546	-7.45465	7.02337	1.220	-.00534	1.061	.135	.696	.7389	.0014	.391	1.000
13.000	24.425	-5.57651	7.07372	1.879	-.00689	1.080	.179	.709	.7191	.0028	.382	1.000
13.500	25.364	-4.63772	7.10791	2.313	-.00927	1.092	.206	.717	.7067	.0039	.376	1.000
14.000	26.304	-3.69931	7.15116	3.040	-.01774	1.108	.241	.727	.6908	.0056	.369	1.000
14.500	27.243	-2.76170	7.20913	4.057	-.02003	1.128	.286	.740	.6702	.0084	.358	1.000
14.750	27.713	-2.29336	7.24484	4.698	-.02764	1.143	.319	.750	.6547	.0103	.352	1.000
15.000	28.182	-1.82550	7.28642	5.466	-.02941	1.160	.357	.761	.6370	.0128	.345	1.000
15.250	28.652	-1.35833	7.33510	6.519	-.04885	1.182	.407	.776	.6135	.0162	.336	1.000
15.500	29.122	-.89242	7.39461	8.143	-.07179	1.221	.494	.801	.5715	.0210	.325	1.000
15.625	29.357	-.66029	7.43022	9.398	-.11482	1.247	.551	.818	.5434	.0245	.318	1.000
15.750	29.592	-.42910	7.47153	10.823	-.09668	1.290	.648	.846	.4940	.0290	.311	1.000
15.875	29.826	-.19998	7.52280	15.563	-.60452	1.383	.855	.907	.3754	.0361	.301	1.000
16.000	30.061	.01918	7.60606	-12.872	4.84681	1.524	1.170	1.000	0.0000	.0519	.286	1.000

TT/TTO = 1.000

ADDITIVE DRAG = .0519

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=W2 , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	0.000	.01918	7.60606	-12.872	4.84681	1.524	1.170	1.000	0.0000	.0519	.286	1.000
16.125	.276	.23216	7.43499	-23.507	-1.35561	1.249	.555	.819	.5413	.0245	.318	1.000
16.187	.414	.36276	7.39087	-14.363	-.95313	1.129	.288	.741	.6693	.0211	.326	1.000
16.250	.552	.49815	7.36434	-8.133	-.65608	1.089	.199	.715	.7098	.0199	.330	1.000
16.375	.828	.77336	7.34478	-1.023	-.07201	1.126	.282	.739	.6719	.0190	.334	1.000
16.500	1.104	1.04940	7.34242	-.008	-.05479	1.146	.327	.752	.6513	.0189	.334	1.000
16.750	1.656	1.60148	7.34901	1.203	-.02016	1.167	.373	.766	.6295	.0193	.333	1.000
17.000	2.209	2.15345	7.36210	1.320	.01448	1.185	.413	.777	.6106	.0203	.331	1.000
17.500	3.313	3.25755	7.37995	.860	-.00013	1.190	.424	.781	.6056	.0216	.328	1.000
18.000	4.417	4.36166	7.39697	.881	-.00013	1.194	.433	.783	.6012	.0230	.325	1.000
19.000	6.625	6.56974	7.43880	1.903	-.01403	1.193	.431	.783	.6022	.0263	.317	1.000
20.000	8.834	8.77555	7.54578	3.620	-.01322	1.222	.495	.801	.5715	.0354	.297	1.000
21.000	11.042	10.97772	7.71217	4.944	-.00876	1.257	.574	.825	.5319	.0522	.266	1.000
22.000	13.251	13.17680	7.91583	5.492	-.00064	1.296	.661	.850	.4869	.0764	.226	1.000
24.000	17.668	17.57785	8.29055	3.657	.01127	1.344	.768	.882	.4279	.1300	.151	1.000

TT/TTO = 1.000

B O U N D A R Y L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0192	0.00000	0.00000	0.00000	0	0.0000	0.00000	0.0000	0.00000	.00310		0.000000
2	.2322	.00056	.00080	.00584	369797	.1380	.00716	.2761	.00074	.00222		0.000000
3	.3628	.00063	.00095	.00668	428704	.1692	.00562	.4141	.00101	.00265		0.000000
4	.4982	.00089	.00137	.00952	444417	.2661	.00537	.5521	.00147	.00368		0.000000
5	.7734	.00179	.00270	.01896	429731	.6242	.00468	.8282	.00269	.00428		.047408
6	1.0494	.00259	.00387	.02740	421266	.9842	.00427	1.1043	.00383	.00409		.061119
7	1.6015	.00401	.00595	.04240	411887	1.6890	.00386	1.6564	.00603	.00363		.080341
8	2.1534	.00544	.00800	.05738	403426	2.4527	.00359	2.2085	.00784	.00314		.080704
9	3.2575	.00747	.01096	.07871	401093	3.6357	.00331	3.3128	.01098	.00247		.047075
10	4.3617	.00939	.01375	.09894	399088	4.8330	.00313	4.4170	.01330	.00219		.053005
11	6.5697	.01258	.01843	.13253	399544	6.9665	.00294	6.6255	.01857	.00278		0.000000
12	8.7755	.01780	.02576	.18707	384917	10.6194	.00281	8.8340	.02559	.00396		.059213
13	10.9777	.02480	.03535	.25994	364939	15.8088	.00273	11.0425	.03605	.00528		.151971
14	13.1768	.03479	.04878	.36347	340621	23.6266	.00245	13.2510	.04892	.00599		.233591
15	17.5779	.05589	.07681	.58174	306380	41.4214	.00317	17.6680	.07681	.00663		.325048

TOTAL FRICTION DRAG= 9.98093

INTEGRAL MOMENTUM BALANCE, CHN=W2 (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	1975.6666
LOWER BOUNDARY PRESSURE FORCE	=	0.0000
UPPER BOUNDARY PRESSURE FORCE	=	217.8016
SUM OF ABOVE		2193.4682
LEAVING MOMENTUM	=	2192.7789
ERROR	=	.6893

Figure 1

STREAMTUBE CURVATURE PROGRAM

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT . STREAMLINE COORDINATE. XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.00007	6.91382	.076	0.00000	1.002	.005	.657	.7978	0.0000	.410	1.000
4.000	7.515	-22.48477	6.92476	.098	-.00010	1.010	.021	.662	.7904	-.0000	.408	1.000
8.000	15.031	-14.96950	6.94661	.280	-.00074	1.023	.051	.671	.7769	-.0002	.404	1.000
10.000	18.788	-11.21193	6.97160	.503	-.00132	1.037	.082	.680	.7630	-.0004	.400	1.000
12.000	22.546	-7.45465	7.02337	1.220	-.00534	1.061	.135	.696	.7389	-.0014	.391	1.000
13.000	24.425	-5.57651	7.07372	1.879	-.00689	1.080	.179	.709	.7191	-.0028	.382	1.000
13.500	25.364	-4.63772	7.10791	2.313	-.00927	1.092	.206	.717	.7067	-.0039	.376	1.000
14.000	26.304	-3.69931	7.15116	3.040	-.01774	1.108	.241	.727	.6908	-.0056	.369	1.000
14.500	27.243	-2.76170	7.20913	4.057	-.02003	1.128	.286	.740	.6702	-.0084	.358	1.000
14.750	27.713	-2.29336	7.24484	4.698	-.02764	1.143	.319	.750	.6547	-.0103	.352	1.000
15.000	28.182	-1.82550	7.28642	5.466	-.02941	1.160	.357	.761	.6370	-.0128	.345	1.000
15.250	28.652	-1.35833	7.33510	6.519	-.04885	1.182	.407	.776	.6135	-.0162	.336	1.000
15.500	29.122	-.89242	7.39461	8.143	-.07179	1.221	.494	.801	.5715	-.0210	.325	1.000
15.625	29.357	-.66029	7.43022	9.398	-.11482	1.247	.551	.818	.5434	-.0245	.318	1.000
15.750	29.592	-.42910	7.47153	10.823	-.09668	1.290	.648	.846	.4940	-.0290	.311	1.000
15.875	29.826	-.19998	7.52280	15.563	-.60452	1.383	.855	.907	.3754	-.0361	.301	1.000
16.000	30.061	.01918	7.60606	60.914	4.84681	1.524	1.170	1.000	0.0000	-.0519	.286	1.000

TT/TTO = 1.000

ADDITIVE DRAG = -.0519

Figure 1

IDENT= NASA INLET CONFIGURATION NO. 8

LOWER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
16.000	0.000	.01918	7.60606	60.914	4.84681	1.524	1.170	1.000	0.0000	-.0519	.286	1.000
16.187	.216	.10854	7.78989	25.274	1.42830	.757	-.543	.496	1.0526	-.0628	.251	1.000
16.281	.324	.20856	7.83045	19.723	.61821	.634	-.817	.416	1.1935	-.0575	.243	1.000
16.375	.433	.31133	7.86413	16.800	.35716	.829	-.383	.544	.9754	-.0536	.236	1.000
16.563	.649	.51996	7.92111	14.186	.14270	.852	-.329	.559	.9504	-.0497	.225	1.000
16.750	.865	.73037	7.97124	12.657	.12482	.869	-.292	.570	.9329	-.0466	.216	1.000
17.125	1.298	1.15434	8.05709	10.473	.06160	.884	-.258	.580	.9174	-.0419	.199	1.000
17.500	1.730	1.58060	8.13086	9.273	.03780	.897	-.230	.588	.9046	-.0383	.184	1.000
18.250	2.596	2.43664	8.25625	7.409	.03344	.905	-.213	.594	.8964	-.0327	.158	1.000
19.000	3.461	3.29593	8.35713	6.156	.01449	.920	-.178	.604	.8805	-.0287	.138	1.000
20.500	5.191	5.01840	8.52251	4.904	.00993	.936	-.143	.614	.8646	-.0232	.103	1.000
22.000	6.922	6.74358	8.65688	4.040	.00779	.942	-.130	.618	.8586	-.0193	.075	1.000
25.000	10.383	10.19853	8.85735	2.680	.00618	.946	-.121	.621	.8545	-.0139	.031	1.000
28.000	13.843	13.65700	8.98374	1.509	.00587	.949	-.113	.623	.8513	-.0106	.004	1.000
34.000	20.765	20.57820	9.04968	.121	-.00000	.984	-.035	.646	.8158	-.0095	-.011	1.000
40.000	27.687	27.49987	9.06383	.114	.00000	.998	-.005	.654	.8024	-.0094	-.014	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	.0192	0.00000	0.00000	0.00000	0	0.0000	0.00000	0.0000	0.00000	.00220		0.000000
2	.1085	.00041	.00074	.00448	523130	.1082	.00641	.2163	.00074	.00468		0.000000
3	.2086	.00058	.00113	.00652	530728	.1734	.00595	.3245	.00132	.00582		0.000000
4	.3113	.00123	.00216	.01352	513389	.4276	.00389	.4326	.00200	.00590		.271657
5	.5200	.00179	.00309	.01959	509301	.6784	.00425	.6489	.00309	.00447		.107407
6	.7304	.00232	.00396	.02524	506168	.9300	.00400	.8652	.00394	.00381		.100778
7	1.1543	.00323	.00547	.03511	503180	1.4025	.00370	1.2978	.00548	.00334		.095149
8	1.5806	.00410	.00690	.04447	500581	1.8823	.00349	1.7304	.00683	.00307		.086314
9	2.4366	.00558	.00936	.06051	498658	2.7637	.00324	2.5956	.00942	.00291		.088299
10	3.2959	.00714	.01189	.07735	495325	3.7499	.00306	3.4608	.01187	.00274		.103351
11	5.0184	.00990	.01635	.10702	491604	5.6168	.00283	5.1913	.01628	.00240		.085491
12	6.7436	.01230	.02025	.13282	490168	7.3524	.00268	6.9217	.02017	.00215		.058757
13	10.1985	.01660	.02728	.17919	489148	10.6846	.00249	10.3825	.02698	.00210		.047459
14	13.6570	.02069	.03396	.22336	488338	14.0667	.00236	13.8434	.03471	.00221		.089696
15	20.5782	.03114	.05022	.33478	478907	23.2148	.00215	20.7651	.04969	.00210		.123117
16	27.4999	.03984	.06384	.42773	475086	31.4701	.00207	27.6867	.06384	.00198		.104100

TOTAL FRICTION DRAG= 27.38004

Figure 1

STREAMTUBE CURVATURE PROGRAM

IDENT= NASA INLET CONFIGURATION NO. 8

UPPER BOUNDARY TO CHN=EXT , STREAMLINE COORDINATE, XI2= 16.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-30.17654	60.02594	.167	-.00000	1.002	.005	.657	.7978	0.0000	-43.483	1.000
4.000	7.482	-22.69417	60.04846	.183	-.00008	1.002	.004	.657	.7982	.0001	-43.516	1.000
8.000	14.870	-15.30662	60.07419	.216	-.00008	1.001	.003	.657	.7985	.0003	-43.554	1.000
10.000	18.508	-11.66858	60.08847	.233	-.00008	1.001	.003	.657	.7987	.0003	-43.576	1.000
12.000	22.058	-8.11878	60.10340	.249	-.00007	1.001	.002	.657	.7990	.0004	-43.596	1.000
14.000	25.464	-4.71316	60.11856	.261	-.00005	1.001	.002	.656	.7993	.0004	-43.620	1.000
16.000	28.346	-1.83088	60.13187	.268	-.00003	1.000	.001	.656	.7996	.0005	-43.640	1.000
19.000	32.241	2.06450	60.15024	.272	-.00000	1.000	-.000	.656	.8000	.0005	-43.667	1.000
22.000	35.960	5.78292	60.16781	.269	.00003	1.000	-.001	.656	.8005	.0005	-43.693	1.000
25.000	39.637	9.46047	60.18484	.261	.00005	.999	-.002	.655	.8008	.0004	-43.719	1.000
28.000	43.294	13.11734	60.20117	.250	.00006	.999	-.003	.655	.8012	.0004	-43.743	1.000
34.000	50.459	20.28250	60.23080	.222	.00008	.998	-.004	.655	.8017	.0002	-43.787	1.000
40.000	57.434	27.25746	60.25660	.207	.00000	.998	-.005	.654	.8024	.0001	-43.825	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=EXT (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=146945.2006
LOWER BOUNDARY PRESSURE FORCE	= -15.8187
UPPER BOUNDARY PRESSURE FORCE	= .0973
SUM OF ABOVE	146929.4792
LEAVING MOMENTUM	=146944.4028
ERROR	= -14.9236

Figure 1

********* ENDJOB *********

Figure 1

```
NAME=  DAVE FERGUSON
ADDRES=  EVENDALE
IDENT=  LAHTI TEST CASE  DEC. 1ST,1972
1 STC        F          T
$A
MACHO=.663,
TSO=537.726,
PSO=10.9425,                                              AXI=F,
AXI=F,
MAXIT=5,
RG=1716.2,VMG1=100.,VMG2=100.,SCON=198.6,
SGR(1)=1.0,
PRPRN=-1,
$
2 BDY        WALL       FLOW
$A
UPPER=T,ZRONLY=F,
B(1)=-16.0,9.0,0.0,
-9.0,9.0,0.0,
-8.0,9.0085,1.022,
-7.0,9.0373,2.327,
-6.0,9.0905,3.703,
-5.0,9.1640,4.672,
-4.0,9.2535,5.502,
-3.0,9.3503,5.273,
-2.0,9.4300,3.744,
-1.0,9.4812,2.139,
0.0,9.5053,0.667,
1.0,9.5072,-0.383,
2.0,9.4930,-1.237,
3.0,9.4653,-1.857,
4.0,9.4303,-2.153,
5.0,9.3887,-2.660,
6.064,9.3344,-3.059,
7.0,9.2867,-2.725,
8.0,9.2417,-2.474,
9.0,9.1991,-2.419,
10.0,9.1572,-2.372,
11.0,9.1171,-2.192,
12.0,9.0815,-1.860,
13.0,9.0526,-1.447,
14.0,9.0309,-1.036,
15.0,9.0160,-0.685,
16.0,9.0066,-0.405,
17.0,9.0015,-0.182,
18.0,9.0,0.0,
22.0,9.0,0.0,
$
2 BDY        BUMP       FLOW
$A
UPPER=F,ZRONLY=F,
BL=T,
B(1)=-16.0,0.0,0.0,
-6.064,0.0,0.0,
-6.0,.0005,0.844,
-5.5,.0347,6.801,
-5.0,.1165,11.551,
-4.5,.2350,14.822,
-4.0,.3755,16.237,
-3.5,.5196,15.567,
-3.364,.5568,15.038,
```

Figure 2

```
-3.0,.6492,13.405,
-2.5,.7577,11.086,
-2.0,.8453,8.810,
-1.5,.9129,6.594,
-1.0,.9611,4.405,
-0.5,.9900,2.210,
0.0,.9997,0.0,
0.5,.9900,-2.211,
1.0,.9611,-4.406,
1.5,.9129,-6.594,
2.0,.8453,-8.810,
2.5,.7577,-11.086,
3.0,.6492,-13.405,
3.364,.5568,-15.038,
3.5,.5196,-15.567,
4.0,.3755,-16.237,
4.5,.2350,-14.821,
5.0,.1165,-11.550,
5.5,.0347,-6.797,
6.0,.0005,-0.841,
6.064,0.0,0.0,
22.0,0.0,0.0,
$
3 CHN       FLOW
$A
VARY=F,
RG=1716.32,
TSO=537.726,
PSO=10.9425,
MACHO=.663,
$
1 STC       T         T
$A
MAXIT=5,
$
```

Figure 2

EXECUTING PROGM=STC
TAPIN= F TAPOT= T

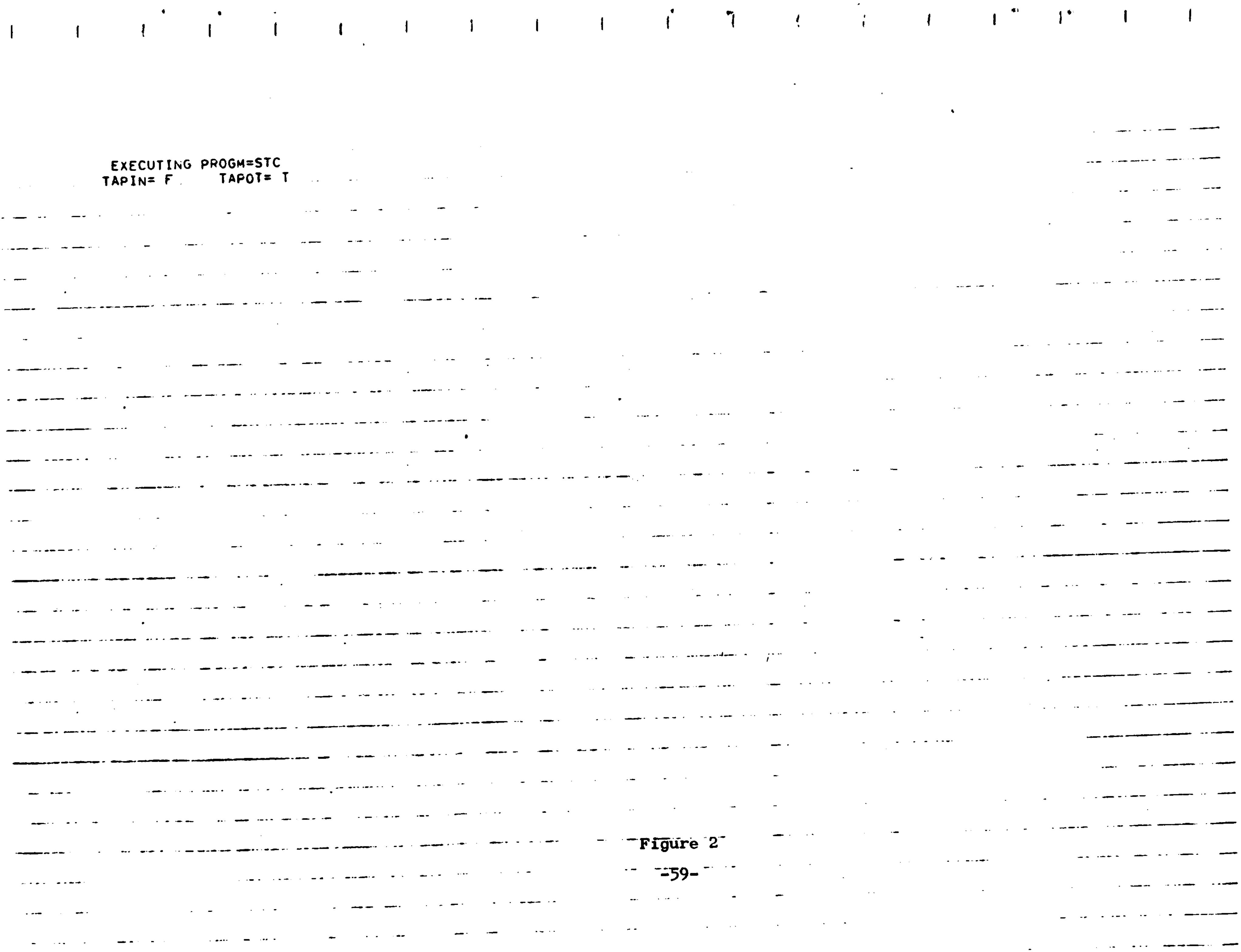


Figure 2

IDENT= LAHTI TEST CASE DEC. 1ST.1972

B O U N D A R Y C O O R D I N A T E S, BDY=WALL CHN=FLOW UPPER= T BL= F

I	X,Z	Y,R	ANGD	CURV-	CURV+
1	-16.00000	9.00000	0.000	0.0000	0.0000
2	-9.00000	9.00000	0.000	0.0000	-.0153
3	-8.00000	9.00850	1.022	-.0203	-.0202
4	-7.00000	9.03730	2.327	-.0254	-.0271
5	-6.00000	9.09050	3.703	-.0208	-.0186
6	-5.00000	9.16400	4.672	-.0152	-.0173
7	-4.00000	9.25350	5.502	-.0116	-.0108
8	-3.00000	9.35030	5.273	.0187	.0216
9	-2.00000	9.43000	3.744	.0316	.0291
10	-1.00000	9.48120	2.139	.0269	.0280
11	0.00000	9.50530	.667	.0233	.0218
12	1.00000	9.50720	-.383	.0149	.0153
13	2.00000	9.49300	-1.237	.0145	.0150
14	3.00000	9.46530	-1.857	.0067	.0051
15	4.00000	9.43030	-2.153	.0052	.0063
16	5.00000	9.38870	-2.660	.0114	.0126
17	6.06400	9.33440	-3.059	.0004	-.0034
18	7.00000	9.28670	-2.725	-.0091	-.0068
19	8.00000	9.24170	-2.474	-.0020	-.0017
20	9.00000	9.19910	-2.419	-.0002	-.0004
21	10.00000	9.15720	-2.372	-.0012	-.0016
22	11.00000	9.11710	-2.192	-.0046	-.0044
23	12.00000	9.08150	-1.860	-.0071	-.0070
24	13.00000	9.05260	-1.447	-.0074	-.0071
25	14.00000	9.03090	-1.038	-.0072	-.0070
26	15.00000	9.01600	-.685	-.0053	-.0056
27	16.00000	9.00660	-.405	-.0042	-.0040
28	17.00000	9.00150	-.182	-.0038	-.0037
29	18.00000	9.00000	0.000	-.0026	0.0000
30	22.00000	9.00000	0.000	0.0000	0.0000

Figure 2

STREAMTUBE CURVATURE PROGRAM

IDENT= LAHTI TEST CASE DEC. 1ST,1972

B O U N D A R Y   C O O R D I N A T E S, BDY=BUMP CHN=FLOW UPPER= F BL= T

I	X,Z	Y,R	ANGD	CURV-	CURV+
1	-16.00000	0.00000	0.000	0.0000	0.0000
2	-6.06400	0.00000	0.000	0.0000	-.2720
3	-6.00000	.00050	.844	-.1882	-.2254
4	-5.50000	.03470	6.801	-.1878	-.1869
5	-5.00000	.11650	11.551	-.1395	-.1408
6	-4.50000	.23500	14.822	-.0811	-.0810
7	-4.00000	.37550	16.237	-.0141	-.0127
8	-3.50000	.51960	15.567	.0577	.0689
9	-3.36400	.55680	15.038	.0621	.0697
10	-3.00000	.64920	13.405	.0820	.0795
11	-2.50000	.75770	11.086	.0786	.0804
12	-2.00000	.84530	8.810	.0760	.0771
13	-1.50000	.91290	6.594	.0761	.0746
14	-1.00000	.96110	4.405	.0774	.0763
15	-.50000	.99000	2.210	.0766	.0757
16	0.00000	.99970	0.000	.0784	.0784
17	.50000	.99000	-2.211	.0759	.0763
18	1.00000	.96110	-4.406	.0766	.0773
19	1.50000	.91290	-6.594	.0747	.0761
20	2.00000	.84530	-8.810	.0771	.0760
21	2.50000	.75770	-11.086	.0804	.0786
22	3.00000	.64920	-13.405	.0795	.0820
23	3.36400	.55680	-15.038	.0697	.0621
24	3.50000	.51960	-15.567	.0689	.0577
25	4.00000	.37550	-16.237	-.0127	-.0140
26	4.50000	.23500	-14.821	-.0811	-.0809
27	5.00000	.11650	-11.550	-.1410	-.1391
28	5.50000	.03470	-6.797	-.1875	-.1871
29	6.00000	.00050	-.841	-.2261	-.1850
30	6.06400	0.00000	0.000	-.2737	0.0000
31	22.00000	0.00000	0.000	0.0000	0.0000

Figure 2

GRID REFINEMENT		INNER ITERATIONS		SOLUTION HISTORY ORTHOGONALIZATION			FLOW BALANCE		MATRIX SOLUTION		TIME
NREFIN	GRID PTS	INRCTR	CNVF	RMS-DS1 (BEFORE	MAX-DS1 DAMPING)	MAX-DS1 (AFTER)	LIM-ES2	MAX-ES2	MAX-DS2	NSWEEPS	(SEC)
1	9	0	1.00	.213740	.398214	.398214	1.900000	.079202	0.000000	0	1.129
1	9	1	1.00	.018961	.036420	.036296	1.900000	.008651	.076005	2	1.186
2	25	0	1.00	.132982	.270053	.263315	.935338	.285125	0.000000	0	1.366
2	25	1	1.00	.076156	.190525	.185143	.935338	.009063	.243939	6	1.536
3	81	0	1.00	.117136	.346877	.329245	.453478	.411447	0.000000	0	2.359
3	81	1	1.00	.101668	.358830	.337505	.453478	.019577	.326487	8	2.963
4	289	0	1.00	.082609	.350997	.330579	.217036	.171289	0.000000	0	9.790
4	289	1	1.00	.042188	.171482	.164508	.217038	.015912	.098471	12	12.199
5	594	0	1.00	.028293	.144130	.139187	.105842	.052619	0.000000	0	19.421
5	594	1	1.00	.010096	.039554	.038463	.105842	.003294	.021812	14	24.606
5	594	2	1.00	.000952	.005258	.005239	.105842	.000750	.001453	16	30.046

Figure 2

```
IDENT=  LAHTI TEST CASE  DEC. 1ST,1972

GENERAL INPUT-
                                          MACHO =    .6630
     AXI    =         F                   TSO   =   537.73
     PG     = 1716.20                     PSO   =   10.942
     GAM    =  1.4000                     PTO   =    14.70
     TTE    =   0.000                     TTO   =  585.000
     CHOTST=        T

STREAMLINE END CONDITIONS-
     NBCIN =          2          2
     ACF   =     0.000      0.000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
     SSFML =         1   (FORMULA NUMBER)
     SSFEND=      .750   (DOWNSTREAM END CONDITION, SSFML=2 ONLY)
     SSFND1=      .750   (UPSTREAM END CONDITION, SSFML=2 ONLY)
     SSEANG=     0.000   (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
     SSEF  =         F   (SUPERSONIC ENTERING FLOW, T OR F)
     SSDF  =         F   (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)
     SSDLE =         F   (SUPERSONIC FLOW BELOW AND AFT OF A L.E. POINT, T OR F)

GRID SIZE CRITERIA-
     NGP/GR=*0000.00
     SGR   =      1.00

     VMG1  =    100.00                    VMG2  =    100.00

     CRX   =      .375      .375      .125     0.000     0.000     0.000

MEMORY UTILIZATION-
                          USED      AVAILABLE
     GRID POINTS           594         768
     TABLES                895        2200
     STREAMLINES            18         128

CONVERGENCE DATA-
     MAXIT =           5     (MAXIMUM ITERATIONS)
     NREFIN=           5 -   NUMBER OF REFINEMENT ITERATIONS
     INRCTR=           2 -   NUMBER OF ADDITIONAL ITERATIONS AFTER LAST REFINEMENT

     TOLINR=   5.0E-02       (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
     TOLES2=   1.0E-03       (FINAL TOLERANCE ON S.L. MOVEMENT)
     CLEN  =     1.000 -     CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
               1.0E-03 -     ABSOLUTE TOLERANCE ON S.L. MOVEMENT
     MAXES2=   7.5E-04 -     LARGEST S.L. MOVEMENT ON LAST ITERATION

     DSIDMP=      .020       (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
     NODENS=         0       (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
```

Figure 2

```
IDENT=  LAHTI TEST CASE   DEC. 1ST,1972

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM   =        0    (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
     RHOBAS=      .500    (ACCELERATION FACTOR, BASE LEVEL)
     RHOAMP=      .500    (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
     TOLRL  = 1.0E-03     (TOLERANCE RELATIVE TO MAXDS2)

     HIGHLIGHT RADIUS=   1.000     HIGHLIGHT AREA=    1.000
     MAX. BODY RADIUS=   1.000     MAX. BODY AREA=    1.000

 CONTENTS OF CHANNEL TABLE-

     CHN    =  FLOW       WTFLOW=  1.0000E+15
     TTO    =*0000.00     PTO    =*000.000     TSO    =  537.73      PSO    =  10.942
     MACHO  =    .6630    AO     =  1.0000E+15 VARY   =       F
     RG     = 1716.32     GAM    =*00.0000

 CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

                 SPECIFIED      ADJUSTED        PT/PSO       TT/TSO
     FLOW          .0804          .0804         14.6959      584.9995
```

Figure 2

LOWER BOUNDARY TO CHN=FLOW , STREAMLINE COORDINATE, XI2= 0.000.

