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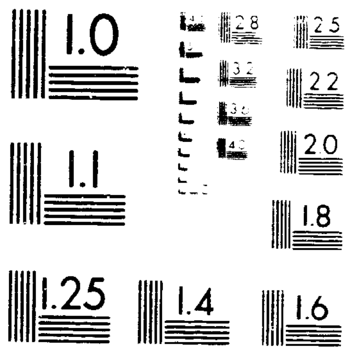

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
ANSI and ISO TEST CHART No. 2

NASA Contractor Report 172213

MINIVER UPGRADE FOR THE AVID SYSTEM

VOLUME II: LANMIN INPUT GUIDE

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Contract NAS1-16983
August 1983

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National Aeronautics and
Space Administration

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FOREWORD

This final report presents work which was conducted for angley Research Center (LaRC) in response to requirements of Contract NAS1-16983. The work presented was performed by REMTECH, Inc. Huntsville, Alabama and is entitled ''MINIVER Upgrade For The AVID System''. The final report consists of three volumes.

Volume I: LANMIN User's Manual

Volume II: LANMIN Input Guide

Volume III: EXITS User's and Input Guide

The NASA technical coordination for this study was provided by Ms. Kathryn E. Wurster of the Vehicle Analysis Branch of the Space Systems Division.

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Section 1.0

INTRODUCTION

The aerothermal software developed for use in the AVID system (Ref. 1) is documented in three volumes. The first volume provides a detailed description of the Langley version of MINIVER (LANMIN). Volume II provides a users input guide to the LANMIN code, and Volume III gives a description and input guide for the Explicit Interactive Thermal Structures (EXITS) code.

The overall information flow for the aerothermal software in the AVID system is given in Fig. 1.1. Volumes I and II cover the components within the dashed lines of Fig. 1.1, and Volume III documents the remainder of the software. As shown in Fig. 1.1, the input to LANMIN is made via an input file. This file is a card image and thus can be treated as card input as discussed in Section 2. The preprocessor's prime function is to produce this input file. A description of how to use the preprocessor (PREMIN) is given in Section 3. The output from LANMIN is documented in Section 4.

The LANMIN program consists of 51 routines and one main program. A comparison of the set of LANMIN routines with the MINIVER routines is given in Table 1.1. The conduction related routines were eliminated from the MINIVER code when generating LANMIN. All conduction related routines were incorporated in the EXITS code documented in Volume III. Thirteen routines which were retained from the original MINIVER code have been modified. Twenty-two new routines have been added to the code in creating the LANMIN version.

The flow diagram for the LANMIN code is given in Fig. 1.2. Functions and block data are listed to the side. The diagram shows the calling hierarchy for the subroutines. The input to LANMIN is through the MAIN. An output file can be created and it is generated in VANOUT.

Table 1.1

LANMIN/MINIVER SUBROUTINES

LANMIN	MINIVER	LANMIN	MINIVER	LANMIN	MINIVER
AIR62	AIR62	INTP1		SWCYL3	SWCYL3
ATMS4	ATMS4	INTP2		TBLIN	TBLIN
BLOCK		LESIDE		TINT6	TINT6
BLOCKA		MAIN*	H800	TRANS*	TRANS
BINTRP	BINTRP		#MATRES	VANOUT	
	#CHEEVY	MOLIER*	MOLIER	VRA71	
BTHICK			#MPROPS	VRUNL	VRUNL
CONE			#NEWT	WRINP*	WRINP
CPIAF			#OPTMYZ		WRTOUT
CRSFLW	CRSFLW		OVLAV01		WYROS
CYT			OV432		
DEFL		PCSW*	PCSW		
DETRAL	DETRAL		PLOTS		
	DINT	PMEXPM	PMEXPM		
	DINT1	PMID	PMID		
DOWNID	DOWNID		#PRINTA		
	#DRIVEL	RADEQT*	RADEQT		
DSTML		REGIME			
DWNSTM*	DWNSTM	RHOMUR	RHOMUR		
ECKERT	ECKERT	SLOPE	#SETMUP		
EDPARM	EDPARM	SPCHI*	SPCHI		
ERF		SPFP			
FAYRID*	FAYRID		#STABLE		
FINH		STHEAT			
FINPKH			#STOCK		
FINPKP		SWCYL	SWCYL		
	#FINALT	SWCYL2*	SWCYL2		
FLAPH					
FLOW*	FLOW				
FMHEAT					
FSUBC*	FSUBC				
	#GUASS				
HANSEN*	HANSEN				
	#INOUTR				

*These Subroutines Have Been Modified.
#Conduction Related Subroutines.

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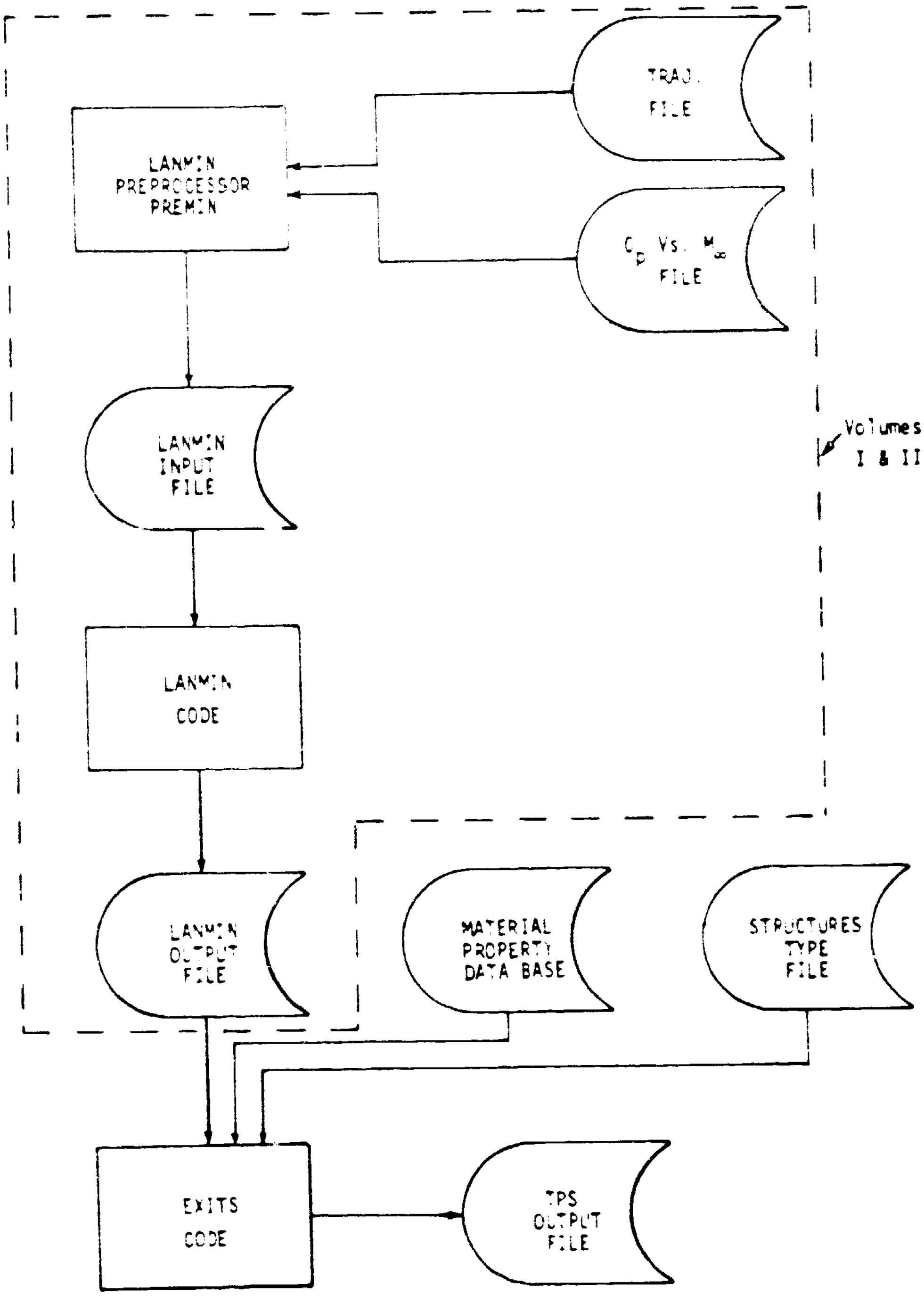

Fig. 1.1 Overall Information Flow

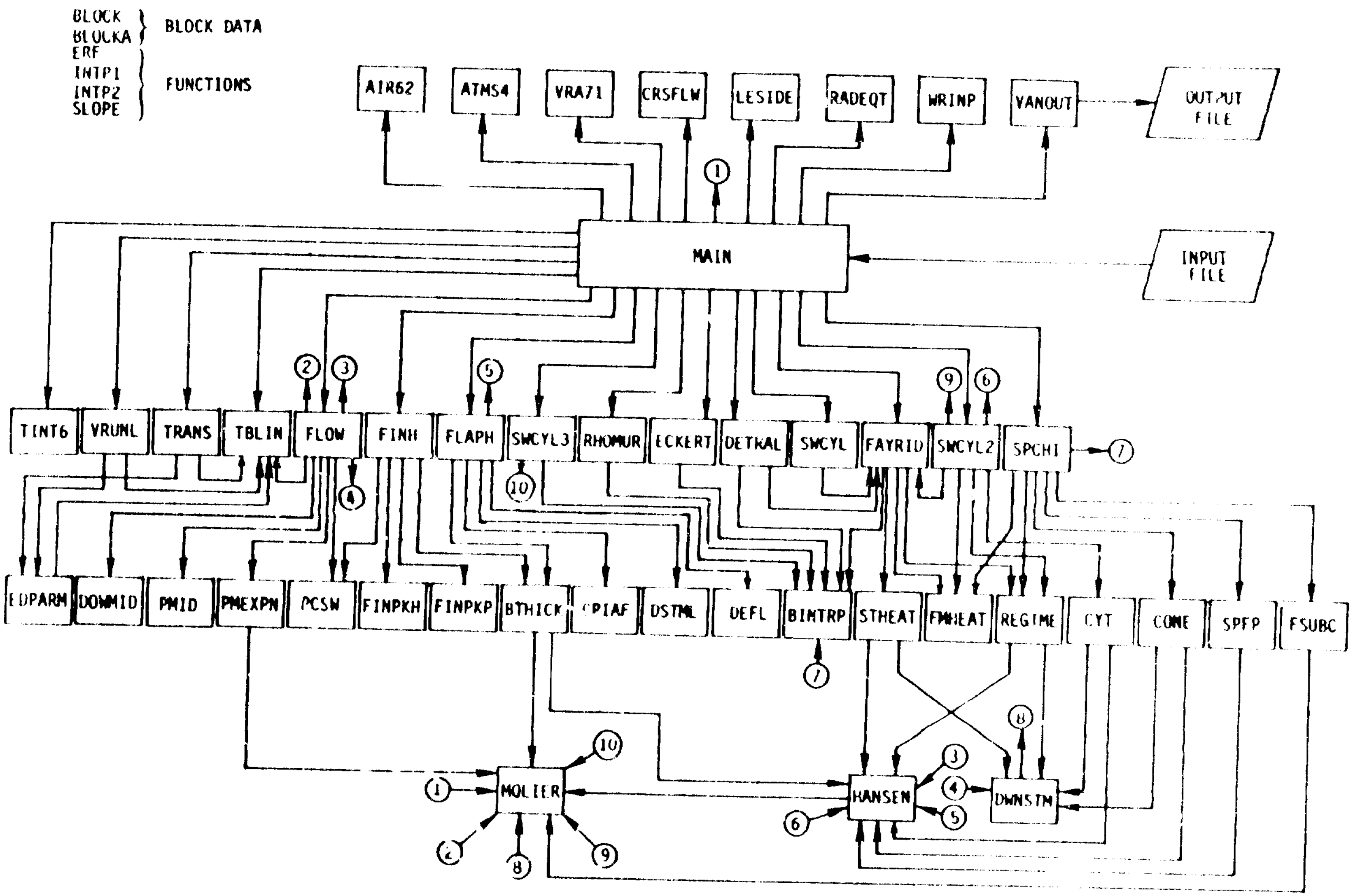

Fig. 1.2 LANMIN Macro Flow Diagram

Section 2.0

CARD INPUT

The card input to LANMIN has been broken into sixteen functional areas. These areas are as follows:

(1) Title
(2) Timing Parameters and Print Control
(3) Trajectory Data
(4) Atmosphere Data
(5) Flowfield Options
(6) Flow Angle Data
(7) Angle of Attack Option
(8) Crossflow Data
(9) Transition Criteria
(10) Heat Transfer Options
(11) Heating Multipliers
(12) Transformations
(13) Surface Condition
(14) Geometry Data
(15) Initial Conditions
(16) Control Parameters

Most of the input for these areas involves specifying the values for the 'W' array. A definition of all the elements of the 'W' array is given in Appendix A.

(1) TITLE

Format (18A4)

Case Description

(2) TIMING PARAMETERS AND PRINT CONTROL

Format (3F20.6)

CARD NO.	COLUMN	INPUT VALUE	
1	1-20	t1	Initial time, sec (W(1))
	21-40	Δt1	Printout interval 1, sec (W(2))
	41-60	t2	Second time, sec (W(3))
2	1-20	Δt2	Printout interval 2, sec (W(4))
	21-40	t3	Third time, sec (W(5))
	41-60	Δt3	Printout interval 3, sec (W(6))
3	1-20	t4	Fourth time, sec (W(7))
	21-40	k_{CALC}	Calculation interval factor (W(8))

Note: If less than three printout intervals are desired, the unused parameter must be input as zero.

(3) TRAJECTORY DATA

Format (3F20.6, 2F10.6)

CARD NO.	COLUMN	INPUT VALUE
1	1-20	Number of time dependent table entries (W(50) limit = 50)
2	1-20	Time (t), sec (W(51)—W(100))
	21-40	Altitude (z), ft (W(101)—W(150))
	41-60	Velocity (v), ft/sec (W(151)—W(200))
	61-70	Angle of Attack (α), degrees (W(211)—W(260))
	71-80	Yaw Angle (β), degrees (W(651)—W(700))

(4) ATMOSPHERE DATA

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
010	Atmosphere/Freestream Properties Option Flag (ATFLAG)
	0. Freestream properties are defined using the 1962 U.S. Standard Atmosphere. Trajectory data are required input.
	1. Wind tunnel input option - Freestream static temperature and pressure are input in locations 451-500 and 501-550, respectively, as a function of time. The time data and freestream velocity data are input in the TRAJECTORY DATA card set with the altitude (z_∞) set equal to zero.
	2. Freestream static temperature and pressure are input in locations 451-500 and 501-550, respectively, as a function of altitude. Altitude values are input in locations 401-450. Trajectory data (time, altitude, velocity and angle of attack) are required input.
	4. Freestream properties are defined using The 1963 Patrick Air Force Base (PAFB) Atmosphere. Trajectory data are required input.
	5. Freestream properties are defined using The 1971 Vandenberg Reference Atmosphere. Trajectory data are required input.
	6. Freestream properties are defined using The 1973 Vandenberg Hot Day Atmosphere. Trajectory data are required input.
	7. Freestream properties are defined using The 1973 Vandenberg Cold Day Atmosphere. Trajectory data are required input.
	8. Freestream properties are defined using The 1971 Kennedy Hot Day Atmosphere. Trajectory data are required input.
	9. Freestream properties are defined using The 1971 Kennedy Cold Day Atmosphere. Trajectory data are required input.
	Freestream Properties Data Input as Follows:
400	Number of table entries (Limit 50) Enaltz
401-450	Table of altitude data, ft
451-500	Table of freestream temperatures, °R
501-550	Table of freestream pressures, lb/sq ft

(5) FLOWFIELD OPTIONS

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
031-036	Flowfield and Local Pressure Option Flags (FF)
046-048	Flowfield and pressure option flags are input beginning in Location 031. A total of 9 locations are available (031-036 and 046-048). The first flowfield option flag must be input in Location 031, followed by additional flowfield and pressure option flags, as needed. Location number must be used in ascending order. Flowfield and pressure flags always occur in pairs except for FF = 39 (Swept Cylinder) and FF = 29 (Prandtl Meyer expansion).

Flowfield Options:

35. Sharp Wedge Shock Angle.
The shock angle for a sharp wedge is determined from a built-in table of sharp wedge shock angle as a function of upstream Mach number and the wedge or flow deflection angle. The wedge angle is input.

36. Sharp Cone Shock Angle.
The shock angle for a sharp cone is determined from an internal table as a function of the cone half-angle and the upstream Mach number. The cone half-angle is input.

38. Oblique and Normal Shock.
The actual shock angle is input. An angle of 90° represents a normal shock.

39. Parallel Shock.
Used alone or as a last option to indicate that a swept cylinder or parallel shock solution is desired (no pressure flag needed). The angle-of-attack or shock angle is input. For swept cylinder the input angle is the $(90-\lambda)$ where λ is the sweep angle in degrees.

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
031-036	Local Pressure Options:
046-048	14. INPUT Cp as a function of M_∞ for the location W(649) = 1.0, Data Stored in TCPM( ) = Cp, TMCP( ) = M_∞ , NCPMT = number of Mach Numbers.
	15. Tangent Wedge Pressure Coefficient. The local pressure coefficient for a tangent wedge is determined from a built-in table as a function of the wedge angle and the upstream Mach number. The wedge angle is input.
	16. Tangent Cone Pressure Coefficient. The local pressure coefficient for a tangent cone is determined from a built-in table as a function of the cone half-angle and the upstream Mach number. The cone half-angle is input.
	17. Oblique Surface Pressure. Provides pressure solution for a surface whose shock angle is slightly greater than the surface angle-of-attack or flow deflection angle. The shock angle must be known and input under the flowfield shock option (flowfield option 38). The input pressure angle is the surface angle-of-attack or flow deflection angle.
	18. Modified Newtonian Pressure - Oblique Shock. Local pressure is calculated as a function of the local slope. Local total pressure is used with this option. The local body angle is input.
	Prandtl-Meyer Expansion:
	29. This option provides a Prandtl-Meyer expansion and is used following any one of the local pressure options. The input angle is the angular difference between the two slopes (flow turning angle).

(6) FLOW ANGLE DATA

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
037-045	Flow Angle Data Input. The angles required as input by the flowfield options are input beginning in location 037. These data must be input in the same order as the flowfield option location requiring their input. (i.e., the angle input in location 037 must correspond to flowfield option in location 031, etc.). All angles are input in degrees.

(7) ANGLE OF ATTACK OPTION

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
	Angle-of-Attack Option Angles input in locations 037 and 038 are adjusted within the program to account for angle-of-attack. If it is desirable for other angles input in locations 039 through 045 to be adjusted for angle-of-attack, the following control parameters must be input:
261	1. Initialized in Main
262	2. Initialized in Main
263	3. Varies angle in Location 039 (input data)
264	4. Varies angle in Location 040 (input data)
265	5. Varies angle in Location 041 (input data)
266	6. Varies angle in Location 042 (input data)
267	7. Varies angle in Location 043 (input data)
268	8. Varies angle in Location 044 (input data)
269	9. Varies angle in Location 045 (input data)

(8) CROSSFLOW DATA

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
201	Crossflow Option Flag (CFFLG)

1. Constant Width Rectangle (Ideal Gas).
   This method assumes a constant width rectangle and ideal gas chordwise velocity gradient. Required inputs are corner radius, Rc, and width, D_o.

2. Constant Width Rectangle (Real Gas).
   This method assumes a constant width rectangle and real gas chordwise velocity gradient. Required inputs are width, Do, and the velocity gradient correction factor, $\dot{U}$. The term $\dot{U}$ can be varied from 0.31 for a flat surface to 1.0 for a swept cylinder.

3. Sharp Edged Delta Configurations (Ideal Gas).
   This method assumes a sharp edged delta configuration and ideal gas chordwise velocity gradient. Required input is the delta sweep angle λ.

4. Delta Configuration (Real Gas).
   This method assumes a delta configuration and real gas chordwise velocity gradient. Required inputs are the delta sweep angle, λ, and the velocity gradient correction factor, $\dot{U}$. A sharp edged delta configuration is represented by $\dot{U}$=0.31. An input of $\dot{U}$=1.0 produces crossflow on a pointed cone whose half angle is (90-λ).

	Crossflow Data Input
202	Rectangle Width, D_o (ft)
203	Delta wing sweep angle, λ (deg)
204	Real Gas velocity gradient correction factor, $\dot{U}$
205	Rectangle corner radius, R_c (ft)

(9) TRANSITION CRITERIA
Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
027	Transition Criteria Option Flag (TRFLAG)

1. This option allows transition from laminar to turbulent flow to occur at a particular time in the trajectory. The time (sec) when transition begins is input in location 014. The time (sec) when fully turbulent flow is reached is input in location 020.

2. This option is the same as option 1, except transition is from turbulent to laminar.

3. Transition based on the Reynolds number R_{e_L}. Input requirements are the onset Reynolds number (PARA1, location 014) and the fully turbulent Reynolds number (PARA2, location 020).

4. Transition based on $R_{e_\theta}^*$. Input requirements are onset Reynolds number (PARA2, location 014) and the fully turbulent Reynolds number (PARA2, location 020).

5. Transition based on ψ (MDAC-E transition parameter). Required inputs are the onset value of ψ (PARA1, location 014) and the fully turbulent value of ψ (PARA2, location 020). The parameter ψ is defined by the equation,

$$\psi = R_{e_\theta}^* [M_e (\rho_e U_e / \mu_e)^{0.2}]$$

6. Transition based on ψ (see option 5). Transition onset determined from built-in curve of ψ as a function of angle of attack. The parameters PARA1 and PARA2 are not required input. Transition zone length is determined from the ratio,

$$L_{FULLY\ TURB} / L_{TRANS\ ONSET}$$

This ratio is input in location 028, if desired. If no value is input the program will select a value from a built-in table of $\log_{10} R_{e_\theta}$ versus ratio.

7. Transition based on built in curve data of onset $R_{e_{TR}}$ versus M_e (Rockwell International criteria). Transition zone length determined in the same manner as option 6.

8. Transition based on $R_{e_\theta}^* / M_e$. Input requirements are onset value (PARA1, location 014) and the fully turbulent value (PARA2, location 020). Nominal values are 150. and $\sqrt{2}$ x 150 respectively.

	Transition Data
014	PARA1
020	PARA2
028	Transition Zone Length Ratio

(10) **HEAT TRANSFER OPTIONS**

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
011	Heat Transfer Method Option Flag (HTFLAG)

1. Fay-Riddell Stagnation Point Method.
   Required input data are nose radius R_N (location 012) and flowfield options 38 and 18 with shock and pressure angles of 90 degrees. An option available (location 315) will allow dissociation to be considered (Lewis no. = 1.4) or not considered (Lewis no. = 1.0).

2. Cato/Johnson Swept Cylinder Method.
   Required input data are local cylinder radius R_N (location 012), sweep angle λ (location 017), flowfield option 38 with a shock angle of 90 degrees, and flowfield local pressure option 18 with a pressure angle of $(90-\lambda)$ degrees.

3. Eckert's Reference Enthalpy Flat Plate Method.
   Required input data are the running length (location 013) and Mangler transformation factors for both laminar and turbulent flow (locations 015 and 016, respectively).

4. Eckert/Spalding-Chi Flat Plate Method.
   Required input data are running length, L (location 013) and Mangler transformation factors for both laminar and turbulent flow (location 015 and 016, respectively). If the Von Karman Reynold's Analogy factor is desired, input a 1.0 in location 319 otherwise it uses Colburn's equation.

5. Boeing $\rho_r\mu_r$ Flat Plate Method.
   Required input is the running length L (location 013).

6. Modified Beckwith/Gallagher Swept Cylinder Method.
   Required input data are local cylinder radius R_N (location 012) and flowfield option 39 with a shock angle of $(90-\lambda)$.

7. Boeing $\rho_r\mu_r$ Swept Cylinder Method.
   Required input data are local cylinder radius R_N (location 012) and flowfield option 39 with a shock angle of $90-\lambda$).

8. Lees, Detra and Hidalgo Hemisphere Method.
   Required input data hemisphere nose radius R_N (location 012), running length L (location 013), local body slope δ (location 017), flowfield option 38 with a shock angle of 90 degrees and flowfield option 18 with a local slope angle of δ.

9. Bertin and Goodrich, Leeside Orbiter Heating.
Requires Fay and Riddell input (R_N = 1 foot for full scale) and windward wall enthalpy for W(21). If W(21) = 0.0 during input, W(21) = 480 BTU/lbm (2000°R wall).

10. Bushnell and Weinstein, Flap Reattachment Heating.
Input is the same as for heat transfer option 4 plus Flap length is input in W(22). Running length is to the hinge line. If separation and reattachment does not occur, option 4 methods are used.

11. Fivel, Fin-Plate Peak Interference Heating. Input is the same as option 4, which is the default option if the fin shock detaches, plus special values for this option.
IF W(30) = 0 the fin angle is used, IF W(30) = 1.0 the angle of attack is added to the fin angle, and IF W(30) = 2.0 the yaw angle, β, is added to the fin angle. The length from the fin leading edge to point of interest along the fin is input in W(25). The fin angle relation to the local flow at $\alpha = \beta = 0$ is input in W(26).

---

315 Dissociation Option

This option is used with the Fay-Riddell stagnation point equation (HTFLAG = 1.0, location 011).