XI1	S1W	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-15.60179	0.00000	0.000	0.00000	1.000	.000	.745	.6630	0.0000	1.000	1.000
.500	1.169	-14.43262	0.00000	0.000	0.00000	1.001	.004	.745	.6617	0.0000	1.000	1.000
1.000	2.338	-13.26344	0.00000	0.000	0.00000	1.003	.008	.746	.6600	0.0000	1.000	1.000
1.500	3.508	-12.09427	0.00000	0.000	0.00000	1.005	.016	.748	.6574	0.0000	1.000	1.000
2.000	4.677	-10.92510	0.00000	0.000	0.00000	1.008	.027	.751	.6531	0.0000	1.000	1.000
2.500	5.846	-9.75593	0.00000	0.000	0.00000	1.014	.047	.755	.6461	0.0000	1.000	1.000
3.000	7.015	-8.58676	0.00000	0.000	0.00000	1.025	.082	.763	.6334	0.0000	1.000	1.000
3.500	8.184	-7.41759	0.00000	0.000	0.00000	1.042	.137	.776	.6131	0.0000	1.000	1.000
4.000	9.353	-6.24847	0.00000	0.000	0.00000	1.091	.296	.812	.5529	0.0000	1.000	1.000
4.500	10.523	-5.08474	.09972	10.839	-.14776	1.120	.388	.834	.5166	-.0341	.900	1.000
5.000	11.692	-3.95263	.38931	16.264	-.00606	1.017	.056	.757	.6427	-.0985	.611	1.000
5.500	12.861	-2.82299	.69004	12.579	.07923	.873	-.414	.650	.8095	-.0447	.310	1.000
6.000	14.030	-1.67182	.89189	7.351	.07650	.786	-.697	.585	.9098	.0673	.108	1.000
6.500	15.199	-.50713	.98972	2.241	.07656	.741	-.841	.552	.9620	.1425	.010	1.000
7.000	16.368	.66162	.98276	-2.919	.07645	.755	-.796	.562	.9457	.1368	.017	1.000
7.500	17.538	1.82507	.87119	-8.030	.07679	.818	-.592	.609	.8725	.0594	.129	1.000
8.000	18.707	2.97371	.65543	-13.282	.07946	.911	-.290	.678	.7659	-.0357	.345	1.000
8.500	19.876	4.10112	.34616	-16.111	-.02764	1.051	.166	.783	.6024	-.0549	.654	1.000
9.000	21.045	5.23669	.07245	-9.466	-.16254	1.137	.444	.846	.4941	.0286	.928	1.000
9.500	22.214	6.40280	0.00000	0.000	0.00000	1.096	.311	.816	.5473	.0559	1.000	1.000
10.000	23.383	7.57196	0.00000	0.000	0.00000	1.056	.183	.787	.5958	.0559	1.000	1.000
10.500	24.553	8.74113	0.00000	0.000	0.00000	1.040	.131	.775	.6153	.0559	1.000	1.000
11.000	25.722	9.91030	0.00000	0.000	0.00000	1.029	.095	.766	.6285	.0559	1.000	1.000
11.500	26.891	11.07947	0.00000	0.000	0.00000	1.021	.069	.760	.6378	.0559	1.000	1.000
12.000	28.060	12.24864	0.00000	0.000	0.00000	1.016	.050	.756	.6448	.0559	1.000	1.000
12.500	29.229	13.41782	0.00000	0.000	0.00000	1.011	.036	.753	.6500	.0559	1.000	1.000
13.000	30.398	14.58699	0.00000	0.000	0.00000	1.008	.025	.750	.6540	.0559	1.000	1.000
13.500	31.568	15.75616	0.00000	0.000	0.00000	1.005	.017	.748	.6570	.0559	1.000	1.000
14.000	32.737	16.92533	0.00000	0.000	0.00000	1.003	.011	.747	.6592	.0559	1.000	1.000
14.500	33.906	18.09450	0.00000	0.000	0.00000	1.002	.006	.746	.6607	.0559	1.000	1.000
15.000	35.075	19.26367	0.00000	0.000	0.00000	1.001	.004	.745	.6617	.0559	1.000	1.000
15.500	36.244	20.43284	0.00000	0.000	0.00000	1.001	.002	.745	.6624	.0559	1.000	1.000
16.000	37.413	21.60201	0.00000	0.000	0.00000	1.000	.000	.745	.6630	.0559	1.000	1.000

TT/TTO = 1.000

B O U N D A R Y L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	-15.6018	0.00000	0.00000	0.00000	0	0.0000	.00622	0.0000	0.00000	.00423		0.000000
2	-14.4326	.00323	.00486	.03423	279239	1.1731	.00480	1.1692	.00461	.00366		0.000000
3	-13.2634	.00565	.00849	.05985	278784	2.3573	.00388	2.3383	.00855	.00308		.000603
4	-12.0943	.00768	.01182	.08340	278067	3.5663	.00355	3.5075	.01182	.00277		.002303
5	-10.9251	.01005	.01505	.10636	276888	4.8282	.00335	4.6767	.01503	.00279		.006537
6	-9.7559	.01230	.01835	.13006	274951	6.1976	.00320	5.8459	.01835	.00283		.016905
7	-8.5868	.01490	.02211	.15738	271357	7.8399	.00310	7.0150	.02164	.00413		.041897
8	-7.4176	.01871	.02681	.19208	265432	10.0022	.00333	8.1842	.02800	.00798		.114399
9	-6.2485	.02674	.03841	.28063	246501	15.7716	.00277	9.3534	.04031	.00639		.277065
10	-5.0847	.03460	.04904	.36222	234140	21.4206	.00503	10.5225	.04294	-.00342		.318626
11	-3.9526	.01925	.02868	.20348	273999	10.8354	.00261	11.6917	.03232	-.01029		0.000000
12	-2.8230	.01148	.01845	.12330	313067	5.9894	.00228	12.8609	.01888	-.00676		0.000000
13	-1.6718	.01008	.01703	.10955	329156	5.2315	.00292	14.0301	.01650	-.00033		0.000000
14	-.5071	.01048	.01817	.11455	335455	5.5577	.00299	15.1992	.01810	.00220		0.000000
15	.6616	.01267	.02180	.13828	333643	7.0229	.00302	16.3684	.02165	.00390		.022025
16	1.8251	.01729	.02867	.18704	323803	10.1679	.00309	17.5376	.02721	.01142		.171062
17	2.9737	.02620	.04127	.26028	304353	16.5988	.00471	18.7067	.04834	.01849		.427414

Figure 2 -

18	4.1011	.05396	.07908	.56863	262203	38.7209	.00839	19.8759	.07044	.01453	SEP	.700980

TOTAL FRICTION DRAG=*3289568.04469

—Figure 2

IDENT= LAHTI TEST CASE DEC. 1ST,1972

UPPER BOUNDARY TO CHN=FLOW , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-15.61537	9.00000	.000	-.00000	1.000	.000	.745	.6630	0.0000	-8.000	1.000
.500	1.167	-14.44822	9.00000	.000	-.00000	.999	-.004	.744	.6643	.0000	-8.000	1.000
1.000	2.329	-13.28594	9.00000	.000	-.00000	.997	-.008	.743	.6660	-.0000	-8.000	1.000
1.500	3.485	-12.13064	9.00000	.000	.00000	.995	-.016	.741	.6687	-.0000	-8.000	1.000
2.000	4.629	-10.98676	9.00000	.000	.00000	.991	-.029	.738	.6733	-.0000	-8.000	1.000
2.500	5.754	-9.86175	9.00000	.000	.00000	.984	-.051	.733	.6815	-.0000	-8.000	1.000
3.000	6.842	-8.77326	9.00040	.266	-.01646	.967	-.108	.720	.7018	-.0000	-8.000	1.000
3.500	7.879	-7.73657	9.01392	1.337	-.02154	.951	-.160	.708	.7202	-.0018	-8.014	1.000
4.000	8.831	-6.78516	9.04665	2.653	-.02579	.942	-.187	.702	.7298	-.0075	-8.047	1.000
4.500	9.700	-5.91708	9.09593	3.791	-.01828	.944	-.183	.703	.7282	-.0167	-8.096	1.000
5.000	10.645	-4.97551	9.16601	4.696	-.01714	.948	-.169	.706	.7232	-.0290	-8.166	1.000
5.500	11.829	-3.79572	9.27336	5.593	-.00474	.967	-.109	.720	.7020	-.0438	-8.273	1.000
6.000	13.263	-2.36800	9.40384	4.374	.02794	.998	-.008	.743	.6657	-.0514	-8.404	1.000
6.500	14.854	-.77936	9.48877	1.791	.02699	1.004	.012	.747	.6587	-.0513	-8.489	1.000
7.000	16.472	.83815	9.50808	-.240	.01598	.999	-.003	.744	.6639	-.0512	-8.508	1.000
7.500	18.017	2.38338	9.48370	-1.531	.01179	.999	-.003	.744	.6641	-.0511	-8.484	1.000
8.000	19.431	3.79626	9.43785	-2.092	.00519	1.002	.006	.746	.6608	-.0512	-8.438	1.000
8.500	20.640	5.00444	9.36849	-2.663	.01258	1.009	.029	.751	.6524	-.0520	-8.388	1.000
9.000	21.625	5.98817	9.33845	-3.055	.00131	1.006	.020	.749	.6556	-.0533	-8.338	1.000
9.500	22.558	6.91989	9.29054	-2.765	-.00857	1.004	.011	.747	.6589	-.0540	-8.291	1.000
10.000	23.583	7.94398	9.24412	-2.481	-.00225	1.007	.022	.750	.6551	-.0548	-8.244	1.000
10.500	24.671	9.03122	9.19778	-2.418	-.00045	1.008	.026	.750	.6537	-.0559	-8.198	1.000
11.000	25.785	10.14394	9.15126	-2.357	-.00207	1.005	.017	.748	.6569	-.0569	-8.151	1.000
11.500	26.910	11.26824	9.10700	-2.118	-.00517	1.000	-.000	.745	.6630	-.0573	-8.107	1.000
12.000	28.039	12.39683	9.06917	-1.699	-.00716	.995	-.016	.741	.6686	-.0570	-8.069	1.000
12.500	29.172	13.52904	9.04023	-1.232	-.00714	.993	-.024	.739	.6717	-.0564	-8.040	1.000
13.000	30.309	14.66596	9.02030	-.792	-.00589	.992	-.026	.739	.6724	-.0559	-8.020	1.000
13.500	31.452	15.80878	9.00803	-.453	-.00447	.993	-.024	.739	.6716	-.0556	-8.006	1.000
14.000	32.601	16.95757	9.00164	-.191	-.00377	.994	-.020	.740	.6701	-.0554	-8.002	1.000
14.500	33.756	18.11287	9.00000	.000	-.00000	.997	-.011	.742	.6668	-.0554	-8.000	1.000
15.000	34.918	19.27464	9.00000	.000	-.00000	.999	-.005	.744	.6646	-.0554	-8.000	1.000
15.500	36.084	20.44041	9.00000	.000	.00000	.999	-.002	.744	.6637	-.0554	-8.000	1.000
16.000	37.252	21.60854	9.00000	.000	.00000	1.000	.000	.745	.6630	-.0554	-8.000	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=FLOW (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	60.6057
LOWER BOUNDARY PRESSURE FORCE	=	.1882
UPPER BOUNDARY PRESSURE FORCE	=	-.1866
SUM OF ABOVE		60.6073
LEAVING MOMENTUM	=	60.6058
ERROR	=	.0016

Figure 2

EXECUTING PROGM=STC
TAPIN= T TAPOT= T

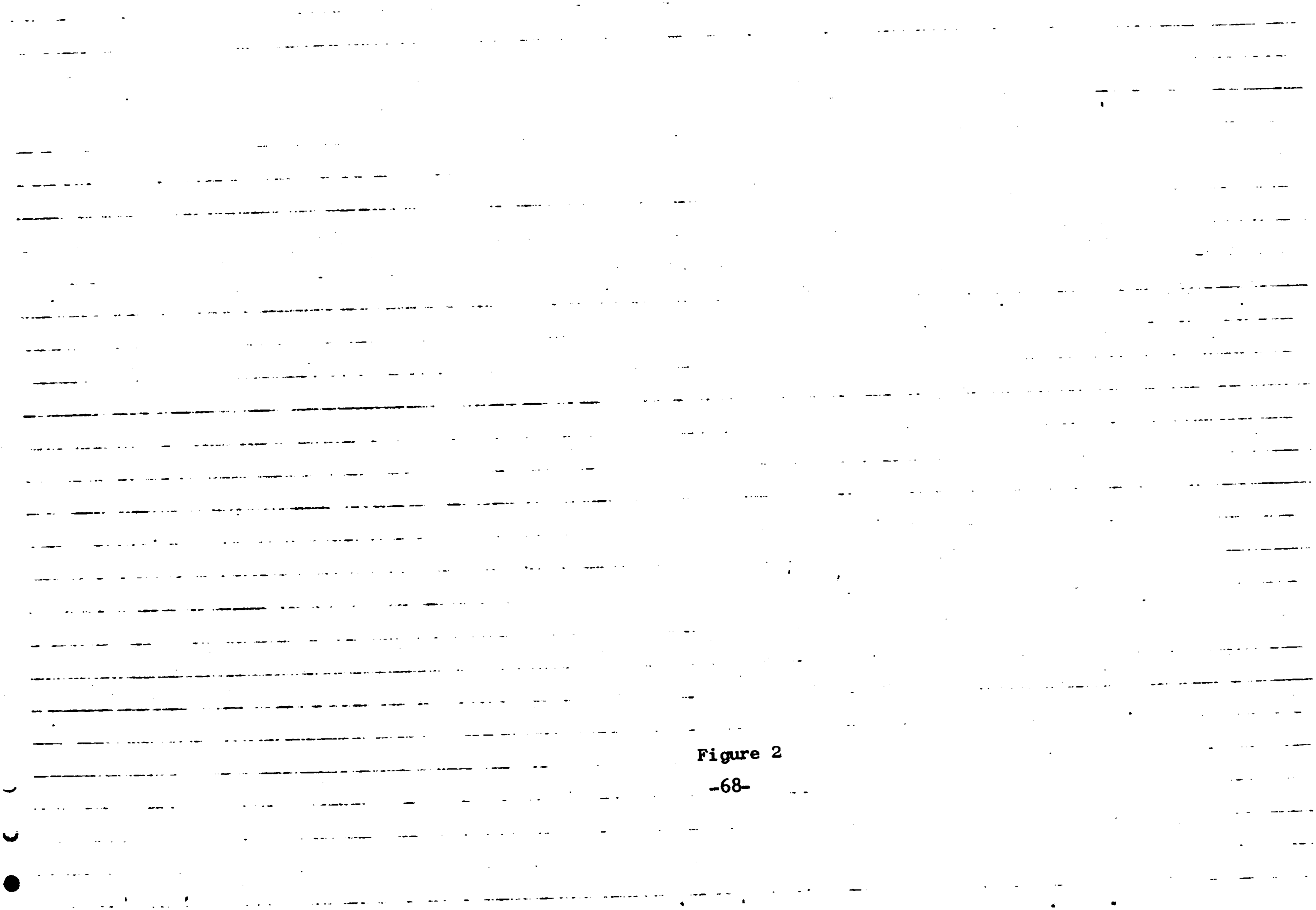


Figure 2

```
                    ***                      SOLUTION     HISTORY                                ***
     GRID            *        INNER          *       ORTHOGONALIZATION          *              FLOW            * MATRIX  SOLUTION  *  TIME
   REFINEMENT               ITERATIONS                                                        BALANCE

 NREFIN   GRID      INRCTR    CNVF        RMS-DS1    MAX-DS1      MAX-DS1      LIM-ES2     MAX-ES2          MAX-DS2  NSWEEPS           (SEC)
           PTS                           (BEFORE DAMPING)          (AFTER)

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906

        * * W A R N I N G * *      SEPARATED BL  *  BOUNDARY= BUMP      SW=       19.875906
```

Figure 2

```
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
* * W A R N I N G * *    SEPARATED BL  ,  BOUNDARY= BUMP    SW=    19.875906
                                          DARY= BUMP    SW=    19.875906
```

Figure 2

```
* * W A R N I N G * *     SEPARATED BL  *  BOUNDARY= BUMP     SW=     19.875906

* * W A R N I N G * *     SEPARATED BL  *  BOUNDARY= BUMP     SW=     19.875906

  5    594    2    1.00   .000088  .000759  .000758  .105842  .000730  .001453   16    34.250
```

Figure 2

```
IDENT=  LAHTI TEST CASE  DEC. 1ST,1972

GENERAL INPUT-

     AXI    =        F                          MACHO =    .6630
     RG     = 1716.20                           TSO   =   537.73
     GAM    =  1.4000                           PSO   =   10.942
     TTE    =   0.000                           PTO   =    14.70
     CHOTST=        T                           TTO   =  585.000

STREAMLINE END CONDITIONS-
     NBCIN  =        2         2
     ACF    =    0.000     0.000

CURVATURE CALCULATION FOR SUPERSONIC FLOW-
     SSFML  =        1    (FORMULA NUMBER)
     SSFEND=      .750    (DOWNSTREAM END CONDITION, SSFML=2 ONLY)
     SSFND1=      .750    (UPSTREAM END CONDITION, SSFML=2 ONLY)
     SSEANG=     0.000    (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)

SUBSONIC/SUPERSONIC BRANCH SELECTION-
     SSEF   =        F    (SUPERSONIC ENTERING FLOW, T OR F)
     SSDF   =        F    (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION, T OR F)
     SSDLE  =        F    (SUPERSONIC FLOW BELOW AND AFT OF A L.E. POINT, T OR F)

GRID SIZE CRITERIA-
     NGR/GR=*0000.00
     SGR    =     1.00

     VMG1   =   100.00                          VMG2  =   100.00

     CRX    =     .375      .375      .125     0.000     0.000     0.000

MEMORY UTILIZATION-
                             USED    AVAILABLE
     GRID POINTS              594       768
     TABLES                  1000      2200
     STREAMLINES               18       128

CONVERGENCE DATA-
     MAXIT  =        5    (MAXIMUM ITERATIONS)
     NRFFIN=         5  - NUMBER OF REFINEMENT ITERATIONS
     INRCTR=         2  - NUMBER OF ADDITIONAL ITERATIONS AFTER LAST REFINEMENT

     TOLINR= 5.0E-02    (INNER ITERATION TOLERANCE ON S.L. MOVEMENT)
     TOLES2= 1.0E-03    (FINAL TOLERANCE ON S.L. MOVEMENT)
     CLEN   =   1.000 - CHARACTERISTIC LENGTH BASED ON GRID SIZE CRITERIA
              1.0E-03 - ABSOLUTE TOLERANCE ON S.L. MOVEMENT
     MAXES2= 7.3E-04 - LARGEST S.L. MOVEMENT ON LAST ITERATION

     DS1DMP=     .020    (STREAMWISE PT MOVEMENT DAMPING, =0 FOR NO DAMPING)
     NODENS=        0    (REFINEMENT LEVEL TO WHICH CONSTANT DENSITY IS ASSUMED)
```

Figure 2

```
IDENT=  LAHTI TEST CASE  DEC. 1ST,1972

SPECIAL BOUNDARY OPTIONS-
     FARFLD=  FF

MATRIX SOLUTION PARAMETERS-
     IADM   =        0   (=-1,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION)
     RHOBAS=      .500   (ACCELERATION FACTOR, BASE LEVEL)
     RHOAMP=      .500   (ACCELERATION FACTOR, AMPLITUDE OF VARIATION)
     TOLRL = 1.0E-03     (TOLERANCE RELATIVE TO MAXDS2)

     HIGHLIGHT RADIUS=   1.000    HIGHLIGHT AREA=   1.000
     MAX. BODY RADIUS=   1.000    MAX. BODY AREA=   1.000

CONTENTS OF CHANNEL TABLE-

     CHN    =  FLOW       WTFLOW=  1.0000E+15
     TTO    =*0000.00     PTO    =*000.000      TSO    =  537.73     PSO    =  10.942
     MACHO  =    .6630    AO     =  1.0000E+15  VARY   =       F
     RG     = 1716.32     GAM    =*00.0000

CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-

               SPECIFIED     ADJUSTED       PT/PSO       TT/TSO
     FLOW          .0804        .0804      14.6959     584.9995
```

Figure 2

LOWER BOUNDARY TO CHN=FLOW , STREAMLINE COORDINATE, XI2= 0.000,

XI1	SIW	XW,ZW	YW,PW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-15.60179	.00157	.231	0.00000	1.000	.000	.745	.6630	0.0000	.998	1.000
.500	1.169	-14.43264	.00595	.198	0.00000	1.001	.004	.745	.6617	-.0000	.994	1.000
1.000	2.338	-13.26347	.00966	.171	0.00000	1.003	.008	.746	.6600	-.0000	.990	1.000
1.500	3.508	-12.09431	.01291	.159	0.00000	1.005	.016	.748	.6574	-.0001	.987	1.000
2.000	4.677	-10.92515	.01616	.161	0.00000	1.008	.027	.751	.6531	-.0001	.984	1.000
2.500	5.846	-9.75600	.01947	.187	0.00000	1.014	.047	.755	.6461	-.0003	.981	1.000
3.000	7.015	-8.58689	.02381	.312	0.00000	1.025	.082	.763	.6334	-.0005	.976	1.000
3.500	8.184	-7.41783	.03219	.426	0.00000	1.042	.137	.776	.6131	-.0015	.968	1.000
4.000	9.353	-6.24859	.04121	.175	0.00000	1.091	.296	.812	.5529	-.0034	.959	1.000
4.500	10.523	-5.09191	.13838	10.509	-.14776	1.120	.389	.834	.5166	-.0367	.862	1.000
5.000	11.692	-3.96015	.41600	15.743	-.00606	1.017	.056	.757	.6426	-.0984	.584	1.000
5.500	12.861	-2.82684	.70769	12.317	.07923	.873	-.414	.650	.8095	-.0463	.292	1.000
6.000	14.030	-1.67401	.90879	7.362	.07650	.786	-.697	.585	.9098	.0654	.091	1.000
6.500	15.199	-.50794	1.00902	2.401	.07656	.741	-.841	.552	.9620	.1425	-.009	1.000
7.000	16.368	.66267	1.00629	-2.549	.07645	.755	-.796	.562	.9458	.1402	-.006	1.000
7.500	17.538	1.82941	.90534	-7.238	.07679	.818	-.592	.609	.8725	.0701	.095	1.000
8.000	18.707	2.98562	.71004	-12.300	.07946	.911	-.289	.678	.7658	-.0159	.290	1.000
8.500	19.876	4.12101	.41795	-15.491	-.02764	1.051	.166	.783	.6023	-.0340	.582	1.000
9.000	21.045	5.25009	.15258	-9.354	-.16254	1.137	.444	.846	.4940	.0469	.847	1.000
9.500	22.214	6.40287	.07908	-.052	0.00000	1.096	.311	.816	.5473	.0746	.921	1.000
10.000	23.383	7.57196	.07908	0.000	0.00000	1.056	.183	.787	.5958	.0746	.921	1.000
10.500	24.553	8.74113	.07908	0.000	0.00000	1.040	.131	.775	.6153	.0746	.921	1.000
11.000	25.722	9.91030	.07908	0.000	0.00000	1.029	.095	.766	.6285	.0746	.921	1.000
11.500	26.891	11.07947	.07908	0.000	0.00000	1.021	.069	.760	.6378	.0746	.921	1.000
12.000	28.060	12.24864	.07908	0.000	0.00000	1.016	.050	.756	.6448	.0746	.921	1.000
12.500	29.229	13.41782	.07908	0.000	0.00000	1.011	.036	.753	.6500	.0746	.921	1.000
13.000	30.398	14.58699	.07908	0.000	0.00000	1.008	.025	.750	.6540	.0746	.921	1.000
13.500	31.568	15.75616	.07908	0.000	0.00000	1.005	.017	.748	.6570	.0746	.921	1.000
14.000	32.737	16.92533	.07908	0.000	0.00000	1.003	.011	.747	.6592	.0746	.921	1.000
14.500	33.906	18.09450	.07908	0.000	0.00000	1.002	.006	.746	.6607	.0746	.921	1.000
15.000	35.075	19.26367	.07908	0.000	0.00000	1.001	.004	.745	.6617	.0746	.921	1.000
15.500	36.244	20.43284	.07908	0.000	0.00000	1.001	.002	.745	.6624	.0746	.921	1.000
16.000	37.413	21.60201	.07908	0.000	0.00000	1.000	.000	.745	.6630	.0746	.921	1.000

TT/TTO = 1.000

B O U N D A R Y   L A Y E R

I	XW	THETA	DSTAR	DELTA	REX	CAPX	CF	SW	DSTR	DDSTR	SEP	FSEP
1	-15.6018	0.00000	0.00000	0.00000	0	0.0000	.00622	0.0000	0.00000	.00423		0.000000
2	-14.4326	.00323	.00486	.03423	279239	1.1731	.00480	1.1692	.00461	.00366		0.000000
3	-13.2635	.00565	.00849	.05985	278784	2.3573	.00388	2.3383	.00855	.00308		.000603
4	-12.0943	.00788	.01182	.08340	278067	3.5663	.00355	3.5075	.01182	.00277		.002303
5	-10.9251	.01005	.01505	.10636	276888	4.8282	.00335	4.6767	.01503	.00279		.006536
6	-9.7560	.01230	.01835	.13006	274951	6.1976	.00320	5.8459	.01835	.00283		.016904
7	-8.5869	.01490	.02211	.15738	271358	7.8399	.00310	7.0150	.02164	.00413		.041895
8	-7.4178	.01821	.02681	.19208	265432	10.0022	.00333	8.1842	.02800	.00798		.114413
9	-6.2486	.02674	.03842	.28066	246495	15.7734	.00277	9.3534	.04031	.00639		.277130
10	-5.0919	.03460	.04904	.36225	234133	21.4230	.00503	10.5225	.04295	-.00342		.318651
11	-3.9602	.01925	.02869	.20351	273989	10.8373	.00261	11.6917	.03232	-.01029		0.000000
12	-2.8268	.01148	.01845	.12330	313069	5.9890	.00228	12.8609	.01888	-.00677		0.000000
13	-1.6740	.01008	.01703	.10954	329159	5.2310	.00292	14.0301	.01650	-.00033		0.000000
14	-.5079	.01047	.01817	.11454	335459	5.5571	.00299	15.1992	.01810	.00220		0.000000
15	.6627	.01267	.02180	.13827	333648	7.0223	.00302	16.3684	.02165	.00390		.022035
16	1.8294	.01729	.02867	.18706	323799	10.1691	.00309	17.5376	.02722	.01142		.171205
17	2.9856	.02621	.04128	.28032	304345	16.6019	.00470	18.7067	.04835	.01849		.427509

Figure 2

18	4.1210	.05397	.07909	.56865	262201	38.7229	.00838	19.8759	.07045	.01453	SEP	.700940

TOTAL FRICTION DRAG=*8012025.97782

Figure 2

IDENT= LAHTI TEST CASE DEC. 1ST,1972

UPPER BOUNDARY TO CHN=FLOW , STREAMLINE COORDINATE, XI2= 8.000.