0. Dissociation considered (Lewis number = 1.4)

1. Dissociation not considered (Lewis number = 1.0)

---

(11) HEATING MULTIPLIERS

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
	Multiplication Factor Input
	Heat transfer multiplication factors can be input as a constant value, a function of trajectory time and/or a function of upstream Mach number. All three input options may be used, if desired. All multiplier values are multiplied together to obtain an overall value.
018	Constant Multiplier (Laminar)
019	Constant Multiplier (Turbulent)
320	Number of Time Dependent Table Entries (Limit 10)
321-330	Time Table, sec
331-340	Multiplier Table (Laminar)
341-350	Multiplier Table (Turbulent)
360	Number of Mach Number Dependent Table Entries (Limit 10)
361-370	Mach Number Table ($Log_{10} M_\infty$)
371-380	Multiplier Table (Laminar) ($Log_{10}\ h_i/h_u)_{LAM}$
381-390	Multiplier Table (Turbulent) ($Log_{10}\ h_i/h_u)_{TURB}$

(12) TRANSFORMATIONS

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
319	Reynold's Analogy Factor 0. Assumes Colburn's Reynold's Analogy factor defined as $S = (P_r)^{2/3}$ (Generally used for design) 1. Assumes Von Karman Reynold's Analogy factor defined by $S = 1 + 5(C_f)^{.5} [(P_r - 1) + \ln ([5P_r + 1]/6)]$ (Generally used for prediction)
029	Virtual Origin Option (VRFLG) 0. Uses the geometric running length in the heat transfer equations. 1. Corrects the geometric running length to account for the onset of transition. Uses the corrected running length in the turbulent heat transfer equations.
	Mangler Transformation Factors
015	Laminar Factor = 3 Cone
016	Turbulent Factor = 2 Cone

(13) SURFACE CONDITION

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
021	Windward Bottom Centerline Wall Enthalpy (Btu/lbm). Used with heat transfer option (9) for orbiter leeside heating
	Material Emissivity
023	Emissivity (must be > 0.0)

(14) GEOMETRY DATA

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
	Geometry Data Input (Constant)
012	Nose or Leading Edge Radius, ft
013	Geometric Running Length, ft
017	Local Slope or Sweep Angle, deg
	Geometry Data Input (Function of Time)
560	Number of Table Entries (Limit 10)
561-570	Time, sec
571-580	Nose Radii, ft
581-590	Running Length, ft
591-600	Local Slope or Sweep Angle, deg
601-610	View Factor (not used)
354	Surface Distance to start of turbulent boundary layer. The value input in location 354 is subtracted from the total running length input in location 013 to provide the new running length for turbulent heating.

(15) INITIAL CONDITIONS

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
024	Initial Temperature, °F
316	Integrated Convective Heat Flux, Btu/sq ft

(16) CONTROL PARAMETERS

Format 5(I3, F10.6)

LOCATION FORMAT (I3)	OPTION OR DATA FORMAT (F10.6)
209	Continuity Option 0. Convective Heating Load initialized, 1. Convective Heating Load not initialized.
314	Rarefied Geometry Option (NFCS) 0. Sharp cone rarefied equations used 1. Flat plate rarefied equations used
611	Body Point Number
641	Program Input Control Parameter (JFK) This parameter must be the last entry in the Control Parameter Card Set (must be > 0.0). 1. Read new case data using title, timing parameters and trajectory data from previous case. (Uses all unchanged case data from previous case.) 2. End of input data (use with last case). 3. Read new title and timing parameters and use trajectory data from previous case. (Uses all unchanged case data from previous case.) 4. Read new title, timing, trajectory and case data (Initially zeros full W array) 5. Same as 1 (except zeros all case data from previous case). 6. Same as 3 (except zeros all timing parameters and case data).
642	Print Option (JFQQ) 0. Normal Miniver printout 1. Normal Miniver printout plus VANOUT (summary) printout 2. VANOUT printout only

643	0. No output file from VANOUT created 1. OUTPUT FILE from VANOUT created
646	Rarefied Flow Option (NONCON) 0. Continuum flow equations are used throughout flight 1. Continuum and rarefied flow equations are used, depending on flow regime encountered during flight.
648	Output Units Option 0. English 1. Metric
649	Pressure Coefficient Input Option (JFCP) These cards follow 641 specifications Card 1 NCPMP (I3) Card 2 M_∞, Cp (2F10.6) Card 3 M_∞, Cp (2F10.6) 0. Pressure coefficients are not input 1. Pressure coefficients are input (Flowfield option 14).
650	Cone Flow Option (NSB) This option is used only when rarefied flow conditions are considered (Control Parameter 646.) 0. Uses sharp cone correlations 1. Uses blunt cone correlations

Section 3.0

PREPROCESSOR INTERACTIVE INPUT

This section contains descriptions of the subroutines used by the preprocessor code PREMIN. PREMIN is an interactive preprocessor code for LANMIN. PREMIN creates a file that is in the same card image format as discussed in Section 2.0 and is used as the input file for LANMIN. The primary information included in this file is the 'W' array. A definition of all the elements of the 'W' array is given in Appendix A.

The PREMIN program consists of 18 routines and one main program, and is capable of creating a new output file or modifying an old one. The routine INPUT is used to input the file to be modified and the routine OUTPUT is used to create the output file. A macro flow diagram of PREMIN is included in Figure 3-1.

3.1 MAIN

MAIN performs the task of managing the rest of PREMIN. The determination of whether PREMIN is to create a new output file or modify an old output file is made within MAIN. After the method is determined, MAIN calls the required routines in their proper sequence a case at a time. The variables transferred in Common or used as control flags by MAIN are:

IIN	- Interactive Input - FORTRAN Unit Number
IOUT	- Interactive Output - FORTRAN Unit Number
MFLAG=0	- English units
MFLAG=1	- Metric units
FLAG=0	- Create new output file
FLAG=1	- Modify old output file
JFLAG=1	- Previous case deleted
INSERT=1	- Current case inserted
TFLAG=1	- TITL1 currently defined
FNAM6	- Name of input
JFKS	- Program Input Control Parameter (W(641)) for the previous case

NC	-	Case number
ND	-	Number cases deleted
NI	-	Number cases inserted
TITL1	-	Title of a set of cases
NCPMT	-	Number of Mach numbers in CP vs. Mach number table
NCPMTS	-	Saved value of NCPMT from previous case
TMCP	-	Mach number array for CP vs. Mach number table
TMCPS	-	Saved values of TMCP array from previous case
TCPM	-	CP array for CP vs. Mach number table
TCPMS	-	Saved values of TCPM array from previous case
W	-	Array of values created and modified by PREMIN (always in English units) (see Appendix A for complete description)
WW	-	Final array copied to output file. Copy of 'W' array except changed to desired output units.

3.2 SUBROUTINE INPUT

Subroutine INPUT is called by MAIN and performs two functions. If IB which is the parameter passed in the subroutine call equals 2 then INPUT zeros out the values in the W array according to the Program Input Control Parameter of the last case and returns to MAIN.

IF IB=1 then INPUT reads an existing LANMIN input file for the purpose of PREMIN creating a new LANMIN input file. INPUT first zeros out the W array according to the Program Input Control Parameter of the last case and then reads in data for a single case from the input file. INPUT keeps track of the current case number and inserts and deletes cases.

3.3 SUBROUTINE MODIFY

Subroutine MODIFY is called by MAIN to modify the W array for the current case. MODIFY calls a requested subroutine in order to modify or redefine a specific section of the W array. MODIFY is also capable of changing the value of a specific W number.

3.4 SUBROUTINE TIMING

Subroutine TIMING is called by MAIN or MODIFY to define the Timing Parameters and Print Control values. TIMING assigns values for W(1) through W(8) and checks to see if the number of print times exceeds 100. SUM equals the total number of print times.

3.5 SUBROUTINE TRAJ

Subroutine TRAJ is called by MAIN or MODIFY to define the trajectory data to be used. TRAJ obtains this data from a user supplied trajectory file or interactively via the terminal.

If the trajectory is read from a trajectory file, TRAJ first determines whether Beta data is included and the number of time dependent table entries. TRAJ then reads ALT, VEL, Angle of Attack, and YAW Angle (if included) for each TIME. After obtaining the trajectory data from the trajectory file, TRAJ will display the trajectory data on the terminal 20 lines at a time waiting for a carriage return between pages. After display TRAJ gives the user the opportunity to modify the trajectory data.

The format for the trajectory file is an A80 for the title on line one. Line two contains the Beta flag using an I2 and the number of trajectory times using an F10.5. The rest of the file contains the trajectory data using either a 4E15.4 or a 5E15.4, depending on whether or not the yaw angle data is included.

The other method of creating the trajectory data is via the terminal by inputting a line at a time. After defining the trajectory in this manner, TRAJ proceeds to display the trajectory data on the terminal as described above.

After the trajectory data table is displayed on the terminal, the user is given the opportunity to modify part or all of the trajectory. TRAJ enables the user to insert, delete, or change a line of the trajectory. After modification, the trajectory is displayed on the terminal as before.

Once the user is satisfied that the trajectory is complete TRAJ will enable the user to create a new trajectory file with a new user supplied file name.

The variables used in TRAJ are:

FNAM1 - The filename of the trajector file.
LINE - The number of a line at the trajectory table.
TITLE - Title of the trajectory file.
BFLAG=1 - YAW Angle included with trajectory.

3.6 SUBROUTINE ATMS

Subroutine ATMS is called by MAIN or MODIFY to select the Atmosphere option to be used.

3.7 SUBROUTINE WNDTUN

Subroutine WNDTUN is called by MAIN or MODIFY if the Atmosphere Option 2 was selected. WNDTUN defines the Atmospheric data for a Wind Tunnel case. WNDTUN sets values for T_∞ and P_∞ for each time point of the trajectory NPTS is the number of time points.

3.8 SUBROUTINE ATMDTA

Subroutine ATMDTA is called by MAIN or MODIFY if the Atmosphere Option 3 was selected. ATMDTA is the routine the user uses to define his own set of Atmospheric data. ATMDTA asks for the number of Altitude entries (NALT) and then asks for the values of Altitude, T_∞ ,and P_∞ for each entry.

3.9 SUBROUTINE HEATIN

Subroutine HEATIN is called by MAIN or MODIFY if a Heating Indicator case is desired. HEATIN sets the 'W' array values for a 1 ft. radius sphere with a wall temperature of 0°F and a Lewis number of 1.0. HEATIN uses the Heat transfer option 1 which is the Fay and Riddell Stagnation Point Method. HEATIN uses the OBLIQUE Shock Flowfield option with a shock angle of 90°. The modified Newtonian Pressure option is used with the body angle of 90°. HEATIN also sets the Print option to 2 which sets the output for Summary Print only.

3.10 SUBROUTINE HTRMTD

Subroutine HTRMTD is called by MAIN or MODIFY to select the Heat Transfer Method to be used. HTRMTD sets the values for the parameters required by the Heat Transfer Option. After these values are given, HTRMTD sets the wall temperature, wall emissivity, and continuation option. HTRMTD lets the user specify whether he wants Rarefied flow and virtual origin options. HTRMTD checks if the rarefied flow option was selected. Rarefied flow cannot be used by Heat Transfer Options 2, 3, 5, 7, 9, 10, or 11.

3.11 SUBROUTINE HTMULT

Subroutine HTMULT is called by MAIN or MODIFY if a Heat Transfer Multiplication Factor is desired. There are 3 option types and HTMULT allows the user to decide if he wishes to use each type. If option 1 is chosen, a Laminar and Turbulent factor must be supplied. If option 2 is chosen, the number of times must be supplied. For each time a Laminar and turbulent multiplier must be supplied. If option 3 is selected, the number of Mach numbers must be supplied. For each Mach number, a Laminar and turbulent multiplier must be supplied. HTMULT converts these last multipliers to log values. For options 2 and 3, there must be a minimum of 2 and a maximum of 10 entries.

3.12 SUBROUTINE TRANS

Subroutine TRANS is called by MAIN or MODIFY to select the transition option to be used. TRANS then requires the highest and lowest values or ratio for the transition region depending on the option selected.

3.13 SUBROUTINE CROSS

Subroutine CROSS is called by MAIN or MODIFY if a Cross Flow adjustment is needed. CROSS selects the Cross Flow adjustment option to be used and asks for data depending on which option is selected.

3.14 SUBROUTINE FLOW

Subroutine FLOW is called by MAIN or MODIFY to set the flowfield and local pressure options. The Parameter ID is passed through the subroutine call. If ID=1 then FLOW will create a new set of flowfield data. If ID=2 then FLOW modifies an old set of flowfield data. If ID=2 then the flowfield data must be transferred from the W array to the flowfield and local pressure arrays. FF is the flowfield option array. FFA is the array containing the angles corresponding to the flowfield option. P is the local pressure option array. PA is the array containing the angles corresponding to the local pressure option. Once converted, FLOW echos the pairs of flowfield and local pressure options with option abreviations and corresponding angles. If no changes are desired, then FLOW is exited. Otherwise, FLOW provides a table of flowfield and local pressure options with option numbers. The user must select options by pairs with corresponding angles. Choosing option -1. for the flowfield option and the local pressure option signifies that no more options are to be included. If the CP vs. Mach number table pressure option is chosen, FLOW requires a filename containing the table, or the number of table entrees, and M_∞ and CP for each entry. The format for the CP vs. Mach number file is an I3 on line one for the number of Mach numbers. The remaining lines contain the Mach number and the pressure coefficient using a ZF10.6 format. After all options are selected, FLOW echos the pairs of options. If the options are correct, the flowfield and local pressure arrays are converted to the W array. FNAM5 is the variable for the filename of the pressure coefficient vs Mach number table.

3.15 SUBROUTINE TDGEOM

Subroutine TDGEOM is called by MAIN or MODIFY if time dependent Geometry is needed. First, the number of time dependent entries is set. Then the time, radius, length, and slope or sweep angl are required for each entry.

3.16 SUBROUTINE CONTRL

Subroutine CONTRL is called by MAIN or MODIFY to set the LANMIN control flags. CONTRL sets the body point number for the ase, the print option, output units option, and the program input control parameters for the case. CONTRL asks if LANMIN will create an output file and if the current case is the first of a set of streamline cases. If the case is the first of a set of streamline cases subroutine STREAM is called.

3.17 SUBROUTINE UNITS

Subroutine UNITS is called by MAIN to copy the working W array into the output WW array. If MFLAG=1, then metric units are required and UNITS converts the WW array into Metric units.

3.18 SUBROUTINE STREAM

Subroutine STREAM is called by CONTRL if a set of streamline cases is to be created. If a streamline file is created by STREAM, it will be used by OUTPUT.

STREAM first checks if the time dependent geometry option was selected. If it was, then streamline cases can not be used and STREAM returns control to CONTRL. If time dependent geometry was not used, then STREAM opens a temporary file to store the data for the streamline cases. Next, STREAM determines the shock and local pressure options to be used by the streamline cases from the previous case. STREAM then requires X distance, shock angle, body angle, and body point number for each streamline case. STREAM writes these values and the 'W' number that these values are to be stored in to the streamline file. The parallel shock and Prandt-Meyer pressure options don't require both the shock and body angles to be input. A negative value of X indicates the end of the streamline cases.

The variables used by STREAM are:

X	- X distance
SA	- Shock angle
BA	- Body angle
BP	- Body point number
CASE	- Case number
XPRT	- Program input control parameter
J1	- 'W' index for CASE
J2	- 'W' index for X
J3	- 'W' index for SA
J4	- 'W' index for BA
J5	- 'W' index for BP
J6	- 'W' index for XPRT
JK	- Flag used to mark parallel shock or Prandt-Meyer cases.

3.19 SUBROUTINE OUTPUT

Subroutine OUTPUT is called by MAIN to write the 'W' array values for a case to the output file. FNAM4 is the variable for the filename of the output file. OUTPUT opens this file unless previously opened. Next OUTPUT writes the data for the current case to the output file according to the program input control parameter of the previous case. OUTPUT writes to the file the title, timing parameters, and print control, the number of time dependent trajectory table entries, the trajectory data, and the case data. The last W of the case data to be written to the file is the program input control parameter. OUTPUT checks to see if the case just written is the first of a set of streamline cases. ISTRM=1 indicates streamline cases. If streamline cases are indicated, then OUTPUT copies the streamline cases to the OUTPUT file from the temporary streamline file. After the last streamline case is written to the OUTPUT file, OUTPUT sets the program input control parameter for the last streamline case. OUTPUT then closes and deletes the temporary streamline file and returns to MAIN.

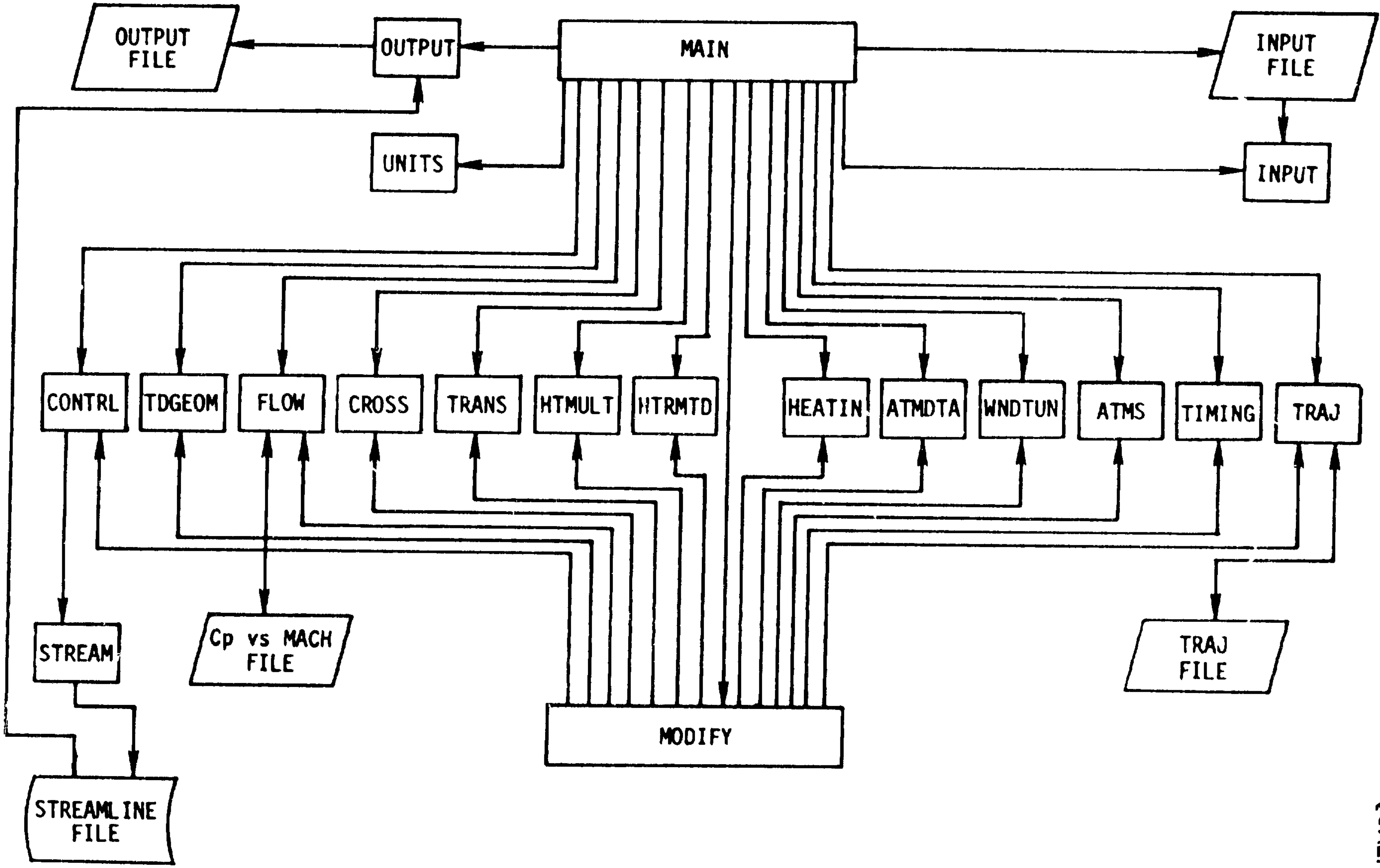

Fig. 3.1 PREMIN Macro Flow Diagram

Section 4.0

OUTPUT DESCRIPTION

The printed output from LANMIN comes in two forms. The detailed printout for each time point is given if JFQQ = 0 or 1. This detailed printout contains the variables listed in Table 4.1. The definitions and units are given in Table 4.1 for each of the variables printed.

If the summary printout is selected (i.e. JFQQ = 1 or 2) the output contains the variables shown in Table 4.2. This table contains a listing of twelve time dependent variables for each body point. The variable and units are clearly labeled on the output. The summary page can be obtained for two sets of output units. If W(648) = 0 the output is in English units and if W(648) = 1 the output is in Metric units as lustrated in Table 4.2.

An output, tape or file, can be created from LANMIN if W(643) = 1.0. The output file is a card image of the printed summary page.

Table 4.1

INTERMEDIATE PRINT OUTPUT PARAMETERS

VARIABLE	DEFINITION	UNITS
TIME	TIME	(SEC)
ZINF	ALTITUDE	(FT)
VINF	FREESTREAM VELOCITY	(FT/SEC)
AINF	FREESTREAM SPEED OF SOUND	(FT/SEC)
VE	EDGE VELOCITY	(FT/SEC)
REINF	FREESTREAM REYNOLDS NO./FT	(1/FT)
REL	FREESTREAM REYNOLDS NO.	(—)
MINF	FREESTREAM MACH NO.	(—)
MU	UPSTREAM MACH NO.	(—)
ME	EDGE MACH NO.	(—)
L	RUNNING LENGTH	(FT)
RN	NOSE RADIUS	(FT)
PR	PRANDTL NUMBER	(—)
EMS*F	EMISSIVITY * VIEW FACTOR	(—)
PINF	FREESTREAM PRESSURE	(LBF/SFT)
PU	UPSTREAM PRESSURE	(LBF/SFT)
PE	EDGE PRESSURE	(LBF/SFT)
PT	POST SHOCK TOTAL PRESSURE	(LBF/SFT)
ALPHA	LOCAL ANGLE OF ATTACK	(DEG)
CF/2	LOCAL SKIN FRICTION COEF./2	(—)
TAU W	WALL SHEAR FORCE	(LBF/SFT)
TINF	FREESTREAM TEMPERATURE	(F)
TU	UPSTREAM TEMPERATURE	(F)
TE	EDGE TEMPERATURE	(F)
TT	POST SHOCK TOTAL TEMPERATURE	(F)
T*	ECKERT REFERENCE TEMPERATURE	(F)
TR	$\rho\mu$ REFERENCE TEMPERATURE	(F)
TW	WALL TEMPERATURE	(F)
H INF	FREESTREAM STATIC ENTHALPY	(BTU/LBM)
HU	UPSTREAM STATIC ENTHALPY	(BTU/LBM)
HE	EDGE STATIC ENTHALPY	(BTU/LBM)
HT	TOTAL ENTHALPY	(BTU/LBM)
H*	ECKERT REFERENCE ENTHALPY	(BTU/LBM)
HR	$\rho\mu$ REFERENCE ENTHALPY	(BTU/LBM)
HW	WALL ENTHALPY	(BTU/LBM)
PHI	SWEEP ANGLE	(DEG)
RHOI	FREESTREAM DENSITY	(SLUG/CFT)
RHOU	UPSTREAM DENSITY	(SLUG/CFT)
RHOE	EDGE DENSITY	(SLUG/CFT)
RHOT	POST SHOCK TOTAL DENSITY	(SLUG/CFT)
RHO*	ECKERT REFERENCE DENSITY	(SLUG/CFT)
RHOR	$\rho\mu$ REFERENCE DENSITY	(SLUG/CFT)
RHOW	WALL DENSITY	(SLUG/CFT)

PARA1	LAMINAR TRANSITION PARAMETER	(—)
MU INF	FREESTREAM VISCOSITY	(LBF-SEC/SFT)
MU U	UPSTREAM VISCOSITY	(LBF-SEC/SFT)
MU E	EDGE VISCOSITY	(LBF-SEC/SFT)
MU T	POSTSHOCK TOTAL VISCOSITY	(LBF-SEC/SFT)
MU *	ECKERT REFERENCE VISCOSITY	(LBF-SEC/SFT)
MU R	ρμ REFERENCE VISCOSITY	(LBF-SEC/SFT)
MU W	WALL VISCOSITY	(LBF-SEC/SFT)
PARA2	TURBULENT TRANSITION PARAMETER	(—)
FF FLAG	FLOWFIELD FLAG NUMBER	(—)
ANGLE	ANGLE FOR CORRESPONDING FLAG	(DEG)
NC L	LAMINAR HEAT TRANSFER COEFFICIENT	(LBM/SFT-SEC)
NC T	TURBULENT HEAT TRANSFER COEFFICIENT	(LBM/SFT-SEC)
HRECOV L	LAMINAR RECOVERY ENTHALPY	(BTU/LBM)
HRECOV T	TURBULENT RECOVERY ENTHALPY	(BTU/LBM)
QC L	LAMINAR HEATING RATE	(BTU/SFT-SEC)
QC T	TURBULENT HEATING RATE	(BTU/SFT-SEC)
KSUB L2	LAMINAR TIME DEPENDENT MULTIPLIER	(—)
KSUB T2	TURBULENT TIME DEPENDENT MULTIPLIER	(—)
KSUB L3	LAMINAR MACH NO. DEPENDENT MULTIPLIER	(—)
KSUB T3	TURBULENT MACH NO. DEPENDENT MULTIPLIER	(—)
KSUB L	TOTAL LAMINAR MULTIPLIER	(—)
KSUB T	TOTAL TURBULENT MULTIPLIER	(—)
PARA	TRANSITION PARAMETER VALUE	(—)
PCTT	PERCENT TURBULENT HEATING/100	(—)
NSUB C	HEAT TRANSFER COEFFICIENT	(LBM/SFT-SEC)
H IDEAL	IDEAL GAS AIR HEAT TRANSFER COEFFICIENT	(BTU/HR-SFT-R)
H RECOV	RECOVERY ENTHALPY	(BTU/LBM)
T RECOV	RECOVERY TEMPERATURE	(F)
QCONV	HEATING RATE BASED ON HW	(BTU/SFT-SEC)
QCTOTAL	HEATING LOAD FOR TW	(BTU/SFT)
QRAD	WALL RADIATION RATE AT TW	(BTU/SFT-SEC)
QR TOT	WALL RADIATION LOAD AT TW	(BTU/SFT)
Q NET	NET HEATING RATE (QCONV-QR)	(BTU/SFT-SEC)
QN TOT	NET HEATING LOAD	(BTU/SFT)
TRAD EQ	RADIATION EQUILIBRIUM WALL TEMPERATURE	(F)
QC CW	COLD WALL HEATING RATE (TW = 0)	(BTU/SFT-SEC)
QC CWT	COLD WALL HEATING LOAD	(BTU/SFT)

Table 4.2

Example Summary Printout (English Units)