XI1	SIW	XW,ZW	YW,RW	ANGW	CURVW	PS/PO	CP	PS/PT	MACH	CDPI	(AMAX-A)/AMAX	PT/PTO
0.000	0.000	-15.61536	9.00000	.000	-.00000	1.000	.000	.745	.6630	0.0000	-8.000	1.000
.500	1.167	-14.44821	9.00000	.000	-.00000	.999	-.004	.744	.6643	.0000	-8.000	1.000
1.000	2.329	-13.28595	9.00000	.000	-.00000	.997	-.008	.743	.6660	-.0000	-8.000	1.000
1.500	3.485	-12.13065	9.00000	.000	.00000	.995	-.016	.741	.6687	-.0000	-8.000	1.000
2.000	4.629	-10.98679	9.00000	.000	.00000	.991	-.029	.738	.6733	-.0000	-8.000	1.000
2.500	5.754	-9.86173	9.00000	.000	.00000	.984	-.051	.733	.6815	-.0000	-8.000	1.000
3.000	6.842	-8.77312	9.00040	.207	-.01646	.967	-.108	.720	.7018	-.0000	-8.000	1.000
3.500	7.879	-7.73645	9.01392	1.337	-.02154	.951	-.160	.708	.7202	-.0018	-8.014	1.000
4.000	8.831	-6.78482	9.04666	2.654	-.02578	.942	-.187	.702	.7298	-.0075	-8.047	1.000
4.500	9.700	-5.91702	9.09593	3.791	-.01827	.944	-.183	.703	.7282	-.0167	-8.096	1.000
5.000	10.645	-4.97556	9.16600	4.696	-.01714	.948	-.168	.706	.7231	-.0290	-8.166	1.000
5.500	11.829	-3.79569	9.27337	5.593	-.00474	.967	-.109	.720	.7020	-.0438	-8.273	1.000
6.000	13.263	-2.36804	9.40384	4.374	.02794	.998	-.008	.743	.6657	-.0514	-8.404	1.000
6.500	14.853	-.78012	9.48874	1.792	.02700	1.004	.012	.747	.6587	-.0512	-8.489	1.000
7.000	16.472	.83798	9.50808	-.240	.01598	.999	-.003	.744	.6639	-.0512	-8.508	1.000
7.500	18.017	2.38367	9.48369	-1.531	.01178	.999	-.003	.744	.6641	-.0511	-8.484	1.000
8.000	19.431	3.79644	9.43784	-2.092	.00519	1.002	.006	.746	.6608	-.0512	-8.438	1.000
8.500	20.640	5.00448	9.38849	-2.663	.01258	1.009	.029	.751	.6524	-.0520	-8.388	1.000
9.000	21.625	5.98807	9.33846	-3.055	.00131	1.006	.020	.749	.6556	-.0533	-8.338	1.000
9.500	22.558	6.91986	9.29054	-2.766	-.00857	1.004	.011	.747	.6589	-.0540	-8.291	1.000
10.000	23.583	7.94391	9.24413	-2.481	-.00225	1.007	.022	.750	.6551	-.0548	-8.244	1.000
10.500	24.671	9.03120	9.19778	-2.418	-.00045	1.008	.026	.750	.6537	-.0559	-8.198	1.000
11.000	25.785	10.14393	9.15126	-2.357	-.00207	1.005	.017	.748	.6569	-.0569	-8.151	1.000
11.500	26.910	11.26824	9.10700	-2.118	-.00517	1.000	-.000	.745	.6630	-.0573	-8.107	1.000
12.000	28.039	12.39685	9.06917	-1.699	-.00716	.995	-.016	.741	.6686	-.0570	-8.069	1.000
12.500	29.172	13.52906	9.04023	-1.232	-.00714	.993	-.024	.739	.6717	-.0564	-8.040	1.000
13.000	30.309	14.66597	9.02030	-.792	-.00589	.992	-.026	.739	.6724	-.0559	-8.020	1.000
13.500	31.452	15.80878	9.00803	-.453	-.00447	.993	-.024	.739	.6716	-.0556	-8.008	1.000
14.000	32.601	16.95756	9.00164	-.191	-.00377	.994	-.020	.740	.6701	-.0554	-8.002	1.000
14.500	33.756	18.11287	9.00000	.000	-.00000	.997	-.011	.742	.6668	-.0554	-8.000	1.000
15.000	34.918	19.27464	9.00000	.000	-.00000	.999	-.005	.744	.6646	-.0554	-8.000	1.000
15.500	36.084	20.44041	9.00000	.000	.00000	.999	-.002	.744	.6637	-.0554	-8.000	1.000
16.000	37.252	21.60854	9.00000	.000	.00000	1.000	.000	.745	.6630	-.0554	-8.000	1.000

TT/TTO = 1.000

INTEGRAL MOMENTUM BALANCE, CHN=FLOW (AXIAL FORCES ONLY)

ENTERING MOMENTUM	=	60.6057
LOWER BOUNDARY PRESSURE FORCE	=	.2513
UPPER BOUNDARY PRESSURE FORCE	=	-.1866
SUM OF ABOVE		60.6704
LEAVING MOMENTUM	=	60.6058
ERROR	=	.0647

Figure 2

********* ENDJOB *********

Figure 2

Comparison of Measured and Predicted Separation Points

- Assumed BL thickness = 0.3 in. @ 2X/C = -1.5
- M_0 = 0.663
- Reference (AIAA PAPER 71-565)

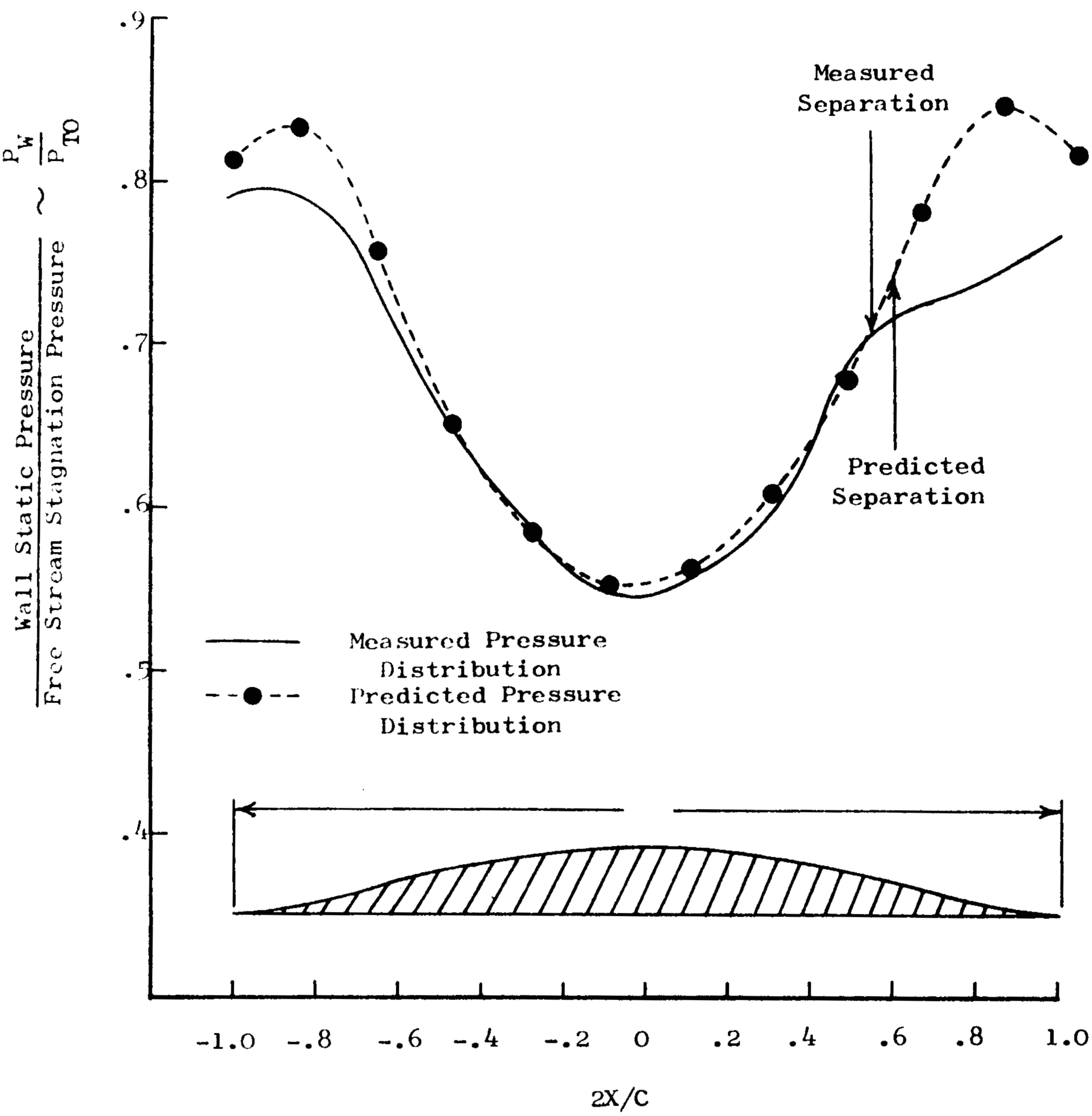


Figure 3. Comparison of Measured and Predicted Separation Points

2 input tape? T or F output tape? T or F

1 STC ____ ____

Mach number, ambient pressure and temperature, fluid properties

$A (1.) (1.) (1.) (1.4)

MACHØ=________, TSØ=________, PSØ=________, RG=________, GAM=________,

Highlight radius, maximum body radius, body closure tolerance

RHL=________, RM=________, TTE=________,

axisymmetric or planar?
(T) or F

AXI=__________,

spacial grid refinement criteria, see notes

GR(1)=________, ________, ________, ________, ________, ________, ________,

SGR(1)=________, ________, ________, ________, ________, ________, ________,

NGR=________,

GZ(1)=________, ________, ________, ________, ________, ________, ________,

SGZ(1)=________, ________, ________, ________, ________, ________, ________,

NGZ=________,

maximum Mach number increment between grid points

streamwise direction	normal direction
(0.1)	(0.1)

VMG1=_________, VMG2=___________,

maximum number of refinements

MAXIT=________,

fluid reference temperature, reference viscosity, Sutherland constant, units conversion constant

(518.7°R) (10^{-6} lbm/in.sec) (198.6°R) (32.174 ft-lbm/lb_f sec^2)

TREF= _______, MUREF= _______, SCON= _______, CG= _______,

$

Boundary Coordinates

boundary name   channel name

24   14   24

2 BDY __________ __________

upper boundary? T or F   angle input? T-no, F-yes   boundary layer? T-yes, (F-no)   equv. flat plate distance to boundary layer origin (0.)

$A 1 UPPER=______, ZRØNLY=________, BL= ________, CAPXI= __________,

Z   R   ANGD

B(1)=__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,
__________, __________, __________,

$

channel
name

2 4 14

3 CHN ________

$A

ratio of specific heats (1.4)	gas constant (1.0)	flow rate may be adjusted? (T) or F

GAM=________, RG=___________, VARY=_________,

stagnation properties, see notes 3 and 4

total temp	total pressure

TTØ=__________, PTØ=______________,

Mach no.	static temp	static pressure

MACHØ=________, TSØ=_________, PSØ=_______________,

flow area normalized by A_{HL}.

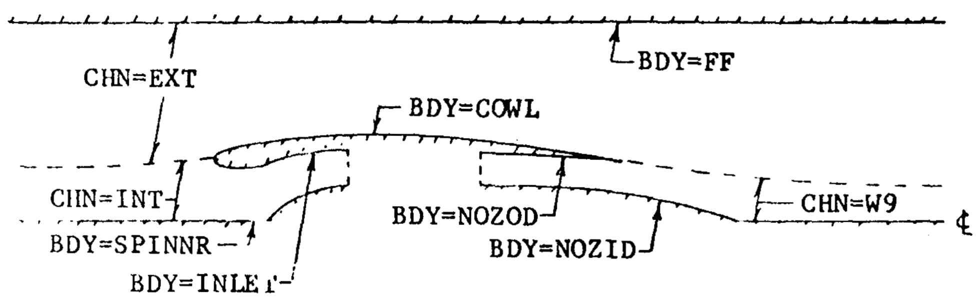
AØ=______________________,

$

General Instruction and Notes for Sheet-1 of the STC Input Forms

1) The STC Program computes the subsonic and transonic field of inviscid flow past (and within) arbitrarily shaped planar and axisymmetric bodies. Inlet and exhaust nozzle flows wherein there may exist jet streams with differing energies are typical applications. An optional boundary layer analysis (SAB) is included to evaluate friction losses and displacement of the inviscid flow.

2) The total flow is composed of one or more streams, the properties of which are to be listed on Sheet-3 (except as noted below). Each stream occupies a "channel" which is identified by a one to six character alphanumeric word. Each channel must be bounded, at least in part, by an "upper boundary" and a "lower boundary". Each boundary is also given an identifying one to six character name and the coordinates are listed on Sheet-2. The following sketch illustrates the naming of channels (CHN) and boundaries (BDY).



An external flow channel must be named EXT, the recommended name for the inlet capture flow channel is INT, and the far-field interface boundary must be named FF. Otherwise the selection of the channel and boundary names is arbitrary. The special channel names EXT and INT cause extra streamlines to be placed in the first refined grid. The boundary name FF indicates that the boundary condition on FF is to be obtained from an analytic far-field solution.

There is no specific limit to the complexity of the flow field in regard to the number of channels or the number of boundaries. Limits are set on the total amount of data which may be input.

3) The solution method consists of constructing a grid of streamlines and orthogonal lines. Starting with two streamlines per channel (one for each boundary) and an orthogonal passing through the first and last point of each boundary, the grid is automatically refined by dividing the grid intervals in half and in half again as required. The numerical resolution, the solution accuracy and the computer execution cost are all directly related to the extent of grid refinement. The input variable MAXIT determines the maximum number of refinements. Providing this limit is not exceeded, the grid will be refined, locally as required, until the spacing of orthogonals and streamlines is less than the value determined from the SGR and SGZ tables and the Mach number difference between any two points on a streamline or an orthogonal line is less than VMG1 and VMG2, respectively. Grid size values versus radius (or y-ordinate) are to be tabulated after SGR and GR, respectively. NGR is the number of entries in each list. Grid size versus the axial coordinate is to be tabulated after SGZ and GZ, respectively. NGZ is the number of GZ values. If dimensional values of RG, TSO and PSO are input (see Note 6), then VMG1 and VMG2 must have units of velocity rather than Mach number. See supplemental notes for additional details.

   A partially refined grid may be saved on tape by specifying a T in column 24 of the first card, or read from a previously created tape by specifying at T in column 14.

   If TAPE 1 and/or TAPE 2 are not assigned via a REQUEST card, they are assigned to disc. This allows the user to obtain output for a given refinement level and provides the option of changing input parameters on the restart. For the restart case, specify a T in column 14 of the first data card and include in the $A list only those input quantities (viz; MAXIT) which differ from those originally input.

4. In the initial calculation grid, an orthogonal line will pass through each leading and trailing edge point and through each sharp corner point (i.e. a point on the boundary with an angle discontinuity). It is not possible to analyze a configuration in which two or more of these points

are approximately opposite to each other. For example, if a configuration contains more than one leading edge, the edges must be staggered relative to the streamwise direction.

5. A free stream Mach number is specified by supplying a value of MACHØ.

6. Perfect gas assumptions are employed and the levels of ambient pressure and temperature may be dimensionless (TSO=PSO=RG=1) or dimensional. Dimensional values in a consistent set of units as described in the STC-SAB User Manual must be supplied if boundary layer calculations are requested.

7. A reference (or highlight) area is calculated from the input value of R_{HL} as follows:

   axisymmetric: $A_{HL} = \pi R_{HL}^{2}$

   planar: $A_{HL} = \Delta y_{HL} = R_{HL}$

   This reference area (or Δy in the planar case) is used for defining the mass flow for each channel. See STC/Sheet-3 note 5.

8. Computed pressure drag forces are normalized by the (maximum) body area where

   axisymetric: $Am = \pi R_{m}^{2}$

   planar: $A_{m} = \Delta y_{m} = R_{m}$

9. Finite trailing edge thickness is permitted; the maximum thickness, or body closure tolerance, is to be supplied after TTE.

10. On this and the following input sheets, the values in parenthesis are used if other values are not input.

11. For boundary layer cases, supply a reference temperature, reference viscosity and a Sutherland constant if different from air values. The following sets of units may be used:

Units

Parameter	Dimensionless(STC)	English(in.)	English(ft.)	MKS
L	any	in.	ft.	M
PSO,PTO	*atm	psia	psfa	N/M^2
TSO,TTO	*atm	°R	°R	°K
TREF	-	°R	°R	°K
MUREF	-	lbm/in.sec	lbm/ft.sec	kg/m.sec
SCON	-	°R	°R	°K
RG	1	ft^2/sec^2°R	ft^2/sec^2°R	J/kg °K
CG	-	ft-l.b/$lb_f sec^2$	ft-lbm/$lb_f sec^2$	(unity)
VMG1,VMG2	**	ft/sec	ft/sec	m/sec

*atm - Normalized by ambient conditions

** - Dimensionless (values are approximately equal to a Mach number difference)

Notes for Sheet-2 of the STC Input Forms

1. Use one of these sheets for each boundary. Supply a one to six character name to identify the boundary in column 14 of the first card. Also indicate the name of the channel to which the boundary is adjacent in column 24. On the second card indicate whether the boundary is above (UPPER = T) or below (UPPER = F) the channel.

2. The upper or lower "contour" which bounds a given stream may be composed of several "boundaries". In this case, an input sheet must be completed for each boundary; the last point of the first boundary must have the same coordinates as the first point of the second boundary, and so forth. This option is useful when considering variable geometry configurations such as flaps or movable nozzle parts. The movable part may be translated and rotated, as indicated by Note 8, while the fixed part is held stationary.

3. List values of Z (or X), R (or Y) and the surface angle in degrees at discrete points along this boundary contour after the symbol "B(1)=". Points at sharp corners must be listed twice, one time for each angle which exists at that point. In each interval, the STC Program fits a locally rotated cubic polynomial. The input points must be smooth and consistent with the specified angles.

All points are to be listed in the streamwise direction. For an inlet lip, the points are listed by starting at the highlight point and then proceeding around the nose to the trailing edge or downstream boundary. The internal and external surfaces are listed separately under different boundary names. However, the coordinates of the first point must be the same with ANGD equal to +90° for the external surface and -90° for the internal surface.

It is recommended that the boundary coordinates and angles be obtained from an analytic definition of the contour, and that around the nose, angle variations between points be 20° or less.

4. Pressure and Mach number distribution data will be printed at each orthogonal intersection with the boundary, and not at each input boundary point. Orthogonal stations, however, will be placed at any repeated point in the boundary table. List the same points twice if it is desired to have an orthogonal placed in that position. (This option is modified slightly when ZRONLY = T.) Orthogonal stations are always placed at the beginning and end of a boundary and at a juncture point between boundaries along the same contour.

5. If the coordinates but not the angles are known, the third column in the B-input array may be omitted. In this case specify ZRONLY = T and list the coordinates twice at any point where a curvature jump or an angle jump exists. The double points will later be deleted if the angle discontinuity is less than 0.01 degrees. These double points are removed because extra calculation stations (see Note 5) are usually not desired at such points. However, the double point angle tolerance, DBLPTS, preset as 0.01, may be input as zero if such double points are to be retained.

6. With either input option, care must be taken to specify the coordinates with precision. The round off or reading error of the coordinate data should be less than $\Delta S^2/(10*L)$, where ΔS is the local distance between points and L is some characteristic length, say the length of the cowl. Conversely, the spacing between points should not be less than $(10\ \delta L)^{1/2}$ where δ is the relative accuracy of the coordinate data. The tabulated output curvatures may be consulted to verify the smoothness of the input data.

7. NACA Series 1 Cowl coordinates are stored internally. With the ZRONLY = T option they may be selected by listing:

B(1) = 991, 1,	
X_1, Y_1,	Series 1 Segment
Y_2, Y_2,	
X_2, Y_2,	
____,____,	Cowl Aft Segment

where X_1, Y_1 are the highlight coordinates and X_2, Y_2 is the position of the maximum diameter at the end of the Series 1 contour segment.

8. The input coordinates of a boundary may be adjusted by supplying the following input quantities not shown on the front of this sheet:

ROTATE	angular rotation in degrees
ZPIVOT RPIVOT	pivot coordinates
SCALE	multiplicative constant to be applied to the coordinate data
ZTRANS	translation increment in the axial direction
RTRANS	translation on increment in the radial/vertical direction

The order of transformation is rotation, scaling and translation. Hence, the pivot coordinates are in the same coordinate frame as the input data and the translation increments are in the rotated coordinate frame after scaling. It is only necessary to input data for the transformation operations to be executed.

9. The normal option assumes no boundary layer (BL = F). If a boundary layer calculation is desired, input BL = T. Also, supply an initial "equivalent" flat plate distance for the boundary layer origin to the first calculation sation if different from 0. (stagnation point)

$$\text{CAPXI} = \frac{\pm 1}{R_1{}^{a}P_1} \int_{S_{orig}}^{S_1} RP^{a}\,dS$$

$$P = \left[\frac{M}{1 + .2M^2}\right]^4$$

$$a = 1.25 \qquad Rex_1 \approx 10^6$$
$$1.2 \qquad Rex_1 \approx 10^7$$

Notes for Sheet-3 of the STC Input Forms

1. Use one of these sheets for each channel to supply entrance flow properties. (See exception under Note 5).

2. Of the input items shown on the face of the input sheet, use only those which are required for the selected options.

3. The total pressure and total temperature may be input by either of the following two procedures:

   a) Specify TTO and PTO if the stagnation properties are known. These values may be normalized by the free stream ambient temperature and pressure.

   b) Specify MACHO, TSO and PSO if the static properties and Mach number are known. Again TSO and PSO may be normalized by the free stream ambient values. If only MACHO is supplied (TSO & PSO are omitted) the TSO and PSO values from STC/Sheet-1 will be used.

   If neither of the above is input, free stream values as supplied on Sheet-1 are used for MACHO, PTO and TTO.

4. If the gas constant, RG, is different from the value supplied on STC/Sheet-1, supply the value which applies to this channel. RG, TSØ TTO, PSO and PTO may all be given as dimensionless (normalized by free stream ambient) or dimensional using a consistant set of units.

5. Input a value AO for the determination of the channel flow rate. AO is an area fraction mormalized by A_{HL} as defined under Note 7 of Sheet-1; the (dimensional) channel flow area is then the product $AO*A_{HL}$. The flow rate for the channel is computed by using one-dimensional relations from the total properties (as determined under Notes 3 & 4), the supplied Mach number, MACHØ, and the flow area. For internal inlet channels, specify R_{HL} as the highlight radius and AO as the mass flow ratio.

5. If for any channel the input data on this sheet is not supplied, the reference properties on STC/Sheet-1 will be employed and the frontal area calculated at the entrance station will be used. This option is suggested for an external stream.

7. Although approximate flow rates must always be supplied according to Note 5, the program will adjust channel flow rates as required to meet the zero pressure loading conditions at a trailing edge or to meet a maximum (choked) flow rate. The number of channels which require flow rate adjustment is equal to the number of trailing edges. If the flow rate is not to be varied for this channel, specify VARY = F.

PROGRAM LISTINGS

```
*DECK BLBLOK
      BLOCK DATA BLBLOK
      COMMON /IXORIG/ IDUM1(14),LDO,LDE,IDUM2(17)
      COMMON /BLBDY / IBLB(60)
      COMMON /VISCOS/ TREF,MUREF,SCON
      REAL                 MUREF
      COMMON /REBL   / RESTBL
      LOGICAL            RESTBL
      DATA IBLB/60*0/
      DATA TREF,MUREF,SCON/518.688,10.E-7,201.6/
      DATA LDO,LDE/1,0/
      DATA RESTBL/F/
      END
```

```
*DECK LBDYBL
      FUNCTION  LBDYBL(BNAME,LOWER)
CLBDYBL         LOCATE INDEX IN BL INPUT TABLE
      LOGICAL           LOWER
      INTEGER           BNAME
      COMMON /CHDATA/ BDT(1),LBNEXT(1),LBZ1(1),
     *                 CHNAME(1),UP(1),LEDEX(1),
     *                 ZBT(1),RBT(1),ANGBT(42)
      LOGICAL          UP
      INTEGER          BDT,CHNAME,BDNAME
      DIMENSION          BDNAME(1),LBA(1),LBB(1)
      EQUIVALENCE        (BDNAME,ZBT),(LBA,RBT),(LBB,ANGBT)
      COMMON /CBITS   / IBITS,IBLANK

C     LBDYBL=0  IF NO BOUNDARY LAYER
C     LBDYBL=INDEX OF BOUNDARY IN BL INPUT TABLE

      COMMON /BLBDY / BLB(60)
      DIMENSION IBLB(60)
      EQUIVALENCE  (IBLB,BLB)

C     CHECK FOR LOWER=T--( POSSIBLE COLLATED BOUNDARY)
      LBDYBL= 0
      IF( LOWER ) GO TO 100
    1 IBL    = -2
    2 IBL    = IBL+3
      IF( IBLB(IBL).EQ.BNAME ) GO TO 10
      IF( IBLB(IBL).EQ.IBITS .OR. IBL.GE.58 ) CALL ERRORK(6HLBDYBL)
      GO TO 2
   10 IF( IBLB(IBL+1).EQ.0 ) GO TO 12
      LBDYBL= IBL
   12 RETURN

C     LOCATE POSITION IN BOUNDARY TABLE
  100 LB     = LBF(BNAME)
      IF( LEDEX(LB).EQ.0 ) GO TO 1
      LBZ    = LBZ1(LB)+3+LB
      IB     = BDT(LBZ)
  110 IBL    = -2
  120 IBL    = IBL+3
      IF( IBLB(IBL).EQ.IB ) GO TO 10
      IF( IBLB(IBL).EQ.IBITS .OR. IBL.GE.58 ) GO TO 140
      GO TO 120
  140 CALL ERRORK(6HLBDYBL)

      END
```

```
*DECK SAB
      SUBROUTINE SAB(ENTRY)
CSAB        MAIN SUBROUTINE FOR BOUNDARY LAYER CALCULATION
      INTEGER            ENTRY

C     ON ENTRY=FIRST,  SAVE B,S2 ON TAPE4
C     ON ENTRY=LAST,  RESTORE B,S2

      COMMON /BLDTA / BDNAME,LOWER,IBTYPE,N1,NI,CAPX1
      INTEGER            BDNAME
      LOGICAL                   LOWER
      COMMON /CB    / B(300)
      COMMON /CS2   / S2(300)
      COMMON /IXORIG/ LHO,LHE, LBTO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA, LSO,LSE, LDO,LDE, LDUM(4),
     *                MO,NM,NJ,NFCOLS,MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE,LRO,LRE,LRD
      COMMON /ERASE2/ XI1(100),SW(100),ZW(100),RW(100),DUM(200),
     *                VE(100),DUM1(800)
      COMMON /ALLCOM/ DUM2(5),AXIA,DUM3(14)
      LOGICAL                    AXIA


      GO TO (1,2,45) , ENTRY
    1 REWIND 4
      WRITE  (4) (B(I),I=1,NM),(S2(I),I=1,NM)

C     SCAN TABLES TO SET N1

    2 IBTYPE= 1
      IF( RW(1).EQ.0 .AND. AXIA ) IBTYPE=2
      GO TO (5,8) , IBTYPE
    5 DO 6 I=1,NI
      IF( VE(I).EQ.0. ) GO TO 20
    6 CONTINUE
      IBTYPE= 3
      N1    = 1
      GO TO 30
    8 DO 10 I=1,NI
      IF( RW(I).NE.0. ) GO TO 12
   10 CONTINUE
      RETURN
   12 N1    = I-1
      GO TO 30
   20 N1    = I

C     CALCULATE BL FOR BOUNDARY-- (BDNAME)

   30 CALL  SABBL

C     INSERT SMOOTHED DATA INTO  /BLTAB/

   40 CALL  BLTBBL
      GO TO 50
   45 REWIND 4
      READ  (4) (B(I),I=1,NM),(S2(I),I=1,NM)

   50 RETURN
```

```
*DECK SABBL
      SUBROUTINE SABBL
*SABBL

      COMMON /CBITS / BITS,BLANK
       EQUIVALENCE    (BITS,IBITS), (BLANK,IBLANK)

      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA,AXI,RG,GAM,MACHC(12)
       REAL           MACHA,MACHO,MACHOS
       LOGICAL        AXI
      COMMON /BLDTA / BDNAME,LOWER,IBTYPE,N1,NI,CAPX1
       LOGICAL         LOWER
      COMMON /ERASE2/ DSTAR(100),SW(100),ZW(100),RW(100),DSTR(100),
     1                DDSTR(100),VE(100),MACH(100),MACHSQ(100),CP(100),
     2                PQPT(100),PW(100),REXP(100),PR(100),CAPX(100)
       DIMENSION      XW(1),YW(1)
       EQUIVALENCE    (ZW,XW),(RW,YW)
       REAL           MACH,MACHSQ
      COMMON /VISCOS/ TREF,MUREF,SCON
       REAL            MUREF
      COMMON /CGRAV/ CG
      COMMON /BLSEP / NSLOC

      DIMENSION       REX(100),THETA(100),DELTA(100),P(100),F1(100),
     1                F2(100),F3(100),CF(100), ISEP(100),DCPQDX(100),
     2                F(100),AVG(100)
     3                ,CPK(100),DCPK(100)
       EQUIVALENCE     (DCPQDX,DCPK)

      DATA PI/3.14159/
      DATA KSEP/3HSEP/

*A*
      NSLOC   = 0
      N2      = N1+1
      NT      = NI-N1+1
      PSO     = PSA
      TSO     = TSA
      MACHO = MACHA
      IF( MACHO.EQ.BITS ) MACHO=MACH(N1)
      IF( MACHO.EQ.0. ) MACHO=MACH(N2)
      MACHOS= MACHO*MACHO
  180 GAM1    = GAM/(GAM-1.)
      CAPX2 = 0.
      IF(CAPX1.NE.0.) CAPX2=CAPX1
      CVP     = RG/(GAM-1.)
      IF( TTA.EQ.BITS .OR. TTA.EQ.1. ) TTO=TSO*(1.+.5*(GAM-1.)*MACHO**2)
      IF( PTA.EQ.BITS .OR. PTA.EQ.1. ) PTO=PSO*(TTO/TSO)**GAM1
      VMAX    = SQRT(2.*GAM1*RG*TTO)
      PTOQPO= (1.+(GAM-1.)*.5*MACHO*MACHO)**GAM1
      CPT     = .5*GAM*MACHO*MACHO
      DO 190 I=N1,NI
      MACHSQ(I)=MACH(I)*MACH(I)
      PQPT(I)=(CP(I)*CPT+1.)/PTOQPO
      PW(I) = PTO*(1.-(VE(I)/VMAX)**2)**GAM1
  190 CONTINUE
*    CALCULATE EXP
      RHOT    = PTO/(RG*TTO)*CG
```

```
      GAMM   = 1.+(GAM-1.)*.5*MACHO*MACHO
      RHOS   = RHOT*GAM**(-(1./(GAM-1.)))
      TSO    = TTO*GAMM
      V      = MACHO*SQRT(GAM*RG*TSO)
      AMU    = MUREF*(TSO/TREF)**1.5*(TREF+SCON)/(TSO+SCON)
      AL     = (SW(NI)-SW(N1))/2.
      RE     = RHOS*V*AL/AMU
      EXP    = 1.25
      IF(RE.GT.2.E7) EXP=1.2
      IF(EXP.EQ.1.25) GO TO 205
      CON1   = .23
      CON2   = .022
      CON3   = .028
      CON4   = -(1./6.)
      GO TO 210
  205 CON1   = .37
      CON2   = .036
      CON3   = .046
      CON4   = -.2

  210 IF(.NOT.AXI) EXP=0.
      DO 215 I=N1,NI
      REXP(I)=0.
      IF( .NOT. AXI ) REXP(I)=1.
      IF(RW(I).GT.0.) REXP(I)=RW(I)**EXP
      PR(I) = (MACH(I)/(1.+MACHSQ(I)*.2))**4*REXP(I)
  215 CONTINUE

*B* CALCULATE SW,CAPX,REX
      GAM12 = (GAM-1.)*.5
      AMU    = MUREF*(TTO/TREF)**1.5*(TREF+SCON)/(TTO+SCON)
      Z2     = SQRT(GAM/((GAM-1.)*CVP*TTO))
      GAMP   = (GAM-2.)/(GAM-1.)
      Z4A    = SCON/TTO
      Z4D    = 1./(1.+Z4A)
      Z1M    = PTO*CG/AMU
      CAPX(N1)=CAPX2
      CALL SETM(1,IBLANK,ISEP,100)
      DO 220 N=N2,NI
      I      = N-1
      SWD    = SW(N)-SW(I)
      AINT   = (PR(N)+PR(I))*.5*SWD
      CAPX(N)= AINT/PR(N)+CAPX(I)*PR(I)/PR(N)+CAPX2
      TTOT   = 1.+GAM12*MACHSQ(N)
      Z1     = MACH(N)*Z1M
      Z3     = TTOT**GAMP
      Z4     = (1./TTOT+Z4A)*Z4D
      REX(N)=Z2*Z1*Z3*Z4
  220 CONTINUE

      CALL LSPFIT(SW(N1),PW(N1),NT, SW(N1),F3(N1),NT,1)

      TTOT   = 1.+GAM12*MACHSQ(N1)
      Z1     = MACH(N1)
      Z3     = TTOT**GAMP
      Z4     = (1./TTOT+Z4A)*Z4D
      REX(N1)=Z2*Z1*Z3*Z4
```

```
*C* CALCULATE THETA,DSTAR,DELTA
      K2     = 0
      CALL SETM(1,0.,F,100)
      THETA(N1)=0.
      DSTAR(N1)=0.
      DELTA(N1)=0.
      F(N1)  = 0.
      FMAX   = -10.**6
      DO 230 I=N1,NI
      IF(I.NE.N1) GO TO 225
      IF(CAPX2.EQ.0.) GO TO 230
  225 CAPXX  = CAPX(I)*(REX(I)*CAPX(I))**CON4
      THETA(I)=CON2*((1.+MACHSQ(I)*.1)**(-.7))*CAPXX
      DSTAR(I)=CON3*(1.+MACHSQ(I)*.8)**(.44)*CAPXX
      DELTA(I)=CON1*CAPXX
      IF(I.EQ.N1) GO TO 230
*  CHECK FOR SEPARATION
      IF( PW(I+1).LE.PW(I) .OR. I.LE.K2 ) GO TO 2290
      K      = I
 1225 K      = K+1
      IF( K.GT.NI ) GO TO 1226
      IF( PW(K).GT.PW(K-1) ) GO TO 1225
 1226 K1     = I
      IF( K1.EQ.(K-1) ) GO TO 2290
      K2     = K-1
      K1M    = K1-1
      IF( MACH(K1M).EQ.0. ) K1M=K1
      MACHOS= MACHSQ(K1)
      CPK(K1M)= 1.
      DO 226 K=K1M,K2
      IF( MACH(K).EQ.0. ) GO TO 226
      CPK(K)=1.-MACHSQ(K)/MACHOS
  226 CONTINUE
      DO 227 K=K1,K2
  227 DCPK(K)=(CPK(K)-CPK(K-1))/(SW(K)-SW(K-1))
      K2M    = K2-1
      DO 228 K=K1,K2M
  228 DCPK(K)=(DCPK(K)+DCPK(K+1))*.5
      DO 229 K=K1,K2
      SWK    = SW(K)-SW(I)+CAPX(I)
      F(K)   = CPK(K)*(SQRT(ABS(SWK*DCPK(K))))*((1E-6)*REX(K)*SWK)**(-.1))
  229 CONTINUE
 2290 FMAX   = AMAX1(F(I),FMAX )
      IF( FMAX.GE. .5 ) GO TO 232
  230 CONTINUE
      N3     = I
      GO TO 234

*  SEPARATION
  232 ISEP(I)=KSEP
      N3     = I
      NSLOC  = N3
      I      = NI-N3
      CALL SETM(1,DSTAR(N3),DSTAR(N3+1),I)

*D* CALCULATE P FOR TOD
  234 P(N1)  = 0.
      DO 240 I=N2,N3
```

```
      K      = I-1
      A1     = (RW(K)+RW(I))*.5
      A2     = (DSTAR(K)+DSTAR(I))*.5
      IF(AXI) GO TO 235
      P(I)   = A2*(PW(I)-PW(K))+P(K)
      GO TO 240
  235 P(I)   = 2.*PI*A1*A2*(PW(I)-PW(K))+P(K)
  240 CONTINUE

*   CALCULATE TOD, TOTAL SKIN FRICTION DRAG
      IF(AXI) GO TO 250
      DRM    = GAM*((PW(NI)*MACHSQ(NI)*THETA(NI))-(PW(N1)*MACHSQ(N1)
     1          *THETA(N1)))
      GO TO 255
  250 DRM    = GAM*((PW(NI)*MACHSQ(NI)*THETA(NI)*2.*PI*RW(NI))-
     1          (PW(N1)*MACHSQ(N1)*THETA(N1)*2.*PI*RW(N1)))
  255 TOD    = DRM-P(NI)

*E* CALCULATE CF
  300 DO 310 I=N1,N3
      RX=1.
      IF(AXI)RX=RW(I)
      F1(I) = RX*PW(I)*MACHSQ(I)
      F2(I) = F1(I)*THETA(I)
  310 CONTINUE

      NN     = N3-N1+1
      CALL LSPFIT(SW(N1),F2(N1),NN,SW(N1),CF(N1),NN,1)

      N11=Ni
      IF(MACH(1) .NE. 0.) GO TO 319
      N11=N2
      CF(1)=0.
  319 DO 320 I=N11,N3
      CF(I) = 2.*CF(I)/F1(I)-2.*DSTAR(I)*F3(I)/(GAM*PW(I)*MACHSQ(I))
  320 CONTINUE
      CALL LESTSQ(SW,DSTAR,N1,NI,3,5,DSTR)
      NN     = NI
      DO 327 I=N1,NI
  327 DSTR(I)= DSTR(I)+DSTAR(I)
      CALL LSPFIT(SW(N1),DSTR(N1),NN,SW(N1),DDSTR(N1),NN,1)

*   WRITE OUTPUT
      WRITE (6,1002)
 1002 FORMAT(//37X,30H B O U N D A R Y     L A Y E R//)
      WRITE (6,1004) (I,XW(I),THETA(I),DSTAR(I),DELTA(I),REX(I),
     1          CAPX(I),CF(I),SW(I),DSTR(I),DDSTR(I),ISEP(I),F(I),I=N1,N3)
 1004 FORMAT(4X,1HI,5X,2HXW,4X,5HTHETA,5X,5HDSTAR,4X,5HDELTA,5X,3HREX,
     * 7X,4HCAPX,6X,2HCF,8X,2HSW,6X,4HDSTR,4X,5HDDSTR,5X,3HSEP,8X,
     * 4HFSEP/
     * (2X,I3,F9.4,3F9.5,F9.0,F9.4,F9.5,F10.4,2F9.5,2X,A6,F13.6),)
      WRITE (6,1003) TOD
 1003 FORMAT(/6X,20HTOTAL FRICTION DRAG=,F14.5)

  900 RETURN
      END
```

```
*DECK BLTBBL
      SUBROUTINE BLTBBL
CBLTBBL         BUILD BOUNDARY LAYER TABLES

      COMMON /BLDTA / BDNAME,LOWER,IBTYPE,N1,NI,CAPX1
      INTEGER         BDNAME
      LOGICAL                LOWER
      COMMON /IXORIG/ LHO,LHE, LBTO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA, LSO,LSE, LDO,LDE, LDUM(4),
     *                MO,NM,NJ,NFCOLS,MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE,LRO,LRE,LRD
C    STATION  TABLE
      COMMON /CHDATA/ X1(1),LNEXT(1),MLB(1),MUB(1),PRIM(1),
     *                TYPELB(1),NAMELB(1),ILB(1),FLB(1)
      COMMON /ERASE2/ XI1(100),SWBL(100),ZW(100),RW(100),DSTR(100),
     *                DDSTR(100),VE(100),MACH(100),DUM(700)
      DIMENSION       LEDEX(1),LBZ1(1)
      EQUIVALENCE     (LEDEX,TYPELB),(LBZ1,MLB)
C     BOUNDARY LAYER TABLE
C     INDEX- LD=LDO,LDE--- INITIALLY 1,0
      DIMENSION       BNAME(1),LBLNXT(1),NSEP(2),SWREF(1),SIGN(1),
     *                SW(1),DSTAR(1),DDSTAR(1)
      INTEGER         BNAME
      EQUIVALENCE     (BNAME,X1),(LBLNXT,LNEXT),(NSEP,MLB),
     *                (SWREF,PRIM),(SIGN,TYPELB),(SW,NAMELB),
     *                (DSTAR,ILB),(DDSTAR,FLB)
      COMMON /BLSEP / NSLOC
      COMMON /REBL  / RESTBL
      LOGICAL         RESTBL
      COMMON /CPRINT/ PDUMM(6),PDUM(20)
      COMMON /CTABPR/ I1TAB
      COMMON /BLBDY / IBLB(60)
      INTEGER          UPPER
      LOGICAL ENTRY1
      DATA ENTRY1/T/
      DATA UPPER,LOWR/5HUPPER,5HLOWER/
      DATA SWSAVE/0./
      IF( RESTBL ) GO TO 1111
      GO TO 1

C     RESTORE  TABLES

 1111 NUM    = LDE-LDO+1
      NMOVE = LESTA-LFO+1
      CALL MOVE(1,X1(LFO),X1(LDO),NMOVE,1)
      LFO    = LDO
      LESTA = LESTA-NUM
      LO     = LO-NUM
      LFE    = LO-1
      LDO    = 1
      LDE    = 0
      RESTBL= .FALSE.


C     RELOCATE FLOW ADJUSTMENT AND STATION TABLES


    1 NUM    = 3*(NI-N1+1)+6
```

```
      MAXT   = LESTA+NUM
      IF( (MAXT-LHO).GT.MAXLE ) GO TO 1000
      LFONEW= LFO+NUM
      NMOVE  = LESTA-LFO+1
      CALL MOVE(1,X1(LFO),X1(LFONEW),-NMOVE,1)
      LD     = LDE+1
      IF( LDE ) 2,2,5
    2 LDO    = LO
      LD     = LDO
      LDE    = LDO+NUM-1
      GO TO 6
    5 LDE    = LDE+NUM
    6 LFO    = LFONEW
      LESTA  = MAXT
      LO     = LO+NUM
      LFE    = LO-1
      LBLNXT(LD)= LD+NUM

C     DETERMINE SWREF FOR  BOUNDARY BDNAME

      LB     = LBF(BDNAME)
      IF( LB.NE.0 ) GO TO 15
      IF( .NOT.LOWER ) CALL ERROR1
      SWREF(LD)= SWSAVE
      SWSAVE= 0.
      GO TO 20

   15 SWREF(LD)= 0.
      IF( LEDEX(LB).EQ.0 ) GO TO 20
      IV1    = 1
      IV2    = (LEDEX(LB)-LBZ1(LB))/3+1
      SWREF(LD)= BARCS(BDNAME,IV1,IV2)
      SWSAVE= SWREF(LD)
   20 BNAME(LD)= BDNAME
      SIGN(LD)= -1.
      IF( LOWER ) SIGN(LD)=1.
      NSEP(LD)= 0
      IF( NSLOC.NE.0 ) NSEP(LD)=LD+3*(NSLOC-N1+1)-3

C     MOVE BL PARAMETERS TO TABLE

   30 DO 40 LD1=N1,NI
      SW(LD)= SWBL(LD1)
      DSTAR(LD)= DSTR(LD1)
      DDSTAR(LD)=DDSTR(LD1)
      LD     = LD+3
   40 CONTINUE
      GO TO 2000
 1000 LUP    = UPPER
      IF( LOWER ) LUP=LOWR
      WRITE (6,1001) LUP,BDNAME
 1001 FORMAT(//2X,48HTABLE SPACE EXHAUSTED--BOUNDARY LAYER DATA FOR  ,
     * A6,2X,8HBOUNDARY,2X,A6,2X,9HNOT SAVED//)
      DO 999 LL=1,58,3
      IF( IBLB(LL).EQ.0 ) GO TO 2000
      IF( IBLB(LL).EQ.BDNAME ) IBLB(LL+1)=0
  999 CONTINUE
```

```
2000 IF( PDUM(15).EQ.0. ) GO TO 2001
     I1TAB = LDO
     CALL TABPRT(6HSTABLT,X1,LESTA,6)
     CALL TABPRT(3HBLB,BLB,60,10)
2001 ENTRY1= .FALSE.
     RETURN
     END
```

```
*DECK LESTSQ
      SUBROUTINE LESTSQ(X,Y,IA,IB,NOC,NS, DY)
*LESTSQ         1ST/2ND ORDER CURV FIT BY LEAST SQUARE DEV  -LESTSQ-
C                * VERSION 2
C                * NO ROTATION OF AXIS
C                * AUTOMATIC REDUCTION OF  NS  AND  NO  NEAR THE END PTS
       DIMENSION       X(10),Y(10),DY(10)

C     INPUT-
C      X(I),Y(I),I=IA,IB ARE ENTRY COORDINATES
C      NOC    = ORDER OF CURVE FIT + 1,   =2 OR 3
C      NS     = NUMBER OF POINTS INCLUDED IS EACH LEAST SQUARE FIT
C               MINIMUM  NS  IS =NO+NO-1.  ALSO,  NS  MUST BE ODD.

C     OUTPUT-
C      DY(I) = DEVIATION OBTAINED FROM THE CURVE FIT

      COMMON /ERASE / B(3),A(3,3)

      MIS    = (NS-1)/2
      IAA    = IA+1
      IBB    = IB-1
      DY(IA)= 0.
      IF(IAA.GT.IBB) GO TO 160
      DO 150 I=IAA,IBB

C     INITIALIZE TO ZERO
      DO 110 J=1,12
  110 B(J)=0.

C     SET UP MATRIX (A)(X)=(B)
      A(1,1)=NS
      MI     = MINO(I-IA,MINO(MIS,IB-I ))
      NO     = MINO(NOC,MI+1)
      JA     = I-MI
      JB     = I+MI
      DO 120 J=JA,JB
      XP=X(J)-X(I)
      YP=Y(J)-Y(I)
      XP2=XP**2
      A(1,2)=A(1,2)+XP
      B(1)=B(1)+YP
      A(2,2)=A(2,2)+XP2
      B(2)=B(2)+YP*XP
      IF(NO-2) 115,120,115
  115 A(2,3)=A(2,3)+XP2*XP
      A(3,3)=A(3,3)+XP2**2
      B(3)=B(3)+YP*XP2
  120 CONTINUE
      A(2,1)=A(1,2)
      IF(NO-2) 125,130,125
  125 A(1,3)=A(2,2)
      A(3,1)=A(1,3)
  129 A(3,2)=A(2,3)

  130 CALL SIMEQ(NO,A,B,3)

      DY(I)=B(1)
```

```
150 CONTINUE
160 DY(IB)= 0.
    RETURN
    END
```

```
*DECK SIMEQ
      SUBROUTINE SIMEQ(NN,A,B,MP)
CSIMEQ         PRO NO F3494A
C             THE EQUATIONS WHICH ARE SOLVED ARE AX=B. THE MATRIX
C             SIMEQ SIMULTANEOUS EQUATIONS
C             A AND THE VECTOR B ARE DESTROYED.  FOR PRINTOUT OF
C             THE MATRIX TO BE SOLVED SET MP NOT EQUAL TO ZERO
C             NN IS THE NUMBER OF EQUATIONS
      DIMENSION A(3,3),B(3)
   25 DO 140 K=1,NN
   30 P=A(K,K)
   35 ASSIGN 85 TO MT
   40 DO 55 I=K,NN
   45 IF(ABS(P)-ABS(A(I,K))) 50,55,55
   50 P=A(I,K)
   52 ASSIGN 65 TO MT
   53 L=I
   55 CONTINUE
   60 GO TO MT,(65,85)
   65 DO 80 J=K,NN
   70 P=A(K,J)
   75 A(K,J)=A(L,J)
   80 A(L,J)=P
   81 P=B(K)
   82 B(K)=B(L)
   83 B(L)=P
   85 B(K)=B(K)/A(K,K)
      IF(K-NN) 90,145,90
   90 L=K+1
      DO 100 J=L,NN
  100 A(K,J)=A(K,J)/A(K,K)
      DO 140 I=L,NN
      IF(A(I,K)) 120,140,120
  120 DO 125 J=L,NN
  125 A(I,J)=A(I,J)-A(I,K)*A(K,J)
  140 B(I)=B(I)-A(I,K)*B(K)
  145 L=NN-1
      DO 170 KK=1,L
      K=NN-KK
      P=0.0
      DO 165 J=K,L
  165 P=P+A(K,J+1)*B(J+1)
  170 B(K)=B(K)-P
 1999 RETURN
      END
```

```
*DECK ERRORN
      SUBROUTINE ERRORN
CEDUMPN          STC EDUMP - INPUT LINK                              -EDUMPN-

      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                DAXIT,SCALEA,TTE,CHOTST
       REAL           MACHA(1),MACHC
       LOGICAL        AXIA,AXIC
       LOGICAL        CHOTST
C     CHANNEL INPUT DATA TABLE
C      INDEX- LH=LHO,LHE
      COMMON /CHDATA/ CHNAM(1),LHNEXT(1),WTFLOW(1),TTO(1),PTO(1),
     1                TSO(1),PSO(1),MACHO(1),AO(1),VARY(1),
     2                RG(1),GAM(1), NR(1),NC(1),TAB(6),
     4                BB(75)
       LOGICAL        VARY
       INTEGER CHNAM
       DIMENSION      VO(1)
       REAL           MACHO
       EQUIVALENCE    (VO,MACHO)
C     BOUNDARY TABLE
C      INDEX- LB=LBDO,LBDE
C      LBNEXT= INCREMENT TO NEXT BOUNDARY
C      LBZ1  = INCREMENT TO THE FIRST BOUNDARY POINT (=0 BEFORE COALLATIO
C      CHNAME= CHANNEL WITH WHICH THE BOUNDARY DATA IS ASSOCIATED
C      UP    = T OR F FOR UPPER OR LOWER BOUNDARY
C      LEDEX = RELATIVE INDEX OF L.E. POINT WHEN LOWER AND UPPER SURFACE
C              CONTOURS ARE CONNECTED
C      BDNAME,LBA,LBB=NAME AND INDEX LIMITS OF SPECIFIC BOUNDARY
C                     DATA WHEN BOUNDARIES ARE COALLATED
      DIMENSION       BDT(1),LBNEXT(1),LBZ1(1),
     1                CHNAME(1),UP(1),LEDEX(1),
     2                ZBT(1),RBT(1),ANGBT(42)
       LOGICAL        UP
       INTEGER BDT,CHNAME,BDNAME
       DIMENSION      BDNAME(1),LBA(1),LBB(1)
       EQUIVALENCE    (BDNAME,ZBT), (LBA,RBT), (LBB,ANGBT)
C     FLOW ADJUSTMENT TABLE
C      INDEX- LF=LFO,LFE
C      NFCOLS= 8
C      X1F   = ORTHOGONAL COORDINATE
C      X2F   = STREAMLINE COORDINATE OF SL EMINATING FROM T.E.
C      X1BF  = X1-COORDINATE OF CHOKE STATION OF FLOW BELOW T.E.
C      X1AF  = X1-COORDINATE OF CHOKE STATION OF FLOW ABOVE T.E.
C      S1F   = S1-COORDINATE OF T.E. (UPPER SURFACE). THIS ITEM
C              IS USED WHEN INTERPOLATING FOR WAKE DELTA-STAR.
C      LFB,LFA=INDICES OF STATIONS BELOW AND ABOVE T.E.
C      NCHB,NCHA=NUMBER OF CHANNELS BELOW AND ABOVE T.E.
C      LRF   = INDEX OF DUMMY ORTCHN LIST FOR THE T.E.
C      LRXF  = INDEX OF LAST CHANNEL BELOW THE T.E.
C      JORDER= 0 IF TOTAL FLOW AT X1F IS GIVEN
C            = 2 IF FLOW ABOVE T.E. IS GIVEN
C            = 1 IF FLOW BELOW T.E. IS GIVEN
C      JORDER= -1 IF FLOW AT X1F IS CHOKED AND SINGLE CHANNEL
      DIMENSION       X1F(1),X2F(1),X1BF(1),X1AF(1),
     1                S1F(1),NCHB(1),NCHA(1),JORDER(1),VNR(12)
       EQUIVALENCE    (LFB,X1BF),(LFA,X1AF),(LRF,NCHB),(LRXF,NCHA)
```

```
      DIMENSION       LFB(1),LFA(1),LRF(1),LRXF(1)
C     TABLE OF CONVECTED PROPERTIES
C      INDEX- LT=LTO,LTE
C      CH     = CHANNELNAME
C      LTNEXT= INDEX INCREMENT TO THE NEXT CHANNEL
C      LPSI   = RELATIVE LOCATION OF PSI LIST
C      NPT    = NO. OF PSI, TT, PT AND RCU VALUES
C      LTT    = RELATIVE LOCATION OF TT LIST
C      LPT    = RELATIVE LOCATION OF PT LIST
C      LRCU   = RELATIVE LOCATION OF RCU LIST
       DIMENSION        CH(1),LTNEXT(1),NPT(1),LPSI(1),LTT(1),LPT(1),
     1                  LRCU(1),
     2                  CRG(1),CPGJ(1),C2CP(1),QGAM(1),FGT(1),FGP(1),
     3                  FGR(1),AREATB(485)
        INTEGER CH
       DIMENSION XCH(1)
       EQUIVALENCE (CH,XCH)
C     STREAMLINE TABLE
       COMMON /SLTAB / W(128),X2(128),SLCHN(128)
        INTEGER SLCHN
C     STATION TABLE
C      INDEX- L=LO,LESTA
C      SCHOKE= STATION CHOKE INDICATOR (ADJWF,BRHS,WRIOUT)
C      MCL    = SHARP CORNER INDICATOR (BLDTBS)
C      MCL    = FIELD INDEX OF CONTROL STREAMLINE (PTMOVE,FLOBAL)
       DIMENSION        X1(1),LNEXT(1),MLB(1),MUB(1),PRIM(1),
     1                  TYPELB(1),NAMELB(1),ILB(1),FLB(1),S1LB(1),
     1                  TYPEUB(1),NAMEUB(1),IUB(1),FUB(1),S1UB(1),
     3                  VMB(1),DWDV(1), X2CL(1),VCL(1),MCL(481)
        LOGICAL         PRIM
        INTEGER TYPELB,TYPEUB
        DIMENSION       SCHOKE(1)
        EQUIVALENCE     (SCHOKE,DWDV)
C     TABLE OF WAKE DISPLACEMENT THICKNESS
C      INDEX- LW=LWO,LWE
       DIMENSION               X2W(1),LWNEXT(1),S1W(47)
        DIMENSION       DST(1)
        EQUIVALENCE     (DST,S1W)
C      SUBTABLE ARRANGEMENT IS-
C       X2W,LWNEXT(=2+2N), S1W(1),S1W(2)...S1W(N), DST(1),DST(2),..DST(N)
C      X2W    = STREAMLINE COORDINATE
C      S1W    = DISTANCE ALONG STREAMLINE FROM T.E.
C      DST    = WAKE DISPLACEMENT THICKNESS AS A FUNCTION OF S1W

C     FIELD TABLES
C      INDEX- M=MO,NM
       COMMON /CZ     / Z(300)
       COMMON /CR     / R(300)
       COMMON /CS2    / S2(300)
       COMMON /CS1    / S1(300)
       COMMON /CPHI1  / PHI1(300)
       COMMON /CM     / JMS(300)
       COMMON /CCURV  / CURV(300)
       COMMON /CB     / B(300)
       COMMON /CIDEX  / M,J,MU,MD,ISTAG

C     TABLE OF INDEX LIMITS
       COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
```

```
     *                  LO,LESTA,LSO,LSE,LDO,LDE,LDUM(4),