STS-1 REENTRY TRAJ. (ORBITER) VAND. REF. B.P. NO. 12

TIME SEC	ALT KFT	VEL FT/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./FT	HEAT COEF LBM/SFT-S	REC ENTHALPY BTU/LBM	RAD EQUIL DEG F	HEAT RATE BTU/SFT-S	HEAT LOAD BTU/SFT	PRESSURE LB/SFT	FLOW TYPE
.0	396.3	24565.1	19.24	41.13	.249+001	.645-005	.113+005	198.9	.694-001	.208+001	.125-001	RARE
25.0	384.0	2458[illegible]	20.54	41.20	.444+001	.877-005	.113+005	251.1	.943-001	.444+001	.204-001	RARE
50.0	371.5	24595.5	21.85	41.25	.628+001	.122-004	.112+005	313.5	.131+000	.772+001	.345-001	RARE
75.0	359.1	24610.3	23.30	41.23	.164+002	.176-004	.112+005	385.2	.189+000	.124+002	.617-001	RARE
100.0	346.7	24624.4	24.21	41.05	.310+002	.250-004	.112+005	462.6	.269+000	.192+002	.109+000	RARE
125.0	334.5	24637.6	25.23	40.63	.614+002	.363-004	.112+005	554.2	.390+000	.289+002	.199+000	RARE
150.0	322.5	24648.1	26.14	40.54	.124+003	.537-004	.112+005	655.4	.576+000	.433+002	.378+000	RARE
175.0	310.5	24656.9	26.87	40.63	.251+003	.801-004	.112+005	771.5	.860+000	.648+002	.731+000	RARE
200.0	299.1	24658.3	27.62	41.20	.508+003	.120-003	.112+005	904.5	.129+001	.971+002	.144+001	RARE
225.0	288.1	24657.6	27.89	41.89	.980+003	.179-003	.113+005	1045.9	.193+001	.145+003	.280+001	RARE
250.0	277.[illegible]	246[illegible]	27.86	40.52	.174+004	.253-003	.112+005	1180.8	.271+001	.213+003	.471+001	RARE
275.0	268.3	24595.5	27.82	39.53	.298+004	.253-003	.111+005	1178.0	.269+001	.280+003	.775+001	LAM
300.0	260.9	24516.6	27.00	40.26	.402+004	.301-003	.111+005	1246.5	.319+001	.360+003	.113+002	LAM

Example Summary Printout (Metric Units)

STS-1 REENTRY TRAJ. (ORBITER) VAND. REF. B.P. NO. 12

TIME SEC	ALT KM	VEL M/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./M	HEAT COEF KGM/SQ.M-S	REC ENTHALPY JOULES/KGM	RAD EQUIL DEG K	HEAT RATE WATTS/SQ.M	HEAT LOAD JOULES/SQ.M	PRESSURE N/SQ.M	FLOW TYPE
.0	120.8	7487.4	19.24	41.13	.817+001	.315-004	.262+008	365.9	.788+003	.236+005	.599+000	RARE
25.0	117.0	7492.1	20.54	41.20	.146+002	.428-004	.262+008	394.9	.107+004	.504+005	.975+000	RARE
50.0	113.2	7496.7	21.85	41.25	.272+002	.596-004	.261+008	429.6	.149+004	.87[illegible]+005	.165+001	RARE
75.0	109.4	7501.2	23.30	41.23	.539+002	.857-004	.261+008	469.4	.214+004	.141+006	.295+001	RARE
100.0	105.7	7505.5	24.21	41.05	.102+003	.122-003	.261+008	512.4	.305+004	.217+006	.522+001	RARE
125.0	102.0	7509.5	25.23	40.63	.401+003	.177-003	.261+008	563.3	.442+004	.328+006	.954+001	RARE
150.0	98.3	75[illegible].7	26.14	40.54	.408+003	.262-003	.261+008	619.5	.653+004	.491+006	.181+002	RARE
175.0	94.7	7[illegible].4	26.87	40.63	.824+003	.391-003	.261+008	684.0	.915+004	.735+006	.350+002	RARE
200.0	91.2	7515.9	27.62	41.20	.167+004	.587-003	.261+008	757.9	.147+005	.110+007	.690+002	RARE
225.0	87.8	7515.7	27.89	41.89	.322+004	.876-003	.262+008	836.5	.220+005	.165+007	.134+003	RARE
250.0	84.7	7507.8	27.86	40.52	.570+004	.124-002	.260+008	911.4	.307+005	.242+007	.226+003	RARE
275.0	81.6	7496.7	27.82	39.53	.979+004	.123-002	.259+008	909.8	.305+005	.318+007	.371+003	LAM
300.0	79.5	7472.7	27.00	40.26	.132+005	.147-002	.258+008	947.9	.362+005	.409+007	.539+003	LAM

APPENDIX A

W ARRAY DESCRIPTION

APPENDIX A

W ARRAY DESCRIPTION

ARRAY/SYMBOL/VARIABLE DEFINITION

W(1) = T1 = t1 (first calculation time, time 1)

W(2) = DT1 = Δt1 (delta time step between time t1 and t2)

W(3) = T2 = t2 (time 2)

W(4) = DT2 = Δt2 (delta time step between and t3)

W(5) = T3 = t3 (time 3)

W(6) = DT3 = Δt3 (delta time step between t3 and t4)

W(7) = T4 = t4 (time 4)

W(8) = DTCALC (KCALC calculation interval factor)

W(9) = (Open Location)

W(10) = ATFLAG (atmospheric freestream properties option flag)

W(11) = HTFLAG (NHFLAG = heat transfer method option flag)

W(12) = RN = R_N(nose radius or local cylinder radius, leading edge radius, ft.)

W(13) = EL (running length, ft.)

W(14) = PARA1 (transition data)

W(15) = ENL (2nd power of Mangler transformation factor for laminar flow)

W(16) = ENT (fifth power of Mangler transformation factor for turbulent flow)

W(17) = PHI (sweep angle, Λ, local slope, δ, deg.)

W(18) = AKL = (constant laminar multiplication factors)

W(19) = AKT = (constant turbulent multiplication factors)

W(20) = PARA2 (transition data)

W(21) = Windward Bottom Centerline Wall Enthalpy (Btu/lbm)

W(22) = Flap Length (ft) for heat transfer option 10

W(23) = EMIS (emissivity > 0): If (EMIS.LE.0)EMIS=0.8

W(24) = TIN (initial temperature, °F)

W(25) = Fin Length to Point of interest for Heat Transfer Option 11 (ft)

W(26) = Fin Angle at $\alpha = \beta = 0$ for Heat Transfer Option 11 (Deg)

W(27) = TRFLAG (transition criteria option flag)

W(28) = ELFAC (transition zone length ratio)

W(29) = VRLFLG (virtual origin option)

W(30) = Fin Option Flag 0 = Fin angle
1 = α + Fin angle
2 = β + Fin angle

W(31) = GF(1) = FF(1)

W(32) = GF(2) = FF(2)

W(33) = GF(3) = FF(3)

——> Flowfield and local pressure option flags

W(34) = GF(4) = FF(4)

W(35) = GF(5) = FF(5)

W(36) = GF(6) = FF(6)

W(37) = BLFA(1) (ALFA(1) = BLFA(1) + ATAK) degree

W(38) = BLFA(2) (ALFA(2) = BLFA(2) + ATAK) degree

W(39) = BLFA(3) = ALFA(3) degree (add ATAK to ALFA if W(263) = 3.)

W(40) = BLFA(4) = ALFA(4) degree (add ATAK to ALFA if W(264) = 4.)

W(41) = BLFA(5) = ALFA(5) degree (add ATAK to ALFA if W(265) = 5.)

W(42) = BLFA(6) = ALFA(6) degree (add ATAK to ALFA if W(266) = 6.)

W(43) = BLFA(7) = ALFA(7) degree (add ATAK to ALFA if W(267) = 7.)

W(44) = BLFA(8) = ALFA(8) degree (add ATAK to ALFA if W(268) = 8.)

W(45) = BLFA(9) = ALFA(9) degree (add ATAK to ALFA if W(269) = 9.)

W(46) = HH(1) = FF(7)

W(47) = HH(2) = FF(8) ——> Flowfield and local pressure option flags

W(48) = HH(3) = FF(9)

W(49) = (Open Location)

W(50) = ENTR (number of trajectory points)

W(51) = TZ(1)
.
.
.
W(100)= TZ(50)
—> (Trajectory Time, sec)

W(101)= ZZ(1)
.
.
.
W(150)= ZZ(50)
—> (Trajectory Altitude, feet)

W(151)= VZ(1)
.
.
.
W(200)= VZ(50)
—> (Trajectory Velocity, ft/sec)

W(201)= CFFLG (crossflow option flag)

W(202)= DSUBO (crossflow rectangular width, D_o, ft)

W(203)= ELMBDA (delta wing sweep angle, λ (deg))

W(204)= UDOT (real gas velocity gradient correction factor, $\dot{U}$)

W(205)= CORNR (rectangle corner radius, R_c (ft))

W(206)=
.
.
.
W(208)=
—> (Open Locations)

W(209)= CONFLG (continuity option)

W(210)= (Open Location)

W(211)= A1(1)
.
.
.
W(260)= A1(50)
—> (Trajectory positive α, degree)

W(261)= 1. —> Built into program: α_{eff} added to W(37):
If (W(261).LE.0)W(261)=1.0

W(262)= 2. —> Built into program: α_{eff} added to W(38):
If (W(262).LE.0)W(262)=2.0

W(263)=	3.	Values	α_{eff} added to W(39)
W(264)=	4.	must be	α_{eff} added to W(40)
W(265)=	5.	input for	α_{eff} added to W(41)
W(266)=	6.	to be	α_{eff} added to W(42)
W(267)=	7.	added to	α_{eff} added to W(43)
W(268)=	8.	body	α_{eff} added to W(44)
W(269)=	9.	angle	α_{eff} added to W(45)

W(270)= ———
.
.
.
W(313)= ——— ---> (Open Locations)

W(314)= NFCS (rarefied flag 0 - sharp cone option used
1 - flat plate option used)

W(315)= NLEW (dissociation flag 0 - Lewis number = 1.4
1 - Lewis number = 1.0)

W(316)= QCSUMA (Integrated convective heat flux, Btu/sq ft)

W(317)= (Open Location)

W(318)= (Open Location)

W(319)= RANFLG (skin friction 1 Karman Reynolds analogy used)
(Flag 0 Colburn's equation used)

W(320)= ENT2 (number of multipliers read in as function of time)
Limit 10

W(321)= TK1(1) ———
.
.
.
W(330)= TK1(10) ——— ---> (Table of multiplier times, sec)

W(331)= AKL2(1) ———
.
.
.
W(340)= AKL2(10) ——— ---> (Table of laminar multiplier factors)

W(341)= AKT2(1) ——
.
. ——> (Table of turbulent multiplier factors)
.
W(350)= AKT2(10) ——

W(351)= ——
.
. ——> (Open Locations)
.
W(353)= ——

W(354)= XJUNC (surface distance to start of turbulent boundary layer, ft)

W(355)= ——
.
. ——> (Open Locations)
.
W(359)= ——

W(360)= ENM3 (number of Mach dependent multipliers)

W(361)= TMACH(1) ——
.
. ——> (Log_{10}) (M_∞)
.
W(370)= TMACH(10) ——

W(371)= AKL3(1) ——
.
. ——> (Log_{10} h_i/h_u) laminar multiplier
.
W(380)= AKL3(10) ——

W(381)= AKT3(1) ——
.
. ——> (Log_{10} h_i/h_u) turbulent multiplier
.
W(390)= AKT3(10) ——

W(391)= ——
.
. ——> (Open Locations)
.
W(399)= ——

W(400)= ENALTZ (Table of wind tunnel freestream properties, limit 50)

W(401)= FSALT(1) ——
.
. ——> (Table of altitude data, ft)
.
W(450)= FSALT(50) ——

W(451)= FSTEMP(1) ─┐
.
. ──> (Table of wind tunnel freestream temperatures, R)
.
W(500)= FSTEMP(50) ─┘

W(501)= FSPRES(1) ─┐
.
. ──> (Table of wind tunnel freestream pressure, lb/sq ft)
.
W(550)= FSPRES(50) ─┘

W(551)= ──────┐
.
. ──> (Open Locations)
.
W(559)= ──────┘

W(560)= ENT3 (Number of Table Entries for Geometry as Function of Time)

W(561)= TMZ(1) ─┐
.
. ──> (Body Geometry is Varying with Time, Sec)
.
W(570)= TMZ(10) ─┘

W(571)= RNZ(1) ─┐
.
. ──> (Nose Radius, Ft)
.
W(580)= RNZ(10) ─┘

W(581)= ELZ(1) ─┐
.
. ──> (Running Length, Ft)
.
W(590)= ELZ(10) ─┘

W(591)= PHIZ(1) ─┐
.
. ──> (Local Slope or Sweep Angle, Degree)
.
W(600)= PHIZ(10) ─┘

W(601)= ──────┐
.
. ──> (Open Locations)
.
W(610)= ──────┘

W(611)= Body Point Number

W(612)= ———————
.
. ——> (Open Locations)
.
W(640)= ———————

W(641)= JFK (Input Control Flag)

W(642)= JFQO (Print Option)

W(643)= Output File from VANOUT

W(644)= (Open Location)

W(645)= JFGO (Initialization Option)

W(646)= NONCON (Rarefied Flow Option)

W(647)= (Case Number)

W(648)= Output Units Option, 0.-English, 1.-Metric

W(649)= JFCP (Pressure Coefficient Input Option)

W(650)= NSB (Cone Flow Option for Rarefied Flow)

W(651)= ———————
.
. ——> (YAW Angle β, degree)
.
W(700)= ———————

APPENDIX B

SAMPLE CASES

APPENDIX B

SAMPLE CASES

Two sample cases are presented in this appendix which exercise both the PREMIN and LANMIN codes. The components shown here follow those depicted in Fig. 1.1.

<u>Heating Indicator Sample Case</u>

The input for a heating indicator run is rather straight-forward using PREMIN. After the execution command, units selection, and printout selection, the trajectory is input. PREMIN then displays the trajectory data twenty lines at a time waiting for a carriage return before displaying the next twenty. After the trajectory is input, the atmospheric option is chosen. The preceeding steps are standard in most input. If the heating indicator option is selected, the remaining input is much simpler than for most other options. During execution of PREMIN, if the answer to a question is an end of file character, then PREMIN will stop execution. If the answer to a question is incompatible with the reading format, then the question will be reasked until an acceptable answer is received.

The PREMIN interactive input is followed by a listing of the input trajectory file. The first line of the trajectory file contains the title. The second line contains a Beta flag and the number of trajectory table entries. The third line through the end of the file contains the trajectory data. Each line of trajectory data contains a time, altitude, velocity, angle of attack, and, if the Beta flag equals one, the yaw angle. A listing of the PREMIN output file follows the trajectory file. The LANMIN output listing is given last. The summary output is labeled with units and is self explanatory.

PREMIN INTERACTIVE RUN
HEATING INDICATOR CASE

```
RUN PREMIN
```

```
INTERACTIVE INPUT TO LAPC MINIVER - LANMIN


        OUTPUT FILE METHOD

1.   CREATE A NEW OUTPUT FILE
2.   MODIFY AN EXISTING OUTPUT FILE

OPTION SELECTED ?
1
DO YOU WANT TO INPUT DATA IN ENGLISH OR METRIC ?
ENGLISH

INTERACTIVE INPUT FOR CASE   1
```

```
     SPECIFY PRINTOUT INTERVALS

INITIAL TIME (SEC)
0.0
PRINTOUT INTERVAL 1 (SEC)          DELTA TIME
25.0
SECOND TIME (SEC)
500.0
PRINTOUT INTERVAL 2 (SEC)          DELTA TIME
14.0
THIRD TIME (SEC)
1200.0
PRINTOUT INTERVAL 3 (SEC)          DELTA TIME
29.0
FOURTH TIME (SEC)
1925.3

ARE THE PRINTOUT TIMES CORRECT ?
Y
```

TRAJECTORY INPUT

DO YOU HAVE A TRAJECTORY INPUT FILE ?
YES
WHAT IS THE FILE NAME ?
REENTRY.TRJ

	TIME (SEC)	ALTITUDE (FT)	VELOCITY (FT/SEC)	ANGLE ATTACK (DEG)
1	0.3000E+00	0.3963E+06	0.2457E+05	0.4113E+02
2	0.4530E+02	0.3738E-06	0.2459E+05	0.4126E+02
3	0.9030E+02	0.3515E+06	0.2462E+05	0.4121E+02
4	0.1353E+03	0.3295E+06	0.2464E+05	0.4046E+02
5	0.1803E+03	0.3080E+06	0.2466E+05	0.4065E+02
6	0.2253E+03	0.2880E+06	0.2466E+05	0.4190E+02
7	0.2703E+03	0.2697E+06	0.2461E+05	0.3939E+02
8	0.3153E+03	0.2563E+06	0.2447E+05	0.4071E+02
9	0.3603E+03	0.2502E+06	0.2422E+05	0.4174E+02
10	0.4053E+03	0.2470E+06	0.2392E+05	0.3995E+02
11	0.4503E+03	0.2446E+06	0.2361E+05	0.3928E+02
12	0.4953E+03	0.2425E+06	0.2328E+05	0.3966E+02
13	0.5453E+03	0.2400E+06	0.2288E+05	0.3907E+02
14	0.5693E+03	0.2388E+06	0.2268E+05	0.3932E+02
15	0.5933E+03	0.2377E+06	0.2247E+05	0.3902E+02
16	0.6173E+03	0.2366E+06	0.2225E+05	0.3925E+02
17	0.6413E+03	0.2353E+06	0.2202E+05	0.3948E+02
18	0.6653E+03	0.2337E+06	0.2178E+05	0.3997E+02
19	0.6893E+03	0.2320E+06	0.2153E+05	0.4001E+02
20	0.7133E+03	0.2323E+06	0.2126E+05	0.4025E+02

	TIME (SEC)	ALTITUDE (FT)	VELOCITY (FT/SEC)	ANGLE ATTACK (DEG)
21	0.7373E+03	0.2303E+06	0.2098E+05	0.4046E+02
22	0.7613E+03	0.2279E+06	0.2068E+05	0.4014E+02
23	0.7853E+03	0.2252E+06	0.2036E+05	0.4016E+02
24	0.8093E+03	0.2223E+06	0.2002E+05	0.4016E+02
25	0.8333E+03	0.2190E+06	0.1965E+05	0.4027E+02
26	0.8573E+03	0.2153E+06	0.1924E+05	0.4040E+02
27	0.8813E+03	0.2114E+06	0.1879E+05	0.4012E+02
28	0.9053E+03	0.2076E+06	0.1830E+05	0.4030E+02
29	0.9293E+03	0.2056E+06	0.1776E+05	0.4001E+02
30	0.9533E+03	0.2025E+06	0.1718E+05	0.4200E+02
31	0.9773E+03	0.1972E+06	0.1654E+05	0.4090E+02
32	0.1001E+04	0.1922E+06	0.1587E+05	0.4075E+02
33	0.1025E+04	0.1872E+06	0.1513E+05	0.3987E+02
34	0.1049E+04	0.1826E+06	0.1435E+05	0.3943E+02
35	0.1073E+04	0.1796E+06	0.1357E+05	0.3953E+02
36	0.1097E+04	0.1766E+06	0.1279E+05	0.3975E+02
37	0.1121E+04	0.1725E+06	0.1201E+05	0.3896E+02
38	0.1145E+04	0.1675E+06	0.1122E+05	0.3812E+02
39	0.1169E+04	0.1619E+06	0.1044E+05	0.3697E+02
40	0.1240E+04	0.1500E+06	0.8336E+04	0.3407E+02

	TIME (SEC)	ALTITUDE (FT)	VELOCITY (FT/SEC)	ANGLE ATTACK (DEG)
41	0.1302E+04	0.1339E+06	0.6757E+04	0.2820E+02
42	0.1364E+04	0.1174E+06	0.5342E+04	0.2305E+02
43	0.1426E+04	0.1062E+06	0.4064E+04	0.2027E+02
44	0.1488E+04	0.891[illegible]E+05	0.2917E+04	0.1647E+02
45	0.1550E+04	0.7635E+05	0.1915E+04	0.1086E+02
46	0.1612E+04	0.5744E+05	0.1151E+04	0.7790E+01
47	0.1674E+04	0.4167E+05	0.8000E+03	0.7720E+01
48	0.1736E+04	0.2760E+05	0.6810E+03	0.7090E+01
49	0.1860E+04	0.3337E+04	0.5120E+03	0.3780E+01
50	0.1925E+04	-0.3000E+01	0.2020E+03	-0.1220E+01

DO YOU WISH TO CHANGE ANY OF THE TRAJECTORY INPUT ?
NO
DO YOU WISH TO WRITE THIS INPUT TO A FILE ?
NO

TRAJECTORY INPUT IS COMPLETE

ATMOSPHERE DAT

OPTIONS
1. 1962 U.S. STANDARD ATMOSPHERE
2. WIND TUNNEL OPTION
3. INPUT ATMOSPHERIC DATA(ALT,T-INF,P-INF)
4. 1963 PATRICK AIR FORCE BASE ATMOSPHERE
5. 1971 VANDENBERG REFERENCE ATMOSPHERE

OPTION SELECTED ?
4

1963 PATRICK AIR FORCE BASE ATMOSPHERE

IS THIS OPTION CORRECT ?
YES

DO YOU WANT TO RUN A HEATING INDICATOR ?
YES

HEATING INDICATOR

FAY AND RIDDELL
RADIUS = 1 FT SPHERE
WALL TEMP = 0 DEG. F
LEWIS NO. = 1.0
SUMMARY PRINT ONLY

```
            CONTROL FLAGS

   YOU ARE COMPLETING INPUT FOR CASE    1

   WHAT IS THE BODY POINT NUMBER FOR CASE    1 ?
   1001
   SHOULD LANMIN CREATE AN OUTPUT FILE FOR CASE    1 ?
   YES


            OUTPUT UNITS OPTIONS

   0.   ENGLISH
   1.   METRIC

   OPTION SELECTED ?
   0.


   IS CASE    2 ALONG THE SAME STREAMLINE
   AS CASE    1 ?
   NO
```

```
            INPUT CONTROL FLAG

   1.   NEW CASE FOLLOWS USING TITLE,TIMING AND TRAJ.
        DATA FROM PREVIOUS CASE
   2.   END OF INPUT (LAST CASE)
   3.   NEW CASE FOLLOWS USING TRAJ.DATA FROM PREVIOUS CASE.
        NEW TITLE AND TIMING. INITIAL CASE DATA UNCHANGED.
   4.   NEW CASE FOLLOWS USING NEW TITLE,TIMING,TRAJ. AND CASE DATA.
        (INITIALLY ZERO W ARRAY)
   5.   SAME AS (1) EXCEPT ZERO ALL CASE DATA FROM PREVIOUS CASE
   6.   SAME AS (3) EXCEPT INITIALIZE ZERO ALL TIMING AND CASE DATA

   OPTION SELECTED ?
   2.


      ***** INFUT COMPLETE FOR CASE    1   *****

   DO YOU WANT TO MAKE ANY MODIFICATIONS TO CASE    1 ?
   NO
```

```
          CREATE OUTPUT FILE

WHAT IS THE NAME OF THE OUTPUT FILE TO BE CREATED ?
OUTPUT.FIL

WHAT IS THE TITLE FOR CASE   1 ?       (NOTE: 72 CHAR. LIMIT)
STS-1 REENT Y TRAJ. (ORBITER) PAFB REF. HTG. IND. CASE

********  OUTPUT FILE COMPLETE  ********
>
```

TRAJECTORY FILE LISTING
HEATING INDICATOR CASE

ORIGINAL PAGE IS
OF POOR QUALITY

STS-1 REENTRY TRAJ. (ORBITER)
0 50.00000

0.3000E+00	0.3963E+06	0.2457E+05	0.4113E+02
0.4530E+02	0.3738E+06	0.2459E+05	0.4126E+02
0.9030E+02	0.3515E+06	0.2462E+05	0.4121E+02
0.1353E+03	0.3295E+06	0.2464E+05	0.4046E+02
0.1803E+03	0.3080E+06	0.2466E+05	0.4065E+02
0.2253E+03	0.2880E+06	0.2466E+05	0.4190E+02
0.2703E+03	0.2697E+06	0.2461E+05	0.3939E+02
0.3153E+03	0.2563E+06	0.2447E+05	0.4071E+02
0.3603E+03	0.2502E+06	0.2422E+05	0.4174E+02
0.4053E+03	0.2470E+06	0.2392E+05	0.3995E+02
0.4503E+03	0.2446E+06	0.2361E+05	0.3928E+02
0.4953E+03	0.2425E+06	0.2328E+05	0.3966E+02
0.5453E+03	0.2400E+06	0.2288E+05	0.3907E+02
0.5693E+03	0.2388E+06	0.2268E+05	0.3932E+02
0.5933E+03	0.2377E+06	0.2247E+05	0.3902E+02
0.6173E+03	0.2366E+06	0.2225E+05	0.3925E+02
0.6413E+03	0.2353E+06	0.2202E+05	0.3948E+02
0.6653E+03	0.2337E+06	0.2178E+05	0.3997E+02
0.6893E+03	0.2320E+06	0.2153E+05	0.4001E+02
0.7133E+03	0.2323E+06	0.2126E+05	0.4025E+02
0.7373E+03	0.2303E+06	0.2098E+05	0.4046E+02
0.7613E+03	0.2279E+06	0.2068E+05	0.4014E+02
0.7853E+03	0.2252E+06	0.2036E+05	0.4016E+02
0.8093E+03	0.2223E+06	0.2002E+05	0.4016E+02
0.8333E+03	0.2190E+06	0.1965E+05	0.4027E+02
0.8573E+03	0.2153E+06	0.1924E+05	0.4040E+02
0.8813E+03	0.2114E+06	0.1879E+05	0.4012E+02
0.9053E+03	0.2076E+06	0.1830E+05	0.4030E+02
0.9293E+03	0.2056E+06	0.1776E+05	0.4001E+02
0.9533E+03	0.2025E+06	0.1718E+05	0.4200E+02
0.9773E+03	0.1972E+06	0.1654E+05	0.4090E+02
0.1001E+04	0.1922E+06	0.1587E+05	0.4075E+02
0.1025E+04	0.1872E+06	0.1513E+05	0.3987E+02
0.1049E+04	0.1826E+06	0.1435E+05	0.3943E+02
0.1073E+04	0.1796E+06	0.1357E+05	0.3953E+02
0.1097E+04	0.1766E+06	0.1279E+05	0.3975E+02
0.1121E+04	0.1725E+06	0.1201E+05	0.3896E+02
0.1145E+04	0.1675E+06	0.1122E+05	0.3812E+02
0.1169E+04	0.1619E+06	0.1044E+05	0.3697E+02
0.1240E+04	0.1500E+06	0.8336E+04	0.3407E+02
0.1302E+04	0.1339E+06	0.6757E+04	0.2820E+02
0.1364E+04	0.1174E+06	0.5342E+04	0.2305E+02
0.1426E+04	0.1062E+06	0.4064E+04	0.2027E+02
0.1488E+04	0.8910E+05	0.2917E+04	0.1647E+02
0.1550E+04	0.7635E+05	0.1915E+04	0.1086E+02
0.1612E+04	0.5745E+05	0.1151E+04	0.7790E+01
0.1674E+04	0.4167E+05	0.8000E+03	0.7720E+01
0.1736E+04	0.2760E+05	0.6810E+03	0.7090E+01
0.1860E+04	0.3337E+04	0.5120E+03	0.3780E+01
0.1925E+04	-0.3000E+01	0.2020E+03	-0.1220E+01

PREMIN OUTPUT FILE
HEATING INDICATOR CASE

STS-1 REENTRY TRAJ. (ORBITER) PAFB REF. HTG. IND. CASE

0.000	25.000	500.000		
14.000	1200.000	29.000		
1925.300	1.000			
50.000				
0.300	396300.000	24570.000	41.130	0.000
45.300	373800.000	24590.000	41.260	0.000
90.300	351500.000	24620.000	41.210	0.000
135.300	329500.000	24640.000	40.460	0.000
180.300	308000.000	24660.000	40.650	0.000
225.300	288000.000	24660.000	41.900	0.000
270.300	269700.000	24610.000	39.390	0.000
315.300	256300.000	24470.000	40.710	0.000
360.300	250200.000	24220.000	41.740	0.000
405.300	247000.000	23920.000	39.950	0.000
450.300	244600.000	23610.000	39.280	0.000
495.300	242500.000	23280.000	39.660	0.000
545.300	240000.000	22880.000	39.070	0.000
569.300	238800.000	22680.000	39.320	0.000
593.300	237700.000	22470.000	39.020	0.000
617.300	236600.000	22250.000	39.250	0.000
641.300	235300.000	22020.000	39.480	0.000
665.300	233700.000	21780.000	39.970	0.000
689.300	232000.000	21530.000	40.010	0.000
713.300	232300.000	21260.000	40.250	0.000
737.300	230300.000	20980.000	40.460	0.000
761.300	227900.000	20680.000	40.140	0.000
785.300	225200.000	20360.000	40.160	0.000
809.300	222300.000	20020.000	40.160	0.000
833.300	219000.000	19650.000	40.270	0.000
857.300	215300.000	19240.000	40.400	0.000
881.300	211400.000	18790.000	40.120	0.000
905.300	207600.000	18300.000	40.300	0.000
929.300	205600.000	17760.000	40.010	0.000
953.300	202500.000	17180.000	42.000	0.000
977.300	197200.000	16540.000	40.900	0.000
1001.000	192200.000	15870.000	40.750	0.000
1025.000	187200.000	15130.000	39.870	0.000
1049.000	182600.000	14350.000	39.430	0.000
1073.000	179600.000	13570.000	39.530	0.000
1097.000	176600.000	12790.000	39.750	0.000
1121.000	172500.000	12010.000	38.960	0.000
1145.000	167500.000	11220.000	38.120	0.000
1169.000	161900.000	10440.000	36.970	0.000
1240.000	150000.000	8336.000	34.070	0.000
1302.000	133900.000	6757.000	28.200	0.000
1364.000	117400.000	5342.000	23.050	0.000
1426.000	106200.000	4064.000	20.270	0.000
1488.000	89100.000	2917.000	16.470	0.000

```
                1550.000            76350.000              1915.000    10.860     0.000
                1612.000            57440.000              1151.000     7.790     0.000
                1674.000            41670.000               800.000     7.720     0.000
                1736.000            27600.000               681.000     7.090     0.000
                1860.000             3337.000               512.000     3.780     0.000
                1925.000               -3.000               202.000    -1.220     0.000
  10    4.0000   11    1.0000   12    1.0000   31   38.0000   32   18.0000
  37   90.0000   38   90.0000  315    1.0000
 611    1001.0
 642    2.0000  643    1.0000  647    1.0000  641    2.0000
```

LANMIN OUTPUT
HEATING INDICATOR CASE

ORIGINAL [illegible]
OF POOR QUALITY

STS-1 REENTRY TRAJ. (ORBITER) PAFB REF. HTG. IND. CASE

TIMING

T1	=	.000 SEC.
DT1	=	25.000 SEC.
T2	=	500.000 SEC.
DT2	=	14.000 SEC.
T3	=	1200.000 SEC.
DT3	=	29.000 SEC.
T4	=	1925.300 SEC.
DT CALC	=	1.000 SEC.
DTEMP MAX	=	.000 SEC.

CONTROL PARAMETERS

W(641)=2.000	W(642)=2.000
W(643)=1.000	W(644)= .000
W(645)= .000	W(646)= .000
W(647)=1.000	W(648)= .000
W(649)= .000	W(650)= .000

HEAT TRANSFER

HT METHOD	=	1.000
RN	=	1.000 FT.
L	=	.000 FT.
N SUB L	=	1.000
N SUB T	=	1.000
PHI	=	.000 DEG.
VIRT-L OPT	=	.000

MULTIPLICATION FACTORS

K SUB L 1	=	1.000
K SUB T 1	=	1.000

MATERIAL

EMISSIVITY= .800

FLOWFIELD

	FLAG	ANGLE
1	38.	90.00
2	19.	90.00

TRANSITION
OPTION
TRAJECTORY

TIME SEC.	ALTITUDE FT	VELOCITY FT/SEC	ANGLE OF ATTACK DEG
.30	396300.	24570.	41.130
45.30	373900.	24590.	41.260
90.30	351500.	24620.	41.210

135.30	329500.	24640.	40.460
180.30	308000.	24660.	40.650
225.30	288000.	24660.	41.900
270.30	269700.	246[illegible].	39.390
315.30	256300.	2447[illegible].	40.[illegible]10
360.30	250200.	24220.	41.740
405.30	247000.	23920.	39.950
450.30	244600.	23610.	39.280
495.30	242500.	23280.	39.660
545.30	240000.	22880.	39.[illegible]
569.30	238800.	22680.	39.[illegible]20
593.30	237700.	22470.	39.[illegible]20
617.30	236600.	22250.	39.250
641.30	235300.	22020.	39.480
665.30	233700.	21780.	39.970
689.30	232000.	21530.	40.010
713.30	232300.	21260.	40.250
737.30	230300.	20980.	40.460
761.30	227900.	20680.	40.140
785.30	225200.	20360.	40.160
809.30	222300.	20020.	40.160
833.30	219000.	19650.	40.270
857.30	215300.	19240.	40.400
881.30	211400.	18790.	40.120
905.30	207600.	18300.	40.300
929.30	205600.	17760.	40.010
953.30	202500.	17180.	42.000
977.30	197200.	16540.	40.900
1001.00	192200.	15870.	40.750
1025.00	187200.	15130.	39.870
1049.00	182600.	14350.	39.430
1073.00	179600.	13570.	39.530
1097.00	176600.	12790.	39.750
1121.00	172500.	12010.	38.960
1145.00	167500.	11220.	38.120
1169.00	161900.	10440.	36.970
1241.00	150000.	8036.	34.070
1302.00	133900.	6757.	28.200
1364.00	117400.	5342.	23.050
1426.00	106200.	4064.	20.270
1488.00	89100.	2917.	16.470
1550.00	76350.	1915.	10.860
1612.00	57440.	1151.	7.790
1674.00	41670.	800.	7.720
1736.00	27600.	681.	7.090
1860.00	3337.	512.	3.780
1925.00	-0.	202.	-1.220

1963 RAFB STD ATMOSPHERE

OF POOR QUALITY

STS-1 REENTRY TRAJ. (ORBITER) PAFB REF. HTG. IND. CASE

B.P. NO. 1001

TIME SEC	ALT KFT	VEL FT/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./FT	HEAT COEF LBM/SFT-S	REC ENTHALPY BTU/LBM	RAD EQUIL DEG F	HEAT RATE BTU/SFT-S	HEAT LOAD BTU SFT	PRESSURE LB/SFT	FLOW TYPE
.0	396.3	24570.0	19.25	41.13	.239+001	.146-003	.122+005	1001.0	.424+000	000	.268-001	LAM
25.0	384.0	24581.0	20.55	41.20	.426+001	.189-003	.122+005	1097.1	.689+000	.172+002	.445-001	LAM
50.0	371.5	24593.1	21.85	41.25	.793+001	.248-003	.122+005	1204.6	.116+001	.463+002	.756-001	LAM
75.0	359.1	24609.8	23.30	41.23	.157+002	.331-003	.122+005	1327.5	.209+001	.984+002	.133+000	LAM
100.0	346.8	24624.3	24.21	41.05	.296+002	.436-003	.122+005	1453.9	.371+001	[illegible]	.229+000	LAM
125.0	334.5	24635.4	25.23	40.63	.586+002	.597-003	.122+005	1609.1	.629+001	.362+003	.429+000	LAM
150.0	322.5	24646.5	26.14	40.52	.119+003	.827-003	.122+005	1782.4	.100+002	.614+003	.818+000	LAM
175.0	310.5	24657.6	26.88	40.63	.240+003	.115-002	.122+005	1972.1	.139+002	.961+003	.157+001	LAM
200.0	299.2	24666.0	27.62	41.20	.466+003	.159-002	.122+005	2175.5	.193+002	.144+004	.299+001	LAM
225.0	288.1	24660.0	27.90	41.89	.936+003	.220-002	.122+005	2291.8	.266+002	.211+004	.565+001	LAM
250.0	278.0	24632.6	27.87	40.52	.165+004	.293-002	.122+005	2595.5	.353+002	.299+004	.997+001	LAM
275.0	268.3	24595.4	27.55	39.53	.273+004	.383-002	.122+005	2803.9	.451+002	.419+004	[illegible]	LAM
300.0	260.9	24517.6	27.01	40.26	.382+004	.458-002	.121+005	2944.3	.548+002	.551+004	[illegible]	LAM
325.0	255.0	24416.1	26.56	40.93	.495+004	.523-002	.120+005	3050.0	.621+002	.707+004	.314+002	LAM
350.0	251.6	24277.2	26.22	41.50	.570+004	.562-002	.118+005	3100.7	.659+002	.872+004	.362+002	LAM
375.0	249.2	24122.0	25.92	41.16	.630+004	.591-002	.117+005	3132.1	.684+002	.104+005	.400+002	LAM
400.0	247.4	23955.3	25.65	40.16	.675+004	.613-002	.115+005	3151.8	.701+002	.122+005	.431+002	LAM
425.0	245.9	23784.3	25.39	39.66	.712+004	.638-002	.114+005	3173.0	.719+002	.140+005	.466+002	LAM
450.0	244.6	23612.1	25.14	39.28	.748+004	.661-002	.112+005	3190.7	.734+002	.158+005	.500+002	LAM
475.0	243.4	23428.9	24.88	39.49	.780+004	.681-002	.110+005	3202.8	.745+002	.177+005	.531+002	LAM
500.0	242.3	23242.4	24.63	39.60	.813+004	.702-002	.109+005	3213.8	.755+002	.196+005	.564+002	LAM
514.0	241.6	23130.4	24.47	39.44	.833+004	.712-002	.108+005	3217.1	.759+002	.206+005	.580+002	LAM
528.0	240.9	23018.4	24.32	39.27	.853+004	.720-002	.107+005	3217.5	.760+002	.217+005	.593+002	LAM
542.0	240.2	22906.4	24.16	39.11	.874+004	.728-002	.106+005	3217.8	.761+002	.228+005	.606+002	LAM
556.0	239.5	22790.8	24.01	39.18	.895+004	.736-002	.105+005	3217.5	.761+002	.238+005	.619+002	LAM
570.0	238.8	22673.9	23.85	39.31	.916+004	.742-002	.104+005	3214.8	.760+002	.249+005	.630+002	LAM
584.0	238.1	22551.4	23.69	39.14	.935+004	[illegible]	.102+005	3208.8	.755+002	.259+005	.636+002	LAM
596.0	237.5	22426.9	23.53	39.07	.955+004	.749-002	.101+005	3202.2	.751+002	.270+005	.647+002	LAM
612.0	236.8	22298.6	23.36	39.20	.974+004	.752-002	.100+005	3194.9	.745+002	.290+005	.648+002	LAM
626.0	236.1	22166.6	23.19	39.33	.997+004	.756-002	.990+004	3188.2	.740+002	.291+005	[illegible]	LAM
640.0	235.4	22032.5	23.01	39.47	.102+005	.761-002	.978+004	3181.7	.736+002	.301+005	.664+002	LAM
654.0	234.5	21893.0	22.83	39.74	.105+005	.768-002	.966+004	3177.1	.733+002	.311+005	.676+002	LAM
668.0	233.5	21751.9	22.63	39.97	.109+005	.775-002	.954+004	3172.3	.730+002	.321+005	.686+002	LAM
682.0	232.5	21606.0	22.44	40.00	.112+005	.782-002	.941+004	3167.3	.727+002	.332+005	.701+002	LAM
696.0	232.1	21454.6	22.26	40.08	.113+005	.779-002	.928+004	3151.1	.715+002	.342+005	.697+002	LAM
710.0	232.3	21297.1	22.10	40.22	.112+005	.767-002	.915+004	3123.1	.693+002	.351+005	.676+002	LAM
724.0	231.4	21135.2	21.90	40.34	.115+005	.771-002	.901+004	3113.4	.666+002	.361+005	.684+002	LAM
738.0	230.2	20971.3	21.68	40.45	.119+005	.785-002	.887+004	3113.6	.688+002	.371+005	.706+002	LAM
752.0	228.8	20796.3	21.43	40.26	.125+005	.802-002	.873+004	3116.2	.691+002	.380+005	.740+002	LAM
766.0	227.4	20617.3	21.19	40.14	.131+005	.820-002	.858+004	3119.0	.695+002	.390+005	.773+002	LAM
780.0	225.8	20430.7	20.93	40.16	.138+005	.840-002	.843+004	3122.4	.699+002	.400+005	.812+002	LAM
794.0	224.1	20236.8	20.66	40.16	.146+005	.862-002	.827+004	3125.7	.703+002	.410+005	.854+002	LAM
808.0	222.5	20038.4	20.38	40.16	.154+005	.884-002	.811+004	3128.6	.707+002	.420+005	.898+002	LAM
822.0	220.6	19824.2	20.09	40.22	.164+005	.909-002	.794+004	3132.6	.712+002	.429+005	.951+002	LAM
836.0	218.6	19603.9	19.78	40.28	.174+005	.939-002	.777+004	3138.3	.719+002	.440+005	.101+003	LAM
850.0	216.4	19364.7	19.46	40.36	.187+005	.978-002	.758+004	3150.2	.731+002	.450+005	.110+003	LAM
864.0	214.2	19114.4	19.12	40.32	.200+005	.102-001	.739+004	3159.0	.741+002	.460+005	.119+003	LAM
878.0	211.9	18851.9	18.77	40.16	.214+005	.106-001	.719+004	3164.6	.749+002	.471+005	.129+003	LAM
892.0	209.7	18571.5	18.41	40.20	.229+005	.109-001	.699+004	3164.3	.752+002	.481+005	.139+003	LAM
906.0	207.5	18284.3	18.05	40.29	.244+005	.112-001	.677+004	3150.7	.743+002	.492+005	.143+003	LAM

OF

STS-1 REENTRY TRAJ. (ORBITER) PAFB REF. HTG. IND. CASE B.P. NO. 1001

(CONTINUED)

TIME SEC	ALT KFT	VEL FT/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./FT	HEAT COEF LBM/SFT-S	REC ENTHALPY BTU/LBM	RAD EQUIL DEG F	HEAT RATE BTU/SFT-S	HEAT LOAD BTU/SFT	PRESSURE LB/SFT	FLOW TYPE
920.0	206.4	17969.3	17.70	40.12	.250+005	.111-001	.655+004	3110.2	.713+002	.502+005	.141+003	LAM
934.0	205.0	17646.4	17.33	40.40	.258+005	.111-001	.63 +004	3077.2	.689+002	.511+005	.142+003	LAM
948.0	203.2	17308.1	16.94	41.56	.270+005	.113-001	.608+004	3051.5	.673+002	.521+005	.147+003	LAM
962.0	200.6	16948.0	16.51	41.60	.289+005	.116-001	.584+004	3033.8	.663+002	.530+005	.155+003	LAM
976.0	197.5	16574.7	16.05	40.96	.315+005	.120-001	.559+004	3021.0	.658+002	.539+005	.168+003	LAM
990.0	194.5	16181.0	15.59	40.82	.341+005	.124-001	.533+004	3000.0	.647+002	.548+005	.179+003	LAM
1004.0	191.6	15777.5	15.12	40.64	.368+005	.127-001	.508+004	2974.1	.632+002	.557+005	.189+003	LAM
1018.0	188.7	15345.8	14.6	40.13	.396+005	.130-001	.481+004	2935.5	.609+002	.566+005	.197+003	LAM
1032.0	185.9	14902.5	14.15	39.74	.423+005	.132-001	.454+004	2895.6	.587+002	.574+005	.206+003	LAM
1046.0	183.2	14447.5	13.66	39.49	.450+005	.134-001	.428+004	2849.0	.560+002	.582+005	.213+003	LAM
1060.0	181.2	13992.5	13.19	39.48	.466+005	.133-001	.401+004	2781.5	.520+002	.589+005	.21 003	LAM
1074.0	179.5	13537.5	12.73	39.54	.478+005	.134-001	.377+004	2723.2	.489+002	.596+005	.214+003	LAM
1088.0	177.7	13082.5	12.27	39.67	.491+005	.132-001	.350+004	2644.3	.447+002	.602+005	.212+003	LAM
1102.0	175.7	12627.5	11.81	39.59	.507+005	.132-001	.330+004	2590.2	.421+002	.608+005	.214+003	LAM
1116.0	173.4	12172.5	11.36	39.12	.530+005	.133-001	.307+004	2527.6	.393+002	.613+005	.216+003	LAM
1130.0	170.6	11713.8	10.89	38.64	.560+005	.134-001	.285+004	2445.6	.367+002	.619+005	.221+003	LAM
1144.0	167.7	11252.9	10.43	38.16	.595+005	.135-001	.264+004	2403.6	.343+002	.623+005	.227+003	LAM
1158.0	164.5	10797.5	9.98	37.50	.639+005	.138-001	.244+004	2344.2	.321+002	.628+005	.235+003	LAM
1172.0	161.4	10351.1	9.55	36.85	.682+005	.139-001	.226+004	2280.5	.299+002	.632+005	.241+003	LAM
1186.0	159.1	9936.2	9.17	36.28	.716+005	.140-001	.209+004	2212.7	.276+002	.636+005	.242+003	LAM
1200.0	156.7	9521.4	8.79	35.70	.753+005	.140-001	.193+004	2142.8	.254+002	.639+005	.243+003	LAM
1229.0	151.8	8662.0	8.03	34.52	.834+005	.140-001	.161+004	1990.5	.210+002	.646+005	.245+003	LAM
1258.0	145.3	7877.6	7.35	32.37	.997+005	.144-001	.135+004	1855.0	.179+002	.651+005	.263+003	LAM
1287.0	137.8	7139.0	6.73	29.62	.126+006	.152-001	.113+004	1726.8	.155+002	.655+005	.299+003	LAM
1316.0	130.2	6437.5	6.14	27.04	.160+006	.159-001	.937+003	1585.0	.132+002	.659+005	.334+003	LAM
1345.0	122.5	5775.6	5.57	24.63	.205+006	.168-001	.773+003	1437.0	.111+002	.662+005	.380+003	LAM
1374.0	115.6	5135.9	5.01	22.60	.253+006	.172-001	.631+003	1268.1	.894+001	.665+005	.410+003	LAM
1403.0	110.4	4538.1	4.46	21.30	.288+006	.168-001	.514+003	1085.0	.677+001	.667+005	.405+003	LAM
1432.0	104.5	3953.0	3.92	19.90	.333+006	.164-001	.413+003	895.3	.497+001	.668+005	.405+003	LAM
1461.0	96.5	3416.5	3.43	18.12	.428+006	.167-001	.332+003	715.5	.371+001	.669+005	.442+003	LAM
1490.0	88.7	2884.7	2.92	16.29	.534+006	.167-001	.263+003	529.9	.255+001	.670+005	.467+003	LAM
1519.0	82.7	2416.0	2.46	13.66	.603+006	.157-001	.212+003	368.9	.159+001	.671+005	.440+003	LAM
1548.0	76.8	1947.3	2.00	11.04	.663+006	.142-001	.170+003	220.9	.842+000	.671+005	.395+003	LAM
1577.0	68.1	1582.3	1.65	9.52	.861+006	.140-001	.141+003	116.0	.433+000	.671+005	.424+003	LAM
1606.0	59.3	1224.9	1.30	8.09	.110+007	.134-001	.118+003	26.7	.107+000	.671+005	.448+003	LAM
1635.0	51.6	1020.8	1.09	7.76	.138+007	.144-001	.108+003	-13.0	-.297-001	.671+005	.511+003	LAM
1664.0	44.2	856.6	.90	7.73	.157+007	.152-001	.105+003	-25.4	-.781-001	.671+005	.583+003	LAM
1693.0	37.4	763.5	.78	7.53	.175+007	.164-001	.108+003	-15.5	-.458-001	.671+005	.716+003	LAM
1722.0	30.8	707.9	.70	7.23	.194+007	.180-001	.112+003	4.1	.357-001	.671+005	.894+003	LAM
1751.0	24.7	660.6	.63	6.69	.212+007	.194-001	.117+003	23.7	.131+000	.671+005	.110+004	LAM
1780.0	19.0	621.0	.58	5.92	.230+007	.208-001	.121+003	40.9	.228+000	.671+005	.132+004	LAM
1809.0	13.3	581.5	.53	5.14	.250+007	.222-001	.125+003	55.5	.323+000	.671+005	.159+004	LAM
1838.0	7.6	542.0	.49	4.37	.271+007	.235-001	.128+003	67.8	.413+000	.671+005	.190+004	LAM
1867.0	3.0	478.6	.43	3.24	.269+007	.237-001	.130+003	75.5	.463+000	.671+005	.217+004	LAM
1896.0	5	340.3	.30	1.01	.198+007	.202-001	.129+003	70.1	.371+000	.671+005	.215+004	LAM
1925.0	.0	202.0	.18	-1.22	.122+007	.158-001	.128+003	67.5	.286+000	.672+005	.217+004	LAM
1954.0	.0	202.0	.18	-1.22	.122+007	.158-001	.128+003	67.5	.286+000	.672+005	.217+004	LAM

Wind Tunnel Sample Case

The example case given herein corresponds to the results presented in Volume I Fig. 7.15 and 7.16 for X/L = 0.1, 0.2 and 0.3. The problem solved is heating to the bottom centerline of an orbiter using the effective running length concept. In the wind tunnel case, time is used to denote different run conditions. Since the effective running length changes with angle of attack and angle of attack with run conditions, the time dependent geometry option is used.

The PREMIN interactive listing is followed by the PREMIN output file. The output listing from LANMIN resulting from the PREMIN output file is given last. The output lisiting contains the intermediate print as well as the summary page. The description of the intermediate output symbols and units is given in Table 4.1. The summary print follows each case. Cases 1, 2, and 3 are for body points 100, 200 and 300 corresponding to X/L = 0.10, 0.20, and 0.30 respectively. The heating load in the summary print has no meaning for a wind tunnel case where time is a run number indicator.