     *                  MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                  LEO,LEE, LRO,LRE,LRD
       DIMENSION        LIMITS(24)
C     TABLE OF LEADING EDGE AND TRAILING EDGE POINTS
C      INDEX- LE=LEO,LEE,10
C      NLE,NTE=NO. OF L.E. AND T.E. COINCIDENT PTS, RESPECTIVELY
C      CHL,CHU=NAME OF CHANNEL ABOVE AND BELOW PT, RESPECTIVELY
C      BDL,BDU=BOUNDARY NAMES ASSOCIATED WITH THE POINTS
C      NUSED = COUNT OF TIMES THAT POINT USED IN CONSTRUCTION OF /ORTCHN/
       COMMON /LETEPT/ XE(1),YE(1),ANGE(1),NLE(1),NTE(1),
     1                 CHL(1),CHU(1),BDL(1),BDU(1),NUSED(491)
       INTEGER          CHL,CHU,BDL,BDU
C     TABLE OF CHANNELS EMBRACED BY EACH ORTHOGONAL
C      INDEX- LR=LRO,LRE,LRD
C      LRD    = NUMBER OF CHANNELS PLUS ONE,   LR INDEX INCREMENT
C      LEDGE  = INDEX OF THE ORTHOGONAL POINT IN THE LETEPT-TABLE
C      LRPREV= POINTER OF LINE OF UPSTREAM CHANNELS IN ORTCHN-TABLE
C      CHNA   = CHANNEL NAMES
       COMMON /ORTCHN/ LEDGE(1),LRPREV(1),CHNA(479)
        INTEGER CHNA
        DIMENSION       JCHNA(1)
        EQUIVALENCE     (JCHNA,CHNA)

        EQUIVALENCE    (CHNAM,BDT,CH,X2W,X1F,X1)
        EQUIVALENCE    (LHNEXT,LBNEXT,LTNEXT,LWNEXT,X2F,LNEXT)
        EQUIVALENCE    (WTFLOW,LBZ1,NPT,S1W,X1BF,MLB)
        EQUIVALENCE    (TTO,CHNAME,LPSI,X1AF,MUB), (PTO,UP,LTT,S1F,PRIM)
        EQUIVALENCE    (TSO,LEDEX,LPT,NCHB,TYPELB)
        EQUIVALENCE    (PSO,ZBT,LRCU,NCHA,NAMELB)
        EQUIVALENCE    (MACHO,RBT,CRG,JORDER,ILB), (AO,ANGBT,CPGJ,VNR,FLB)
        EQUIVALENCE    (VARY,C2CP,S1LB), (RG,QGAM,TYPEUB)
        EQUIVALENCE    (GAM,FGT,NAMEUB), (NR,FGP,IUB), (NC,FGR,FUB)
        EQUIVALENCE    (TAB(1),AREATB,S1UB), (TAB(2),VMB), (TAB(3),DWDV)
        EQUIVALENCE    (TAB(4),X2CL), (TAB(5),VCL), (TAB(6),MCL)

       COMMON /CBITS / BITS,BLANK
       COMMON /CREDIN/ ZTRANS,RTRANS,ROTATE,ZPIVOT,RPIVOT,SCALE,NB,TBB(9)
        EQUIVALENCE     (XTRANS,ZTRANS),(YTRANS,RTRANS),(XPIVOT,ZPIVOT),
     1                  (YPIVOT,RPIVOT)
       COMMON /CTABPR/ I1TAB

       COMMON /CSEGME/ IA(10),IB(10),IMA(10),IMB(10),JTYPE(10),
     1                 N,NSEG, NI,NIM
       COMMON /CSMOOB/ XA(100),YA(100),DEVI(100)
       COMMON /CSMOOC/ DUM1(200),ANG(100),DUM2(400),DEV(100),CURVB(100)
       COMMON /BLBDY / IBLB(60)
       DATA TXA/2HXA/,TZA/2HZA/

       IGGO  = 1
       GO TO 1777
       ENTRY EDUMP
       IGGO  = 2
 1777  CONTINUE
 1100  FORMAT(///1X36HCHANNEL INPUT DATA TABLE, /CHDATA/ -)
       WRITE (6,1100)
       I1TAB = LHO
       NCX   = NC
```

```
      IF(NCX.LT.3) NCX=5
      CALL TABPRT(BLANK,CHNAM,LHE,NCX)

 1120 FORMAT(///1X54HBOUNDARY COORDINATES AND ANGLES IN RADIANS, /BDYTAB
     */ -)
      WRITE (6,1120)
      I1TAB = LBDO
      CALL TABPRT(BLANK,BDT,LBDE,3)

 1110 FORMAT(///1X41HTABLE OF CONVECTED PROPERTIES, /CONVTB/ -)
      WRITE (6,1110)
      I1TAB = LTO
      CALL TABPRT(BLANK,CH,LTE,7)

      IF(LEE.LT.LEO) GO TO 140
 1130 FORMAT(///1X125HORDERED LIST OF UPSTREAM BOUNDARY PNTS, L.E. PNTS,
     * T.E. PNTS, AND DOWNSTREAM PNTS WITH REFERENCES TO CHANNELS AND BO
     *UNDARIES./1X10H/LETEPT/ -//4X2HLE6X,2HXE10X,15HYE          ANGE12X,
     *3HNLE9X,12HNTE       CHL9X,3HCHU9X,3HBDL9X,3HBDU10X,5HNUSED)
      WRITE (6,1130)
      I1TAB = LEO
      CALL TABPRT(BLANK,XE,LEE,10)

  140 IF(LRE.LT.LRO) GO TO 150
 1140 FORMAT(///1X98HTABULATION OF CHANNELS EMBRACED BY THE ORTHOGONALS
     *WHICH PASS THROUGH THE ABOVE POINTS, /ORTCHN/ -//4X26HLR
     *LE      LR-PREV)
      WRITE (6,1140)
      I1TAB = LRO
      CALL TABPRT(BLANK,LEDGE,LRE,LRO)

 1150 FORMAT(///1X17HSTREAMLINE TABLE-/17X32HJ        X2              SLCHN
     *      W/(I18,F12.6,6X,A6,F12.6,),)
  150 WRITE (6,1150) (J,X2(J),SLCHN(J),W(J),J=1,NJ)

 1190 FORMAT(///1X37HWAKE DISPLACEMENT THICKNESS, /WAKETB///11X19HX2W/S1
     *W          DST)
      WRITE (6,1190)
      I1TAB = LWO
      CALL TABPRT(BLANK,X2W,LWE,2)

 1180 FORMAT(///1X43HTABLE OF FLOW ADJUSTMENT STATIONS, /CADJWF///15X3HX
     *1F9X,3HX2F8X,4HX1BF8X,4HX1AF9X,3HS1F8X,4HNCHB8X,16HNCHA       JORDE
     *R)
      WRITE (6,1180)
      I1TAB = LFO
      CALL TABPRT(BLANK,X1F,LFE,NFCOLS)

 1160 FORMAT(///1X25HSTATION TABLE, /STATAB/ -)
      WRITE (6,1160)
      I1TAB = LO
      CALL TABPRT(BLANK,X1,LESTA,5)

      CALL JMSPRT

 1170 FORMAT(///1X19HFIELD COORDINATES -)
      WRITE (6,1170)
      CALL TABPRT(1HZ,Z,NM,10)
```

```
      CALL TABPRT(1HR,R,NM,10)

C     PRINT OVERALL DATA
      CALL TABPRT(6HALLCOM,MACHA,20,8)

      IF( IBLB(1).NE.0 ) CALL TABPRT(5HBLBDY,IBLB,60,3)
      IF( LDE.EQ.0 ) GO TO 1321
      IITAB = LDO
      CALL TABPRT(5HBLTAB,CHNAM,LDE,3)
 1321 CONTINUE

      IF( IGGO.EQ.2 ) RETURN
      LSTOP = 5
      GO TO (900,1777) , LSTOP
  900 RETURN
      END
```

```
*DECK REDINP
      SUBROUTINE REDINP
*REDINP         STC READ INPUT                                    -REDINP-

      COMMON /BCOMMN/ PROGM(8),PROGSV,FILIN,FILOT
       LOGICAL                       FILIN,FILOT
      COMMON /ADAMO1/ NAME(6),ADDRES(6),TITLE(6),IDENT(6)
      COMMON /ADAMO2/ ENDJOB,NUMPLT,PLOTED,ENDCRD
       LOGICAL        ENDJOB,       PLOTED,ENDCRD
      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                DAXIT,SCALEA,TTE,CHOTST
       REAL           MACHA(1),MACHC
       LOGICAL        AXIA,AXIC
       LOGICAL        CHOTST
       LOGICAL        AXI
       REAL           MACHO(1)
       EQUIVALENCE    (MACHO,MACHC),(PSO,PSC),(TSO,TSC),(PTO,PTC),
     1                (TTO,TTC), (AXI,AXIC),(RG,RGC),(GAM,GAMC)
      COMMON /CSS   / SSFML,SSEF,SSEANG,SSDF,SSFEND,SSFND1
     1               ,SSDLE,A4FACT,BRLX,CURRLX,TSIC,RHOC,RHOCSS
       INTEGER        SSFML
       LOGICAL             SSEF,      SSDF,   SSDLE
C     SSFML = SUPERSONIC CURVATURE FORMULA NUMBER
C     SSEF  = SUPERSONIC ENTERING FLOW, T OR F
C     SSEANG= ENTERING FLOW ANGLE (DEGREES) FOR SSEF=T
C     SSDF  = SUPERSONIC DISCHARGE FLOW, T OR F
C     SSFEND= SUPERSONIC BEAM DOWNSTREAM END CONDITION, =0,1 FOR PARABOL
C     SSFND1= SUPERSONIC BEAM UPSTREAM END CONDITION, =0,1, FOR PARABOLA
C     SSDLE = SS FLOW BELOW AND AFT OF LE PT, T OR F
C     A4FACT= CENTRAL POINT INFLUENCE COEFFICIENT FACTOR
C     BRLX  = B-RELAXATION FACTOR
C     CURRLX= CURVATURE RELAXATION FACTOR
C     RHOC  = ACCELERATION FACTOR ON CURVATURE ITERATION AT
C             SUBSONIC POINTS
C     RHOCSS= ACCELERATION FACTOR ON CURVATURE AT SUPERSONIC POINTS
      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA, LDUMA(2),LDO,LDE, LDUM(4),
     *                MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE, LRO,LRE,LRD
       DIMENSION      LIMITS(24)
       EQUIVALENCE    (LIMITS,LHO)
      COMMON /SLTAB / W(128),X2(128),SLCHN(128)
       INTEGER SLCHN
      COMMON /BENDIN/ NBCIN(2),ACF(2)
      COMMON /CB    / B(300)
      COMMON /CBITS / BITS,BLANK
      COMMON /CCRX  / CRXSL,CRXOL,CRXSS,CRXE,CRXC,CRMACH
       DIMENSION      CRX(6)
       EQUIVALENCE    (CRX,CRXSL)
      COMMON /CHDATA/ TABLES(2046)
      COMMON /CEND  / TBLEND(2)
      COMMON /CIADIN/ RHOBAS,RHOAMP,IADM
      COMMON /CINNER/ INRCTR,RDUM,NINNER(16),CNVF(16)
      COMMON /CISBOT/ FARFLD(2),FREE(2),PRES(2),RFF,NZP,
     1                ZP(10),PPS(10), A1,A2,ADUM(6)
       INTEGER        FARFLD,FREE,PRES
      COMMON /CLINES/ LINES,OMITFK,PTITLE(6)
```

```
      COMMON /CLWOSV/ LWOSV
      COMMON /CM     / JMS(300)
      COMMON /CMAXIT/ MAXIT,MAJCTR,GREFIN,EDUM
       LOGICAL                          GREFIN
      COMMON / CNORM / RHL,RM,AHL,ARM
      COMMON /CNTRL / K5(1),STA(6),INSERT
      COMMON /CPRINT/ PRTES2,PRTB,PRTA,PREFIN,PREFN2,SSONIC,PDUM(20)
      COMMON /CPRPRN/ PRPRN
       INTEGER        PRPRN
      COMMON /CPTMOV/ VELPOT,ICOB,NODENS,FBASTG
       LOGICAL        VELPOT
      COMMON /CR     / RF(300)
      COMMON /CREFIN/ SLS,SG21,VMG1,VMG2, NGR,NGZ,SGR(10),GR(10),
     1                SGZ(10),GZ(10)
      COMMON /CS1    / S1(300)
      COMMON /CS2    / S2(300)
      COMMON /CTAPOS/ RESTRT,ENDBDT,STCFIL,K6SV
       LOGICAL        RESTRT,ENDBDT,STCFIL
      COMMON /CTHICK/ NTHKX,NTHKY,THKX(20),THKY(20),THIK2D(78)
      COMMON /CTOLRL/ TOLRL,MAXSWP,CLEN,DS2MX,TOLES2,NSWP,
     1                DS1DMP,DS1MXA,DS1MXB,DS1RMS,ES2MX
     *               ,DS1RMO,SG1MIN,TOLINR
      COMMON /CVM    / VMF(300)
      COMMON /CZ     / ZF(300)
      COMMON /SPACER/ MAXLH,MAXLT,MAXLF,MAXLW
      COMMON /TROUBL/ ERR,ERRMAJ,INERR,PRERR
       LOGICAL        ERR,ERRMAJ,INERR,PRERR
      COMMON /TAPES / NTAPO,NTAPN

      COMMON /BLBDY / BLB(60)
      DIMENSION IBLB(60)
      EQUIVALENCE (IBLB,BLB)
      COMMON /VISCOS/ TREF,MUREF,SCON
      REAL                  MUREF
      COMMON /REBL  / RESTBL
      LOGICAL         RESTBL
      COMMON /CGRAV/ CG

      LOGICAL         FIRST

      DATA KA/1HA/, KBDY/3HBDY/, KCHN/3HCHN/, KSTA/3HSTA/
      DATA FIRST/.TRUE./

C     ENDCRD= T IF END OF CARD INPUT
C     ENDBDT= T IF END OF BOUNDARY DATA ON TAPE
C     STCFIL= T IF A STC-SUBFILE EXISTS ON TAPE=ORGF.

      NAMELIST /A/ IDENT, AXI, RG,GAM, MACHO,PSO,TSO, PTO,TTO, PRPRN,
     1      INRCTR,TTE,CHOTST,MAXIT,MAJCTR,NINNER,VELPOT,ICOB,NODENS,RN,
     2               VMG1,VMG2, NGR,NGZ, SGR,GR, SGZ,GZ, SLS,SG21,
     3               NBCIN,ACF, SSFML,SSEF,SSEANG,SSDF,SSFEND,SSFND1,
     4               SSDLE, A4FACT, BRLX, CURRLX, TSIC, RHOC, RHOCSS,
     5               FARFLD,FREE,PRES,RFF,NZP,ZP,PPS,A1,A2,ADUM,
     6               LIMITS,TABLES, B,JMS,S1,S2,ZF,RF,VMF, W,X2,SLCHN,
     8               TOLRL,MAXSWP,TOLES2,TOLINR,SG1MIN,DS1DMP,DS1RMO,
     9               CRXSL,CRXOL,CRXSS,CRXE,CRXC,CRX,
     *                  PRTES2,PRTB,PRTA,PREFIN,PREFN2,SSONIC,PDUM,
     *               MAXLH,MAXLT,MAXLF,MAXLW, KEYB,  RDUM, CNVF,
```

```
     *                PLOT,IPLOT,SAMEXY,XSCALE,YSCALE,
     A                RHOBAS,RHOAMP,IADM,
     B                NTHKX,NTHKY,THKX,THKY,THIK2D,
     C                LBL,MAXLBL,TOLLBL
     *                ,TREF,MUREF,SCON , CG

C**   INITIALIZE AND READ OVERALL (A) INPUT DATA
      IF(.NOT.FIRST .AND. (K5.NE.KA .OR. ENDCRD)) GO TO 200
      IF(FIRST .AND. K5.EQ.KA) GO TO 100
      WRITE (6,1000)
      ERR    = .TRUE.
      PROGSV= 0.
      GO TO 200

  100 PROGSV= 0.
      ENDBDT= .FALSE.
      FIRST = .FALSE.
      LINES = 64
      MAJCTR= 0
      RESTRT= .TRUE.
      STCFIL= .FALSE.
      CALL SETM(1,BITS, MACHO,8)

C     DETERMINE FIELD ARRAY SIZE
      MAXLE = LOC2(TABLES,TBLEND)
      MAXNM = LOC2(RF,ZF)
      GO TO 120

C    READ CARD INPUT
  130 READ (5,A)
      DO 135 I=1,8
  135 IF(MACHO(I).NE.BITS) MACHA(I)=MACHO(I)
      DATA A00000/6HA00000/
      K6SV   = A00000

C    DEFINE THE CHARACTERISTIC LENGTH, CLEN
      CLEN   = SGR
      IF(NGR.LE.1) GO TO 146
      DO 144 I=2,NGR
  144 CLEN   = CLEN+SGR(I)
  146 IF(NGZ.LE.0) GO TO 149
      DO 148 I=1,NGZ
  148 CLEN   = CLEN+SGZ(I)
  149 CLEN   = CLEN/FLOAT(NGR+NGZ)

C    SET UP INDEX-ORIGIN TABLE IF THERE IS NO  STC-TAPE INPUT
C     ORDER OF TABLES IN BLOCK COMMON
C      LH     /CHDATA/
C      LB     /BDYTAB/
C      LT     /CONVTB/
C      LW     /WAKETB/
C      LF     /CADJWF/
C      L      /STATAB/
      IF(STCFIL) RETURN
      RESTRT= .FALSE.
      LBDO   = LHO+MAXLH
      LBDE   = LBDO
C     (OTHER INDEX LIMITS ARE SET IN SUBROUTINE BLDTBS)
```

```
      RETURN

C     READ INPUT FILE
  120 IF(.NOT.FILIN) GO TO 130
      REWIND NTAPO
      READ (NTAPO)  STCFIL,(LIMITS(I),I=1,24)
       LWOSV = LWO
      IF(STCFIL) GO TO 125
      ENDBDT= .TRUE.
      WRITE (6,1120)
      GO TO 130

  125 READ (NTAPO) ((IDENT(I),I=1,6),AXI,RG,GAM,MACHO,PSO,TSO,PTO,TTO,
     1  PRPRN,TTE,CHOTST,MAXIT,MAJCTR, (NINNER(I),I=1,16), VELPOT,ICOB,
     2  NODENS,RN,NGR,NGZ,(SGR(I),I=1,40),VMG1,VMG2, INRCTR, SLS,SG21,
     3  NBCIN(1),NBCIN(2),ACF(1),ACF(2), SSFML,SSEF,SSEANG,SSDF,SSFEND,
     4  SSFND1,SSDLE,A4FACT,BRLX,CURRLX,TSIC,(FARFLD(I),I=1,8),
     * RHOC,RHOCSS,RHL,RM,
     *    TREF,MUREF,SCON,(BLB(I),I=1,60),
     5  (ZP(I),I=1,28), (TABLES(I),I=1,LESTA), (B(I),I=1,NM), (JMS(I),
     6  I=1,NM), (S1(I),I=1,NM), (S2(I),I=1,NM),(ZF(I),I=1,NM), (RF(I),
     7  I=1,NM), (VMF(I),I=1,NM), (W(I),I=1,NJ), (X2(I),I=1,NJ),
     8  (SLCHN(I),I=1,NJ),TOLRL,MAXSWP,TOLES2,TOLINR,SG1MIN,DS1DMP,
     A  DS1RMO,(CRX(I),I=1,6), RHOBAS,RHOAMP,IADM,NTHKX,NTHKY,
     B  (THKX(I),I=1,118)  )
C       CHECK TO SEE IF STC-A INPUT DATA EXCEEDED DIMENSIONS
      IF(NM.GT.LOC2(RF,ZF) .OR. LESTA.GT.LOC2(TABLES,TBLEND)) ERR=.TRUE.
      IF( LDE.NE.0 ) RESTBL=.TRUE.
      GO TO 130

C     READ BOUNDARY DATA
  200 CALL RBD
      IF(ENDCRD) GO TO 700
      IF(K5.EQ.KBDY) RETURN

C     READ CHANNEL DATA
  300 IF(K5.NE.KCHN) GO TO 400
C       IF RESTRT, UNPACK TABLES TO MAKE ROOM FOR NEW CHDATA AND CONVTB.
        IF(.NOT.RESTRT .OR. LBDO.GT.(LHE+1)) GO TO 350
        MOVE1 = LOC2(TABLES,S1)-LESTA
        MOVE2 = MOVE1/2
        LWTO  = LWO+MOVE1
        LBTO  = LBDO+MOVE2
        CALL MOVE(2, TABLES(LWO),TABLES(LWTO),LWO-LESTA-1,1,
     1               TABLES(LBDO),TABLES(LBTO),LBDO-LTE-1,1)
        LBDO  = LBDO+MOVE2
        LTE   = LTE+MOVE2
        LBDE  = LBDE+MOVE2
        LTO   = LTO+MOVE2
        LWO   = LWO+MOVE1
  350 CALL RCD
      RETURN

  400 WRITE (6,1690)
      ERRMAJ= .TRUE.
      RETURN

C     CONSTRUCT LETEPT, ORTCHN, CONVTB, SLTAB, STATAB AND THE FIELD TABLE
```

```
 700 IF(ERRMAJ .OR. LBDE.EQ.LBDO) ERR=.TRUE.
 900 RETURN
1000 FORMAT(/1X73HERROR- THE K5=A INPUT DATA DOES NOT IMMEDIATELY FOLLO
    *W THE PROGM=STC CARD)
1120 FORMAT(//1X43H***  NO  STC  DATA FOUND ON THE INPUT TAPE.//)
1690 FORMAT(//1X44H**   PLEASE CHECK THE INPUT VALUE OF K5 (K5=A6,18H).
    *  IT MUST BE ONE/6X37HOF THE FOLLOWING-   A, BDY, CHN, STA.//)
     END
```

```
*DECK RBD
      SUBROUTINE RBD
*RBD---          READ IN BOUNDARY DATA                            -RBD-

C     INPUT-
C      ENDBDT= END OF BDY/STC TAPE RECORDS, T OR F
C      ENDCRD= END OF ALL STC CARD INPUT, T OR F
C      K6SV  = VALUE OF KEY(6) OF LAST RECORD READ FROM TAPE
C      RESTRT= RESTART (WITH EXISTING TABLES) IS TRUE ONLY
C              IF CARD BDY-DATA HAS NOT YET BEEN ENCOUNTERED
C      STCFIL= T IF A STC-SUBFILE EXISTS ON TAPE=ORGF.
C     OUTPUT-
C      ENDBDT=
C      K6SV  =
C      RESTRT=

      INTEGER          REFS,BDY,CHN
      COMMON /BCOMMN/  PROGM(8),PROGSV,FILIN,FILOT,REFS(5)
       LOGICAL                              FILIN,FILOT

      COMMON /ALLCOM/  MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                 MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                 DAXIT,SCALEA,TTE,CHOTST
       REAL            MACHA(1),MACHC
       LOGICAL         AXIA,AXIC,CHOTST
C     BOUNDARY TABLE
C      INDEX- LB=LBDO,LBDE
C      LBNEXT= INCREMENT TO NEXT BOUNDARY
C      LBZ1  = INCREMENT TO THE FIRST BOUNDARY POINT (=0 BEFORE COALLATIO
C      CHNAME= CHANNEL WITH WHICH THE BOUNDARY DATA IS ASSOCIATED
C      UP    = T OR F FOR UPPER OR LOWER BOUNDARY
C      LEDEX = RELATIVE INDEX OF L.E. POINT WHEN LOWER AND UPPER SURFACE
C              CONTOURS ARE CONNECTED
C      BDNAME,LBA,LBB=NAME AND INDEX LIMITS OF SPECIFIC BOUNDARY
C                     DATA WHEN BOUNDARIES ARE COALLATED
      COMMON /CHDATA/  BDT(1),LBNEXT(1),LBZ1(1),
     1                 CHNAME(1),UP(1),LEDEX(1),
     2                 ZBT(1),RBT(1),ANGBT(42)
       LOGICAL         UP
       INTEGER BDT,CHNAME,BDNAME
       DIMENSION       BDNAME(1),LBA(1),LBB(1)
       EQUIVALENCE     (BDNAME,ZBT), (LBA,RBT), (LBB,ANGBT)
      COMMON /IXORIG/  LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                 LO,LESTA,  LDUM(8),
     *                 MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                 LEO,LEE, LRO,LRE,LRD
       DIMENSION       LIMITS(24)
       EQUIVALENCE     (LIMITS,LHO)

      COMMON /ADAMO2/  ENDJOB,NUMPLT,PLOTED,ENDCRD
       LOGICAL         ENDJOB,       PLOTED,ENDCRD
      COMMON /CBITS /  BITS,BLANK
      COMMON /CLINES/  LINES,OMITFK,PTITLE(6)
       LOGICAL                OMITFK
      COMMON /CNTRL /  K5,BDY(6),INSERT,CARRY,CHN
       EQUIVALENCE     (BDY,IBDY)
      COMMON /CPI   /  PI,TWOPI,PIO2,PIO4,TODEG,TORAD
      COMMON /CREDIN/  ZTRANS,RTRANS,ROTATE,ZPIVOT,RPIVOT,SCALE,NB,TAB(9)
```

```
      EQUIVALENCE     (XTRANS,ZTRANS),(YTRANS,RTRANS),(XPIVOT,ZPIVOT),
     1                (YPIVOT,RPIVOT)
      COMMON /CTAPOS/ RESTRT,ENDBDT,STCFIL,K6SV
      LOGICAL         RESTRT,ENDBDT,STCFIL
      COMMON /ERASE / B(800)
      COMMON /SPACER/ MAXLH,MAXLT,MAXLF,MAXLW
      COMMON /TROUBL/ ERR,ERRMAJ,INERR,PRERR
      LOGICAL         ERR,ERRMAJ,INERR,PRERR

C     SMOOTH COMMONS
      COMMON /ADAM01/ NAME(6),ADDRES(6),TITLE(6),IDENT(6)
      COMMON /CALCPT/ DX,XMOD
      COMMON /CELLPT / DZETA
      COMMON /CSEGME/ IA(10),IB(10),IMA(10),IMB(10),JTYPE(10),N,NSEG,
     1                NII,NIM
      EQUIVALENCE (NI,NII)
      COMMON /CSMOOA/ DEVA(20),FENDA(20),ANGA(20),CURVA(20),NARB
      COMMON /CSMOOB/ XA(100),YA(100),DEVI(100)
      DIMENSION       ZA(100),RA(100)
      EQUIVALENCE     (ZA,XA),(RA,YA)
      COMMON /CDS2   / X(100),Y(100),ANG(100),ANGD(100),CURV(100),S(100),
     1                FQK(100),DEV(100),CURVB(100)
      DIMENSION       Z(100),R(100),DUM(100)
      EQUIVALENCE     (Z,X),(R,Y),(DUM,CURVB)

      COMMON /BLBDY / BLB(60)
      DIMENSION IBLB(60)
      EQUIVALENCE (IBLB,BLB)
      LOGICAL BL
      DATA LBLB/1/

      LOGICAL DATAIN,ENDBDC,UPPER,ZRONLY

      DATA KBDY/3HBDY/, KHIGH/6H      /

      NAMELIST /A/          B,          NB,         TAB,      DBLPTS,      ZRONLY,
     1       BDY,         CHN,      UPPER,         X,Z,         Y,R,        ANGD,
     2    ROTATE,      ZPIVOT,     RPIVOT,      ZTRANS,      RTRANS,       SCALE,
     3      FLIP,      XPIVOT,     YPIVOT,      XTRANS,      YTRANS,         DUM
     4,    IDENT,          DX,       XMOD,        DEVA,       FENDA,        ANGA,
     5     CURVA,       ZA,XA,      RA,YA,        DEVI,         NII,         DEV,
     6       ANG,        CURV,      CURVB,         FQK,           S,         NIM,
     7    UPPER
     *   ,CAPX1,BL

C     DEFINTE DOUBLE POINT TOLERANCE, DPTOL
      DPTOL = 1.E-5

C     INITIALIZE
C     ENDBDC= END OF BDY CARD INPUT, T OR F
      ENDBDC= .FALSE.
      IF(K5.NE.KBDY .OR. ENDCRD) ENDBDC=.TRUE.
   15 DATAIN= .FALSE.
      DBLPTS= .01
      JFOUND= 0
      CAPX1 = 0.
      BL    = .FALSE.
C     READ BDY INPUT CARDS
```

```
   35 IF( ENDBDC ) GO TO 40
      FLIP   = 1.
      ROTATE= 0.
      ZPIVOT= 0.
      RPIVOT= 0.
      SCALE  = SCALEA
      ZTRANS= 0.
      RTRANS= 0.
      ZRONLY= .FALSE.
      CALL SETM(1,.1, DEVI,100)
      CALL SETM(3,BITS,XA,200,DEVA,80,B,300)
      CALL SETM(1,BITS,X,200)
      READ  (5,A)
      IF(ZRONLY) CALL ISORT(XA,YA,DUM,B,200,2)
      IF( .NOT.ZRONLY ) CALL ISORT(X,Y,ANGD,B,300,1)
      IF(.NOT.ZRONLY) CALL ISORT(X,Y,ANGA, B,300)
      IF(INERR) ERRMAJ=.TRUE.
      DATAIN= .TRUE.
      RESTRT= .FALSE.

C     COUNT THE LENGTH OF THE  Z-LIST
   40 IF(.NOT.DATAIN) GO TO 900
      IF( JFOUND .EQ.1 ) GO TO 43
      NI     = 0
      DO 41 I=1,100
      IF(XA(I).EQ.BITS) GO TO 42
   41 NI     = I
   42 IF(NI .EQ. 0) GO TO 43
      LINES = 64
      CALL SMOTH
      JFOUND= 1
   43 NZ     = 0
      DO 45 I=1,100
      IF(Z(I).EQ.BITS) GO TO 50
   45 NZ     = I
   50 IF(NZ-2) 55,100,100
   55 WRITE (6,1055) BDY(1)
      ERRMAJ= .TRUE.
      RETURN

C     DELETE DOUBLE POINTS FROM SMOOTH BOUNDARY RECORDS
  100 OMITFK= .TRUE.
      CALL FHEAD(NZ+10)
      WRITE (6,1090) IBDY,CHN,UPPER
      IF(JFOUND.NE.1 .OR. DBLPTS.EQ.0. .OR. NZ.LE.2) GO TO 150
      WRITE (6,1100) DBLPTS,DBLPTS
      I      = 1
  110 I      = I+1
      IF(I.GT.NZ) GO TO 150
      IF(ABS(Z(I)-Z(I-1)).GE.DPTOL .OR.
     1   ABS(R(I)-R(I-1)).GE.DPTOL) GO TO 110
      ANGDIF= ABS(ANGD(I)-ANGD(I-1))
      IF (ANGDIF.GE.DBLPTS) GO TO 110
      NMOVE = NZ-I
      ANGSV  = .5*(ANGD(I)+ANGD(I-1))
      IF(ANGD(I)*ANGD(I-1).EQ.0. .AND. ANGDIF.LE..0005) ANGSV=0.
      ANGD(I-1)=ANGSV
      CALL MOVE(3, Z(I+1),Z(I),NMOVE,1,
```

```
     1                   R(I+1),R(I),NMOVE,1,
     2                   ANGD(I+1),ANGD(I),NMOVE,1)
      NZ     = NZ-1
      GO TO 110

C     CALCULATE CURVATURES FOR PRINTOUT
  150 I      = 1
      CURV(1)=0.0
  155 CURVB(I)=BITS
      CURV(I+1)=CURV(I)
      DX     = Z(I+1)-Z(I)
      DY     = R(I+1)-R(I)
      CHD    = SQRT(DX*DX+DY*DY)
      IF(CHD.LT..00001) GO TO 160
      ACHD   = ATAN3(DY,DX,ANGD(I)*TORAD)
      YPA    = ANG(I)*TORAD-ACHD
      YPB    = ANGD(I+1)*TORAD-ACHD
      CURVB(I)=(4.*YPA+2.*YPB)/(CHD*(1.+1.5*YPA*YPA))
      CURV(I+1)=(-2.*YPA-4.*YPB)/(CHD*(1.+1.5*YPB*YPB))
      GO TO 165
  160 IF(I.EQ.1) GO TO 165
      IF(CURVB(I-1).EQ.BITS) CURVB(I-1)=CURVB(I)
  165 I      = I+1
      IF(I.LT.NZ) GO TO 155
      CURVB(I)=0.0
*RELO13       RELOCATE FROM A ONE TO A THREE DIMENSIONED ARRAY -RELO13-
C     SUBROUTINE RELO13

C     INPUT-
C     Z,R    = BOUNDARY COORDINATES
C     ANGD   = ANGLE OF THE BOUNDARY (DEGREES)
C     NZ     = NUMBER OF BOUNDARY COORDINATE POINTS