INTERACTIVE PREMIN
WIND TUNNEL RUN CASE

```
RUN PREMIN
```

```
INTERACTIVE INPUT TO LARC MINIVER - LANMIN


         OUTPUT FILE METHOD

1.   CREATE A NEW OUTPUT FILE
2.   MODIFY AN EXISTING OUTPUT FILE

OPTION SELECTED ?
1
DO YOU WANT TO INPUT DATA IN ENGLISH OR METRIC ?
ENGLISH

INTERACTIVE INPUT FOR CASE    1
```

```
      SPECIFY PRINTOUT INTERVALS

INITIAL TIME (SEC)
1.0
PRINTOUT INTERVAL 1 (SEC)          DELTA TIME
1.0
SECOND TIME (SEC)
4.0
PRINTOUT INTERVAL 2 (SEC)          DELTA TIME
0.0
THIRD TIME (SEC)
0.0
PRINTOUT INTERVAL 3 (SEC)          DELTA TIME
0.0
FOURTH TIME (SEC)
0.0

ARE THE PRINTOUT TIMES CORRECT ?
YES
```

```
TRAJECTORY INPUT

DO YOU HAVE A TRAJECTORY INPUT FILE ?
NO
WHAT IS THE NUMBER OF TRAJECTORY POINTS ? (50 TRAJ.PTS. MAXIMUM)
4
WILL BETA VALUES BE INPUT ?
NO
TYPE IN THE FOLLOWING TRAJECTORY VARIABLES SEPERATED BY COMMAS
- - - - - - - - - - - - 50 TIMES MAXIMUM - - - - - - - - - - - -
TIME(SEC),ALTITUDE(FT),VELOCITY(FT/SEC),ANGLE OF ATTACK(DEG)
 1
1.0,0.0,3816.0,20.0
 2
2.0,0.0,3821.0,29.86
 3
3.0,0.0,3821.0,39.98
 4
4.0,0.0,3859.0,39.98
```

	TIME (SEC)	ALTITUDE (FT)	VELOCITY (FT/SEC)	ANGLE ATTACK (DEG)
1	0.1000E+01	0.0000E+00	0.3816E+04	0.2000E+02
2	0.2000E+01	0.0000E+00	0.3821E+04	0.2986E+02
3	0.3000E+01	0.0000E+00	0.3821E+04	0.3998E+02
4	0.4000E+01	0.0000E+00	0.3859E+04	0.3998E+02

```
DO YOU WISH TO CHANGE ANY OF THE TRAJECTORY INPUT ?
NO
DO YOU WISH TO WRITE THIS INPUT TO A FILE ?
YES
WHAT IS THE NEW FILE NAME ?
TRAJ.FIL

TRAJECTORY INPUT IS COMPLETE
```

```
ATMOSPHERE DATA

OPTIONS   1.  1962 U.S. STANDARD ATMOSPHERE
          2.  WIND TUNNEL OPTION
          3.  INPUT ATMOSPHERIC DATA(ALT,T-INF,P-INF)
          4.  1963 PATRICK AIR FORCE BASE ATMOSPHERE
          5.  1971 VANDENBERG REFERENCE ATMOSPHERE

OPTION SELECTED ?
2.0

WIND TUNNEL OPTION

IS THIS OPTION CORRECT ?
YES
```

WIND TUNNEL OPTION

INPUT STATIC TEMPERATURE AND PRESSURE AS A FUNCTION OF TIME.
TIME AND FREESTREAM VEL. ARE INPUT IN TRAJ. DATA WITH ALT. SET = 0.0

------- 4 VALUES REQUIRED ------

```
T-INF(R),P-INF(LB/SFT)
 1
94.7,8.064
 2
95.0,8.208
 3
95.0,8.208
 4
96.9,12.672
ARE ALL INPUTS CORRECT ?
YES
```

```
DO YOU WANT TO RUN A HEATING INDICATOR ?
NO
```

HEAT TRANSFER METHOD

```
OPTIONS     1.  HEMISPHERE STAGNATION POINT
            2.  CATO/JOHNSON SWEPT CYLINDER
            3.  ECKERT REF. ENTHALPY FLAT PLATE METHOD
            4.  ECKERT/SPAULDING-CHI FLAT PLATE METHOD
            5.  BOEING RHO-MU FLAT PLATE METHOD
            6.  BECKWITH/GALLAGHER SWEPT CYLINDER METHOD
            7.  BOEING RHO-MU SWEPT CYLINDER METHOD
            8.  LEES/DETRA-HIDALGO HEMISPHERE DISTRIBUTION
            9.  LEESIDE ORBITER HEATING
           10.  FLAP REATTACHMENT HEATING
           11.  FIN-PLATE PEAK INTERFERENCE HEATING
OPTION SELECTED ?
4.0
SHOULD RAREFIED FLOW HEATING BE INCLUDED ?
NO
IS THE HEAT TRANSFER OPTION CORRECT ?
YES
```

```
4.   ECKERT/SPAULDING-CHI FLAT PLATE METHOD

RUNNING LENGTH (FT) ?
.2097
SURFACE DISTANCE TO START OF TURBULENT B.L.
THIS DISTANCE IS SUBTRACTED FROM THE RUNNING LENGTH
FOR TURBULENT HEATING CALCULATIONS.
DESIRED LENGTH ?
0.0
IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION DESIRED ?
NO
TURBULENT MANGLER FACTOR ?
.6667
LAMINAR MANGLER FACTOR ?
1.0

REYNOLDS-ANALOGY FACTOR

          0.   COLBURN
          1.   VON KARMAN

DESIRED FACTOR ?
1.
ANY CHANGES ?
NO


* * * WALL CONDITIONS * * *

WALL TEMPERATURE (DEG F) ?
0.0
WALL EMISSIVITY ?
0.8


* * * CONTINUATION OPTION * * *

DO YOU WANT TO PROVIDE AN INITIAL HEATING LOAD GT 0.0 (BTU/SQ.FT) ?
NO
```

```
DO YOU WANT TO USE A HEAT TRANSFER MULTIPLICATION METHOD ?
NO


          TRANSITION OPTIONS

OPTIONS   1.    TIME DEPENDENT: LAM TO TURB
          2.    TIME DEPENDENT: TURB TO LAM
          3.    REYNOLDS NO. DEPENDENT
          4.    RE-THETA
          5.    MDAC-E TRANSITION
          6.    MDAC-E TABLE LOOK-UP
          7.    NAR RE VS ME TABLE LOOK-UP
          8.    RE-THETA/ME

OPTION SELECTED ?
1.0


1.   TIME DEPENDENT: LAM TO TURB

TRANSITION BEGINS AT TIME(SEC) ?
3.2
FULLY TURBULENT AT TIME(SEC) ?
3.6
ANY CHANGES ?
NO
```

```
DO YOU WANT CROSS FLOW ADJUSTMENT OPTION ?
NO
```

```
          FLOWFIELD AND LOCAL PRESSURE OPTIONS

   - - - - - FLOWFIELD - - - - - -     - - - - - - PRESSURE - - - - - -
-1. FLOWFIELD TYPE NOT NEEDED         -1. PRESSURE TYPE NOT NEEDED
 1. SHARP WEDGE SHOCK ANGLE            1. INPUT CP VS MACH NO. TABLE
 2. SHARP CONE SHOCK ANGLE             2. TANGENT WEDGE PRESSURE
 3. OBLIQUE AND NORMAL SHOCK (90 DEG)  3. TANGENT CONE PRESSURE
 4. PARALLEL SHOCK (PRES NOT NEEDED)   4. OBLIQUE SURFACE PRESSURE
                                       5. MODIFIED NEWTONIAN
                                       6. PRANDTL-MEYER EXP. (FF NOT NEEDED)

 * * * * INPUT OPTIONS IN PAIRS WITH ASSOCIATED DELTA ANGLES * * * *
(NOTE: TO SIGNIFY END OF CASE USE -1.0 FOR BOTH FF AND PRESS. OPTIONS.)
FLOWFIELD,DEL ANGLE,PRESSURE,DEL ANGLE
1
2.0,2.8,2.0,2.8
2
-1.0,0.0,-1.0,0.0


                         TOTAL EFFECTIVE ANGLE
SET1
 FF       SHRP-CONE      ALPHA +    2.800
 P        TAN-WEDGE      ALPHA +    2.800

ANY CHANGES ?
NO
```

```
DO YOU WANT TO USE TIME DEPENDENT GEOMETRY ?
YES


            TIME DEPENDENT GEOMETRY


NUMBER OF TIME DEPENDENT ENTRIES ? (MAX=10)
4
TIME(SEC),RADII(FT),LENGTH(FT),SLOPE OR SWEEP(DEG)
1.0,0.0,.2097,0.0
2.0,0.0,.1239,0.0
3.0,0.0,.0858,0.0
4.0,0.0,.0858,0.0
ANY CHANGES ?
NO
```

```
            CONTROL FLAGS


YOU ARE COMPLETING INPUT FOR CASE    1

WHAT IS THE BODY POINT NUMBER FOR CASE    1 ?
100
SHOULD LANMIN CREATE AN OUTPUT FILE FOR CASE    1 ?
YES

          PRINT CONTROL OPTIONS
0.    DETAILED PRINTOUT
1.    DETAILED PLUS SUMMARY PRINTOUT
2.    SUMMARY PRINTOUT

NOTE: IF AN OUTPUT FILE IS TO BE CREATED EITHER
OPTION 1. OR 2. MUST BE SELECTED

OPTION SELECTED ?
1.0


          OUTPUT UNITS OPTIONS

0.    ENGLISH
1.    METRIC

OPTION SELECTED ?
0.


IS CASE    2 ALONG THE SAME STREAMLINE
AS CASE    1 ?
NO
```

ORIGINAL PAGE IS
OF POOR QUALITY

INPUT CONTROL FLAG

1. NEW CASE FOLLOWS USING TITLE,TIMING AND TRAJ. DATA FROM PREVIOUS CASE
2. END OF INPUT (LAST CASE)
3. NEW CASE FOLLOWS USING TRAJ.DATA FROM PREVIOUS CASE. NEW TITLE AND TIMING. INITIAL CASE DATA UNCHANGED.
4. NEW CASE FOLLOWS USING NEW TITLE,TIMING,TRAJ. AND CASE DATA. (INITIALLY ZERO W ARRAY)
5. SAME AS (1) EXCEPT ZERO ALL CASE DATA FROM PREVIOUS CASE
6. SAME AS (3) EXCEPT INITIALIZE ZERO ALL TIMING AND CASE DATA

OPTION SELECTED ?
1.0

***** INPUT COMPLETE FOR CASE 1 *****

DO YOU WANT TO MAKE ANY MODIFICATIONS TO CASE 1 ?
NO

CREATE OUTPUT FILE

WHAT IS THE NAME OF THE OUTPUT FILE TO BE CREATED ?
PREMIN.OUT

WHAT IS THE TITLE FOR CASE 1 ? (NOTE 72 CHAR. LIMIT)
BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8-TUNNEL B

INTERACTIVE INPUT FOR CASE 2

IS CASE 2 ATMOSPHERE DATA SAME AS FOR CASE 1 ?
YES

IS CASE 2 WIND TUNNEL DATA SAME AS FOR CASE 1 ?
YES

DO YOU WANT TO RUN A HEATING INDICATOR ?
NO

```
IS CASE   2 HEAT TRANSFER DATA SAME AS FOR CASE   1 ?
NO

     HEAT TRANSFER METHOD

OPTIONS     1.  HEMISPHERE STAGNATION POINT
            2.  CATO/JOHNSON SWEPT CYLINDER
            3.  ECKERT REF. ENTHALPY FLAT PLATE METHOD
            4.  ECKERT/SPAULDING-CHI FLAT PLATE METHOD
            5.  BOEING RHO-MU FLAT PLATE METHOD
            6.  BECKWITH/GALLAGHER SWEPT CYLINDER METHOD
            7.  BOEING RHO-MU SWEPT CYLINDER METHOD
            8.  LEES/DETRA-HIDALGO HEMISPHERE DISTRIBUTION
            9.  LEESIDE ORBITER HEATING
           10.  FLAP REATTACHMENT HEATING
           11.  FIN-PLATE PEAK INTERFERENCE HEATING

OPTION SELECTED ?
4.0
SHOULD RAREFIED FLOW HEATING BE INCLUDED ?
NO
IS THE HEAT TRANSFER OPTION CORRECT ?
YES
```

```
4.   ECKERT/SPAULDING-C   FLAT PLATE METHOD

RUNNING LENGTH (FT) ?
.3532
SURFACE DISTANCE TO START OF TURBULENT B.L.
THIS DISTANCE IS SUBTRACTED FROM THE RUNNING LENGTH
FOR TURBULENT HEATING CALCULATIONS.
DESIRED LENGTH ?
0.0
IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION DESIRED ?
NO
TURBULENT MANGLER FACTOR ?
.6667
LAMINAR MANGLER FACTOR ?
1.0

REYNOLDS-ANALOGY FACTOR

          0.   COLBURN
          1.   VON KARMAN

DESIRED FACTOR ?
1.
ANY CHANGES ?
NO
```

* * * WALL CONDITIONS * * *

WALL TEMPERATURE (DEG F) ?
0.0
WALL EMISSIVITY ?
0.8

* * * CONTINUATION OPTION * * *

DO YOU WANT TO PROVIDE AN INITIAL HEATING LOAD GT 0.0 (BTU/SQ.FT) ?
NO

DO YOU WANT TO USE A HEAT TRANSFER MULTIPLICATION METHOD ?
NO

IS CASE 2 TRANSITION DATA THE SAME FOR CASE 1 ?
YES

DO YOU WANT CROSS FLOW ADJUSTMENT OPTION ?
NO

IS CASE 2 FLOWFIELD DATA THE SAME AS FOR CASE 1 ?
NO

FLOWFIELD AND LOCAL PRESSURE OPTIONS

- - - - - - FLOWFIELD - - - - - -	- - - - - - PRESSURE - - - - - -
-1. FLOWFIELD TYPE NOT NEEDED	-1. PRESSURE TYPE NOT NEEDED
1. SHARP WEDGE SHOCK ANGLE	1. INPUT CP VS MACH NO. TABLE
2. SHARP CONE SHOCK ANGLE	2. TANGENT WEDGE PRESSURE
3. OBLIQUE AND NORMAL SHOCK (90 DEG)	3. TANGENT CONE PRESSURE
4. PARALLEL SHOCK (PRES NOT NEEDED)	4. OBLIQUE SURFACE PRESSURE
	5. MODIFIED NEWTONIAN
	6. PRANDTL-MEYER EXP. (FF NOT NEEDED)

```
* * * * INPUT OPTIONS IN PAIRS WITH ASSOCIATED DELTA ANGLES * * * *
(NOTE: TO SIGNIFY END OF CASE USE -1.0 FOR BOTH FF AND PRESS  OPTIONS.)
FLOWFIELD,DEL ANGLE,PRESSURE,DEL ANGLE
1
2.0,0.3,2.0,0.3
2
-1.0,0.0,-1.0,0.0


SET1                                TOTAL EFFECTIVE ANGLE
 FF        SHRP-CONE          ALPHA +    0.300
 P         TAN-WEDGE          ALPHA +    0.300

ANY CHANGES ?
NO
```

```
DO YOU WANT TO USE TIME DEPENDENT GEOMETRY ?
YES


IS CASE    2 TIME DEPENDENT GEOMETRY DATA THE SAME AS FOR CASE    1 ?
NO


          TIME DEPENDENT GEOMETRY


NUMBER OF TIME DEPENDENT ENTRIES ? (MAX=10)
4
TIME(SEC),RADII(FT),LENGTH(FT),SLOPE OR SWEEP(DEG)
1.0,0.0,.5692,0.0
2.0,0.0,.3152,0.0
3.0,0.0,.2277,0.0
4.0,0.0,.2277,0.0
ANY CHANGES ?
NO
```

```
                CONTROL FLAGS

     YOU ARE COMPLETING INPUT FOR CASE    2

     WHAT IS THE BODY POINT NUMBER FOR CASE    2 ?
     200
     SHOULD LANMIN CREATE AN OUTPUT FILE FOR CASE    2 ?
     YES

               PRINT CONTROL OPTIONS
     0.    DETAILED PRINTOUT
     1.    DETAILED PLUS SUMMARY PRINTOUT
     2.    SUMMARY PRINTOUT

     NOTE: IF AN OUTPUT FILE IS TO BE CREATED EITHER
     OPTION 1. OR 2. MUST BE SELECTED

     OPTION SELECTED ?
     1.0


               OUTPUT UNITS OPTIONS

     0.    ENGLISH
     1.    METRIC

     OPTION SELECTED ?
     0.


     IS CASE    3 ALONG THE SAME STREAMLINE
     AS CASE    2 ?
     NO


               INPUT CONTROL FLAG

     1.    NEW CASE FOLLOWS USING TITLE,TIMING AND TRAJ.
           DATA FROM PREVIOUS CASE
     2.    END OF INPUT (LAST CASE)
     3.    NEW CASE FOLLOWS USING TRAJ.DATA FROM PREVIOUS CASE.
           NEW TITLE AND TIMING. INITIAL CASE DATA UNCHANGED.
     4.    NEW CASE FOLLOWS USING NEW TITLE,TIMING,TRAJ. AND CASE DATA.
           (INITIALLY ZERO W ARRAY)
     5.    SAME AS (1) EXCEPT ZERO ALL CASE DATA FROM PREVIOUS CASE
     6.    SAME AS (3) EXCEPT INITIALIZE ZERO ALL TIMING AND CASE DATA

     OPTION SELECTED ?
     1.0


        ***** INPUT COMPLETE FOR CASE    2 *****

     DO YOU WANT TO MAKE ANY MODIFICATIONS TO CASE    2 ?
     YES
```

MODIFICATION SECTIONS

```
 1.   TIMING PARAMETERS
 2.   TRAJECTORY DATA
 3.   ATMOSPHERE DATA
 4.   FLOWFIELD AND PRESSURE DATA
 5.   CROSSFLOW DATA
 6.   TRANSITION CRITERIA
 7.   HEAT TRANSFER OPTION
 8.   HEATING MULTIPLIERS
 9.   GEOMETRY DATA
10.   CONTROL PARAMETERS
11.   HEATING INDICATOR
12.   OR CHANGE A SPECIFIC VARIABLE IN W ARRAY

SECTION TO BE MODIFIED ?
9.


IS CASE   2 TIME DEPENDENT GEOMETRY DATA THE SAME AS FOR CASE   1 ?
NO


          TIME DEPENDENT GEOMETRY


NUMBER OF TIME DEPENDENT ENTRIES ? (MAX=10)
4
TIME(SEC),RADII(FT),LENGTH(FT),SLOPE OR SWEEP(DEG)
1.0,0.0,.3532,0.0
2.0,0.0,.1943,0.0
3.0,0.0,.1448,0.0
4.0,0.0,.1448,0.0
ANY CHANGES ?
NO

DO YOU WISH TO MODIFY ANY OTHER SECTIONS FOR CASE   2 ?
NO


   ***** INPUT COMPLETE FOR CASE   2  *****

DO YOU WANT TO MAKE ANY MODIFICATIONS TO CASE   2 ?
NO

INTERACTIVE INPUT FOR CASE   3
```

```
IS CASE   3 ATMOSPHERE DATA SAME AS FOR CASE   2 ?
YES
```

```
IS CASE   3 WIND TUNNEL DATA SAME AS FOR CASE   2 ?
YES
```

```
DO YOU WANT TO RUN A HEATING INDICATOR ?
NO
```

```
IS CASE   3 HEAT TRANSFER DATA SAME AS FOR CASE   2 ?
NO


     HEAT TRANSFER METHOD

OPTIONS     1.  HEMISPHERE STAGNATION POINT
            2.  CATO/JOHNSON SWEPT CYLINDER
            3.  ECKERT REF. ENTHALPY FLAT PLATE METHOD
            4.  ECKERT/SPAULDING-CHI FLAT PLATE METHOD
            5.  BOEING RHO-MU FLAT PLATE METHOD
            6.  BECKWITH/GALLAGHER SWEPT CYLINDER METHOD
            7.  BOEING RHO-MU SWEPT CYLINDER METHOD
            8.  LEES/DETRA-HIDALGO HEMISPHERE DISTRIBUTION
            9.  LEESIDE ORBITER HEATING
           10.  FLAP REATTACHMENT HEATING
           11.  FIN-PLATE PEAK INTERFERENCE HEATING

OPTION SELECTED ?
4.0
SHOULD RAREFIED FLOW HEATING BE INCLUDED ?
NO
IS THE HEAT TRANSFER OPTION CORRECT ?
YES
```

```
4.   ECKERT/SPAULDING-CHI FLAT PLATE METHOD

RUNNING LENGTH (FT) ?
.5254
SURFACE DISTANCE TO START OF TURBULENT B.L.
THIS DISTANCE IS SUBTRACTED FROM THE RUNNING LENGTH
FOR TURBULENT HEATING CALCULATIONS.
DESIRED LENGTH ?
0.0
IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION DESIRED ?
NO
TURBULENT MANGLER FACTOR ?
.6667
LAMINAR MANGLER FACTOR ?
1.0
```

REYNOLDS-ANALOGY FACTOR

0. COLBURN
1. VON KARMAN

DESIRED FACTOR ?
1.
ANY CHANGES ?
NO

* * * WALL CONDITIONS * * *

WALL TEMPERATURE (DEG F) ?
0.0
WALL EMISSIVITY ?
0.8

* * * CONTINUATION OPTION * * *

DO YOU WANT TO PROVIDE AN INITIAL HEATING LOAD GT 0.0 (BTU/SQ.FT) ?
NO

DO YOU WANT TO USE A HEAT TRANSFER MULTIPLICATION METHOD ?
NO

IS CASE 3 TRANSITION DATA THE SAME FOR CASE 2 ?
YES

DO YOU WANT CROSS FLOW ADJUSTMENT OPTION ?
NO

IS CASE 3 FLOWFIELD DATA THE SAME AS FOR CASE 2 ?
NO

FLOWFIELD AND LOCAL PRESSURE OPTIONS

```
- - - - - - FLOWFIELD - - - - - -                    - - - - - - PRESSURE - - - - - -
-1. FLOWFIELD TYPE NOT NEEDED                        -1. PRESSURE TYPE NOT NEEDED
 1. SHARP WEDGE SHOCK ANGLE                           1. INPUT CP VS MACH NO. TABLE
 2. SHARP CONE SHOCK ANGLE                            2. TANGENT WEDGE PRESSURE
 3. OBLIQUE AND NORMAL SHOCK (90 DEG)                 3. TANGENT CONE PRESSURE
 4. PARALLEL SHOCK (PRES NOT NEEDED)                  4. OBLIQUE SURFACE PRESSURE
                                                      5. MODIFIED NEWTONIAN
                                                      6. PRANDTL-MEYER EXP. (FF NOT NEEDED)

 * * * * INPUT OPTIONS IN PAIRS WITH ASSOCIATED DELTA ANGLES * * * *
(NOTE: TO SIGNIFY END OF CASE USE -1.0 FOR BOTH FF AND PRESS. OPTIONS.)
FLOWFIELD,DEL ANGLE,PRESSURE,DEL ANGLE
1
2.0,0.0,2.0,0.0
2
-1.0,0.0,-1.0,0.0


                              TOTAL EFFECTIVE ANGLE
SET1
 FF        SHRP-CONE          ALPHA +    0.000
 P         TAN-WEDGE          ALPHA +    0.000

ANY CHANGES ?
NO
```

```
DO YOU WANT TO USE TIME DEPENDENT GEOMETRY ?
YES

IS CASE   3 TIME DEPENDENT GEOMETRY DATA THE SAME AS FOR CASE   2 ?
NO

           TIME DEPENDENT GEOMETRY

NUMBER OF TIME DEPENDENT ENTRIES ? (MAX=10)
4
TIME(SEC),RADII(FT),LENGTH(FT),SLOPE OR SWEEP(DEG)
1.0,0.0,.5692,0.0
2.0,0.0,.3152,0.0,
3.0,0.0,.2277,0.0
4.0,0.0,.2277,0.0
ANY CHANGES ?
NO
```

CONTROL FLAGS

```
YOU ARE COMPLETING INPUT FOR CASE   3

WHAT IS THE BODY POINT NUMBER FOR CASE   3 ?
300
SHOULD LANMIN CREATE AN OUTPUT FILE FOR CASE   3 ?
YES

          PRINT CONTROL OPTIONS
0.   DETAILED PRINTOUT
1.   DETAILED PLUS SUMMARY PRINTOUT
2.   SUMMARY PRINTOUT

NOTE: IF AN OUTPUT FILE IS TO BE CREATED EITHER
OPTION 1. OR 2. MUST BE SELECTED

OPTION SELECTED ?
1.0


          OUTPUT UNITS OPTIONS

0.   ENGLISH
1.   METRIC

OPTION SELECTED ?
0.


IS CASE   4 ALONG THE SAME STREAMLINE
AS CASE   3 ?
NO


          INPUT CONTROL FLAG

1.   NEW CASE FOLLOWS USING TITLE,TIMING AND TRAJ.
     DATA FROM PREVIOUS CASE
2.   END OF INPUT (LAST CASE)
3.   NEW CASE FOLLOWS USING TRAJ.DATA FROM PREVIOUS CASE.
     NEW TITLE AND TIMING. INITIAL CASE DATA UNCHANGED.
4.   NEW CASE FOLLOWS USING NEW TITLE,TIMING,TRAJ. AND CASE DATA.
     (INITIALLY ZERO W ARRAY)
5.   SAME AS (1) EXCEPT ZERO ALL CASE DATA FROM PREVIOUS CASE
6.   SAME AS (3) EXCEPT INITIALIZE ZERO ALL TIMING AND CASE DATA

OPTION SELECTED ?
2.0
```

```
***** INPUT COMPLETE FOR CASE   3  *****

DO YOU WANT TO MAKE ANY MODIFICATIONS TO CASE   3 ?
NO


********  OUTPUT FILE COMPLETE  ********
>
```

PREMIN OUTPUT FILE
WIND TUNNEL CASE

```
BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8-TUNNEL B
                  1.000                   1.000                   4.000
                  0.000                   0.000                   0.000
                  0.000                   1.000
                  4.000
                  1.000                   0.000                3816.000     20.000      0.000
                  2.000                   0.000                3821.000     29.860      0.000
                  3.000                   0.000                3821.000     39.980      0.000
                  4.000                   0.000                3859.000     39.980      0.000
 10    1.0000  11    4.0000
 130.2097000
 14    3.2000  15    1.0000
 160.6667000
 20    3.6000
 230.8000000
 27    1.0000  31   36.0000  32   15.0000  37    2.8000  38    2.8000
261    1.0000 262    2.0000 319    1.0000 451   94.7000 452   95.0000
453   95.0000 454   96.9000 501    8.0640 502    8.2080 503    8.2080
504   12.6720 560    4.0000 561    1.0000 562    2.0000 563    3.0000
564    4.0000
5810.2097000
5820.1239000
5830.0858000
5840.0858000
611  100.0000 642    1.0000 643    1.0000 647    1.0000 641    1.0000
 10    1.0000  11    4.0000
 130.3532000
 14    3.2000  15    1.0000
 160.6667000
 20    3.6000
 230.8000000
 27    1.0000  31   36.0000  32   15.0000
 370.3000000
 380.3000000
261    1.0000 262    2.0000 319    1.0000 451   94.7000 452   95.0000
453   95.0000 454   96.9000 501    8.0640 502    8.2080 503    8.2080
504   12.6720 560    4.0000 561    1.0000 562    2.0000 563    3.0000
564    4.0000
5810.3532000
5820.1943000
5830.1448000
5840.1448000
611  200.0000 642    1.0000 643    1.0000 647    2.0000 641    1.0000
```

```
 10    1.0000  11    4.0000
130.5254000
 14    3.2000  15    1.0000
160.6667000
 20    3.6000
230.8000000
 27    1.0000  31   36.0000  32   15.0000 261    1.0000 262    2.0000
319    1.0000 451   94.7000 452   95.0000 453   95.0000 454   96.9000
501    8.0640 502    8.2080 503    8.2080 504   12.6720 560    4.0000
561    1.0000 562    2.0000 563    3.0000 564    4.0000
5810.5692000
5820.3152000
5830.2277000
5840.2277000
611  300.0000 642    1.0000 643    1.0000 647    3.0000 641    2.0000
```

LANMIN OUTPUT
WIND TUNNEL CASE

BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8 TUNNEL B

TIMING

```
    T1         =   1.000 SEC.
    DT1        =   1.000 SEC.
    T2         =   4.000 SEC.
    DT2        =    .000 SEC.
    T3         =    .000 SEC.
    DT3        =    .000 SEC.
    T4         =    .000 SEC.
    DT CALC    =   1.000 SEC.
    DTEMP MAX  =    .000 SEC.
```

CONTROL PARAMETERS

```
    W(641)=1.000    W(642)=1.000
    W(643)=1.000    W(644)= .000
    W(645)= .000    W(646)= .000
    W(647)=1.000    W(648)= .000
    W(649)= .000    W(650)= .000
```

HEAT TRANSFER

```
    HT METHOD =    4.000
    RN        =     .000 FT.
    L         =     .210 FT.
    N SUB L   =    1.000
    N SUB T   =     .667
    PHI       =     .000 DEG.
    VIRT-L OPT=     .000
```

TIME DEPENDENT GEOMETRIC PARAMETERS

TIME	RN	L	PHI
1.00	.0000	.21	.00
2.00	.0000	.12	.00
3.00	.0000	.09	.00
4.00	.0000	.09	.00

MULTIPLICATION FACTORS

K SUB L 1 =	1.000	
K SUB T 1 =	1.000	

MATERIAL

EMISSIVITY= .800

FLOWFIELD

	FLAG	ANGLE
1	36.	2.80
2	15.	2.80

TRANSITION
OPTION

1	LAMINAR PRIOR TO	1.20 SEC.	
	TRANSITIONAL FROM	1.20 SEC. TO	1.60 SEC.
	TURBULENT AFTER	1.60 SEC.	

FREE STREAM PROPERTIES

TIME	VELOCITY	F.S.TEMP.	F.S.PRESS.
1.00	8816.	94.70	.80640+001
2.00	8821.	95.00	.82080+001
3.00	8821.	95.00	.83080+001
4.00	8859.	96.90	.12672+002

```
TIME  =    1.000  M INF=  7.999  P INF =  .806+001  T INF =   -365.00  H INF =     22.63  RHO I =  .496-004  MU INF =  .713-007
Z INF =       0.  M U  =  7.999  P U   =  .806+001  T U   =   -365.00  H U   =     22.63  RHO U =  .496-004  MU U   =  .713-007
V INF =    3816.  M E  =  3.771  P E   =  .146+003  T E   =   -121.08  H E   =     81.27  RHO E    .251-003  MU E   =  .262-006
A INF =     477.  L    =   .210  P T   =  .163+005  T T   =    843.90  H T   =    313.37  RHO T =  .727-002  MU T   =  .713-006
V E   =    3410.  RN   =   .000  ALPHA =    22.800  T *   =    119.37  H *   =    139.20  RHO * =  .147-003  MU *   =  .406-006
REINF =2.654+006  PR   =   .710  CF/2  =  .401-003  T R   =   -459.70  H R   =       .00  RHO R =  .000      MU R   =  .000
REL   =6.852+005  EMS*F =  .800  TAU W =  .133+001  T W   =       .00  H W   =    110.33  RHO W =  .185-003  MU W   =  .330-006
                                                                      PHI   =       .00  PARA1 =.32000+001  PARA2  =.36000+001
           1        2        3        4        5        6        7        8        9
FF FLAG   36.      15.       0.       0.       0.       0.       0.       0.       0.
ANGLE     22.80    22.80     .00      .00      .00      .00      .00      .00      .00

NC L =  .125-001  HRECOV L=   278.55  QC L =   .21+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L =  1.000  PARA =     .00
NC T =  .345-001  HRECOV T=   288.30  QC T =   .61+001  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T =  1.000  PCT T=     .000

N SUB C=  .1254-001 H RECOV=  278.55   Q CONV  =  .2110+001  Q RAD =  .1701-001  Q NET =  .2093+001
H IDEAL=  .1108+002 T RECOV=  685.78   QC TOTAL=  .0000      QR TOT=  .0000      QN TOT=  .0000     T RAD EQ=    552.32

                                       QC CW   =  .3494+001  QC CNT=  .0000

TIME  =    2.000  M INF=  7.997  P INF =  .821+001  T INF =   -364.70  H INF =     22.70  RHO I =  .503-004  MU INF =  .716-007
Z INF =       0.  M U  =  7.997  P U   =  .821+001  T U   =   -364.70  H U   =     22.70  RHO U =  .503-004  MU U   =  .716-007
V INF =    3821.  M E  =  2.647  P E   =  .272+003  T E   =     85.36  H E   =    130.96  RHO E =  .290-003  MU E   =  .387-006
A INF =     478.  L    =   .124  P T   =  .598+004  T T   =    819.97  H T   =    314.11  RHO T =  .272-002  MU T   =  .705-006
V E   =    3029.  RN   =   .000  ALPHA =    32.660  T *   =    184.90  H *   =    154.91  RHO * =  .245-003  MU *   =  .440-006
REINF =2.687+006  PR   =   .710  CF/2  =  .643-003  T R   =   -459.70  H R   =       .00  RHO R =  .000      MU R   =  .000
REL   =2.813+005  EMS*F =  .800  TAU W =  .195+001  T W   =       .00  H W   =    110.35  RHO W =  .344-003  MU W   =  .330-006
                                                                      PHI   =       .00  PARA1 =.32000+001  PARA2  =.36000+001
      .    1        2        3        4        5        6        7        8        9
FF FLAG   36.      15.       0.       0.       0.       0.       0.       0.       0.
ANGLE     32.66    32.66     .00      .00      .00      .00      .00      .00      .00

NC L =  .207-001  HRECOV L=   286.63  QC L =   .36+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L =  1.000  PARA =     .00
NC T =  .516-001  HRECOV T=   294.33  QC T =   .95+001  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T =  1.000  PCT T=     .000

N SUB C=  .2068-001 H RECOV=  286.63   Q CONV  =  .3645+001  Q RAD =  .1701-001  Q NET =  .3628+001
H IDEAL=  .1829+002 T RECOV=  717.67   QC TOTAL=  .2110+001  QR TOT=  .1701-001  QN TOT=  .2093+001  T RAD EQ=    613.39

                                       QC CW   =  .5927+001  QC CNT=  .3494+001
```

```
TIME  =     3.000  M INF=  7.997  P INF  =  .821+001  T INF  =   -364.70  H INF  =     22.70  RHO I =  .503-004  MU INF  =  .716-007
Z INF =        0.  M U  =  7.997  P U    =  .821+001  T U    =   -364.70  H U    =     22.70  RHO U =  .503-004  MU U    =  .716-007
V INF =     3821.  M E  =  1.828  P E    =  .427+003  T E    =    324.65  H E    =    189.33  RHO E =  .317-003  MU E    =  .500-006
A INF =      478.  L    =   .086  P T    =  .255+004  T T    =    823.72  H T    =    314.11  RHO T =  .116-002  MU T    =  .706-006
V E   =     2500.  RN   =   .000  ALPHA  =    42.780  T *    =    260.26  H *    =    173.18  RHO * =  .346-003  MU *    =  .477-006
REINF =2.687+006   PR   =   .710  CF/2   =  .958-003  T R    =   -459.70  H R    =       .00  RHO R =  .000      MU R    =  .000
REL   =1.341+005 EMS#F =   .800  TAU W  =  .217+001  T W    =       .00  H W    =    110.35  RHO W =  .541-003  MU W    =  .339-006
                                                                          PHI    =       .00  PARA1 =.32000+001  PARA2 =.36000+001
              1         2        3        4        5        6        7        8        9
FF FLAG     36.       15.       0.       0.       0.       0.       0.       0.       0.
ANGLE     42.78     42.78      .00      .00      .00      .00      .00      .00      .00

NC L =  .279-001  HRECOV L=   295.39  QC L =  .52+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L =  1.000  PARA =    .00
NC T =  .621-001  HRECOV T=   300.63  QC T =  .12+002  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T =  1.000  PCT T=   .000

N SUB C=  .2789-001 H RECOV=  295.39  Q CONV  =  .5160+001  Q RAD  =  .1701-001  Q NET  =  .5143+001
H IDEAL=  .2470+002 T RECOV=  752.17  QC TOTAL=  .5755+001  QR TOT=  .3401-001  QN TOT=  .5721+001  T RAD EQ=    659.44

                          QC CW   =  .8238+001  QC CWT=  .9421+001

TIME  =     4.000  M INF=  7.997  P INF  =  .127+002  T INF  =   -362.80  H INF  =     23.16  RHO I =  .762-004  MU INF  =  .733-007
Z INF =        0.  M U  =  7.997  P U    =  .127+002  T U    =   -362.80  H U    =     23.16  RHO U =  .762-004  MU U    =  .733-007
V INF =     3859.  M E  =  1.831  P E    =  .660+003  T E    =    339.18  H E    =    192.91  RHO E =  .481-003  MU E    =  .514-006
A INF =      483.  L    =   .086  P T    =  .398+004  T T    =    845.22  H T    =    320.38  RHO T =  .177-002  MU T    =  .713-006
V E   =     2527.  RN   =   .000  ALPHA  =    42.780  T *    =    274.57  H *    =    176.65  RHO * =  .523-003  MU *    =  .484-006
REINF =4.012+006   PR   =   .710  CF/2   =  .199-002  T R    =   -459.70  H R    =       .00  RHO R =  .000      MU R    =  .000
REL   =2.027+005 EMS#F =   .800  TAU W  =  .694+001  T W    =       .00  H W    =    110.35  RHO W =  .836-003  MU W    =  .181-006
                                                                          PHI    =       .00  PARA1 =.32000+001  PARA2 =.36000+001
              1         2        3        4        5        6        7        8        9
FF FLAG     36.       15.       0.       0.       0.       0.       0.       0.       0.
ANGLE     42.78     42.78      .00      .00      .00      .00      .00      .00      .00

NC L =  .348-001  HRECOV L=   301.26  QC L =  .66+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L =  1.000  PARA =    .00
NC T =  .884-001  HRECOV T=   306.62  QC T =  .17+002  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T =  1.000  PCT T=  1.000

N SUB C=  .8842-001 H RECOV=  306.62  Q CONV  =  .1735+002  Q RAD  =  .1701-001  Q NET  =  .1734+002
H IDEAL=  .7845+002 T RECOV=  796.35  QC TOTAL=  .1092+002  QR TOT=  .5102-001  QN TOT=  .1086+002  T RAD EQ=  [illegible].66

                          QC CW   =  .2711+002  QC CWT=  .1766+002
```

BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8 TUNNEL B   B.P. NO   100

TIME SEC	ALT KFT	VEL FT/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./FT	HEAT COEF LBM/SFT-S	REC ENTHALPY BTU/LBM	RAD EQUIL DEG F	HEAT RATE BTU/SFT-S	HEAT LOAD BTU/SFT	PRESSURE LB/SFT	FLOW [illegible]
1.0	.0	3816.0	8.00	20.00	.265+007	.175-001	.279+003	552.3	.211+001	.000	.146+003	LAM
2.0	.0	3821.0	8.00	29.86	.269+007	.207-001	.287+003	613.4	.365+001	.365+001	.272+003	LAM
3.0	.0	3821.0	8.00	39.98	.269+007	.279-001	.295+003	659.4	.516+001	.881+001	.427+003	LAM
4.0	.0	3859.0	8.00	39.98	.401+007	.884-001	.307+003	750.7	.174+002	.262+002	.660+003	TURB

ORIGINAL PAGE IS
OF POOR QUALITY

BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8 TUNNEL B

TIMING

T1	=	1.000 SEC.
DT1	=	1.000 SEC.
T2	=	4.000 SEC.
DT2	=	.000 SEC.
T3	=	.000 SEC.
DT3	=	.000 SEC.
T4	=	.000 SEC.
DT CALC	=	1.000 SEC.
DTEMP MAX	=	.000 SEC.

CONTROL PARAMETERS

W(641)=1.000	W(642)=1.000
W(643)=1.000	W(644)= .000
W(645)= .000	W(646)= .000
W(647)=2.000	W(648)= .000
W(649)= .000	W(650)= .000

HEAT TRANSFER

HT METHOD	=	4.000
RN	=	.000 FT.
L	=	.353 FT.
N SUB L	=	1.000
N SUB T	=	.667
PHI	=	.000 DEG.
VIRT-L OPT=		.000

TIME DEPENDENT GEOMETRIC PARAMETERS

TIME	RN	L	PHI
1.00	.0000	.35	.00
2.00	.0000	.19	.00
3.00	.0000	.14	.00
4.00	.0000	.14	.00

MULTIPLICATION FACTORS
K SUB L 1 = 1.000
K SUB T 1 = 1.000

MATERIAL
EMISSIVITY= .800

FLOWFIELD

	FLAG	ANGLE
1	36.	.00
2	15.	.00

TRANSITION
OPTION

1 LAMINAR PRIOR TO 3.20 SEC.
TRANSITIONAL FROM 3.20 SEC. TO 3.60 SEC.
TURBULENT AFTER 3.60 SEC.

FREE STREAM PROPERTIES

TIME	VELOCITY	F.S.TEMP.	F.S.PRESS.
1.00	3816.	94.70	.80640+001
2.00	3821.	95.00	.82080+001
3.00	3821.	95.00	.82080+001
4.00	3859.	96.90	.12672+002

ORIGINAL PAGE IS
OF POOR QUALITY

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TIME  =     1.000  M INF=  7.999  P INF =  .806+001  T INF =    -365.00  H INF =     22.63  RHO I =  .496-004  MU INF   =  .213-007
Z INF =        0.  M U  =  7.999  P U   =  .806+001  T U   =    -365.00  H U   =     22.63  RHO U =  .496-004  MU U     =  .213-007
V INF =     3816.  M E  =  4.115  P E   =  .123+003  T E   =    -163.00  H E   =     71.21  RHO E =  .243-003  MU E     =  .234-006
A INF =      477.  L    =   .353  P T   =  .217+005  T T   =     843.[illegible]  H T   =    313.37  RHO T =  .969-002  MU T     =  .113-006
V E   =     3483.  RN   =   .000  ALPHA =    20.300  T *   =     106.27  H *   =    136.05  RHO * =  .126-003  MU *     =  .399-006
REINF =2.654+006   PR   =   .710  CF/2  =  .294-003  T R   =    -459.70  H R   =       .00  RHO R =  .000      MU R     =  .000
REL   =1.268+006 EMS*F =   .800  TAU W =  .971+000  T W   =        .00  H W   =    110.33  RHO W =  .155-003  MU W     =  .330-006
                                                                          PHI   =       .00  PARA1 =.32000+001  PARA2 =.36000+001

              1        2        3        4        5        6        7        8        9
FF FLAG     36.      15.       0.       0.       0.       0.       0.       0.       0.
ANGLE     20.30    20.30      .00      .00      .00      .00      .00      .00      .00

NC L =  .[illegible]-002  HRECOV L=   277.04  QC L =  .15+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB [illegible] =  1.000  PARA   =  .00
NC T =  .284-001  HRECOV T=   287.[illegible]  QC T =  .50+001  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB [illegible] =  1.000  PCT T= .000

N SUB C=  .8772-002 H RECOV=   277.04   Q CONV  =  .1496+001   Q RAD =  .1701-001   Q NET =  .1479+001
H IDEAL=  .7921+001 T RECOV=   679.82   QC TOTAL=  .0000       QR TOT=  .0000       QN TOT=  .0000     T RAD EQ=   [illegible]18.56

                              QC CW   =  .2486+001   QC CWT=  .0000

TIME  =     2.000  M INF=  7.997  P INF =  .821+001  T INF =    -364.70  H INF =     22.70  RHO I =  .503-004  MU INF   =  .216-007
Z INF =        0.  M U  =  7.997  P U   =  .821+001  T U   =    -364.70  H U   =     22.70  RHO U =  .503-004  MU U     =  .216-007
V INF =     3821.  M E  =  2.912  P E   =  .235+003  T E   =      25.70  H E   =    116.56  RHO E =  .212-003  MU E     =  .251-006
A INF =      478.  L    =   .194  P T   =  .779+004  T T   =     819.90  H T   =    314.11  RHO T =  .355-002  MU T     =  .704-006
V E   =     3146.  RN   =   .000  ALPHA =    30.160  T *   =     166.30  H *   =    150.40  RHO * =  .[illegible]-003  MU *     =  .431-006
REINF =2.687+006   PR   =   .710  CF/2  =  .486-003  T R   =    -459.70  H R   =       .00  RHO R =  .000      MU R     =  .000
REL   =4.884+005 EMS*F =   .800  TAU W =  .154+001  T W   =        .00  H W   =    110.35  RHO W =  .258-003  MU W     =  .33[illegible]-006
                                                                          PHI   =       .00  PARA1 =.32000+001  PARA2 =.36000+001

              1        2        3        4        5        6        7        8        9
FF FLAG     36.      15.       0.       0.       0.       0.       0.       0.       0.
ANGLE     30.16    30.16      .00      .00      .00      .00      .00      .00      .00

NC L =  .157-001  HRECOV L=   284.47  QC L =  .27+001  K SUB L 2 =  1.000  K SUB L 3 =  [illegible]  K SUB [illegible]  PARA   =  .00
NC T =  .449-001  HRECOV T=   292.7[illegible]  QC T =  .32+001  K SUB T 2 =  1.000  K SUB T 3 =  [illegible]  K SUB [illegible]  PCT T= .000

N SUB C=  .1572-001 H RECOV=   284.47   Q CONV  =  .2738+001   Q RAD =  .1701-001   Q NET =  .2721+001
H IDEAL=  .[illegible]90+002 T RECOV=   709.15   QC TOTAL=  .1496+001   QR TOT=  .1701-001   QN TOT=  .1479+001   T RAD EQ=   [illegible]

                              QC CW   =  .2473+001   QC CWT=  .2486+001
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TIME  =    3.000  M INF=  7.997  P INF =  .821+001  T INF =   -364.70  H INF =    22.70  RHO I =  .503-004  MU INF =  .716-007
Z INF =      0.   M U  =  7.997  P U   =  .821+001  T U   =   -364.70  H U   =    22.70  RHO U =  .503-004  MU U   =  .716-007
V INF =   3821.   M E  =  2.013  P E   =  .383+003  T E   =    263.21  H E   =   174.23  RHO E =  .309-003  MU E   =  .479-006
A INF =    478.   L    =   .145  P T   =  .306+004  T T   =    822.23  H T   =   314.11  RHO T =  .139-002  MU T   =  .705-006
V E   =   2647.   RN   =   .000  ALPHA =    40.280  T *   =    240.77  H *   =   168.45  RHO * =  .319-003  MU *   =  .468-006
REINF =2.687+006  PR   =   .710  CF/2  =  .704-003  T R   =   -459.70  H R   =      .00  RHO R =  .000      MU R   =  .000
REL   =2.471+005  EMS*F =  .800  TAU W =  .173+001  T W   =       .00  H W   =   110.35  RHO W =  .485-003  MU W   =  .337-006
                                                                      PHI   =      .00  PARA1 =.320.. 001  PARA2  =.3600+001

            1        2        3        4        5        6        7        8        9
FF FLAG   36.      15.       0.       0.       0.       0.       0.       0.       0
ANGLE     40.28    40.28     .00      .00      .00      .00      .00      .00      .00

NC L =  .210-001  HRECOV L=   293.12  QC L =  .38+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L =  1.000  PARA =   .00
NC T =  .554-001  HRECOV T=   299.00  QC T =  .10+002  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T =  1.000  PCT T=  .000

N SUB C=  .2099-001 H RECOV=   293.12   Q CONV  =  .3836+001  Q RAD =  .1701-001  Q NET =  .3819+001
H IDEAL=  .1858+002 T RECOV=   743.25   QC TOTAL=  .4234+001  QR TOT=  .3401-001  QN TOT=  .4200+001  T RAD EQ=   433.12

                                        QC CW   =  .615? ?01  QC CWT=  .6959+001


TIME  =    4.000  M INF=  7.997  P INF =  .127+002  T INF =   -362.80  H INF =    23.16  RHO I =  .762-004  MU INF =  .733-007
Z INF =      0.   M U  =  7.997  P U   =  .127+002  T U   =   -362.80  H U   =    23.16  RHO U =  .762-004  MU U   =  .733-007
V INF =   3859.   M E  =  2.017  P E   =  .591+003  T E   =    276.71  H E   =   177.56  RHO E =  .468-003  MU E   =  .485-006
A INF =    483.   L    =   .145  P T   =  .478+004  T T   =    844.66  H T   =   320.36  RHO T =  .214-002  MU T   =  .713-006
V E   =   2675.   RN   =   .000  ALPHA =    40.280  T *   =    255.34  H *   =   171.98  RHO * =  .482-003  MU *   =  .475-006
REINF =4.012+006  PR   =   .710  CF/2  =  .174-002  T R   =   -459.70  H R   =      .00  RHO R =  .000      MU R   =  .000
REL   =3.735+005  EMS*F =  .800  TAU W =  .657+001  T W   =       .00  H W   =     0.00  RHO W =  .749-003  MU W   =  .338-006
                                                                      PHI   =      .00  PARA1 =.32000+001  PARA2  =.36000+001

            1        2        3        4        5        6        7        8        9
FF FLAG   36.      15.       0.       0.       0.       0.       0.       0.       0.
ANGLE     40.28    40.28     .00      .00      .00      .00      .00               .00

NC L =  .262-001  HRECOV L=   298.96  QC L =  .49+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L =  1.000  PARA =   .00
NC T =  .791-001  HRECOV T=   304.96  QC T =  .15+002  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T =  1.000  PCT T=  1.000

N SUB C=  .7910-001 H RECOV=   304.96   Q CONV  =  .1539+002  Q RAD =  .1701-001  Q NET =  .1538+002
H IDEAL=  .7016+002 T RECOV=   789.83   QC TOTAL=  .8070+001  QR TOT=  .5102-001  QN TOT=  .8019+001  T RAD EQ=   741.72

                                        QC CW   =  .2412+002  QC CWT=  .1311+002
```

BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8-TUNNEL B   B.P. NO.

TIME SEC	ALT KFT	VEL FT/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./FT	HEAT COEF LBM/SFT-S	REC ENTHALPY BTU/LBM	RAD EQUIL DEG F	HEAT RATE BTU/SFT-S	HEAT LOAD BTU/SFT	PRESSURE LB/SFT	FLOW TYPE
1.0	.0	3816.0	8.00	20.00	.265+007	.897-002	.277+003	518.6	.150+001	[illegible]	.170+003	LAM
2.0	.0	3821.0	8.00	29.86	.269+007	.157-001	.284+003	586.7	.274+001	.42[illegible]+001	.235+003	LAM
3.0	.0	3821.0	8.00	39.98	.269+007	.210-001	.293+003	637.1	.384+001	.807+001	.380+003	LAM
4.0	.0	3859.0	8.00	39.98	.401+007	.791-001	.305+003	741.2	.154+002	.235+002	.591+003	TURB

BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8-TUNNEL B

TIMING

T1	=	1.000 SEC.
DT1	=	1.000 SEC.
T2	=	4.000 SEC.
DT2	=	.000 SEC.
T3	=	.000 SEC.
DT3	=	.000 SEC.
T4	=	.000 SEC.
DT CALC	=	1.000 SEC.
DTEMP MAX	=	.000 SEC.

CONTROL PARAMETERS

W(641)=2.000	W(642)=1.000
W(643)=1.000	W(644)= .000
W(645)= .000	W(646)= .000
W(647)=3.000	W(648)= .000
W(649)= .000	W(650)= .000

HEAT TRANSFER

HT METHOD	=	4.000
RN	=	.000 FT.
L	=	.525 FT.
N SUB L	=	1.000
N SUB T	=	.667
PHI	=	.000 DEG.
VIRT-L OPT	=	.000

TIME DEPENDENT GEOMETRIC PARAMETERS

TIME	RN	L	PHI
1.00	.0000	.57	.00
2.00	.0000	.32	.00
3.00	.0000	.23	.00
4.00	.0000	.23	.00

MULTIPLICATION FACTORS

K SUB L 1 = 1.000

K SUB T 1 = 1.000

MATERIAL

EMISSIVITY= .800

FLOWFIELD

	FLAG	ANGLE
1	36.	.30
2	15.	.30

TRANSITION

OPTION

1	LAMINAR PRIOR TO	3.20 SEC.		
	TRANSITIONAL FROM	3.20 SEC.	TO	3.60 SEC.
	TURBULENT AFTER	3.60 SEC.		

FREE STREAM PROPERTIES

TIME	VELOCITY	F.S.TEMP.	F.S.PRESS.
1.00	3816.	94.70	.80640+001
2.00	3821.	95.00	.82080+001
3.00	3821.	95.00	.82080+001
4.00	3859.	96.90	.12672+002

```
TIME   =    1.000  M INF=  7.999  P INF  =  .806+001  T INF  =   -365.00  H INF  =     22.63  RHO I =  .496-004  MU INF  =  .713-007
Z INF  =       0.  M U   =  7.999  P U    =  .806+001  T U    =   -365.00  H U    =     22.63  RHO U =  .496-004  MU U    =  .713-007
V INF  =    3816.  M E   =  4.115  P E    =  .123+003  T E    =   -163.00  H E    =     71.21  RHO E =  .241-003  MU E    =  .234-006
A INF  =     477.  L     =   .569  P T    =  .217+005  T T    =    843.90  H T    =    313.37  RHO T =  .969-002  MU T    =  .713-006
V E    =    3483.  RN    =   .000  ALPHA  =    20.300  T *    =    106.27  H *    =    136.05  RHO * =  .126-003  MU *    =  .199-006
RE INF =2.654+006  PR    =   .710  CF/2   =  .231-003  T R    =   -459.70  H R    =       .00  RHO R =  .000      MU R    =  .000
REL    =2.044+006  EMS*F =   .800  TAU W  =  .765+000  T W    =       .00  H W    =    110.33  RHO W =  .155-003  MU W    =  .138-006
                                                                           PHI    =       .00  PARA1 =.32000+001   PARA2   = .36000+001
            1          2          3          4          5          6          7          8          9
FF FLAG    36.        15.         0.         0.         0.         0.         0.         0.         0.
ANGLE     20.30      20.30       .00        .00        .00        .00        .00        .00        .00

NC L =  .707-002  HRECOV L=   277.04  QC L =   .12+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L =  1.000  PARA =      .00
NC T =  .263-001  HRECOV T=   287.21  QC T =   .46+001  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T =  1.000  PCT T=     .000

N SUB C=  .7067-002 H RECOV=   277.04   Q CONV  =  .1178+001  Q RAD  =  .1701-001  Q NET  =  .1161+001
H IDEAL=  .6239+001 T RECOV=   679.82   QC TOTAL=  .0000      QR TOT=  .0000      QN TOT=  .0000      RAD EQ=    495.5

                                        QC CW   =  .1958+001  QC CWT=  .0000


TIME   =    2.000  M INF=  7.997  P INF  =  .821+001  T INF  =   -364.70  H INF  =     22.70  RHO I =  .500-004  MU INF  =  .716-007
Z INF  =       0.  M U   =  7.997  P U    =  .821+001  T U    =   -364.70  H U    =     22.70  RHO U =  .500-004  MU U    =  .716-007
V INF  =    3821.  M E   =  2.912  P E    =  .235+003  T E    =     25.70  H E    =    116.56  RHO E =  .282-003  MU E    =  .353-006
A INF  =     478.  L     =   .315  P T    =  .779+004  T T    =    819.90  H T    =    314.11  RHO T =  .355-002  MU T    =  .704-006
V E    =    3146.  RN    =   .000  ALPHA  =    30.160  T *    =    166.30  H *    =    150.40  RHO * =  .219-002  MU *    =  .431-006
RE INF =2.687+006  PR    =   .710  CF/2   =  .383-003  T R    =   -459.70  H R    =       .00  RHO R =  .000      MU R    =  .000
REL    =7.922+005  EMS*F =   .800  TAU W  =  .121+001  T W    =       .00  H W    =    110.35  RHO W =  .298-003  MU W    =  .138-006
                                                                           PHI    =       .00  PARA1 =.32000+001   PARA2   = .36000+001
            1          2          3          4          5          6          7          8          9
FF FLAG    36.        15.         0.         0.         0.         0.         0.         0.         0.
ANGLE     30.16      30.16       .00        .00        .00        .00        .00        .00        .00