C     FLIP   = SCALER ON R(I) BEFORE ROTATION OR TRANSLATION
C     ROTATE= ANGULAR ROTATION IN DEGREES
C     ZPIVOT,RPIVOT=PIVOT POINT FOR ROTATION BEFORE SCALING
C     SCALE  = MULTIPLICATIVE CONSTANT ON INPUT COORDINATES
C     ZTRANS= Z-TRANSLATION AFTER SCALING
C     RTRANS= R-TRANSLATION AFTER SCALING
C     BDY    = BOUNDARY NAME
C     UPPER  = T IF UPPER BOUNDARY, = F IF LOWER BOUNDARY
C     CHN    = CHANNEL NAME
C     LBDE   = NEXT AVAILABLE LOCATION IN THE BOUNDARY TABLE

C     OUTPUT-
C     BDT    = TABLE OF Z,R,ANG  IN 3-D ARRAY FORM
C     LBDE   = NEXT AVAILABLE LOCATION IN THE BOUNDARY TABLE

      IF(FLIP.NE.1..OR. ROTATE.NE.0. .OR. SCALE.NE.1. .OR. ZTRANS.NE.0.
     1 .OR. RTRANS.NE.0.) WRITE (6,1151) FLIP,ROTATE,ZPIVOT,RPIVOT,
     2 SCALE,ZTRANS,RTRANS
      WRITE (6,1152)
      LB1    = LBDE
      LB2    = LB1+3*(NZ-1)
      LB     = LB1
      BDT(LB)=BDY
      CHNAME(LB)=CHN
      LBZ1(LB)=0
      UP(LB)= UPPER
```

```
      LEDEX(LB)=0
      I      = 1
      LBDEL  = 3
      ADDPI  = 0.
      IF(.NOT.UPPER) GO TO 240
      LB     = LB2
      LBDEL  = -3
      ADDPI  = PI
  240 ROTAT  = ROTATE*TORAD
      SN     = SIN(ROTAT)
      CS     = COS(ROTAT)
  250 IF(ROTATE.NE.0.) GO TO 260
      ZBT(LB)=Z(I)*SCALE + ZTRANS
      RBT(LB)=R(I)*FLIP*SCALE + RTRANS
      GO TO 270
  260 RFLP   = R(I)*FLIP
      ZBT(LB)=(ZPIVOT+CS*(Z(I)-ZPIVOT)-SN*(RFLP-RPIVOT))*SCALE + ZTRANS
      RBT(LB)=(RPIVOT+CS*(RFLP-RPIVOT)+SN*(Z(I)-ZPIVOT))*SCALE + RTRANS
  270 ANGD(I)=ANGD(I)*FLIP + ROTATE
      ANGBT(LB)=ANGD(I)*TORAD + ADDPI
      WRITE (6,1280) I,ZBT(LB),RBT(LB),ANGD(I),CURV(I),CURVB(I)
      IF(I.GE.NZ) GO TO 300
      I      = I+1
      LB     = LB+LBDEL
      GO TO 250
  300 LBDE   = LB2+9
      LBNEXT(LB1)=LBDE-LB1
      BDT(LBDE)=BLANK
C     END SUBROUTINE REL013


C    SET UP BOUNDARY LAYER INPUT TABLE

      IBLB(LBLB)= IBDY
      IBLB(LBLB+1)= 0
      IF( BL) IBLB(LBLB+1)=1
      BLB(LBLB+2)= CAPX1
      LBLB   = LBLB+3
  900 RETURN

 1055 FORMAT(//1X43H**   NO COORDINATE INPUT WAS FOUND FOR BDY=A6,//)
 1090 FORMAT(///1X,45HB O U N D A R Y  C O O R D I N A T E S,  BDY=A6,
     * 5X4HCHN=A6,5X6HUPPER=
     *L2,6X,3HBL=L2,)
 1100 FORMAT(/6X46HDOUBLE POINTS WITH ANGLE DIFFERENCES LESS THANF6.3,1X
     *24HARE ELIMINATED  (DBLPTS=F5.3,2H).)
 1151 FORMAT(/6X5HFLIP=F7.3,3X7HROTATE=F8.3,3X7HZPIVOT=F10.5,3X7HRPIVOT=
     *F11.5,3X5HSCALEF7.3,3X7HZTRANS=F10.5,3X7HRTRANS=F10.5,)
 1152 FORMAT/9X48HI    X,Z         Y,R        ANGD      CURV-      CURV+)
 1280 FORMAT(I10,2F10.5,F10.3,2F10.4)
      END
```

```
*DECK STCB
      PROGRAM STCB
      COMMON /CHNFPT/ ICHN(10),WTFS(10),WTFA(10),WPTO(10),WTTO(10), IC
      COMMON /SELECT/ LENTRY
      GO TO (10,20), LENTRY
C     NORMAL ENTRY-- STATION LOOP, FLOW BALANCE
   10 CALL OVERLAY(3HSTC,2,1,6HRECALL)
      GO TO 30
   20 CALL OVERLAY(3HSTC,2,2,6HRECALL)
   30 RETURN
      END
```

```
*DECK ERRORX
      SUBROUTINE ERROR1
CEDUMPX         EDUMP FOR STC EXECUTE SECTION                    -EDUMPX-

      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                DAXIT,SCALEA,TTE,CHOTST
       REAL           MACHA(1),MACHC
       LOGICAL        AXIA,AXIC
       LOGICAL        CHOTST
      COMMON /CFB    / L,MA,MB,PLB,PUB,WF,CHOKE,SUBSON, NK,PLBC,PUBC,
     1                XCHOKE, TAREA,VMBC, WRQST,WCALC, QV(8),QVP(8),
     *                JSUM,VMLBSQ
       LOGICAL                                  CHOKE,SUBSON
      COMMON /ERASE / ERASEC(800)
      COMMON /ERASE2/ AREA(96),AREAO(96),DISP(96),PT(96),LAMBDA(96),
     1                RHO(96),SQRTVV(96),TS(96),TT(96),VMSQ(96),
     2                VVKQKP(96),
     2                WQA(96),WSTA(96), RG(96),C2CP(96),FGR(96)
       REAL           LAMBDA
       DIMENSION      ES2(96),SDNQRM(96)
       EQUIVALENCE    (ES2,VVKQKP),(SDNQRM,RHO)
       DIMENSION      RCU(96)
       EQUIVALENCE    (RCU,LAMBDA)
C     FIELD TABLES
C      INDEX- M=MO,NM
      COMMON /CZ     / Z(300)
      COMMON /CR     / R(300)
      COMMON /CS2    / S2(300)
      COMMON /CS1    / S1(300)
      COMMON /CPHI1  / PHI1(300)
      COMMON /CM     / JMS(300)
      COMMON /CCURV  / CURV(300)

      COMMON /CB     / B(300)
      COMMON /CIDEX  / M,J,MU,MD,ISTAG
C     TABLE OF INDEX LIMITS
      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA,LSO,LSE,LDO,LDE,LDUM(4),
     *                MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE, LRO,LRE,LRD
       DIMENSION      LIMITS(24)
       EQUIVALENCE    (LIMITS,LHO)
      COMMON /CVM    / VM(300)

C     STREAMLINE TABLE
      COMMON /SLTAB / W(128),X2(128),SLCHN(128)
       INTEGER SLCHN
C     BOUNDARY TABLE
C      INDEX- LB=LBDO,LBDE
C      LBNEXT= INCREMENT TO NEXT BOUNDARY
C      LBZ1  = INCREMENT TO THE FIRST BOUNDARY POINT (=0 BEFORE COALLATIO
C      CHNAME= CHANNEL WITH WHICH THE BOUNDARY DATA IS ASSOCIATED
C      UP    = T OR F FOR UPPER OR LOWER BOUNDARY
C      LEDEX = RELATIVE INDEX OF L.E. POINT WHEN LOWER AND UPPER SURFACE
C              CONTOURS ARE CONNECTED
C      BDNAME,LBA,LBB=NAME AND INDEX LIMITS OF SPECIFIC BOUNDARY
C                      DATA WHEN BOUNDARIES ARE COALLATED
```

```
      DIMENSION          BDT(1),LBNEXT(1),LBZ1(1),
     1                   CHNAME(1),UP(1),LEDEX(1),
     2                   ZBT(1),RBT(1),ANGBT(42)
       LOGICAL          UP
       INTEGER BDT,CHNAME,BDNAME
       DIMENSION        BDNAME(1),LBA(1),LBB(1)
       EQUIVALENCE      (BDNAME,ZBT), (LBA,RBT), (LBB,ANGBT)
C     FLOW ADJUSTMENT TABLE
C      INDEX- LF=LFO,LFE
C      NFCOLS= 8
C      X1F    = ORTHOGONAL COORDINATE
C      X2F    = STREAMLINE COORDINATE OF SL EMINATING FROM T.E.
C      X1BF   = X1-COORDINATE OF CHOKE STATION OF FLOW BELOW T.E.
C      X1AF   = X1-COORDINATE OF CHOKE STATION OF FLOW ABOVE T.E.
C      S1F    = S1-COORDINATE OF T.E. (UPPER SURFACE). THIS ITEM
C               IS USED WHEN INTERPOLATING FOR WAKE DELTA-STAR.
C      LFB,LFA=INDICES OF STATIONS BELOW AND ABOVE T.E.
C      NCHB,NCHA=NUMBER OF CHANNELS BELOW AND ABOVE T.E.
C      LRF    = INDEX OF DUMMY ORTCHN LIST FOR THE T.E.
C      LRXF   = INDEX OF LAST CHANNEL BELOW THE T.E.
C      JORDER= 0 IF TOTAL FLOW AT X1F IS GIVEN
C            = 2 IF FLOW ABOVE T.E. IS GIVEN
C            = 1 IF FLOW BELOW T.E. IS GIVEN
C      JORDER= -1 IF FLOW AT X1F IS CHOKED AND SINGLE CHANNEL
      DIMENSION          X1F(1),X2F(1),X1BF(1),X1AF(1),
     1                   S1F(1),NCHB(1),NCHA(1),JORDER(1),VNR(12)
       EQUIVALENCE      (LFB,X1BF),(LFA,X1AF),(LRF,NCHB),(LRXF,NCHA)
       DIMENSION        LFB(1),LFA(1),LRF(1),LRXF(1)
C     STATION TABLE
C      INDEX- L=LO,LESTA
C      SCHOKE= STATION CHOKE INDICATOR (ADJWF,BRHS,WRIOUT)
C      MCL    = SHARP CORNER INDICATOR (BLDTBS)
C      MCL    = FIELD INDEX OF CONTROL STREAMLINE (PTMOVE,FLOBAL)
      COMMON /CHDATA/ X1(1),LNEXT(1),MLB(1),MUB(1),PRIM(1),
     1                   TYPELB(1),NAMELB(1),ILB(1),FLB(1),S1LB(1),
     1                   TYPEUB(1),NAMEUB(1),IUB(1),FUB(1),S1UB(1),
     3                   VMB(1),DWDV(1), X2CL(1),VCL(1),MCL(481)
       LOGICAL          PRIM
       DIMENSION        SCHOKE(1)
       EQUIVALENCE      (SCHOKE,DWDV)

       EQUIVALENCE     (BDT,X1F,X1), (LBNEXT,X2F,LNEXT), (LBZ1,X1BF,MLB)
       EQUIVALENCE     (CHNAME,X1AF,MUB), (UP,S1F,PRIM)
       EQUIVALENCE     (LEDEX,NCHB,TYPELB), (ZBT,NCHA,NAMELB)
       EQUIVALENCE     (RBT,JORDER,ILB), (ANGBT,VNR,FLB)

      COMMON /CTABPR/ I1TAB
      COMMON /BLBDY / IBLB(60)

      CALL TABPRT(6HALLCOM,MACHA,20,8)
      CALL TABPRT(3HCFB,L,33,4)
      CALL TABPRT(5HCIDEX,M,5,5)
      I1TAB = LBDO
      CALL TABPRT(6HBDYTAB,BDT,LBDE,3)
      I1TAB = LFO
      CALL TABPRT(6HCADJWF,X1F,LFE,8)
      I1TAB = LO
      CALL TABPRT(6HSTATAB,X1,LESTA,5)
```

```
150 WRITE (6,1150) (J,X2(J),SLCHN(J),W(J),J=1,NJ)
    CALL TABPRT(5HERASL,ERASLC,800,5)

    CALL JMSPRT
    CALL TABPRT(2HS1,S1,NM,10)
    CALL TABPRT(2HS2,S2,NM,10)
    CALL TABPRT(1HZ,Z,NM,10)
    CALL TABPRT(1HR,R,NM,10)
    CALL TABPRT(4HPHI1,PHI1,NM,10)
    CALL TABPRT(4HCURV,CURV,NM,10)
    CALL TABPRT(2HVM,VM,NM,10)
    CALL TABPRT(1HB,B,NM,10)
    CALL TABPRT(6HERASE2,AREA,1536,8)
    IF( IBLB(1).NE.0 ) CALL TABPRT(5HBLBDY,IBLB,60,3)
    IF( LDE.EQ.0 ) GO TO 1321
    IITAB = LDO
    CALL TABPRT(5HBLTAB,CHNAM,LDE,3)
1321 CONTINUE

    LSTOP = 5
    GO TO (999,999) , LSTOP
999 RETURN
1150 FORMAT(///1X17HSTREAMLINE TABLE-/17X32HJ       X2          SLCHN
   *     W/(I18,F12.6,6X,A6,F12.6,),)
    END
```

```
*DECK STCW1
      PROGRAM STCW1
C     WRITE THE OVER-ALL STC DATA RECORD, KEY(5)=A.
      CALL WRIA
      CALL WRIOUT
      CALL WRIBDY
      CALL WRIATP
      RETURN
      END
```

```
*DECK WRIA
      SUBROUTINE WRIA
*WRIA--         WRITE THE KEY(5)=A  STC DATA RECORD          -WRIA-

      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                DAXIT,SCALEA,TTE,CHOTST
       REAL           MACHA(1),MACHC
       LOGICAL        AXIA,AXIC
       LOGICAL        CHOTST
       REAL           MACHO
       EQUIVALENCE    (MACHO,MACHA),(PSO,PSA),(TSO,TSA),
     1                           (AXI,AXIA),(RG,RGA),(GAM,GAMA)
      COMMON /CSS   / SSFML,SSEF,SSEANG,SSDF,SSFEND,SSFND1
     1               ,SSDLE,A4FACT,BRLX,CURRLX,TSIC,RHOC,RHOCSS
       INTEGER        SSFML
       LOGICAL                 SSEF,        SSDF,   SSDLE
C     SSFML  = SUPERSONIC CURVATURE FORMULA NUMBER
C     SSEF   = SUPERSONIC ENTERING FLOW, T OR F
C     SSEANG= ENTERING FLOW ANGLE (DEGREES) FOR SSEF=T
C     SSDF   = SUPERSONIC DISCHARGE FLOW, T OR F
C     SSFEND= SUPERSONIC BEAM DOWNSTREAM END CONDITION, =0,1 FOR PARABOL
C     SSFND1= SUPERSONIC BEAM UPSTREAM END CONDITION, =0,1, FOR PARABOLA
C     SSDLE  = SS FLOW BELOW AND AFT OF LE PT, T OR F
C     A4FACT= CENTRAL POINT INFLUENCE COEFFICIENT FACTOR
C     BRLX   = B-RELAXATION FACTOR
C     CURRLX= CURVATURE RELAXATION FACTOR
C     TSIC   = NUMBER OF POINTS TO BE READ FOR TRANSONIC INTERPOLATION
      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA,  LDUM(8),
     *                MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE, LRO,LRE,LRD
       DIMENSION      LIMITS(24)
       EQUIVALENCE    (LIMITS,LHO)
      COMMON /SLTAB / W(128),X2(128),SLCHN(128)
       INTEGER SLCHN

      COMMON /BCOMMN/ PROGM(9),FILIN,FILOT
       LOGICAL        FILIN, FILOT
      COMMON /ADAM01/ NAME(6),ADDRES(6),TITLE(6),IDENT(6)
      COMMON /BENDIN/ NBCIN(2),ACF(2)
      COMMON /CB    / B(300)
      COMMON /CBITS / BITS,IBLANK
      COMMON /CCRX  / CRXSL,CRXOL,CRXSS,CRXE,CRXC,CRMACH
       DIMENSION      CRX(6)
       EQUIVALENCE    (CRX,CRXSL)
C      CHANNEL INPUT DATA TABLE
C      INDEX - LH=LHO,LHE
      COMMON /CHDATA/ CHNAM(1),LHNEXT(1),WTFLOW(10),NR(1),NC(1),TAB(6),
     1                BB(75)
       DIMENSION      TABLES(998), TTO(1),PTO(1)
C     TABLE OF CONVECTED PROPERTIES
C      INDEX- LT=LTO,LTE
C     CH     = CHANNELNAME
C     LTNEXT= INDEX INCREMENT TO THE NEXT CHANNEL
C     LPSI   = RELATIVE LOCATION OF PSI LIST
C     NPT    = NO. OF PSI, TT, PT AND RCU VALUES
       DIMENSION      CH(1),LTNEXT(1),NPT(1),LPSI(1),LTT(495)
```

```
      INTEGER CH,CHNAM
      DIMENSION XCH(1)
      EQUIVALENCE     (CHNAM,TABLES,CH,XCH),(LHNEXT,LTNEXT),
     *                (WTFLOW,NPT),
     *                (WTFLOW(2),LPSI,TTO),
     *                (WTFLOW(3),LTT,PTO)
      COMMON /CIADIN/ RHOBAS,RHOAMP,IADM
      COMMON /CINNER/ INRCTR,RDUM,NINNER(16),CNVF(16)
      COMMON /CISBOT/ FARFLD(2),FREE(2),PRES(2),RFF,NZP,
     1                ZP(10),PPS(10), A1,A2,ADUM(6)
      INTEGER         FARFLD,FREE,PRES
      COMMON /CLINES/ LINES,OMTIFK,PTITLE(6)
      LOGICAL               OMTIFK
      COMMON /CM    / JMS(300)
      COMMON /CMAXIT/ MAXIT,MAJCTR,GREFIN,EDUM
      LOGICAL                     GREFIN
      EQUIVALENCE (MAJCTR,NREFIN)
      COMMON / CNORM / RHL,RM,AHL,ARM
      COMMON /CPI   / PI,TWOPI,PIQ2,PIQ4,TODEG,TORAD
      COMMON /CPRINT/ PDUM1(3),PREFIN,PREFN2,PDUM(11)
      COMMON /CPRPRN/ PRPRN
      INTEGER         PRPRN
      COMMON /CPTMOV/ VELPOT,ICOB,NODENS,CPTDUM
      LOGICAL         VELPOT
      COMMON /CR    / RF(300)
      COMMON /CREFIN/ SLS,SG21,VMG1,VMG2, NGR,NGZ,SGR(10),GR(10),
     1                SGZ(10),GZ(10)
      COMMON /CS1   / S1(300)
      COMMON /CS2   / S2(300)
      COMMON /CTOLRL/ TOLRL,MAXSWP,CLEN,DS2MX,TOLES2,NSWP,
     1                DS1DMP,DS1MXA,DS1MXB,DS1RMS,ES2MX,DS1RMO,
     2                SG1MIN,TOLINR
      COMMON /CTHICK/ NTHKX,NTHKY,THKX(20),THKY(20),THIK2D(78)
      COMMON /CVM   / VMF(300)
      COMMON /CZ    / ZF(300)

      COMMON /CHNFPT/ ICHN(10),WTFS(10),WTFA(10),WPTO(10),WTTO(10), IC
      COMMON /TAPES / NTAPO,NTAPN
      COMMON /BLBDY / BLB(60)
      DIMENSION IBLB(60)
      EQUIVALENCE (IBLB,BLB)
      COMMON /VISCOS/ TREF,MUREF,SCON
      REAL                 MUREF

      LOGICAL STCFIL
      DATA STCFIL/T/
      DATA KA/1HA/


      OMTIFK= .TRUE.
      IF(FILOT) OMTIFK=.FALSE.
      CALL FHEAD(64)
      TSC    = TSA
      TTC    = TSC*(1.+(GAMA-1.)*.5*MACHO*MACHO)
      PTC    = PSC*(TTC/TSC)**(GAMA/(GAMA-1.))
   55 WRITE(6,1000) AXI,MACHO,RG,TSC,GAM,PSC,TTE,PTC,CHOTST,TTC,
     1              NBCIN,ACF
 1000 FORMAT (/15H GENERAL INPUT-// 6X,7HAXI    =,L8,26X,7HMACHO =,F8.4/
```

```
     16X,7HRG     =,F8.2,26X,7HTSO    =,F8.2/ 6X,7HGAM    =,F8.4,26X,
     17HPSO    =,F8.3/ 6X,7HTTE    =,F8.3,26X,7HPTO    =,F8.2/ 6X,7HCHOTST=
     .,L8,26X,7HTTO    =,F8.3//  27H STREAMLINE END CONDITIONS-/ 6X,7HNBC
     1IN =,2I8/ 6X,7HACF    =,2F8.3/ )

      WRITE(6,1005) SSFML,SSFEND,SSFND1,SSEANG,SSEF,SSDF,SSDLE
 1005 FORMAT(43H CURVATURE CALCULATION FOR SUPERSONIC FLOW-/
     16X,7HSSFML =,I8,19H   (FORMULA NUMBER)/
     26X,7HSSFEND=,F8.3,43H   (DOWNSTREAM END CONDITION, SSFML=2 ONLY)/
     36X,7HSSFND1=,F8.3,41H   (UPSTREAM END CONDITION, SSFML=2 ONLY)/
     46X,7HSSEANG=,F8.3,43H   (INLET FLOW ANGLE, DEGREES, SSEF=T ONLY)/
     5/38H SUBSONIC/SUPERSONIC BRANCH SELECTION-/
     66X,7HSSEF   =,L8,37H   (SUPERSONIC ENTERING FLOW, T OR F)/
     76X,7HSSDF   =,L8,56H   (SUPERSONIC FLOW DOWNSTREAM OF CHOKE STATION
     *, T OR F)/       6X,7HSSDLE =,L8,58H   (SUPERSONIC FLOW BELOW AND
     8AFT OF A L.E. POINT, T OR F)  )

      WRITE (6,1010) (GR(I),I=1,NGR)
      WRITE (6,1011) (SGR(I),I=1,NGR)
      IF(NGZ.EQ.0) GO TO 65
      WRITE (6,1012) (GZ(I),I=1,NGZ)
      WRITE (6,1013) (SGZ(I),I=1,NGZ)
   65 WRITE (6,1014) VMG1,VMG2,CRX
 1010 FORMAT(/1X19HGRID SIZE CRITERIA-/6X7HNGR/GR=10F8.2)
 1011 FORMAT (6X,7HSGR    =,10F8.2)
 1012 FORMAT (/6X,7HNGZ/GZ=,10F8.2)
 1013 FORMAT(6X,7HSGZ    =,10F8.2)
 1014 FORMAT(/6X,7HVMG1   =,F8.2,25X,7HVMG2  =,F8.2//6X,7HCRX    =,6F8.3)

      WRITE (6,1030) NM,MAXNM, LESTA,MAXLE, NJ,MAXNJ
 1030 FORMAT(/1X19HMEMORY UTILIZATION-/24X17HUSED    AVAILABLE/6X11HGRID
     * POINTSI11,I10,/6X6HTABLESI16,I10,/6X11HSTREAMLINESI11,I10,)

      ATLDS2= CLEN*TOLES2
      WRITE(6,1040) MAXIT,NREFIN,INRCTR,TOLINR,TOLES2,CLEN,ATLDS2,ES2MX,
     1                 DS1DMP,NODENS
 1040 FORMAT (/18H CONVERGENCE DATA-/
     16X,7HMAXIT =,I8,3X,20H(MAXIMUM ITERATIONS)/
     26X,7HNREFIN=,I8,34H - NUMBER OF REFINEMENT ITERATIONS/ 6X,7HINRCTR
     3=,I8,56H - NUMBER OF ADDITIONAL ITERATIONS AFTER LAST REFINEMENT//
     46X,7HTOLINR=,  E8.1,47H   (INNER ITERATION TOLERANCE ON S.L. MOVEM
     4ENT)/ 6X,7HTOLES2=,  E8.1,37H   (FINAL TOLERANCE ON S.L. MOVEMENT)
     5/6X,7HCLEN   =,  F8.3,52H - CHARACTERISTIC LENGTH BASED ON GRID SIZ
     6E CRITERIA/   E21.1,38H - ABSOLUTE TOLERANCE ON S.L. MOVEMENT/
     76X,7HMAXES2=,  E8.1,42H - LARGEST S.L. MOVEMENT ON LAST ITERATION/
     8/6X,7HDS1DMP=,  F8.3,54H   (STREAMWISE PT MOVEMENT DAMPING, =0 FOR
     9 NO DAMPING)/ 6X,7HNODENS=,I8,58H   (REFINEMENT LEVEL TO WHICH CON
     ASTANT DENSITY IS ASSUMED))

      LINES = 64
      CALL FHEAD(13)
      WRITE (6,1090) FARFLD
      WRITE (6,1092) IADM,RHOBAS,RHOAMP,TOLRL
 1090 FORMAT (/26H SPECIAL BOUNDARY OPTIONS-/ 6X,7HFARFLD=,2(2X,A6))
 1092 FORMAT(/ 28H MATRIX SOLUTION PARAMETERS-/6X,7HIADM   =,I8,3X,70H(=-
     11,0,1, FOR STREAMLINE, ALTERNATING, AND ORTHOGONAL LINE RELAXATION
     2)/ 6X,7HRHOBAS=,F8.3,3X,33H(ACCELERATION FACTOR, BASE LEVEL)/
     36X,7HRHOAMP=,F8.3,3X,45H(ACCELERATION FACTOR, AMPLITUDE OF VARIATI
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     40N)/  6X,7HTOLRL =,  E8.1,3X,30H(TOLERANCE RELATIVE TO MAXDS2)  )
C     PRINT HIGHLIGHT AND MAX. BODY RADII AND AREAS
      AHL    = RHL
      IF(AXIA) AHL=PI*RHL*RHL
      ARM    = RM
      IF(AXIA) ARM=PI*RM*RM
      WRITE (6,1091) RHL,AHL,RM,ARM
 1091 FORMAT (//6X, 17HHIGHLIGHT RADIUS=,F8.3,4X,15HHIGHLIGHT AREA=,
     * F8.3/6X,17HMAX. BODY RADIUS=, F8.3,4X,15HMAX. BODY AREA=,F8.3)
C     PRINT CHANNEL TABLE OF CONTENTS
      CALL FHEAD(2)
      WRITE (6,1060)
      LH      = LHO
   80 IF(LH.GE.LHE) GO TO 96
       MOREL  = 4
      IF(NR(LH).NE.0) MOREL=MOREL+2+NR(LH)
      CALL FHEAD(MOREL)
      LH2    = LH+9
      WRITE (6,1070) CHNAM(LH),(WTFLOW(LHX),LHX=LH,LH2)
      NCX    = NC(LH)
      IF(NR(LH).LE.0) GO TO 95
      WRITE (6,1080) (TAB(I),I=1,NCX)
      CALL TABPRT(2HB=,BB(LH),NCX*NR(LH),NCX)
   95 LH     = LH+LHNEXT(LH)
      GO TO 80
   96 CONTINUE
 1060 FORMAT(/1X26HCONTENTS OF CHANNEL TABLE-)
 1070 FORMAT(//6X7HCHN    =2X,A6,5X7HWTFLOW=  E12.4,/6X7HTTO    =  F8.2,5X
     *7HPTO    =F8.3,5X7HTSO    =F8.2,5X7HPSO    =F8.3,/6X7HMACHO =F8.4,5X7
     *HAO     =  E12.4,1X7HVARY   =L8,/6X7HRG     =  F8.2,5X7HGAM    =F8.4,)
 1080 FORMAT(/6X7HNB/TAB=2X,A6,1H,5X,A6,1H,5X,A6,1H,5X,A6,1H,5X,A6,1H,)

C      LOOP THROUGH CHANNELS TO PRINT FLOW RATES, PRESSURES, AND TEMP
       RHOINF= PSA/(RGA*TSA)
       VINF   = SQRT(GAMA*RGA*TSA)*MACHA
       WTNORM= RHOINF*VINF*PI
       J2     = 0
       IC     = 0
  100  J2     = J2+1
       JCHN   = SLCHN(J2)
  105  IF(JCHN.NE.SLCHN(J2+1) .OR. J2.EQ.NJ) GO TO 110
       J2     = J2+1
       GO TO 105
  110  IC     = IC+1
       WTFA(IC)=W(J2)/WTNORM
       IF( RGA.NE.1. ) WTFA(IC)=W(J2)
       ICHN(IC)=JCHN
       LT     = LTO
  115  IF(JCHN.EQ.CH(LT)) GO TO 120
       LTP    = LT+LTNEXT(LT)
       IF(LTP.GE.LTE) GO TO 120
       LT     = LTP
       GO TO 115
  120  LTP    = LT+LPSI(LT)+NPT(LT)-1
       WTFS(IC)=XCH(LTP)/WTNORM
       IF( RGA.NE.1. ) WTFS(IC)=XCH(LTP)
       WPTO(IC)=PTC
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      WTTO(IC)=TTC
      LH     = LHO
  122 IF(JCHN.EQ.CHNAM(LH)) GO TO 124
      LHP    = LH+LHNEXT(LH)
      IF(LHP.GE.LHE) GO TO 128
      LH     = LHP
      GO TO 122
  124 IF(PTO(LH).NE.BITS .AND. PTO(LH).NE.0.) WPTO(IC)=PTO(LH)
      IF(TTO(LH).NE.BITS .AND. TTO(LH).NE.0.) WTTO(IC)=TTO(LH)
  128 IF(J2.LT.NJ) GO TO 100
  130 WRITE (6,1130) (ICHN(I),WTFS(I),WTFA(I),WPTO(I),WTTO(I),I=1,IC)
 1130 FORMAT (/49H CHANNEL FLOW RATES, PRESSURES, AND TEMPERATURES-//
     * 16X,9HSPECIFIED,5X,8HADJUSTED,7X,6HPT/PSO,7X,6HTT/TSO /
     * (6X,A6,4F13.4,),)


      RETURN


      ENTRY WRIATP

      REWIND  NTAPN
      WRITE (NTAPN) STCFIL,(LIMITS(I),I=1,24)
      WRITE (NTAPN) ((IDENT(I),I=1,6),AXI,RG,GAM,MACHO,PSO,TSO,PTO,TTO,
     1  PRPRN,TTE,CHOTST,MAXIT,MAJCTR, (NINNER(I),I=1,16), VELPOT,ICOB,
     2  NODENS,RN,NGR,NGZ,(SGR(I),I=1,40),VMG1,VMG2, INRCTR, SLS,SG21,
     3  NBCIN(1),NBCIN(2),ACF(1),ACF(2), SSFML,SSEF,SSEANG,SSDF,SSFEND,
     4  SSFND1,SSDLE,A4FACT,BRLX,CURRLX,TSIC,(FARFLD(I),I=1,8),
     * RHOC,RHOCSS,RHL,RM,
     *     TREF,MUREF,SCON,(BLB(I),I=1,60),
     5  (ZP(I),I=1,28), (TABLES(I),I=1,LESTA), (B(I),I=1,NM), (JMS(I),
     6  I=1,NM), (S1(I),I=1,NM), (S2(I),I=1,NM),(ZF(I),I=1,NM), (RF(I),
     7  I=1,NM), (VMF(I),I=1,NM), (W(I),I=1,NJ), (X2(I),I=1,NJ),
     8  (SLCHN(I),I=1,NJ),TOLRL,MAXSWP,TOLES2,TOLINR,SG1MIN,DS1DMP,
     A  DS1RMO,(CRX(I),I=1,6), RHOBAS,RHOAMP,IADM,NTHKX,NTHKY,
     B  (THKX(I),I=1,118)   )
      NTSAV = NTAPO
      NTAPO = NTAPN
      NTAPN = NTSAV
      RETURN
      END
```

```
*DECK USECDW
      BLOCK DATA USECDW
*USECDW         REPLACE STCW USE CARDS
      COMMON /ERASE3/ WDUM(318)
      COMMON /CPSM  / PSM(768)
      END
```

```
*DECK WRIOUT
      SUBROUTINE WRIOUT
*WRIOUT          WRITE STC OUTPUT DATA                              -WRIOUT-

      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                DAXIT,SCALEA,TTE,CHOTST
       REAL           MACHA(1),MACHC
       LOGICAL        AXIA,AXIC
       LOGICAL        CHOTST
      COMMON /CFB    / L,MA,MB,PLB,PUB,WF,CHOKE,SUBSON, NK,PLBC,PUBC,
     1                XCHOKE, TAREA,VMBC, WRQST,WCALC, QV(8),QVP(8),
     *                JSUM,VMLBSQ
       LOGICAL                                 CHOKE,SUBSON
      COMMON /CSS    / SSFML,SSEF,SSEANG,SSDF,SSFEND,SSFND1
     1               ,SSDLE,A4FACT,BRLX,CURRLX
       INTEGER        SSFML
       LOGICAL                SSEF,          SSDF,    SSDLE
C      SSFML  = SUPERSONIC CURVATURE FORMULA NUMBER
C      SSEF   = SUPERSONIC ENTERING FLOW, T OR F
C      SSEANG= ENTERING FLOW ANGLE (DEGREES) FOR SSEF=T
C      SSDF   = SUPERSONIC DISCHARGE FLOW, T OR F
C      SSFEND= SUPERSONIC BEAM DOWNSTREAM END CONDITION, =0,1 FOR PARABOL