NC L =  .123-001  HRECOV L=   284.47  QC L =   .21+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L =  1.000  PARA =      .00
NC T =  .413-001  HRECOV T=   292.77  QC T =   .75+001  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T =  1.000  PCT T=     .000

N SUB C=  .1235-001 H RECOV=   284.47   Q CONV  =  .2150+001  Q RAD  =  .1701-001  Q NET  =  .2133+001
H IDEAL=  .1091+002 T RECOV=   709.15   QC TOTAL=  .1178+001  QR TOT=  .1701-001  QN TOT=  .1161+001  RAD EQ=    566.87

                                        QC CW   =  .3512+001  QC CWT=  .1958+001
```

```
TIME   =    3.000  M INF=  7.997  P INF  =  .3821+001  T INF  =   364.70  H INF  =    22.70  RHO I  =  [illegible]  MU INF =  [illegible]
Z INF  =       0.  M U   = 7.997  P U    =  .3821+001  T U    =   364.70  H U    =    22.70  RHO U  =  [illegible]  MU U   =  [illegible]
V INF  =    3821.  M E   = 2.017  P E    =  .1830+003  T E    =   263.21  H E    =   174.23  RHO E  =  [illegible]  MU E   =  [illegible]
A INF  =     478.  L     =  .228  P T    =  .306+004   T T    =   822.23  H T    =   314.11  RHO T  =  [illegible]  MU T   =  [illegible]
V E    =    2647   RN    =  .000  ALPHA  =    40.280   T *    =   240.77  H *    =   168.45  RHO *  =  [illegible]  MU *   =  [illegible]
RE INF =-2.687+006 PR    =  .710  CF/2   =  .364-003   T R    =   459.70  H R    =      .00  RHO R  =  [illegible]  MU R   =  [illegible]
REL    =3.886+005  EMSWF =  .800  TAU W  =  .130+001   T W    =      .00  H W    =   110.35  RHO W  =  [illegible]  MU W   =  [illegible]
                                                                          PHI    =      .00  PARA1  =.32000+001  PARA2  =  [illegible]000+001
           1         2         3         4         5         6         7         8         9
FT FLAG   36.       15.        0.        0.        0.        0.        0.        0.        0.
ANGLE     40.28     40.28      .00       .00       .00       .00       .00       .00       .00

NC L  =  .167-001  HRECOV L=   293.12  QC L  =  .31+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L [illegible]  PARA [illegible]  .00
NC T  =  .512-001  HRECOV T=   299.00  QC T  =  .97+001  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T [illegible]  PCT T=  .000

N SUB C=  .1674-001 H RECOV=   293.12   Q CONV  =  .3059+001  Q RAD  =  .1701-001  Q NET  =  [illegible]
H IDEAL=  .1482+002 T RECOV=   743.25   QC TOTAL=  .3328+001  QR TOT=  .3401-001  QN TOT=  .3294+001  [illegible]

                                        QC CW   =  .4906+001  QC CWT=  .5470+001

TIME   =    4.000  M INF=  7.997  P INF  =  .127+002   T INF  =   362.80  H INF  =    23.16  RHO I  =  [illegible]  MU INF =  [illegible]
Z INF  =       0.  M U   = 7.997  P U    =  .127+002   T U    =   362.80  H U    =    23.16  RHO U  =  [illegible]  MU U   =  [illegible]
V INF  =    3859.  M E   = 2.017  P E    =  .591+003   T E    =   276.71  H E    =   177.56  RHO E  =  [illegible]  MU E   =  [illegible]
A INF  =     483.  L     =  .728  P T    =  .478+004   T T    =   844.66  H T    =   320.38  RHO T  =  [illegible]  MU T   =  [illegible]
V E    =    2675.  RN    =  .000  ALPHA  =    40.280   T *    =   255.34  H *    =   171.98  RHO *  =  [illegible]  MU *   =  [illegible]
RE INF =4.012+006  PR    =  .710  CF/2   =  .162-002   T R    =   459.70  H R    =      .00  RHO R  =  [illegible]  MU R   =  [illegible]
REL    =5.873+005  EMSWF =  .800  TAU W  =  .609+001   T W    =      .00  H W    =   110.35  RHO W  =  [illegible]  MU W   =  [illegible]
                                                                          PHI    =      .00  PARA1  =.32000+001  PARA2  =  [illegible]
           1         2         3         4         5         6         7         8         9
FT FLAG   36.       15.        0.        0.        0.        0.        0.        0.        0.
ANGLE     40.28     40.28      .00       .00       .00       .00       .00       .00       .00

NC L  =  .209-001  HRECOV L=   298.96  QC L  =  .39+001  K SUB L 2 =  1.000  K SUB L 3 =  1.000  K SUB L [illegible]  PARA [illegible]  .00
NC T  =  .733-001  HRECOV T=   304.96  QC T  =  .14+002  K SUB T 2 =  1.000  K SUB T 3 =  1.000  K SUB T [illegible]  PCT [illegible]  .000

N SUB C=  .7334-001 H RECOV=   304.96   Q CONV  =  .1427+002  Q RAD  =  .1701-001  Q NET  =  .1425+002
H IDEAL=  .6505+002 T RECOV=   799.83   QC TOTAL=  .2387+001  QR TOT=  .5102-001  QN TOT=  .6336+001  [illegible]

                                        QC CW   =  [illegible]+002  QC CWT=  .1038+002
```

ORIGINAL PAGE IS
OF POOR QUALITY

BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8 TUNNEL B [illegible]

TIME	ALT	VEL	MACH	ANGLE	REYNOLDS	HEAT COEF	REC ENTHALPY	RAD EQUIL	HEAT RATE	HEAT LOAD	PRESSURE	[illegible]
SEC	KFT	FT/SEC	NO	ATTACK	NO./FT	LBM/SFT-S	BTU/LBM	DEG F	BTU/SFT-S	BTU/SFT	[illegible]	[illegible]
1.0	.0	3816.0	8.00	20.00	.265+007	.767-002	.2[illegible]+003	495.1	.118+001	.119+001	[illegible]	[illegible]
2.0	.0	[illegible]1.0	8.00	29.86	.269+007	.123-001	.284+003	566.4	.215+001	.333+001	[illegible]	[illegible]
3.0	.0	[illegible]21.0	8.00	39.98	.269+007	.167-001	.2[illegible]+003	615.4	.306+001	.639+001	[illegible]	[illegible]
4.0	.0	3859.0	8.00	39.98	.401+007	.[illegible]-001	.[illegible]+003	738.5	.143+002	.2[illegible]+002	[illegible]	[illegible]

APPENDIX C

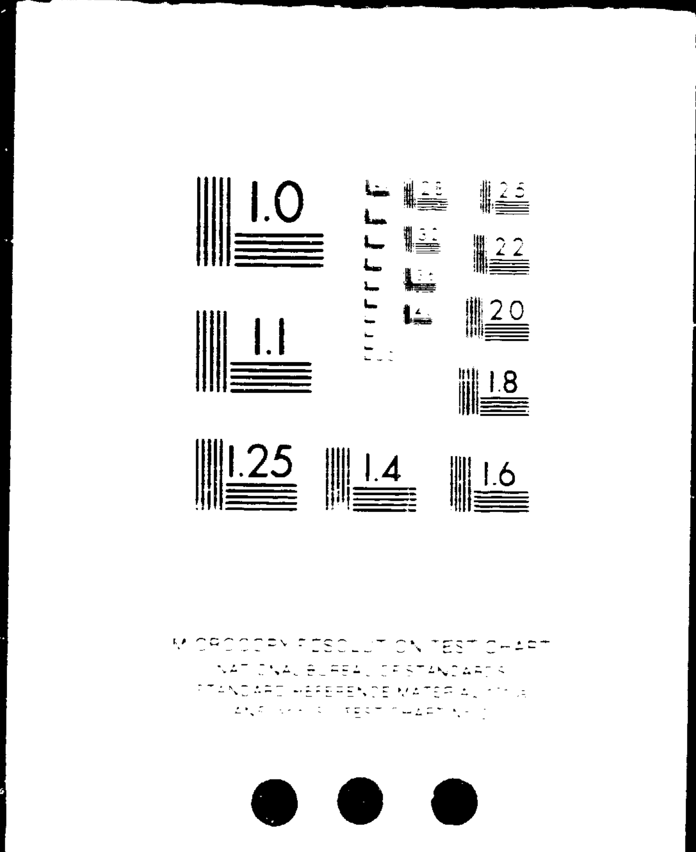
PREMIN CODE LISTING

```
C                   PREMIN CODE
C        LANGLEY MINIVER PREPROCESSOR CODE
C             REMTECH, INC.  1983
C
C
C                                  BY:
C                                     C. ENGEL
C                                     C. SCHMITZ
C
C                                  PH. 205-536-8581
C
      PROGRAM MAIN
C
C
      COMMON/WARRAY/W(700)
      COMMON/WWARAY/WW(700)
      COMMON/WWWARY/WWW(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/TITLE/TITL1
      COMMON/PCOEFF/TMCP(50),TCPM(50),NCPMT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
      COMMON/INP/NI,ND,INSERT,NCPMTS,TMCPS(50),TCPMS(50),JFLAG,IADD
C
      CHARACTER*20 FNAM6
      CHARACTER*72 TITL1
      INTEGER ANS,TFLAG,ANS1,FLAG
C  IIN  - INTERACTIVE INPUT  UNIT NUMBER
C  IOUT - INTERACTIVE OUTPUT UNIT NUMBER
      IIN=1
      IOUT=1
C
C  MFLAG  = 0  ENGLISH UNITS
C  MFLAG  = 1  METRIC  UNITS
C  FLAG   = 1  CREATE NEW OUTPUT FILE
C  FLAG   = 1  MODIFY AN EXISTING OUTPUT FILE
C  JFLAG  = 1  DELETED LAST CASE
C  INSERT = 1  CURRENT CASE AN INSERTION CASE
C  TFLAG  = 1  TITLE EXISTS FOR CURRENT CASE
C  FNAM6  -  NAME OF INPUT FILE TO BE MODIFIED
C  JFKS   -  PROGRAM INPUT CONTROL PARAMETER FOR PREVIOUS CASE
C  NC     -  CASE NUMBER
C  ND     -  NUMBER OF CASES DELETED
C  NI     -  NUMBER OF CASES INSERTED
C  TITL1  -  TITLE FOR A SET OF CASES
C  NCPMT  -  NUMBER OF ENTRIES IN PRESSURE COEFFICIENT TABLE
C  NCPMTS -  SAVED VALUE OF NCPMT
C  TMCP   -  MACH NUMBERS
C  TMCPS  -  SAVED VALUES OF TMCP ARRAY
C  TCPM   -  CP ARRAY
C  TCPMS  -  SAVED VALUES OF TCPM ARRAY
C  W      -  WORKING ARRAY OF W VALUE TO BE MODIFIED
C  WW     -  W ARRAY MODIFIED TO DESIRED UNITS FOR OUTPUT
C              (INPUT ARRAY FOR LANMIN)
      INSERT=0
      NC=0
```

```
      NI=0
      ND=0
      MFLAG=1
      JFKS=0
      W(641)=0.J
      WRITE(IOUT,30)
 30   FORMAT(1H1,'INTERACTIVE INPUT TO LARC MINIVER - LANMIN')
C  CREATE OR MODIFY OUTPUT FILE
 35   WRITE(IOUT,36)
 36   FORMAT(///,10X,'OUTPUT FILE METHOD'//,
     $ 1X,'1.   CREATE A NEW OUTPUT FILE',/,
     $ 1X,'2.   MODIFY AN EXISTING OUTPUT FILE',//,
     $ 1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=35,END=9999)FLAG
      IF(FLAG.EQ.1)GO TO 20
C  NAME FILE FOR MODIFICATION
 10   WRITE(IOUT,12)
 12   FORMAT(//,1X,'WHAT IS THE NAME OF THE INPUT FILE ?')
      READ(IIN,13,ERR=10,END=9999)FNAM6
 13   FORMAT(A20)
      OPEN(UNIT=9,FILE=FNAM5,STATUS='OLD',ERR=8888)
      IF(MFLAG.EQ.1)WRITE(IOUT,25)
 25   FORMAT(/,1X,'INPUT FILE IS IN ENGLISH UNITS.',/,1X,
     $ 'ALL CHANGES MUST BE IN ENGLISH UNITS.',/)
      MFLAG=0
 33   IF(IADD.EQ.1)GO TO 37
      IF(FLAG.EQ.2)CALL INPUT(1)
      IF(INSERT.EQ.1)GO TO 37
      IF(JFLAG.EQ.1)GO TO 3
 34   IF(FLAG.EQ.2)GO TO 200
C  CHOOSE UNITS TO BE USED
 20   WRITE(IOUT,21)
 21   FORMAT(1X,'DO YOU WANT TO INPUT DATA IN ENGLISH OR ',
     $ 'METRIC ?')
      READ(IIN,45,ERR=20,END=9999)ANS
      MFLAG=0
      IF(ANS.EQ.1HM)MFLAG=1
 37   CONTINUE
      NC=NC+1
      W(647)=NC
C  INPUT DATA FOR CASE
 3    WRITE(IOUT,38)NC
 38   FORMAT(/,1X,'INTERACTIVE INPUT FOR CASE ',I3)
      IF(JFKS.GT.0)GO TO (2,9900,1,1,2,1)JFKS
 1    CALL TIMING
      IF(JFKS.EQ.3.OR.JFKS.EQ.6)GO TO 2
      CALL TRAJ
 2    CALL ATMS
      IF(W(10).EQ.1.)CALL WNDTUN
      IF(W(10).EQ.2.)CALL ATMDTA
 39   WRITE(IOUT,40)
 40   FORMAT(1H1,'DO YOU WANT TO RUN A HEATING INDICATOR ?')
      READ(IIN,45,ERR=39,END=9999)ANS1
 45   FORMAT(A1)
      IF(ANS1.EQ.1HN)GO TO 50
```

2 OF 2

N84-10780 UNCLAS



```
      CALL HEATIN
      GO TO 9000
 50   CALL HTRMTD
 54   WRITE(IOUT,55)
 55   FORMAT(1H1,'DO YOU WANT TO USE A HEAT TRANSFER ',
     $ 'MULTIPLICATION METHOD ?')
      READ(IIN,45,ERR=54,END=9999)ANS
      IF(ANS.EQ.1HY)CALL HTMULT
      CALL TRANS
 69   WRITE(IOUT,70)
 70   FORMAT(1H1,'DO YOU WANT CROSS FLOW ADJUSTMENT OPTION ?')
      READ(IIN,45,ERR=69,END=9999)ANS
      IF(ANS.EQ.1HY)CALL CROSS
      CALL FLOW(1)
 89   WRITE(IOUT,90)
 90   FORMAT(1H1,'DO YOU WANT TO USE TIME DEPENDENT GEOMETRY ?')
      READ(IIN,45,ERR=89,END=9999)ANS
      IF(ANS.EQ.1HY)CALL TDGEOM
 9000 CONTINUE
      CALL CONTRL
 200  CONTINUE
      WRITE(IOUT,100)NC
 100  FORMAT(//,1X,'    ***** INPUT COMPLETE FOR CASE ',I3,'  *****')
 210  WRITE(IOUT,220)NC
 220  FORMAT(/,1X,'DO YOU WANT TO MAKE ANY MODIFICATIONS TO ',
     $ 'CASE ',I3,' ?')
      READ(IIN,45,ERR=210,END=9999)ANS
      IF(ANS.EQ.1HY)CALL MODIFY
      IF(ANS.EQ.1HY)GO TO 200
      CALL UNITS
      CALL OUTPUT
      IF(W(641).EQ.2.)GO TO 9900
C  ZERO W ARRAY ACCORDING TO PROGRAM INPUT CONTROL PARAMETER
C     OF LAST CASE
      CALL INPUT(2)
      IF(INSERT.EQ.1)GO TO 33
      IF(JFLAG.EQ.1)FLAG=1
      IF(FLAG.EQ.2)GO TO 33
      GO TO 37
 9900 WRITE(IOUT,110)
 110  FORMAT(//,1X,'*********  OUTPUT FILE COMPLETE  *********')
      CALL EXIT
 8888 CONTINUE
      WRITE(IOUT,8889)FNAM6
 8889 FORMAT(/,1X,'CANNOT OPEN FILE ',A20,/)
      GO TO 10
 9999 CONTINUE
      CALL EXIT
      END
```

C-2

```
      SUBROUTINE INPUT(IB)
C
C  THIS ROUTINE HAS 2 FUNCT.ONS
C    IB = 1  ROUTINE READS IN W ARRAY DATA FROM OLD RUN FILE
C    IB = 2  ZEROS OUT W ARRAY ACCORDING TO PROGRAM INPUT CONTROL
C              PARAMETER OF LAST CASE
C  JFK  -  PROGRAM INPUT CONTROL PARAMETER
C  JFCP -  PRESSURE COEFFICIENT INPUT OPTION
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/PCOEFF/TMCP(50),TCPM(50),NCPMT
      COMMON/TITLE/TITL1
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
      COMMON/INP/NI,ND,INSERT,NCPMTS,TMCPS(50),TCPMS(50),JFLAG,IADD
C
      CHARACTER*72 TITL1
      INTEGER ANS,TFLAG,ANS1
      DIMENSION L(5),X(5)
C
C  CHECK FOR IB = 2
      IF(IB.EQ.2)GO TO 5
C  CHECK IF LAST CASE WAS AN INSERTED CASE
      IF(INSERT.EQ.1)GO TO 400
      NC1=NC+1
    2 WRITE(IOUT,3)NC1
    3 FORMAT(1X,'DO YOU WISH TO INSERT A CASE BEFORE CASE ',
     $ I3,' ?')
      READ(IIN,4,ERR=2,END=9999)ANSS
      IF(ANSS.EQ.1HY)GO TO 300
    4 FORMAT(A1)
 5    CONTINUE
      JFK=W(641)+.0001
      IF(IB.EQ.1)JFK=JFKS
      JFKS=W(641)+.0001
      IF(JFK.EQ.1.AND.IB.EQ.1)GO TO 160
      IF(JFK.EQ.3)GO TO 130
      IF(JFK.EQ.4)GO TO 100
      IF(JFK.EQ.5)GO TO 120
      IF(JFK.EQ.6)GO TO 110
      IF(IB.EQ.2)GO TO 130
C ------------------------------------------ ZERO W ARRAY ------
 100  CONTINUE
      DO 1000 J=1,700
 1000 W(J)=0.0
C -------------------- ZERO TIMING PARAMETERS AND PRINT CONTROL
 110  DO 1100 J=1,8
 1100 W(J)=0.0
C ------------------------------------------ ZERO CASE DATA ----
 120  DO 1200 J=9,49
 1200 W(J)=0.0
      DO 1300 J=201,210
 1300 W(J)=0.0
      DO 1400 J=261,650
 1400 W(J)=0.0
      IF(JFK.EQ.5.AND.IB.EQ.1)GO TO 160
```

```
      IF(JFK.EQ.6)GO TO 130
      IF(IB.EQ.2)GO TO 130
      JFK=0
 130  CONTINUE
      IF(IB.EQ.2)W(641)=FLOAT(JFK)
      IF(IB.EQ.2)RETURN
      TFLAG=1
C ---------------------------------------------- TITLE ---------
      READ(9,135)TITL1
 135  FORMAT(A72)
C ---------------------------- TIMING PARAMETER AND PRINT CONTROL
      READ(9,140)(W(J),J=1,8)
 140  FORMAT(3F20.6)
      IF(JFK.EQ.3.OR.JFK.EQ.6)GO TO 160
C -------------- NUMBER OF TIME DEPENDENT TABLE ENTRIES FOR TRAJ.
 150  READ(9,155)W(50)
 155  FORMAT(3F20.6,2F10.6)
      N=W(50)+.0001
      NT=50+N
C ---------------------------------------------- TRAJ DATA -----
      READ(9,155)(W(K),W(K+50),W(K+100),W(K+160),W(K+600),K=51,NT)
 160  W(641)=0.0
C ---------------------------------------------- CASE DATA -----
 170  READ(9,175)(L(J),X(J),J=1,5)
      DO 171 J=1,5
 171  IF(L(J).GT.0)W(L(J))=X(J)
 175  FORMAT(5(I3,F10.6))
      IF(W(641))170,170,180
 180  CONTINUE
      IF(W(641).NE.2.0)GO TO 185
C ------------------------------------------- APPENDING CASES -
 181  WRITE(IOUT,182)
 182  FORMAT(/,1X,'DO YOU WANT TO ADD ADDITIONAL CASES AFTER THE ',
     $ 'CURRENT END CASE ?')
      READ(IIN,4,ERR=181,END=9999)ANS
      IF(ANS.EQ.1HY)IADD=1
 185  CONTINUE
      W(647)=W(647)-FLOAT(ND)+FLOAT(NI)
      JFK=W(641)+.0001
      NC=W(647)+.0001
      JFCP=W(649)+.0001
      IF(JFCP.LE.0)GO TO 210
      READ(9,190)NCPMT
 190  FORMAT(I3)
      READ(9,200)(TMCP(J),TCPM(J),J=1,NCPMT)
 200  FORMAT(2F10.6)
 210  CONTINUE
      IF(W(641).EQ.2.)CLOSE(UNIT=9,STATUS='KEEP')
C ------------------------------------- DELETED CASES ----
 220  WRITE(IOUT,230)NC
 230  FORMAT(1X,'DO YOU WISH TO DELETE CASE ',I3,' ?')
      READ(IIN,4,ERR=220,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 290
      IF(W(641).EQ.2.)JFLAG=1
      IF(JFLAG.EQ.1)GO TO 290
```

```
 240  WRITE(IOUT,250)NC,NC+1,NC
 250  FORMAT(1X,'CASE ',I3,' DELETED. CASE ',I3,' REDEFINED ',
     $ 'AS CASE ',I3)
      ND=ND+1
      IF(NC.NE.1)GO TO 5
      IF(JFK.EQ.4)GO TO 5
 260  WRITE(IOUT,270)
 270  FORMAT(1X,'SINCE YOU WISHED TO DELETE CASE 1 DO YOU ALSO ',
     $ 'WANT TO DELETE THE ',/,1X,'TITLE,TIMING,AND TRAJ. THAT ',
     $ 'CORRESPONDS TO CASE 1 ?')
      READ(IIN,4,ERR=260,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 5
      GO TO 160
 290  CONTINUE
      RETURN
C ---------------------------------------- INSERTED CASES -----
 300  CONTINUE
      ANSS='N'
      INSERT=1
      W(641)=FLOAT(JFKS)
      GO TO 290
C ---------------------------------------- LAST CASE INSERTED -
 400  CONTINUE
      INSERT=0
      NI=NI+1
      NC=NC+1
      W(647)=FLOAT(NC)
 430  WRITE(IOUT,3)NC
      READ(IIN,4,ERR=430,END=9999)ANSS
      IF(ANSS.EQ.1HY)GO TO 300
      GO TO 5
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE ATMDTA
C
C  ROUTINE FOR INPUTING ATMOSPHERE DATA FOR ATMOSPHERE
C    OPTION 2
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER ANS,TFLAG,ANS1
C   MAY USE DATA FROM PREVIOUS CASE IF JFKS =1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
    1 WRITE(IOUT,2)NC,NCM1
    2 FORMAT(1H1,'IS CASE ',I3,' ATMS. DATA SAME AS ',
     $ 'FOR CASE ',I3,' ?')
      READ(IIN,100,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
    9 CONTINUE
   10 WRITE(IOUT,20)
   20 FORMAT(///,'        INPUT ATMOSPHERIC DATA',//,
     $ 1X,'FREESTREAM STATIC TEMPERATURE AND PRESSURE AS A ',
     $ 'FUNCTION OF ALTITUDE',/,1X,10(' -'),' 50 MAXIMUM '
     $ 'VALUES',10(' -'))
   30 WRITE(IOUT,40)
   40 FORMAT(1X,'HOW MANY ALTITUDE VALUES WILL BE INPUT ?')
      READ(IIN,*,ERR=30,END=9999)W(400)
C  NALT = NUMBER OF ALTITUDE ENTRIES
      NALT=W(400)+.001
      IF(MFLAG.EQ.0)WRITE(IOUT,50)
      IF(MFLAG.EQ.1)WRITE(IOUT,51)
   50 FORMAT(1X,'ALTITUDE(FT),T-INF(R),P-INF(LB/SFT)')
   51 FORMAT(1X,'ALTITUDE(M),T-INF(K),P-INF(NEWTON/SQ.M)')
      DO 1000 I=1,NALT
   60 WRITE(IOUT,70)I
   70 FORMAT(1X,I2)
      READ(IIN,*,ERR=60,END=9999)W(400+I),W(450+I),W(500+I)
 1000 CONTINUE
   80 WRITE(IOUT,90)
   90 FORMAT(/,1X,'ARE ALL INPUTS CORRECT ?')
      READ(IIN,100,ERR=80,END=9999)ANS
  100 FORMAT(A1)
      IF(ANS.EQ.1HN)GO TO 10
      RETURN
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE ATMS
C
C  ROUTINE THAT CHOOSES ATMOSPHERE OPTION TO BE USED
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      CHARACTER*40 CHAR(5)
      INTEGER ANS,TFLAG,ANS1
C  TITLES FOR ATMOSPHERE OPTIONS
      DATA CHAR/'1962 U.S. STANDARD ATMOSPHERE',
     $ 'WIND TUNNEL OPTION',
     $ 'INPUT ATMOSPHERIC DATA(ALT,T-INF,P-INF)',
     $ '1963 PATRICK AIR FORCE BASE ATMOSPHERE',
     $ '1971 VANDENBERG REFERENCE ATMOSPHERE'/
C  USE ATMS. DATA FROM PREVIOUS CASE IF JFKS = 1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
    1 WRITE(IOUT,2)NC,NCM1
    2 FORMAT(1H1,'IS CASE ',I3,' ATMOSPHERE DATA SAME AS ',
     $ 'FOR CASE ',I3,' ?')
      READ(IIN,60,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
    9 CONTINUE
   10 WRITE(IOUT,20)(I,CHAR(I),I=1,5)
   20 FORMAT(///,5X,'ATMOSPHERE DATA',//,1X,'OPTIONS   ',
     $ I1,'.  ',A40,/,4(11X,I1,'.  ',A40,/),
     $ /,1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=10,END=9999)W(10)
      J=IFIX(W(10))
      WRITE(IOUT,30)CHAR(J)
   30 FORMAT(/,1X,A40)
   40 WRITE(IOUT,50)
   50 FORMAT(/,1X,'IS THIS OPTION CORRECT ?')
      READ(IIN,60,ERR=40,END=9999)ANS
   60 FORMAT(A1)
      IF(ANS.EQ.1HN)GO TO 10
      IF(W(10).LT.4.)W(10)=W(10)-1.
      RETURN
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE CONTRL
C
C  ROUTINE FOR SETTING CONTROL FLAGS
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
      COMMON/STRM/ISTRM,NNC
C
      INTEGER ANS,TFLAG,ANS1
C
      ISTRM=0
      NC=W(647)
 10   WRITE(IOUT,20)
 20   FORMAT(1H1,10X,'CONTROL FLAGS',//)
 30   CONTINUE
 50   WRITE(IOUT,60)NC
 60   FORMAT(1X,'YOU ARE COMPLETING INPUT FOR CASE ',I3)
 65   FORMAT(A1)
 70   WRITE(IOUT,80)NC
 80   FORMAT(/,1X,'WHAT IS THE BODY POINT NUMBER FOR CASE ',
     $ I3,' ?')
      READ(IIN,*,ERR=70,END=9999)W(611)
 90   WRITE(IOUT,100)NC
 100  FORMAT(1X,'SHOULD LANMIN CREATE AN OUTPUT FILE FOR CASE '
     $ ,I3,' ?')
      READ(IIN,65,ERR=90,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 110
      W(643)=0.0
      GO TO 120
 110  W(643)=1.0
C  CHECK FOR HEATING INDICATOR OPTION
 120  IF(ANS1.EQ.1HY)GO TO 140    /* HEATING INDICATOR W(642)=2.0
C ------------------------------------- PRINT OPTION --------
      WRITE(IOUT,130)
 130  FORMAT(/,10X,'PRINT CONTROL OPTIONS',/,
     $ 1X,'0.   DETAILED PRINTOUT',/,
     $ 1X,'1.   DETAILED PLUS SUMMARY PRINTOUT',/,
     $ 1X,'2.   SUMMARY PRINTOUT',//,
     $ 1X,'NOTE: IF AN OUTPUT FILE IS TO BE CREATED EITHER ',/,
     $ 1X,'OPTION 1. OR 2. MUST BE SELECTED',//,
     $ 1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=120,END=9999)W(642)
C ----------------------------------- OUTPUT UNITS OPTION ---
 140  WRITE(IOUT,150)
 150  FORMAT(//,10X,'OUTPUT UNITS OPTIONS',//,
     $ 1X,'0.   ENGLISH',/,
     $ 1X,'1.   METRIC',//,
     $ 1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=140,END=9999)W(648)
C --------------------------------------- STREAMLINE OPTION --
 160  WRITE(IOUT,170)NC+1,NC
 170  FORMAT(//,1X,'IS CASE ',I3,' ALONG THE ',
     $ 'SAME STREAMLINE',/,1X,'AS CASE ',I3,' ?')
      READ(IIN,65,ERR=160,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 200
```