C      SSFND1= SUPERSONIC BEAM UPSTREAM END CONDITION, =0,1, FOR PARABOLA
C      SSDLE  = SS FLOW BELOW AND AFT OF LE PT, T OR F
C      A4FACT= CENTRAL POINT INFLUENCE COEFFICIENT FACTOR
C      BRLX   = B-RELAXATION FACTOR
C      CURRLX= CURVATURE RELAXATION FACTOR
      COMMON /ERASE2/ AREA(96),AREAO(96),DISP(96),PT(96),LAMBDA(96),
     1                RHO(96),SQRTVV(96),TS(96),TT(96),VMSQ(96),
     2                VVKQKP(96),
     2                WQA(96),WSTA(96), RG(96),C2CP(96),FGR(96)
       REAL           LAMBDA
      COMMON /ERASE3/ J1(10),K1(10),CHANLS(10),PS(96),MACH(96),FLOW(96)
       DIMENSION      XI2(96),Z(96),R(96),PHI(96),CURV(96),PSQPO(96),
     *                VM(96),FVX(96),FVY(96),FPX(96),FPY(96),SVX(96),
     *                SVY(96),SPX(96),SPY(96),STX(96),STY(96)
       EQUIVALENCE    (AREAO,XI2,FVX,STX), (DISP,Z,FVY,STY),
     *                (SQRTVV,R,FPX), (VMSQ,PHI,FPY), (VVKQKP,CURV,SVX),
     *                (WQA,PSQPO,SVY), (C2CP,VM,SPX), (FLOW,SPY)
       REAL           MACH
       DIMENSION      X(1),Y(1)
       EQUIVALENCE    (X,Z),(Y,R)
C   NEW VARIABLES FOR NASA VERSION ONLY
C   CAN USE FOR IF NEEDED
        DIMENSION     PFLOW(96),PSQPT(96),TSQTT(96),CP(96),AQAREF(96),
     *                PTQPTO(96),FLOWMX(10)
        EQUIVALENCE   (FLOW,PFLOW), (LAMBDA,PSQPT), (TS,TSQTT),
     *                (RHO,CP) ,(FGR,AQAREF), (RG,PTQPTO)
      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA,  LDUM(8),
     *                MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LLO,LEE, LRO,LRE,LRD
       DIMENSION      LIMITS(24)
       EQUIVALENCE    (LIMITS,LHO)
      COMMON /CBEND / NBCB(2),ANGE(2),CURVE(2),FB(2)
      COMMON /CBITS / BITS,BLANK
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      COMMON /CCUBE / NBC(2),C1(2),C2(2),FEND(2)
      COMMON /CGRAV / CG
      COMMON /CPI   / PI,TWOPI,PIO2,PIO4,TODEG,TORAD
      COMMON /CREFIN/ SG1,SG2,VMG1,VMG2
     1,               NGR,NGZ, SGR(10),GR(10), SGZ(10),GZ(10)
      COMMON /SLTAB / W(128),X2(128),SLCHN(128)
       INTEGER SLCHN
C     STATION TABLE
C     INDEX- L=LO,LESTA
C     SCHOKE= STATION CHOKE INDICATOR (ADJWF,BRHS,WRIOUT)
C     MCL    = SHARP CORNER INDICATOR (BLDTBS)
C     MCL    = FIELD INDEX OF CONTROL STREAMLINE (PTMOVE,FLOBAL)
      COMMON /CHDATA/ X1(1),LNEXT(1),MLB(1),MUB(1),PRIM(1),
     1                TYPELB(1),NAMELB(1),ILB(1),FLB(1),S1LB(1),
     1                TYPEUB(1),NAMEUB(1),IUB(1),FUB(1),S1UB(1),
     3                VMB(1),DWDV(1), X2CL(1),VCL(1),MCL(481)
       LOGICAL        PRIM
       INTEGER TYPELB,TYPEUB
       DIMENSION      SCHOKE(1)
       EQUIVALENCE    (SCHOKE,DWDV)

      COMMON /BCOMMN/ PROGM(9),FILIN,FILOT
       LOGICAL                   FILIN,FILOT
      COMMON /ADAM01/ NAME(6),ADDRES(6),TITLE(6),IDENT(6)
      COMMON /CCURV / CURVF(300)
      COMMON /CDS2  / MACHM(300)
       REAL           MACHM
      COMMON /CPHI1 / PHI1(300)
      COMMON /CPRINT/ PRTES2,PRTB,PRTA,PREFIN,PREFN2,SSONIC,PDUM(10)
      COMMON /CPRPRN/ PRPRN
       INTEGER        PRPRN
      COMMON /CPSM  / PSM(300)
      COMMON /CS2   / PTM(300)
      COMMON /CR    / RF(300)
      COMMON /CRHS  / TTM(300)
      COMMON /CVM   / VMF(300)
      COMMON /CZ    / ZF(300)

      COMMON /CIDEX / M,J,MU,MD,ISTAG
      COMMON /CLINES/ LINES,OMITFK,PTITLE(6)

      COMMON /CFRFLD/ FSAV(300), STXU(128),STXD(128),STYU(128),STYD(128)
      COMMON /CHNFPT/ ICHN(10),WTFS(10),WTFA(10),WPTO(10),WTTO(10), IC

       INTEGER DBSTAR,SUB,SUPER,BLANK,BRANCH,CHANLS,ASTERP,TE
      LOGICAL         UPSTRM,DNSTRM
      DATA TE/2HTE/

      PIINV = 1./PI
      QO    = 0.
      IF(MACHA.LE..1) GO TO 95
      IF(GAMA.NE.0.) GO TO 92
      QO    = (RGA*TSA)/(PSA*MACHA*MACHA)
      GO TO 95
   92 QO    = 2./(GAMA*PSA*MACHA*MACHA)

C     BEGIN LOOP THROUGH STATIONS
   95 CHOKE = .FALSE.
```

```
      IFIELD= 0
      JSUM   = 0
      LINES  = 64
      LINEA  = 0
      L      = LO
  500 PLB    = 0.
      PUB    = 0.
      WF     = 0.

C     SUBSONIC/SUPERSONIC BRANCH SELECTION
      M      = MLB(L)
      CALL GETIX
      JA     = J
      MAA    = M
      M      = MUB(L)
      CALL GETIX
      JB     = J
      MBB    = M
      IF(JSUM.EQ.0) SUBSON=.TRUE.
      IF(SSEF) SUBSON=.FALSE.
      IF(SCHOKE(L).NE.XCHOKE) GO TO 510
      IF(SSOF) SUBSON=.FALSE.
      JSUM   = JA+256*JB

C     EXECUTE FLOW BALANCE
  510 CALL FLOBAL
      IF(TYPELB(L).EQ.TE .OR. TYPEUB(L).EQ.TE) JSUM=0

C      BRANCH AND ASTERP ARE PRINTOUT INDICATORS
      DATA DBSTAR/2H**/, SUB/3HSUB/, SUPER/5HSUPER/, ICHOKE/5HCHOKE/
  501 ASTERP= BLANK
      IF(PRIM(L)) ASTERP=DBSTAR
      BRANCH= SUPER
      IF(SUBSON) BRANCH=SUB
      IF(SCHOKE(L).EQ.XCHOKE) BRANCH=ICHOKE

      CALL SETM(1,BLANK, CHANLS,10)
      CALL MOVE(2,ZF(MA),Z,NK,1, RF(MA),R,NK,1)
      CALL MOVE(2,CURVF(MA),CURV,NK,1, VMF(MA),VM,NK,1)

      LQ     = 0
      K      = 1
      M      = MA
  520 FLOW(K)=WSTA(K)*CG
      PHI(K)= PHI1(M)*TODEG
      QGAM   = FGR(K)/(1.+FGR(K))
      MACH(K)=VM(K)*SQRT(QGAM/(RG(K)*TS(K)))
      AQAREF(K) = R(K)
      IF ( AXIA ) AQAREF(K) = PI*R(K)*R(K)
      PS(K) = RHO(K)*RG(K)*TS(K)
      PSQPO(K)=PS(K)/PSA
      PSQPT(K)=PS(K)/PT(K)
      TSQTT(K)=TS(K)/TT(K)
C     CP MUST FOLLOW USE OF RG
      CP(K)= (PS(K)-PSA)*QO
      CALL GETIX
      XI2(K)= X2(J)
      IF(SLCHN(J).EQ.CHANLS(LQ)) GO TO 530
```

```
      LQ     = LQ+1
      J1(LQ)= J
      K1(LQ)= K
      CHANLS(LQ)=SLCHN(J)
      IF(LQ.GT.1) FLOWMX(LQ-1)=FLOW(K)
      I      = 0
  525 I      = I+1
      IF(SLCHN(J).NE.ICHN(I).AND.I.LT.IC) GO TO 525
      QPTO   = 1./WPTO(I)
  530 PTQPTO(K)=PT(K)*QPTO
      K      = K+1
      M      = M+1
      IF(K.LE.NK) GO TO 520
      J1(LQ+1)=J+1
      K1(LQ+1)=K
      FLOWMX(LQ)=FLOW(K-1)
      LQS    = 0
  533 LQS    = LQS+1
      KB     = K1(LQS)
      KE     = K1(LQS+1)-1
      FLMX   = 1./FLOWMX(LQS)
      DO 535 K=KB,KE
  535 PFLOW(K)=FLOW(K)*FLMX
      IF(LQS.LT.LQ) GO TO 533

      XI1    = X1(L)
      IF(PRPRN.EQ.(-1)) GO TO 610
      CALL FHEAD(LINEA+NK)
      LINEA = 4
      IF(.NOT.PRIM(L)) LINEA=8
      WRITE (6,1600) XI1,ASTERP,CHANLS,BRANCH,
     1 (XI2(K),PFLOW(K),Z(K),R(K),PHI(K),CURV(K),PSQPO(K),PSQPT(K),
     2 TSQTT(K),CP(K),MACH(K),AQAREF(K),PTQPTO(K),K=1,NK)

 1600 FORMAT (/25H STATION COORDINATE, XI1=,F7.3,A2,13H  CHANNELS-  ,
     110(A6,2X),A5//   5X,13HXI2 STRM FNCT,6X,3HX,Z,8X,3HY,R,8X,3HPHI,
     16X,4HCURV,6X,21HPS/PO    PS/PT    TS/TT,6X,2HCP,6X,4HMACH,6X,
     3 6H  AREA,3X,6HPT/PTO    / (2X,F6.3,F10.3,F12.5,F11.5,F9.3,F11.5,
     4 F9.3,2F8.3,F10.3,F9.4,F11.3,F9.3,7X,),)


  610 IF(.NOT.PRIM(L)) GO TO 800
      M      = MA
      DO 620 K=1,NK
      COSPHI= COS(PHI1(M))
      SINPHI= SIN(PHI1(M))
      FVX(K)=VM(K)*COSPHI
      FVY(K)=VM(K)*SINPHI
      FPX(K)=(PS(K)-PSA)*COSPHI
      FPY(K)=(PS(K)-PSA)*SINPHI
  620 M      = M+1
      SVX(1)= 0.
      SVY(1)= 0.
      SPX(1)= 0.
      SPY(1)= 0.
      CALL LSPFIT(WSTA,FVX,NK, WSTA,SVX,NK, -1)
      CALL LSPFIT(WSTA,FVY,NK, WSTA,SVY,NK, -1)
      CALL LSPFIT(AREA,FPX,NK, AREA,SPX,NK, -1)
```

```
      CALL LSPFIT(AREA,FPY,NK, AREA,SPY,NK, -1)
      DO 630 K=1,NK
      STX(K)= SVX(K)+SPX(K)
  630 STY(K)= SVY(K)+SPY(K)

      KA     = 1
      DO 640 LL=1,LQ
      J      = J1(LL+1)-1
      K      = K1(LL+1)-1
      IF(MD.NE.0) GO TO 635
      STXU(J)=STX(K)-STX(KA)
      STYU(J)=STY(K)-STY(KA)
  635 IF(MD.NE.0) GO TO 640
      STYD(J)=STY(K)-STY(KA)
      STXD(J)=STX(K)-STX(KA)
  640 KA     = K

      IF(PRPRN.EQ.(-1)) GO TO 800
      WRITE (6,1700) SVX(NK),SVY(NK),SPX(NK),SPY(NK),STX(NK),STY(NK)
      LINES = LINES+4
 1700 FORMAT(/6X25HSUM-VM*COS(PHI)*DFLOW    =F10.2,36X,25HSUM-VM*SIN(PHI)
     **DFLOW    =F10.2,/6X25HSUM-(P-PSO)*COS(PHI)*DA =F10.2,36X,25HSUM-(P
     *-PSO)*SIN(PHI)*DA =F10.2,/6X25HTOT AXIAL MOMENTUM FLUX =F10.2,36X,
     *25HTOTAL Y-MOMENTUM FLUX    =F10.2,)

C     RELOCATE DATA INTO THE M-ARRAYS
  800 CALL MOVE(2, MACH,MACHM(MA),NK,1, PS,PSM(MA),NK,1)
      CALL MOVE(2,PT,PTM(MA),NK,1, TT,TTM(MA),NK,1)

C     FILL IN STAGNATION POINT VALUES
      IF(MLB(L).EQ.MA) GO TO 820
      M      = MLB(L)
      CALL GETIX
      MACHM(M)=0.
      PTM(M)=PTM(MU)
      PSM(M)=PTM(M)
      TTM(M)=TTM(MU)
      VMF(M)= 0.
  820 IF(MUB(L).EQ.MB) GO TO 830
      M      = MUB(L)
      CALL GETIX
      MACHM(M)=0.
      PTM(M)=PTM(MU)
      PSM(M)=PTM(M)
      TTM(M)=TTM(MU)
      VMF(M)= 0.

C     INDEX TO NEXT STATION
  830 L      = L+LNEXT(L)
      IF(L.LT.LESTA) GO TO 500

      RETURN
      END
```

```
*DECK WRIBDY
      SUBROUTINE WRIBDY
*WRIBDY         WRITE OUTPUT FOR EACH BOUNDARY                     -WRIBDY-

      COMMON /BCOMMN/ PROGM(9),FILIN,FILOT
       LOGICAL                 FILIN,FILOT
      COMMON /ADAMO1/ NAME(6),ADDRES(6),TITLE(6),IDENT(6)
      COMMON /CLINES/ LINES,OMITFK,PTITLE(6)
      COMMON / CNORM / RHL,RM,AHL,ARM
      COMMON /ERASE2/ XI1(100),SW(100),ZW(100),RW(100),ANGW(100),
     *                CURVW(100),VE(100),MACH(100),PSQPO(100),CP(100),
     *        PSQPT(100),PTQPTO(100), TT(100),AW(100),SPDA(100)
C  NEW VARIABLES FOR NASA VERSION ONLY--PSQPT AND PTQPTO
      COMMON /ERASE3/ AQAN(100),CDPI(100),PSMPO(100)
       REAL           MACH
       DIMENSION      XW(1),YW(1)
       EQUIVALENCE    (XW,ZW),(YW,RW)
      COMMON /CFRFLD/ FSAV(300), STXU(128),STXD(128),STYU(128),STYD(128)

      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                DAXIT,SCALEA,TTE,CHOTST
       REAL           MACHA(1),MACHC
       LOGICAL        AXIA,AXIC
       LOGICAL        CHOTST
C     BOUNDARY TABLE
C      INDEX- LB=LBDO,LBDE
C      LBNEXT= INCREMENT TO NEXT BOUNDARY
C      LBZ1  = INCREMENT TO THE FIRST BOUNDARY POINT (=0 BEFORE COALLATIO
C      CHNAME= CHANNEL WITH WHICH THE BOUNDARY DATA IS ASSOCIATED
C      UP    = T OR F FOR UPPER OR LOWER BOUNDARY
C      LEDEX = RELATIVE INDEX OF L.E. POINT WHEN LOWER AND UPPER SURFACE
C              CONTOURS ARE CONNECTED
C      BDNAME,LBA,LBB=NAME AND INDEX LIMITS OF SPECIFIC BOUNDARY
C                    DATA WHEN BOUNDARIES ARE COALLATED
       DIMENSION      BDT(1),LBNEXT(1),LBZ1(1),
     1                CHNAME(1),UP(1),LEDEX(1),
     2                ZBT(1),RBT(1),ANGBT(42)
       LOGICAL        UP
       INTEGER BDT,CHNAME,BDNAME
       DIMENSION      BDNAME(1),LBA(1),LBB(1)
       EQUIVALENCE    (BDNAME,ZBT), (LBA,RBT), (LBB,ANGBT)
C     STATION TABLE
C      INDEX- L=LO,LESTA
C      SCHOKE= STATION CHOKE INDICATOR (ADJWF,BRHS,WRIOUT)
C      MCL   = SHARP CORNER INDICATOR (BLDTBS)
C      MCL   = FIELD INDEX OF CONTROL STREAMLINE (PTMOVE,FLOBAL)
       COMMON /CHDATA/ X1(1),LNEXT(1),MLB(1),MUB(1),PRIM(1),
     1                TYPELB(1),NAMELB(1),ILB(1),FLB(1),S1LB(1),
     1                TYPEUB(1),NAMEUB(1),IUB(1),FUB(1),S1UB(1),
     3                VMB(1),DWDV(1), X2CL(1),VCL(1),MCL(481)
       LOGICAL        PRIM
       INTEGER TYPELB,TYPEUB
       DIMENSION      SCHOKE(1)
       EQUIVALENCE    (SCHOKE,DWDV)
       EQUIVALENCE    (X1,BDT),(LNEXT,LBNEXT),(MLB,LBZ1),(MUB,CHNAME)
       EQUIVALENCE    (PRIM,UP),(TYPELB,LEDEX),(NAMELB,ZBT),(ILB,RBT)
       EQUIVALENCE    (FLB,ANGBT)
```

```
      COMMON /CFB    / L,MA,MB,PLB,PUB,WF,CHOKE,SUBSON, NK,PLBC,PUBC,
     1                 XCHOKE, TAREA,VMBC, WRQST,WCALC, QV(8),QVP(8),
     *                 JSUM,VMLBSQ
       LOGICAL                                  CHOKE,SUBSON
C     INDEX- M=MO,NM
      COMMON /CZ     / Z(300)
      COMMON /CR     / R(300)
      COMMON /CS1    / S1(300)
      COMMON /CPHI1  / PHI1(300)
      COMMON /CM     / JMS(300)
      COMMON /CCURV  / CURV(300)
      COMMON /CIDEX  / M,J,MU,MD,ISTAG
      COMMON /CVM    / VM(300)
      COMMON /CDS2   / MACHM(300)
       REAL             MACHM
      COMMON /CPSM   / PSM(300)
      COMMON /CS2    / PTM(300)
      COMMON /CRHS   / TTM(300)

      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                 LO,LESTA, LSO,LSE, LDO,LDE, LDUM(4),
     *                 MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                 LEO,LEE, LRO,LRE,LRD
       DIMENSION        LIMITS(24)
       EQUIVALENCE      (LIMITS,LHO)
      COMMON /CBEND / NBCB(2),ANGE(2),CURVE(2),FB(2)
      COMMON /CBITS / BITS,BLANK
      COMMON /CCUBE / NBC(2),C1(2),C2(2),FEND(2)
      COMMON /CGRAV / CG
      COMMON /CPI   / PI,TWOPI,PIQ2,PIQ4,TODEG,TORAD
      COMMON /CREFIN/ SG1,SG2,VMG1,VMG2
     1,                NGR,NGZ, SGR(10),GR(10), SGZ(10),GZ(10)
      COMMON /SLTAB / W(128),X2(128),SLCHN(128)
       INTEGER SLCHN
      COMMON /CHNFPT/ ICHN(10),WTFS(10),WTFA(10),WPTO(10),WTTO(10), IC

      COMMON /BLBDY / BLB(60)
      DIMENSION IBLB(60)
      EQUIVALENCE (IBLB,BLB)
      COMMON /BLDTA / BNAME,LOWER,IBTYPE,N1,NI,CAPX1
      INTEGER          BNAME


       INTEGER HLE,HTE,ASL,BDY,TSL,CHNN,CHN,XK5SV,XKEYB,BLANK

      LOGICAL          DOUBLE,LOWER,UPPER
      DIMENSION        LOWUP(2)
      DATA LOWUP/5HLOWER,5HUPPER/
      DATA HLE,HTE/2HLE,2HTE/, ASL,BDY,TSL/3HASL,3HBDY,3HTSL/

      NTRY   = 1
C     DEFINE REFERENCE DYNAMIC PRESSURE, ETC
      QO     = 0.
      IF(MACHA.LE..1) GO TO 95
      IF(GAMA.NE.0.) GO TO 92
      QO     = (RGA*TSA)/(PSA*MACHA*MACHA)
      GO TO 95
   92 QO     = 2./(GAMA*PSA*MACHA*MACHA)
```

```
C     BEGIN LOOP THROUGH CHANNELS
   95 LINES = 64
      IUP    = 4
      NCHN   = 1
      J2     = 1
  105 CHNN   = SLCHN(J2)
      LOWER  = .TRUE.
      I      = 0
  107 I      = I+1
      IF(CHNN.NE.ICHN(I) .AND. I.LT.IC) GO TO 107
      QPTO   = 1./WPTO(I)
      QTTO   = 1./WTTO(I)
      GO TO 122
  110 J2     = J2+1
      IF(J2.EQ.NJ .OR. SLCHN(J2+1).NE.CHNN) GO TO 120
      GO TO 110
  120 LOWER  = .FALSE.

C     BUILD I-SUBSCRIPTED ARRAYS
  122 M      = MBEGIN(J2)
      L      = 0
      SPDASV= 0.
      XK5SV  = BDY
  123 I      = 1
      SWORG  = S1(M)
      PTO    = PTM(M)
      TTO    = TTM(M)
      TTQTTO= TTM(M)*QTTO
  124 DOUBLE= .FALSE.
  125 SW(I)  = S1(M) - SWORG
      ZW(I)  = Z(M)
      RW(I)  = R(M)
      ANGW(I)=PHI1(M)*TODEG
      CURVW(I)= CURV(M)
      PS     = PSM(M)
      PSQPT(I)=PS/PTM(M)
      PTQPTO(I)=PTM(M)*QPTO
      MACH(I)=MACHM(M)
      VE(I)=VM(M)
      AW(I)  = RW(I)
      IF( AXIA ) AW(I)=PI*RW(I)*RW(I)
      PSQPO(I)=PS/PSA
      PSMPO(I)=PS-PSA
      CP(I)  = PSMPO(I)*QO
      IF(LOWER) PSMPO(I)=-PSMPO(I)
      CALL GETIX
      CALL STANO(M,L,UPPER)
      XI1(I)=X1(L)
      NI     = I
      I      = I+1
      IF(NI.EQ.1) GO TO 160

C      CHECK FOR LEADING EDGE POINT
      IF(ISTAG.NE.1) GO TO 140
      IF(TYPELB(L).EQ.HLE .OR. TYPEUB(L).EQ.HLE) GO TO 170
C      ISTAG=1
      IF(DOUBLE) GO TO 160
```

```
      DOUBLE= .TRUE.
      GO TO 125

C       CHECK FOR TRAILING EDGE POINT
  140 IF(ISTAG.NE.2) GO TO 160
C       ISTAG=2
      IF(TYPELB(L).EQ.HTE .OR. TYPEUB(L).EQ.HTE) GO TO 190

C       ISTAG=0,3 OR DOUBLE=T
  160 M       = MO
      IF(M.GT.0) GO TO 124
      GO TO 180

C     APPROACH STREAMLINE
  170 XKEYB    =ASL
      GO TO 200
C     BODY SURFACE
  180 XKEYB    =XK5SV
      GO TO 200
C     TRAILING STREAMLINE
  190 XKEYB    =XK5SV
      XK5SV  = TSL

  200 IF(XKEYB    .EQ.TSL) GO TO 220
      IF(.NOT.LOWER) GO TO 220
      LB      = LBF(NAMELB(L))
      IF(LEDEX(LB).EQ.0) GO TO 220
C       LOOP TO FIND BOUNDARY NAME OF UPPER SIDE OF L.E.
      LBX     = LB
  214 IF(LBA(LBX).GE.LEDEX(LB)) GO TO 220
      LBX     = LBX+3
      IF(LBX.LT.(LB+LBZ1(LB))) GO TO 214
      CALL ERROR1
  220 SPDA(1)=SPDASV
      CALL LSUM(AW,PSMPO,NI, SPDA)
      SPDASV= SPDA(NI)
      ARM     = RM
      IF ( AXIA ) ARM = PI*RM*RM
      DO 225 I=1,NI
      AW(I) = (ARM-AW(I))/ARM
  225 CDPI(I) = SPDA(I) *QO/ARM
      ADDG    = SPDASV*QO/ARM
  230 LINES = 64
      CALL FHEAD(NI+6)
      KUP     = 2
      IF(LOWER) KUP=1
      CHN     = SLCHN(J2)
      XI2     = X2(J2)
      SWORG = 0.
      WRITE (6,1200) LOWUP(KUP),CHN,XI2, (XI1(I),SW(I),ZW(I),RW(I),
     * ANGW(I),CURVW(I),PSQPO(I),CP(I),PSQPT(I),MACH(I),CDPI(I),AW(I),
     * PTQPTO(I),I=1,NI)
 1200 FORMAT (/2X,A6,17H BOUNDARY TO CHN=,A6,31H,    STREAMLINE COORDINAT
     *E, XI2=,F7.3,1H.//    5X,3HXI1,6X,3HSIW,7X,5HXW,ZW,6X,5HYW,RW,5X,
     * 4HANGW,5X,5HCURVW,5X,5HPS/PO,5X,2HCP,4X,5HPS/PT,4X,4HMACH,5X,
     * 4HCDPI,14H (AMAX-A)/AMAX,8H   PT/PTO   / (2X,2F8.3,F12.5,F11.5,
     * F8.3,F11.5,2F9.3,F7.3,2F9.4,F14.3,F8.3,),)
```

```
      WRITE (6,1210) TTQTTO
 1210 FORMAT (/6X,8HTT/TTO =,F9.3)
      IF ( XKEYB.EQ.ASL ) WRITE (6,1220) ADDG
 1220 FORMAT (/6X,15HADDITIVE DRAG =,F9.4)
      IF( XKEYB.EQ.ASL .OR. XKEYB.EQ.TSL ) GO TO 309
C*****************************  BOUNDARY LAYER  ************************
      NAME  = NAMELB(L)
      IF( .NOT.LOWER ) NAME=NAMEUB(L)
      LBL   = LBDYBL(NAME,LOWER)
      IF( LBL.EQ.0 ) GO TO 309
      CAPXI = BLB(LBL+2)
      BNAME = IBLB(LBL)
      CALL SAB(NTRY)
      NTRY  = 2
C**********************************************************************
  309 IF( MD.GT.0 ) GO TO 123


C     INTEGRAL MOMENTUM BALANCE ON THE CHANNEL
      IF(.NOT. LOWER) GO TO 310
      PFLB  = SPDASV
      GO TO 110
  310 PFUB  = SPDASV
      FTOT  = STXU(J2)+PFLB+PFUB
      FERR  = FTOT-STXD(J2)
      WRITE (6,1300) CHN,STXU(J2),PFLB,PFUB,FTOT,STXD(J2),FERR
 1300 FORMAT(/1X32HINTEGRAL MOMENTUM BALANCE,  CHN=A6,2X19H(AXIAL FORCES
     * ONLY)/6X31HENTERING MOMENTUM                =F11.4,/6X31HLOWER BOUND
     *ARY PRESSURE FORCE =F11.4,/6X31HUPPER BOUNDARY PRESSURE FORCE =F11
     *.4,/12X12HSUM OF ABOVEF24.4,/6X31HLEAVING MOMENTUM              =F
     *11.4,/12X25HERROR                   =F11.4,)

      J2    = J2+1
      IF(J2.LE.NJ) GO TO 105
      IF( NTRY.EQ.2 ) CALL SAB(3)
      RETURN
      END
```

```
*DECK ERRORY
      SUBROUTINE ERROR1
CEDUMPX          FDUMP FOR STC EXECUTE SECTION                       -EDUMPX-

C$               ALLCOM
      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                DAXIT,SCALEA,TTE,CHOTST
       REAL           MACHA(1),MACHC
       LOGICAL        AXIA,AXIC
       LOGICAL        CHOTST
      COMMON /CFB   / L,MA,MB,PLB,PUB,WF,CHOKE,SUBSON, NK,PLBC,PUBC,
     1                XCHOKE, TAREA,VMBC, WRQST,WCALC, QV(8),QVP(8),
     *                JSUM,VMLBSQ
       LOGICAL                              CHOKE,SUBSON
      COMMON /ERASE / ERASEC(800)
      COMMON /ERASE2/ AREA(96),AREAO(96),DISP(96),PT(96),LAMBDA(96),
     1                RHO(96),SQRTVV(96),TS(96),TT(96),VMSQ(96),
     2                VVKQKP(96),
     3                WQA(96),WSTA(96), RG(96),C2CP(96),FGR(96)
       REAL           LAMBDA
       DIMENSION      ES2(96),SDNQRM(96)
       EQUIVALENCE    (ES2,VVKQKP),(SDNQRM,RHO)
       DIMENSION      RCU(96)
       EQUIVALENCE    (RCU,LAMBDA)
C     FIELD TABLES
C      INDEX- M=MO,NM
      COMMON /CZ    / Z(300)
      COMMON /CR    / R(300)
      COMMON /CS2   / S2(300)
      COMMON /CS1   / S1(300)
      COMMON /CPHI1 / PHI1(300)
      COMMON /CM    / JMS(300)
      COMMON /CCURV / CURV(300)

      COMMON /CB    / B(300)
      COMMON /CIDEX / M,J,MU,MD,ISTAG
C     TABLE OF INDEX LIMITS
      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA,LSO,LSE,LDO,LDE,LDUM(4),
     *                MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE, LRO,LRE,LRD
       DIMENSION      LIMITS(24)
       EQUIVALENCE    (LIMITS,LHO)
      COMMON /CVM   / VM(300)

C     STREAMLINE TABLE
      COMMON /SLTAB / W(128),X2(128),SLCHN(128)
       INTEGER SLCHN
C     BOUNDARY TABLE
C      INDEX- LB=LBDO,LBDE
C      LBNEXT= INCREMENT TO NEXT BOUNDARY
C      LBZ1  = INCREMENT TO THE FIRST BOUNDARY POINT (=0 BEFORE COALLATIO
C      CHNAME= CHANNEL WITH WHICH THE BOUNDARY DATA IS ASSOCIATED
C      UP    = T OR F FOR UPPER OR LOWER BOUNDARY
C      LEDEX = RELATIVE INDEX OF L.E. POINT WHEN LOWER AND UPPER SURFACE
C              CONTOURS ARE CONNECTED
C      BDNAME,LBA,LBB=NAME AND INDEX LIMITS OF SPECIFIC BOUNDARY
```

```
C                       DATA WHEN BOUNDARIES ARE COALLATED
      DIMENSION           BDT(1),LBNEXT(1),LBZ1(1),
     1                    CHNAME(1),UP(1),LEDEX(1),
     2                    ZBT(1),RBT(1),ANGBT(42)
      LOGICAL             UP
      INTEGER BDT,CHNAME,BDNAME
      DIMENSION           BDNAME(1),LBA(1),LBB(1)
      EQUIVALENCE         (BDNAME,ZBT), (LBA,RBT), (LBB,ANGBT)
C     FLOW ADJUSTMENT TABLE
C      INDEX- LF=LFO,LFE
C      NFCOLS= 8
C      X1F   = ORTHOGONAL COORDINATE
C      X2F   = STREAMLINE COORDINATE OF SL EMINATING FROM T.E.
C      X1BF  = X1-COORDINATE OF CHOKE STATION OF FLOW BELOW T.E.
C      X1AF  = X1-COORDINATE OF CHOKE STATION OF FLOW ABOVE T.E.
C      S1F   = S1-COORDINATE OF T.E. (UPPER SURFACE). THIS ITEM
C              IS USED WHEN INTERPOLATING FOR WAKE DELTA-STAR.
C      LFB,LFA=INDICES OF STATIONS BELOW AND ABOVE T.E.
C      NCHB,NCHA=NUMBER OF CHANNELS BELOW AND ABOVE T.E.
C      LRF   = INDEX OF DUMMY ORTCHN LIST FOR THE T.E.
C      LRXF  = INDEX OF LAST CHANNEL BELOW THE T.E.
C      JORDER= 0 IF TOTAL FLOW AT X1F IS GIVEN
C            = 2 IF FLOW ABOVE T.E. IS GIVEN
C            = 1 IF FLOW BELOW T.E. IS GIVEN
C      JORDER= -1 IF FLOW AT X1F IS CHOKED AND SINGLE CHANNEL
      DIMENSION           X1F(1),X2F(1),X1BF(1),X1AF(1),
     1                    S1F(1),NCHB(1),NCHA(1),JORDER(1),VNR(12)
      EQUIVALENCE         (LFB,X1BF),(LFA,X1AF),(LRF,NCHB),(LRXF,NCHA)
      DIMENSION           LFB(1),LFA(1),LRF(1),LRXF(1)
C     STATION TABLE
C      INDEX- L=LO,LESTA
C      SCHOKE= STATION CHOKE INDICATOR (ADJWF,BRHS,WRIOUT)
C      MCL   = SHARP CORNER INDICATOR (BLDTBS)
C      MCL   = FIELD INDEX OF CONTROL STREAMLINE (PTMOVE,FLOBAL)
      COMMON /CHDATA/ X1(1),LNEXT(1),MLB(1),MUB(1),PRIM(1),
     1                    TYPELB(1),NAMELB(1),ILB(1),FLB(1),S1LB(1),
     1                    TYPEUB(1),NAMEUB(1),IUB(1),FUB(1),S1UB(1),
     3                    VMB(1),DWDV(1), X2CL(1),VCL(1),MCL(481)
      LOGICAL             PRIM
      DIMENSION           SCHOKE(1)
      EQUIVALENCE         (SCHOKE,DWDV)

      EQUIVALENCE   (BDT,X1F,X1), (LBNEXT,X2F,LNEXT), (LBZ1,X1BF,MLB)
      EQUIVALENCE   (CHNAME,X1AF,MUB), (UP,S1F,PRIM)
      EQUIVALENCE   (LEDEX,NCHB,TYPELB), (ZBT,NCHA,NAMELB)
      EQUIVALENCE   (RBT,JORDER,ILB), (ANGBT,VNR,FLB)

      COMMON /CTABPR/ I1TAB
      COMMON /BLBDY / IBLB(60)

      CALL TABPRT(6HALLCOM,MACHA,20,8)
      CALL TABPRT(3HCFB,L,33,4)
      CALL TABPRT(5HCIDEX,M,5,5)
      I1TAB = LBDO
      CALL TABPRT(6HBDYTAB,BDT,LBDE,3)
      I1TAB = LFO
      CALL TABPRT(6HCADJWF,X1F,LFE,8)
      I1TAB = LO
```

```
      CALL TABPRT(6HSTATAB,X1,LESTA,5)
  150 WRITE (6,1150) (J,X2(J),SLCHN(J),W(J),J=1,NJ)
      CALL TABPRT(5HERASE,ERASLC,800,5)

      CALL JMSPPT
      CALL TABPRT(2HS1,S1,NM,10)
      CALL TABPRT(2HS2,S2,NM,10)
      CALL TABPRT(1HZ,Z,NM,10)
      CALL TABPRT(1HR,R,NM,10)
      CALL TABPRT(4HPHI1,PHI1,NM,10)
      CALL TABPRT(4HCURV,CURV,NM,10)
      CALL TABPRT(2HVM,VM,NM,10)
      CALL TABPRT(1HB,B,NM,10)
      CALL TABPRT(6HERASE2,AREA,1536,8)
      IF( IBLB(1).NE.0 ) CALL TABPRT(5HBLBDY,IBLB,60,3)
      IF( LDE.EQ.0 ) GO TO 1321
      I1TAB = LDO
      CALL TABPRT(5HBLTAB,CHNAM,LDE,3)
 1321 CONTINUE

      LSTOP = 5
      GO TO (999,999) , LSTOP
  999 RETURN
 1150 FORMAT(///1X17HSTREAMLINE TABLE-/17X32HJ        X2                 SLCHN
     *     W/(I18,F12.6,6X,A6,F12.6,),)
      END
```

```
*DECK BDYPTM
      SUBROUTINE BDYPTM(NAME,INTVL, ZD,RD,FD,S1DD,DS1,DS1GMA)
*BDYPTM          BOUNDARY POINT MOVEMENT                          -BDYPTM-

C     INPUT-
C      BDT    = BOUNDARY TABLE
C      NAME   = BOUNDARY NAME
C      INTVL  = INDEX OF INTERVAL OF THE INPUT POINT IN THE BOUNDARY TABLE
C      FD     = FRACTION POSITION OF THE INPUT POINT IN THE INTERVAL
C      S1DD   = ARC DISTANCE FROM THE BEGINING OF THE INPUT INTERVAL
C      DS1    = REQ-D MOVEMENT IN THE CLOCKWISE DIRECTION FROM THE INPUT P

C     OUTPUT-
C      INTVL  = INDEX OF INTERVAL OF THE OUTPUT POINT
C      ZD,RD  = COORDINATES OF THE CALCULATED OUTPUT POINT
C      ANGD   = ANGLE OF OUTPUT POINT
C      CURVD  = CURVATURE OF OUTPUT POINT
C      FD     = FRACTION POSITION IN THE OUTPUT INTERVAL
C      S1DD   = ARC DISTANCE FROM THE BEGINING OF THE OUTPUT INTERVAL
C      DS1GMA= -GET- MINUS -ASK- POINT MOVEMENT DISTANCE

C     BOUNDARY TABLE
C      INDEX- LB=LBDO,LBDE
C      LBNEXT= INCREMENT TO NEXT BOUNDARY
C      LBZ1   = INCREMENT TO THE FIRST BOUNDARY POINT (=0 BEFORE COALLATIO
C      CHNAME= CHANNEL WITH WHICH THE BOUNDARY DATA IS ASSOCIATED
C      UP     = T OR F FOR UPPER OR LOWER BOUNDARY
C      LEDEX  = RELATIVE INDEX OF L.E. POINT WHEN LOWER AND UPPER SURFACE
C               CONTOURS ARE CONNECTED
C      BDNAME,LBA,LBB=NAME AND INDEX LIMITS OF SPECIFIC BOUNDARY
C                        DATA WHEN BOUNDARIES ARE COALLATED
      COMMON /CHDATA/ BDT(1),LBNEXT(1),LBZ1(1),
     1                CHNAME(1),UP(1),LEDEX(1),
     2                ZBT(1),RBT(1),ANGBT(42)
       LOGICAL        UP
       INTEGER BDT,CHNAME,BDNAME
       DIMENSION      BDNAME(1),LBA(1),LBB(1)
       EQUIVALENCE    (BDNAME,ZBT), (LBA,RBT), (LBB,ANGBT)
      COMMON /CBEAM2/ DR,DZ,YPA,YPB,F,G, DX,YQDX,ZM,RM,ANGM,CURVM,S1M,
     1                RZONLY, ANGCHD,SINTVL, YPASQ,YPAB,YPBSQ
       LOGICAL        RZONLY
      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA, LSO,LSE, LDO,LDE, LDUM(4),
     *                MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE, LRO,LRE,LRD
       DIMENSION      LIMITS(24)
       EQUIVALENCE    (LIMITS,LHO)
      COMMON /CBDYPT/ ANGD,CURVD
      COMMON /CBITS / BITS,BLANK

      COMMON /CFB   / L,DUMCFB(33)
      COMMON /CPRINT/ PPDUM(6),PDUM(6)
      COMMON /BLBDY / BLB(60)
      DIMENSION IBLB(60)
      EQUIVALENCE (IBLB,BLB)
      COMMON /REBL  / RESTBL
      LOGICAL         RESTBL
      COMMON /CPI   / PI,DUMPI(5)
```

```
      COMMON /CIDEX / M,DUMX(3),ISTAG
      DIMENSION       BNAME(1),LBLNXT(1),NSEP(2),SWREF(1),
     *                SIGN(1),SW(1),DSTAR(1),DDSTAR(1)
      INTEGER         BNAME
      EQUIVALENCE     (BNAME,BDT),(LBLNXT,LBNEXT),(NSEP,LBZ1),
     *                (SWREF,UP),(SIGN,LEDEX),(SW,ZBT),(DSTAR,RBT),
     *                (DDSTAR,ANGBT)
      LOGICAL  LOWER
      DIMENSION NAMEUB(1)
      EQUIVALENCE (NAMEUB,ANGBT(4))
      DIMENSION SWT(100),DSTART(100),DDSTRT(100)

      F     = FD
      SID   = SIDD
      IF(F.EQ.0. .OR. F.EQ.1.) F=BITS
      DSIGMA= 0.

C     SEARCH FOR MATCHING BOUNDARY NAME
      LB    = LBF(NAME)
      IF(LB.EQ.0) CALL ERROR1

C     I     = INDEX OF POINT WHICH BEGINS THE INTERVAL
C     SFI   = DISTANCE FROM POINT (I)
C     SFIP1 = DISTANCE FROM POINT (I+1)
      MINI  = LB+LBZ1(LB)
      I     = MINI+3*(INTVL-1)
      MAXI  = LB+LBNEXT(LB)-12
   75 CALL BARC(I)
C        IF -I- IS THE FIRST OF A DOUBLE POINT, BACK UP TO PREV INTERVAL
         IF(SINTVL.NE.0.) GO TO 80
         I     = I-3
         FD    = 1.
         IF(I.LT.MINI) CALL ERROR1
         GO TO 75
   80 IF(FD.EQ.1. .OR. SID.GT.SINTVL) SID=SINTVL
      SFI   = DS1+SID
      SFIP1 = SFI-SINTVL

C     IS THE NEW POINT WITHIN THIS INTERVAL
  100 IF(SFI)   120,114,114
  114 IF(SFIP1) 160,160,140

C     (MOVE COUNTERCLOCKWISE)
  120 IF(I.GT.MINI) GO TO 125
      DSIGMA=-SFI
      SFI   = 0.
      GO TO 235
  125 I     = I-3
      F     = BITS
      SFIP1 = SFI
      CALL BARC(I)
      SFI   = SFIP1+SINTVL
      GO TO 100

C     (MOVE CLOCKWISE)
  140 IF(I.LT.MAXI) GO TO 145
      DSIGMA= -SFIP1
      SFI   = SINTVL
```

```
      GO TO 230
  145 I       = I+3
      F       = BITS
      SFI     = SFIP1
      CALL BARC(I)
      SFIP1 = SFI-SINTVL
      GO TO 100

C     CALCULATE  COORDINATES OF THE NEW POINT (PROPER INTERVAL FOUND)
  160 IF(F.EQ.BITS) GO TO 230
      IF(DS1) 210,220,220
  210 F       = F*SFI/S1D
      GO TO 250
  220 F       = ((SFI-S1D)+(SINTVL-SFI)*F)/(SINTVL-S1D)
      GO TO 250
C     (NEW INTERVAL)
  230 F       = SFI/SINTVL

  250 G       = 1.-F
      RZONLY= .FALSE.
      CALL BFI
      ZD      = ZBT(I)+ZM
      RD      = RBT(I)+RM
      ANGD    = ANGCHD+ANGM
      CURVD   = CURVM
      S1DD    = S1M

      FD      = F
      INTVL   = (I - (LB+LBZ1(LB)))/3 + 1


C************************ BOUNDARY LAYER ADJUSTMENT ********************

      IF( LDE.NE.0 .AND. PDUM(15).NE.0. ) WRITE (6,288) NAME,ZD,RD,
     *                                                   ANGD,CURVD,S1DD
      IF( LDE.EQ.0 ) GO TO 300
      CALL GETIX
      IF( ISTAG.EQ.1 ) GO TO 300
      LOWER = .TRUE.
      IF( NAMEUB(L).EQ.NAME ) LOWER=.FALSE.
      LBL     = LBDYBL(NAME,LOWER)
      IF( LBL.EQ.0 ) GO TO 300
      NAMBL = IBLB(LBL)

C     SEARCH FOR NAMBL IN BL TABLE

      LD      = LDO
  270 IF( LD.GT.LDE ) CALL ERROR1
      IF( BNAME(LD).EQ.NAMBL ) GO TO 280
      LD      = LBLNXT(LD)
      GO TO 270
  280 NVAL    = (LBLNXT(LD)-LD-6)/3
      LD1     = LD
      DO 281 I=1,NVAL
      SWT(I)= SW(LD1)
      DSTART(I)= DSTAR(LD1)
      DDSTRT(I)= DDSTAR(LD1)
  281 LD1     = LD1+3
```

```
C      EVALUATE SWI FOR INTERPOLATION
       SWI    = SIGN(LD)*(BARCS(NAME,I,INTVL)+S1DD-SWREF(LD))
       IF( NSEP(LD).EQ.0 ) GO TO 285
       SWSEP = SW( NSEP(LD) )
       WRITE (6,1001) NAMBL,SWSEP
 1001 FORMAT(/6X,21H* * W A R N I N G * *,6X,
     * 26HSEPARATED BL   ,   BOUNDARY=,1X,A6,3X, 3HSW=,F14.6//)

  285 CALL LFIT1(SWT,DSTART,NVAL,SWI,DSTRC,1)
       CALL LFIT1(SWT,DDSTRT,NVAL,SWI,ANGC,1)
       ANGD   = ANGD+SIGN(LD)*ANGC
       CANG   = 0.
       IF( .NOT.LOWER ) CANG=PI
       ZD      = ZD-SIGN(LD)*DSTRC*SIN(ANGD-CANG)
       RD      = RD+SIGN(LD)*DSTRC*COS(ANGD-CANG)
       IF( PDUM(15).EQ.0. ) GO TO 300
       WRITE (6,289) NAME,NAMBL,ZD,RD,ANGD,CURVD,S1DD,SWI,DSTRC,ANGC
  288 FORMAT(//5X,A6,2X,5E16.8)
  289 FORMAT(//5X,A6,2X,A6,2X,5E16.8/21X,3E16.8)

  300 RETURN
       END
```

```
*DECK INSTA
      SUBROUTINE INSTA(LNEW,LBASE,L3,DOWNB,MA,MB)
*INSTA-                 INSERT A STATION                          -INSTA-
      LOGICAL                             DOWNB

C     INPUT-
C      LNEW   = LOCATION IN STATION-TABLE OF NEW STATION
C      LBASE  = LOCATION OF BASE STATION
C      L3     = LOCATION OF DOWNSTREAM (OR UPSTREAM) STATION
C      DOWNB  = T IF L3 IS AN UPSTREAM STA, OTHERWISE =F
C      MA,MB  = NEW STATION FILED POINT INDEX LIMITS
C      Z,R,PHI1 FIELD VALUES

C     OUTPUT-
C      LNEW   = STATION FOLLOWING NEW STATION

      COMMON /ALLCOM/ MACHA,PSA,TSA,PTA,TTA, AXIA,RGA,GAMA,
     1                MACHC,PSC,TSC,PTC,TTC, AXIC,RGC,GAMC,
     2                DAXIT,SCALEA,TTE,CHOTST
       REAL           MACHA(1),MACHC
       LOGICAL        AXIA,AXIC
       LOGICAL        CHOTST
      COMMON /CBEAM2/ DR,DZ,YPA,YPB,F,G, DX,YQDX,ZM,RM,ANGM,CURVM,S1M,
     1                RZONLY, ANGCHD,SINTVL, YPASQ,YPAB,YPBSQ
       LOGICAL        RZONLY
C      INDEX- M=MO,NM
      COMMON /CZ     / Z(300)
      COMMON /CR     / R(300)
      COMMON /CS2    / S2(300)
      COMMON /CS1    / S1(300)
      COMMON /CPHI1  / PHI1(300)
      COMMON /CM     / JMS(300)
      COMMON /CCURV  / CURV(300)
      COMMON /CB     / B(300)
      COMMON /CIDEX  / M,J,MU,MD,ISTAG
      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA,  LDUM(8),
     *                MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE, LRO,LRE,LRD
       DIMENSION      LIMITS(24)
       EQUIVALENCE    (LIMITS,LHO)
      COMMON /SLTAB / W(128),X2(128),SLCHN(128)
       INTEGER SLCHN
C     STATION TABLE
C      INDEX- L=LO,LESTA
C      SCHOKE= STATION CHOKE INDICATOR (ADJWF,BRHS,WRIOUT)
C      MCL    = SHARP CORNER INDICATOR (BLDTBS)
C      MCL    = FIELD INDEX OF CONTROL STREAMLINE (PTMOVE,FLOBAL)
      COMMON /CHDATA/ X1(1),LNEXT(1),MLB(1),MUB(1),PRIM(1),
     1                TYPELB(1),NAMELB(1),ILB(1),FLB(1),S1LB(1),
     1                TYPEUB(1),NAMEUB(1),IUB(1),FUB(1),S1UB(1),
     3                VMB(1),DWDV(1), X2CL(1),VCL(1),MCL(481)
       LOGICAL        PRIM
       INTEGER        TYPELB,TYPEUB
       DIMENSION      SCHOKE(1)
       EQUIVALENCE    (SCHOKE,DWDV)

      COMMON /CATAN3/ DANG
```

```
      COMMON /CBDYPT/ ANGD,CURVD
      COMMON /CBITS / BITS,IBLANK
      COMMON /CMAXIT/ MAXIT,MAJCTR,GREFIN,EDUM
      COMMON /CPI    / PI,TWOPI,PIQ2,PIQ4,TODEG,TORAD
      COMMON /CPRINT/ PDUM1(3),PREFIN
      COMMON /CVM    / VM(300)
      COMMON /FRASL  / ASL(800)
      COMMON /CFB    / LN,DUMCFB(33)

      INTEGER          BDYNAM,FARFLD,FREE,FIELD,PRES,SOLID
      LOGICAL          UPU,UPD

      DATA FARFLD/6HFARFLD/, FIELD/5HFIELD/, FREE/4HFREE/, PRES/4HPRES/,
     *     SOLID/5HSOLID/

C*** RELOCATE TO MAKE ROOM FOR THE NEW STATION
C    INITIALIZE NEW-STATION VALUE TO THE BASE-STATION VALUES
C     CORRECT THE STA-TABLE INDICIES- L-END, L-BASE, L-THREE, L-UPSTREAM
      LN     = LNEW
      NMOVE  = LN-1 - LESTA
      LB     = LBASE
      CALL MOVE(2, X1(LN),X1(LN+20),NMOVE,D, X1(LB),X1(LN),20,1)
      LESTA  = LESTA+20
      LT     = L3+20
      LU     = LB
      IF(.NOT.DOWNB) GO TO 60
      LB     = LB+20
      LT     = L3
      LU     = L3

C    UPDATE THE POINTERS TO THE FIELD-TABLE
   60 NPTS   = MB-MA+1
      LNEXI(LN)=20
      CALL STTOFI(LN,NPTS)

C*** DEFINE STATION-TABLE VALUES FOR THE NEW STATION
      X1(LN) = .5*(X1(LB)+X1(LT))
      MLB(LN)=MA
      MUB(LN)=MB
      PRIM(LN)=.FALSE.
      X2CL(LN)=BITS

C**  LOWER BOUNDARY STATION-TABLE VALUES
      M      = MA
      CALL GETIX
      MX     = MU
      IF(DOWNB) MX=MD
      LX     = LU
      CALL STANO(MX,LX,UPPER)
      IF(MX-MLB(LX)) 210,220,250
  210 CALL ERROR1

C    LOWER BOUNDARIES OF NEW AND BASE STATIONS ARE ON THE SAME SL
  220 IF(TYPELB(LB).EQ.FIELD) GO TO 250
      IF(TYPELB(LB).EQ.FARFLD) GO TO 260

C    FREE BOUNDARY
      IF(TYPELB(LB).NE.FREE .AND. TYPELB(LT).NE.FREE) GO TO 224
```

```
      TYPELB(LN)=FREE
      GO TO 260

C     PRESSURE BOUNDARY
  224 IF(TYPELB(LB).NE.PRES .AND. TYPELB(LT).NE.PRES) GO TO 230
      TYPELB(LN)=PRES
      GO TO 260

C     SOLID BOUNDARY
  230 TYPELB(LN)=SOLID
      BDYNAM= NAMELB(LX)
      NAMELB(LN)=BDYNAM
      ILB(LN)=ILB(LX)
      FLB(LN)=FLB(LX)
      S1LB(LN)=S1LB(LX)
      LD     = LU
      CALL STANO(MU,LU,UPU)
      CALL STANO(MD,LD,UPD)
      DS1    = .5*(BARCS(BDYNAM,ILB(LU),ILB(LD)) ● S1LB(LD)-S1LB(LU))
      IF(UPU.OR.UPD) CALL ERROR1
      IF(DOWNB) DS1=-DS1
      CALL BDYPTM(BDYNAM,ILB(LN),Z(M),R(M),FLB(LN),S1LB(LN),DS1,GMA)
      IF(GMA.NE.0.) CALL ERROR1
      PHI1(M)=ANGD
      B(M)   = .5*(B(MU)+B(MD))
      VM(M)  = .5*(VM(MU)+VM(MD))
      IF(VM(M).EQ.0.) VM(M)=VM(MU+1)
      GO TO 300

C     INFIELD BOUNDARY
  250 TYPELB(LN)=FIELD
      ISTAG =3
      CALL SAVIX
      NAMELB(LN)=IBLANK
  260 ILB(LN)=0
      FLB(LN)=BITS
      S1LB(LN)=BITS

C**  UPPER BOUNDARY STATION-TABLE VALUES
  300 M      = MB
      CALL GETIX
      MX     = MU
      IF(DOWNB) MX=MD
      CALL STANO(MX,LX,UPPER)
      IF(MUB(LX)-MX) 310,320,350
  310 CALL ERROR1

C     UPPER BOUNDARIES OF  NEW  AND  BASE  STATIONS ARE ON THE SAME SL
  320 IF(TYPEUB(LB).EQ.FIELD) GO TO 350
      IF(TYPEUB(LB).EQ.FARFLD) GO TO 360

C     FREE BOUNDARY
      LD     = LU
      CALL STANO(MU,LU,UPU)
      CALL STANO(MD,LD,UPD)
      IF (TYPEUB(LB).NE.FREE .AND. TYPEUB(LD).NE.FREE) GO TO 324
      TYPEUB(LN)=FREE
      GO TO 360
```

```
C     PRESSURE BOUNDARY
  324 IF (TYPEUB(LB).NE.PRES .AND. TYPEUB(LD).NE.PRES) GO TO 330
      TYPEUB(LN)=PRES
      GO TO 360

C     SOLID BOUNDARY
  330 TYPEUB(LN)=SOLID
      BDYNAM= NAMEUB(LX)
      NAMEUB(LN)=BDYNAM
      IUB(LN)=IUB(LX)
      FUB(LN)=FUB(LX)
      S1UB(LN)=S1UB(LX)
      LP     = LU
      CALL STAND(MU,LU,UPU)
      CALL STAND(MD,LD,UPD)
      IF(.NOT.UPU .OR. .NOT.UPD) CALL ERROR1
      DS1    = .5*(BARCS(BDYNAM,IUB(LD),IUB(LU)) + S1UB(LU)-S1UB(LD))
      IF(.NOT.DOWNB) DS1=-DS1
      CALL BDYPTM(BDYNAM,IUB(LN),Z(M),R(M),FUB(LN),S1UB(LN),DS1,GMA)
      IF(GMA.NE.0.) CALL ERROR1
      PHI1(M)= ANGD-PI
      B(M)   = .5*(B(MU)+B(MD))
      VM(M)  = .5*(VM(MU)+VM(MD))
      IF(VM(M).EQ.0.) VM(M)=VM(MU-1)
      GO TO 400

C     INFIELD BOUNDARY
  350 TYPEUB(LN)=FIELD
      ISTAG = 3
      CALL SAVIX
      NAMEUB(LN)=IBLANK
  360 IUB(LN)=0
      FUB(LN)=BITS
      S1UB(LN)=BITS

C     DEFINE THE FIELD POINTS BY CUBIC POLYNOMIAL INTERPOLATION ON SL-S
  400 M      = MA
      RZONLY= .TRUE.
      IF(TYPELB(LN).EQ.SOLID) GO TO 420
  410 CALL GETIX
      DZ     = Z(MD)-Z(MU)
      DR     = R(MD)-R(MU)
      F      = .5
      G      = .5
      ANGCHD= ATAN3(DR,DZ,PHI1(MU))
      YPA    = PHI1(MU)-ANGCHD
      YPB    = PHI1(MD)-ANGCHD
          MSV    = M
          MUSV   = MU
          MDSV   = MD
          M      = MD
          CALL GETIX
          ISTAGD= ISTAG
          MD     = M
          M      = MSV
          MU     = MUSV
          IF(ISTAGD.EQ.1) YPB=-YPA
```

```
      RZONLY= .FALSE.
      CALL BFI
      Z(M)   = Z(MU)+ZM
      R(M)   = R(MU)+RM
      PHI1(M)=ANGCHD+ANGM
      VM(M)  = F*VM(MD)+G*VM(MU)
      B(M)   = F*B(MD)+G*B(MU)
C       CHECK FOR POINTS ON A SLIP LINE
      IF(M.EQ.MA .OR. W(J).NE.0.) GO TO 420
      Z(M)   = .5*(Z(M-1)+Z(M))
      M      = M-1
      CALL GETIX
      M      = MSV
      DZ     = .25*(Z(MUSV)-Z(MU)+Z(MDSV)-Z(MD))
      DR     = .25*(R(MUSV)-R(MU)+R(MDSV)-R(MD))
      Z(M-1)= Z(M)-DZ
      R(M-1)= R(M)-DR
      Z(M)   = Z(M)+DZ
      R(M)   = R(M)+DR
  420 M      = M+1
      IF(M-MB) 410,425,500
  425 IF(TYPEUB(LN).NE.SOLID) GO TO 410

C     CHECK FOR OUT-OF-ORDER POINTS
  500 NORDER= 0
  502 NORDER= NORDER+1
      IF(NORDER.GE.20) CALL ERROR1
      MX1    = 0
      MAP1   = MA+1
      MSV    = MA
      S2(MA)= 0.
      DO 520 M=MAP1,MB
      DR     = R(M)-R(M-1)
      DZ     = Z(M)-Z(M-1)
      S2(M)  = S2(M-1)+SQRT(DR*DR+DZ*DZ)
      CALL GETIX
      IF(W(J).EQ.0.) GO TO 518
      ANG2   = ATAN3(DR,DZ,PHI1(M-1))
      ADANG  = ABS(DANG-PIQ2)
      IF(MX1.NE.0) GO TO 515
      IF(ADANG.GE.PIQ2) MX1=MSV
      MSV    = M-1
  515 IF(ADANG.GE.PIQ2) MX2=M
      GO TO 520
  518 IF((M-1).EQ.MX2) MX2=M
  520 CONTINUE
C     DEFINE THE FIELD PT LOCATIONS BY UPSTREAM AREA DISTRIBUTIONS
      IF(MX1.EQ.0) GO TO 999
      MX1    = MAX0(MX1-NORDER,MA)
      MX2    = MIN0(MX2+NORDER,MB)
      WRITE (6,1550) MX1,MX2
 1550 FORMAT(14H INSTA-MX1,MX2,2I6)
      MX1    = MAX0(MX1-1,MA)
      MX2    = MIN0(MX2+1,MB)
C      ADD UP UPSTREAM AREAS
      M      = MX1
      CALL GETIX
      K      = 1
```

```
      ASL(1)= 0.
  562 MUM1   = MU
      M      = M+1
      K      = K+1
      CALL GETIX
      AREA   = SQRT((R(MU)-R(MUM1))*(R(MU)-R(MUM1)) +
     1                 (Z(MU)-Z(MUM1))*(Z(MU)-Z(MUM1)))
      IF(AXIA) AREA=(R(MU)+R(MUM1))*AREA
      ASL(K)= ASL(K-1)+AREA
      IF(M.LT.MX2) GO TO 562
      ASLNK  = ASL(K)

C       INTERPOLATE FOR COORDINATES
      DZBA   = Z(MX2)-Z(MX1)
      DRBA   = R(MX2)-R(MX1)
      DRSQBA= DRBA*(R(MX2)+R(MX1))
      RMASQ  = R(MX1)*R(MX1)
      DVMBA  = VM(MX2)-VM(MX1)
      M      = MX1+1
      K      = 2
  564 F      = ASL(K)/ASLNK
      Z(M)   = Z(MX1)+F*DZBA
      R(M)   = R(MX1)+F*DRBA
      IF(AXIA) R(M)=SQRT(RMASQ+F*DRSQBA)
      VM(M)  = VM(MX1)+F*DVMBA
      M      = M+1
      K      = K+1
      IF(M.LT.MX2) GO TO 564
      GO TO 502

  999 LNEW   = LN+20
      RETURN
      END
```

```
*DECK ERRORM
      SUBROUTINE ERROR1
CEDUMPM        EDUMP FOR STCM LINK


C     TABLE OF INDEX LIMITS
      COMMON /IXORIG/ LHO,LHE, LBDO,LBDE, LTO,LTE, LWO,LWE, LFO,LFE,
     *                LO,LESTA,LSO,LSE,LDO,LDE,LDUM(4),
     *                MO,NM, NJ,NFCOLS, MAXNJ,MAXOL,MAXNM,MAXLE,
     *                LEO,LEE, LRO,LRE,LRD
       DIMENSION      LIMITS(24)
       EQUIVALENCE    (LIMITS,LHO)
C     STREAMLINE TABLE
      COMMON /SLTAB / W(128),X2(128),SLCHN(128)
       INTEGER SLCHN
C     STATION TABLE
C     INDEX- L=LO,LESTA
C     SCHOKE= STATION CHOKE INDICATOR (ADJWF,BRHS,WRIOUT)
C     MCL   = SHARP CORNER INDICATOR (BLDTBS)
C     MCL   = FIELD INDEX OF CONTROL STREAMLINE (PTMOVE,FLOBAL)
      COMMON /CHDATA/ X1(1),LNEXT(1),MLB(1),MUB(1),PRIM(1),
     1                TYPELB(1),NAMELB(1),ILB(1),FLB(1),S1LB(1),
     1                TYPEUB(1),NAMEUB(1),IUB(1),FUB(1),S1UB(1),
     3                VMB(1),DWDV(1), X2CL(1),VCL(1),MCL(481)
       LOGICAL        PRIM
       INTEGER TYPELB,TYPEUB
       DIMENSION      SCHOKE(1)
       EQUIVALENCE    (SCHOKE,DWDV)
      COMMON /CA2   / A2(300)
      COMMON /CA3   / A3(300)
      COMMON /CA4   / A4(300)
      COMMON /CA5   / A5(300)
      COMMON /CA6   / A6(300)
      COMMON /CA7   / A7(300)
      COMMON /CA8   / A8(300)
      COMMON /CB    / B(300)
      COMMON /CCURV / CURV(300)
      COMMON /CDS2  / DS2(300)
      COMMON /CDDS2 / DDS2
      COMMON /CFB   / L,MA,MB,PLB,PUB,WF,CHOKE,SUBSON, NK,PLBC,PUBC,
     1                XCHOKE, TAREA,VMBC, WRQST,WCALC, QV(8),QVP(8),
     *                JSUM,VMLBSQ
       LOGICAL                              CHOKE,SUBSON
      COMMON /CIDEX/ C1(5)
      COMMON /CIDEXR/ C2(25)
      COMMON /CPHI1 / PHI1(300)
      COMMON /CR    / R(300)
      COMMON /CRHS  / RHS(300)
      COMMON /CS1   / S1(300)
      COMMON /CS2   / S2(300)
      COMMON /CTABPR/ I1TAB
      COMMON /CTOLRL/ C3(12)
      COMMON /CVM   / VM(300)
      COMMON /CZ    / Z(300)
      COMMON /BLBDY / IBLB(60)

      CALL TABPRT(3HCFB,L,33,4)
      CALL TABPRT (5HCIDEX,C1,5,5)
```

```
      CALL TABPRT (6HCIDEXR,C2,25,5)
      CALL TABPRT (6HCTOLRL,C3,6,6)
      I1TAB  = LO
      CALL TABPRT (6HSTATAB,X1,LESTA,5)
      CALL JMSPRT
      CALL TABPRT (2HS1,S1,NM,10)
      CALL TABPRT (2HS2,S2,NM,10)
      CALL TABPRT (1HZ,Z,NM,10)
      CALL TABPRT (1HR,R,NM,10)
      CALL TABPRT(4HCURV,CURV,NM,10)
      CALL TABPRT (2HVM,VM,NM,10)

      WRITE (6,1000)
      DO 100 I=1,NM
      WRITE (6,1001) I,B(I),A2(I),A3(I),A4(I),A5(I),A6(I),A7(I),A8(I),
     1                   DS2(I),RHS(I)
  100 CONTINUE
      WRITE (6,1002) DDS2
 1000 FORMAT (4H1  M,11X,1HB,10X,2HA2,10X,2HA3,10X,2HA4,10X,2HA5,10X,
     1          2HA6,10X,2HA7,10X,2HA8,9X,3HDS2,9X,3HRHS)
 1001 FORMAT (1H ,I3,8F12.3,2F12.6)
 1002 FORMAT(///8H  DS2MX=,F12.6)
      IF( IBLB(1).NE.0 ) CALL TABPRT(5HBLBDY,IBLB,60,3)
      IF( LDE.EQ.0 ) GO TO 1321
      I1TAB = LDO
      CALL TABPRT(5HBLTAB,CHNAM,LDE,3)
 1321 CONTINUE
      LSTOP = 5
      GO TO (999,999) , LSTOP
  999 RETURN
      END
```