```
C ---------------------- PROGRAM INPUT CONTROL PARAMETERS -----
 180  WRITE(IOUT,190)
 190  FORMAT(//,10X,'INPUT CONTROL FLAG',//,
     $ 1X,'1.    NEW CASE FOLLOWS USING TITLE,TIMING AND TRAJ. ',
     $ /,6X,'DATA FROM PREVIOUS CASE',/,
     $ 1X,'2.    END OF INPUT (LAST CASE)',/,
     $ 1X,'3.    NEW CASE FOLLOWS USING TRAJ.DATA FROM PREVIOUS ',
     $ 'CASE.',/,6X,'NEW TITLE AND TIMING. INITIAL CASE DATA ',
     $ 'UNCHANGED.',/,
     $ 1X,'4.    NEW CASE FOLLOWS USING NEW TITLE,TIMING,TRAJ. ',
     $ 'AND CASE DATA.',/,6X,'(INITIALLY ZERO W ARRAY)',/,
     $ 1X,'5.    SAME AS (1) EXCEPT ZERO ALL CASE DATA FROM ',
     $ 'PREVIOUS CASE',/,
     $ 1X,'6.    SAME AS (3) EXCEPT INITIALIZE ZERO ALL TIMING ',
     $ 'AND CASE DATA',//,
     $ 1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=180,END=9999)W(641)
      GO TO 300
C ----------------------------------- STREAMLINE CASES -------
 200  CONTINUE
      W(641)=1.0
      CALL STREAM
 300  CONTINUE
      RETURN
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE CROSS
C
C  ROUTINE TO CHOOSE CROSS FLOW OPTIONS
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER ANS,TFLAG,ANS1
C  MAY USE CROSS FLOW DATA FROM PREVIOUS CASE IF JFKS = 1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
  1   WRITE(IOUT,2)NC,NCM1
  2   FORMAT(///,' IS CASE ',I3,' CROSS FLOW DATA THE SAME AS ',
     $ 'FOR CASE ',I3,' ?')
      READ(IIN,160,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
  9   CONTINUE
 10   WRITE(IOUT,20)
 20   FORMAT(///,1X,10X,'CROSS FLOW ADJUSTMENTS',//,
     $ 10X,'1.   CONSTANT WIDTH RECTANGLE(IDEAL GAS)',/,
     $ 10X,'2.   CONSTANT WIDTH RECTANGLE(REAL GAS)',/,
     $ 10X,'3.   SHARP EDGE DELTA WING(IDEAL GAS)',/,
     $ 10X,'4.   SHARP EDGE DELTA WING(REAL GAS)',//,
     $ 1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=10,END=9999)W(201)
      IT=IFIX(W(201))
      GO TO (100,200,300,400)IT
      GO TO 500
C ------------------------------ CROSS FLOW OPTION 1 -------
 100  IF(MFLAG.EQ.0)WRITE(IOUT,110)
      IF(MFLAG.EQ.1)WRITE(IOUT,111)
 110  FORMAT(//,1X,'1.    CONSTANT WIDTH RECTANGLE(IDEAL GAS)',
     $ //,1X,'RECTANGLE WIDTH(FT) ?')
 111  FORMAT(//,1X,'1.    CONSTANT WIDTH RECTANGLE(IDEAL GAS)',
     $ //,1X,'RECTANGLE WIDTH(M) ?')
      READ(IIN,*,ERR=100,END=9999)W(202)
 120  IF(MFLAG.EQ.0)WRITE(IOUT,130)
      IF(MFLAG.EQ.1)WRITE(IOUT,131)
 130  FORMAT(1X,'EDGE RADIUS(FT) ?')
 131  FORMAT(1X,'EDGE RADIUS(M) ?')
      READ(IIN,*,ERR=120,END=9999)W(205)
 140  WRITE(IOUT,150)
 150  FORMAT(1X,'ANY CHANGES ?')
      READ(IIN,160,ERR=140,END=9999)ANS
 160  FORMAT(A1)
      IF(ANS.EQ.1HY)GO TO 100
      GO TO 600
C ------------------------------ CROSS FLOW OPTION 2 -------
 200  IF(MFLAG.EQ.0)WRITE(IOUT,210)
      IF(MFLAG.EQ.1)WRITE(IOUT,211)
 210  FORMAT(//,1X,'2.    CONSTANT WIDTH RECTANGLE(REAL GAS)',
     $ //,1X,'RECTANGLE WIDTH(FT) ?')
 211  FORMAT(//,1X,'2.    CONSTANT WIDTH RECTANGLE(REAL GAS)',
     $ //,1X,'RECTANGLE WIDTH(M) ?')
      READ(IIN,*,ERR=200,END=9999)W(202)
```

```
220   IF(MFLAG.EQ.0)WRITE(IOUT,130)
      IF(MFLAG.EQ.1)WRITE(IOUT,131)
      READ(IIN,*,ERR=220,END=9999)W(205)
230   WRITE(IOUT,240)
240   FORMAT(1X,'REAL GAS VELOCITY GRADIENT (0.31 FLAT ',
     $ 'SURFACE,1.0 SWEPT CYLINDER) ?')
      READ(IIN,*,ERR=230,END=9999)W(204)
250   WRITE(IOUT,150)
      READ(IIN,160,ERR=230,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 200
      GO TO 600
C ------------------------------ CROSS FLOW OPTION 3 -------
300   WRITE(IOUT,310)
310   FORMAT(//,1X,'3.    SHARP EDGE DELTA WING(IDEAL GAS)',
     $ //,1X,'DELTA WING SWEEP ANGLE(DEG) ?')
      READ(IIN,*,ERR=300,END=9999)W(203)
320   WRITE(IOUT,150)
      READ(IIN,160,ERR=320,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 300
      GO TO 600
C ------------------------------ CROSS FLOW OPTION 4 -------
400   WRITE(IOUT,410)
410   FORMAT(//,1X,'4.    SHARP EDGE DELTA WING(REAL GAS)',
     $ //,1X,'DELTA WING SWEEP ANGLE(DEG) ?')
      READ(IIN,*,ERR=400,END=9999)W(203)
420   WRITE(IOUT,430)
430   FORMAT(1X,'REAL GAS VELOCITY GRADIENT(SHARP EDGE ',
     $ 'DELTA WING = 0.31, POINTED CONE = 1.0) ?')
      READ(IIN,*,ERR=420,END=9999)W(204)
440   WRITE(IOUT,150)
      READ(IIN,160,ERR=440,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 400
      GO TO 600
C ------------------------------------- BAD OPTION --------
500   CONTINUE
      WRITE(IOUT,510)
510   FORMAT(//,1X,'BAD OPTION',/)
      GO TO 10
600   CONTINUE
610   WRITE(IOUT,620)
620   FORMAT(/,1X,'IS THE OPTION CORRECT ?')
      READ(IIN,160,ERR=610,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 10
      RETURN
9999  CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE FLOW(ID)
C
C  ROUTINE TO SET FLOWFIELD AND LOCAL PRESSURE OPTIONS
C    ID = 1  CREATING NEW FLOWFIELD DATA
C    ID = 2  MODIFYING OLD FLOWFIELD DATA
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/PCOEFF/TMCP(50),TCPM(50),NCPMT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
C   FF(N)   -  FLOWFIELD OPTION
C   FFA(N)  -  ANGLE CORRESPONDING TO FF(N)
C   P(N)    -  LOCAL PRESSURE OPTION
C   PA(N)   -  ANGLE CORRESPONDING TO P(N)
C   FNAM5   -  NAME FOR PRESSURE COEFFICIENT INPUT TABLE FILE
      DIMENSION FF(9),FFA(9),P(9),PA(9)
      INTEGER ANS,TFLAG,ANS1
      CHARACTER*10 CHARF(4),CHARP(6)
      CHARACTER*20 FNAM5
C
      DATA CHARF/'SHRP-WEDGE',
     $           'SHRP-CONE ',
     $           'OBLIQ/NORM',
     $           'PARALLEL  '/
      DATA CHARP/'CP-VS-MACH',
     $           'TAN-WEDGE ',
     $           'TAN-CONE  ',
     $           'OBLIQ-SURF',
     $           'MOD-NEWT. ',
     $           'PRANDT-MEY'/
C  MAY USE FLOWFIELD DATA FROM PREVIOUS CASE IF JFKS = 1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
    1 WRITE(IOUT,2)NC,NCM1
    2 FORMAT(1H1,'IS CASE ',I3,' FLOWFIELD DATA THE SAME AS ',
     $ 'FOR CASE ',I3' ?')
      READ(IIN,20,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
    9 CONTINUE
      W(261)=1.0
      W(262)=2.0
      W(263)=0.0
      W(264)=0.0
      W(265)=0.0
      W(266)=0.0
      W(267)=0.0
      W(268)=0.0
      W(269)=0.0
      DO 5 I=1,9
      FF(I)=-1.0
      P(I)=-1.0
      FFA(I)=0.0
      PA(I)=0.0
    5 CONTINUE
C
```

```
 10   WRITE(IOUT,15)
 15   FORMAT(///,10X,' FLOWFIELD AND LOCAL PRESSURE OPTIONS',//)
 20   FORMAT(A1)
      IF(ID.EQ.1)GO TO 1000
C ---------------------------------------------------------------
C   CONVERT W ARRAY TO FLOWFIELD/PRESSURE TABLE
 100  CONTINUE
      I=1
      J=31
      K=37
 110  CONTINUE
      IF(W(J).EQ.0.0.OR.I.GT.9)GO TO 500
      IF(W(J).LT.30.)GO TO 200
      IF(W(J).GT.37.)GO TO 120
      FF(I)=W(J)-34.
      FFA(I)=W(K)
      GO TO 130
 120  FF(I)=W(J)-35.
      FFA(I)=W(K)
 130  J=J+1
      K=K+1
      IF(J.EQ.37)J=46
      IF(FF(I).EQ.4.)GO TO 300
 200  IF(W(J).EQ.29.)GO TO 220
      P(I)=W(J)-13.
      PA(I)=W(K)
      GO TO 230
 220  P(I)=6.
      PA(I)=W(K)
 230  J=J+1
      K=K+1
      IF(J.EQ.37)J=46
 300  I=I+1
      GO TO 110
C ---------------------------------------------------------------
C   ECHO FLOWFIELD/PRESSURE DATA
 500  CONTINUE
      I=1
      WRITE(IOUT,505)
 505  FORMAT(///,1X,25X,'TOTAL EFFECTIVE ANGLE ')
 510  WRITE(IOUT,515)I
 515  FORMAT(1X,'SET',I1)
      IF(FF(I).GT.0.0)WRITE(IOUT,520)CHARF(FF(I)),(FFA(J),J=1,I)
 520  FORMAT(2X,'FF',6X,A10,5X,'ALPHA + ',9(F7.3:,' + '))
      IF(P(I).GT.0.0)WRITE(IOUT,525)CHARP(P(I)),(PA(J),J=1,I)
 525  FORMAT(2X,'P',7X,A10,5X,'ALPHA + ',9(F7.3:,' + '))
      I=I+1
      IF(FF(I).EQ.-1.0.AND.P(I).EQ.-1.0)GO TO 600
      GO TO 510
 600  WRITE(IOUT,610)
 610  FORMAT(//,1X,'ANY CHANGES ?')
      READ(IIN,20,ERR=600,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 1000
      GO TO 2000
C ---------------------------------------------------------------
```

```
C     INPUT FLOWFIELD/PRESSURE DATA
 1000 CONTINUE
 1010 WRITE(IOUT,1015)
 1015 FORMAT(///,1X,6(' -'),' FLOWFIELD',6(' -'),3X,6(' -'),
     $ ' PRESSURE',6(' -'),/,1X,'-1. FLOWFIELD TYPE NOT NEEDED',
     $ 8X,'-1. PRESSURE TYPE NOT NEEDED',/,2X,'1. SHARP WEDGE ',
     $ 'SHOCK ANGLE',11X,'1. INPUT CP VS MACH NO. TABLE',/,2X,
     $ '2. SHARP CONE SHOCK ANGLE',12X,'2. TANGENT WEDGE PRESSURE',
     $ /,2X,'3. OBLIQUE AND NORMAL SHOCK (90 DEG)',1X,
     $ '3. TANGENT CONE PRESSURE',/,2X,'4. PARALLEL SHOCK (PRES ',
     $ 'NOT NEEDED)',2X,'4. OBLIQUE SURFACE PRESSURE',/,39X,
     $ '5. MODIFIED NEWTONIAN',/,39X,'6. PRANDTL-MEYER EXP. ',
     $ '(FF NOT NEEDED)',//,1X,4(' *'),' INPUT OPTIONS IN PAIRS ',
     $ 'WITH ASSOCIATED DELTA ANGLES',4(' *'),/,1X,'(NOTE: TO ',
     $ 'SIGNIFY END OF CASE USE -1.0 FOR BOTH FF AND PRESS. ',
     $ 'OPTIONS.)',/,1X,'FLOWFIELD,DEL ANGLE,PRESSURE,DEL ANGLE')
      DO 1020 I=1,9
 1030 WRITE(IOUT,1035)I
 1035 FORMAT(1X,I1)
      READ(IIN,*,ERR=1030,END=9999)FF(I),FFA(I),P(I),PA(I)
      IF(FF(I).EQ.-1..AND.P(I).EQ.-1.)GO TO 500
 1020 CONTINUE
C -----------------------------------------------------------------
C     CONVERT FLOWLIELD/PRESSURE TABLE TO W ARRAY
 2000 CONTINUE
      DO 2001 I=1,9
      IF(FF(I).GT.2.0)FF(I)=FF(I)+35.0
      IF(FF(I).GE.1.0.AND.FF(I).LE.2.0)FF(I)=FF(I)+34.0
      IF(P(I).EQ.6.0)P(I)=29.0
 2001 IF(P(I).GE.1.0.AND.P(I).LE.5.0)P(I)=P(I)+13.0
      I=1
      J=31
      JP1=J+1
      K=37
      KP1=K+1
 2100 IF(FF(I).EQ.-1..AND.P(I).EQ.-1.)GO TO 3000
      IF(P(I).EQ.-1.)GO TO 2300
      IF(FF(I).EQ.-1.)GO TO 2200
      W(J)=FF(I)
      W(K)=FFA(I)
      W(JP1)=P(I)
      W(KP1)=PA(I)
      J=J+2
      K=K+2
 2150 I=I+1
      JP1=J+1
      KP1=K+1
      IF(J.EQ.37)J=46
      IF(J.EQ.38)J=47
      IF(JP1.EQ.37)J=46
      IF(JP1.EQ.38)J=47
      GO TO 2100
 2200 W(J)=P(I)
      W(K)=PA(I)
      J=J+1
```

```
      K=K+1
      GO TO 2150
 2300 W(J)=FF(I)
      W(K)=FFA(I)
      J=J+1
      K=K+1
      GO TO 2150
C ------------------------------------------------------------------
C     CHECK FOR PRESSURE TYPE 1
 3000 CONTINUE
      DO 3001 L=1,9
 3001 IF(P(L).EQ.14.0)GO TO 3100
      GO TO 5000
 3100 CONTINUE
      WRITE(IOUT,3110)
 3110 FORMAT(1H1,10X,'INPUT PRESSURE COEFICIENT VS. MACH NO. ',
     $ 'TABLE')
      W(649)=1.0
 3120 WRITE(IOUT,3125)
 3125 FORMAT(1X,'IS THERE AN INPUT FILE AVAILABLE ?')
      READ(IIN,20,ERR=3120,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 4000
C ------------------------------------------------------------------
C     INPUT MACH TABLE VIA FILE
 3130 WRITE(IOUT,3135)NC
 3135 FORMAT(1X,'WHAT IS THE FILE NAME FOR CASE ',I3,' ?')
      READ(IIN,3140,ERR=3130,END=9999)FNAM5
 3140 FORMAT(A20)
      OPEN(UNIT=8,FILE=FNAM5,STATUS='OLD',ERR=8888)
      READ(8,3160)NCPMT
 3160 FORMAT(I3)
      WRITE(IOUT,3165)NCPMT
 3165 FORMAT(//,1X,I3,' MACH NUMBERS')
      WRITE(IOUT,3166)
 3166 FORMAT(//,5X,'M-INF',T21,'CP',/)
      DO 3333 I=1,NCPMT
      READ(8,3170)TMCP(I),TCPM(I)
 3170 FORMAT(2F10.6)
      WRITE(IOUT,3175)TMCP(I),TCPM(I)
 3175 FORMAT(1X,2F10.6)
 3333 CONTINUE
      CLOSE(UNIT=8,STATUS='KEEP')
 3180 WRITE(IOUT,3185)
 3185 FORMAT(/,1X,'IS THIS THE DATA YOU WANT ?')
      READ(IIN,20,ERR=3180,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 5000
      CLOSE(UNIT=8,STATUS='KEEP')
      GO TO 3120
C ------------------------------------------------------------------
C     INPUT MACH TABLE VIA TERMINAL
 4000 WRITE(IOUT,4010)
 4010 FORMAT(1H1,'* * * INPUT VIA TERMINAL * * *',//,1X,
     $ 'HOW MANY MACH NO.S WILL BE INPUT ? (MAXIMUM OF 50)')
      READ(IIN,*,ERR=4000,END=9999)NCPMT
      WRITE(IOUT,4015)
```

```
4015 FORMAT(1X,'M-INF,CP')
     DO 4444 I=1,NCPMT
4020 WRITE(IOUT,4025)I
4025 FORMAT(1X,I2)
     READ(IIN,*,ERR=4020,END=9999)TMCP(I),TCPM(I)
4444 CONTINUE
4030 WRITE(IOUT,4035)
4035 FORMAT(/,1X,'ARE THERE ANY CHANGES TO THE INPUT ?')
     READ(IIN,20,ERR=4030,END=9999)ANS
     IF(ANS.EQ.1HY)GO TO 4000
5000 CONTINUE                       /*    EXIT SUBROUTINE
     RETURN
8888 WRITE(IOUT,8889)
8889 FORMAT(/,1X,'UNABLE TO OPEN FILE.')
     GO TO 3120
9999 CONTINUE
     CALL EXIT
     END
```

```
      SUBROUTINE HEATIN
C
C  ROUTINE FOR SETTING W ARRAY VALUES FOR A HEATING
C     INDICATOR CASE
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/TITLE/TITL1
C
      CHARACTER*72 TITL1
      INTEGER ANS
C
 10   WRITE(IOUT,20)
 20   FORMAT(///,1X,'      HEATING INDICATOR',//)
 30   FORMAT(A1)
      WRITE(IOUT,40)
 40   FORMAT(1X,'      FAY AND RIDDELL',/,
     $         1X,'  RADIUS    = 1 FT SPHERE',/,
     $         1X,'  WALL TEMP = 0 DEG. F',/,
     $         1X,'  LEWIS NO. = 1.0',/,
     $         1X,'  SUMMARY PRINT ONLY',/)
      W(12)=1.0          /* RADIUS
      W(11)=1.0          /* FAY _RIDDELL
      W(24)=0.0          /* WALL TEMPERATURE (F)
      W(31)=38.0         /* OBLIQUE SHOCK
      W(37)=90.0         /* SHOCK ANGLE
      W(32)=18.0         /* MODIFIED NEWTONIAN PRESSURE
      W(38)=90.0         /* BODY ANGLE
      W(642)=2.0         /* SUMMARY PRINT ONLY
      W(644)=0.0
      W(646)=0.0
      W(315)=1.0         /* LEWIS NO. = 1.0
      RETURN
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE HTMULT
C
C  ROUTINE TO SET HEAT TRANSFER MULTIPLICATION FACTORS
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER ANS,TFLAG,ANS1
C  MAY USE MULTIPLIER DATA FROM PREVIOUS CASE IF JFKS = 1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
  1   WRITE(IOUT,2)NC,NCM1
  2   FORMAT(///,1X,'IS CASE ',I3,' MULTIPLICATION FACTOR DATA ',
     $ 'THE ~AME AS FOR CASE ',I3,' ?')
      READ(IIN,30,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
  9   CONTINUE
 10   WRITE(IOUT,20)
 20   FORMAT(///,1X,10X,'HEAT TRANSFER MULTIPLICATION FACTORS',
     $ //,1X,'OPTION TYPES',/,10X,
     $ '1.   CONSTANT VALUE',/,10X,
     $ '2.   MULTIPLIER A FUNCTION OF TIME',/,10X,
     $ '3.   MULTIPLIER A FUNCTION OF FREESTREAM MACH NO.',
     $ //,1X,'NOTE: MULTIPLIERS ARE MULTIPLIED(I.E. ',
     $ 'AMPLIFICATION = TYPE1*TYPE2*TYPE3)',//)
 30   FORMAT(A1)
C ------------------------------ MULTIPLIER TYPE 1 ----------
 100  WRITE(IOUT,110)
 110  FORMAT(//,1X,'1.   CONSTANT VALUE',//,1X,
     $ 'DO YOU WANT THIS TYPE ?')
      READ(IIN,30,ERR=100,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 200
 120  WRITE(IOUT,130)
 130  FORMAT(1X,'ENTER LAMINAR,TURBULENT VALUES')
      READ(IIN,*,ERR=120,END=9999)W(18),W(19)
 140  WRITE(IOUT,150)
 150  FORMAT(1X,'ANY CHANGES ?')
      READ(IIN,30,ERR=140,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 100
C ------------------------------ MULTIPLIER TYPE 2 ----------
 200  WRITE(IOUT,210)
 210  FORMAT(//,1X,'2.   MULTIPLIER A FUNCTION OF TIME',
     $ //,1X,'DO YOU WANT THIS TYPE ?')
      READ(IIN,30,ERR=200,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 300
 220  WRITE(IOUT,230)
 230  FORMAT(1X,'NUMBER OF TIMES (10 MAXIMUM) ?')
      READ(IIN,*,ERR=220,END=9999)W(320)
 240  WRITE(IOUT,250)
 250  FORMAT(1X,'TIME,LAM MULTIPLIER,TURB MULTIPLIER')
      IT=W(320)+.0001
      DO 1000 I=1,IT
 260  WRITE(IOUT,265)I
 265  FORMAT(I2)
      READ(IIN,*,ERR=260,END=9999)W(320+I),W(330+I),W(340+I)
```

```
1000 CONTINUE
 270  WRITE(IOUT,150)
      READ(IIN,30,ERR=270,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 200
C ---------------------------------- MULTIPLIER TYPE 3 --------
 300  WRITE(IOUT,305)
 305  FORMAT(//,1X,'3.   MULTIPLIER A FUNCTION OF FREESTREAM',
     $ ' MACH NO.',/,5X,'LINEAR INTERPOLATION IN LOG(M-INF)',
     $ ' VS LOG(MULTIPLIER) SPACE',//,1X,'DO YOU WANT THIS',
     $ ' TYPE ?')
      READ(IIN,30,ERR=300,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 400
 310  WRITE(IOUT,315)
 315  FORMAT(1X,33HNUMBER OF MACH  'S (10 MAXIMUM) ?)
      READ(IIN,*,ERR=310,END=9999)W(360)
      WRITE(IOUT,320)
 320  FORMAT(1X,'M-INF,LAM MULT,TURB MULT')
      ITT=W(360)+.0001
      DO 2000 I=1,ITT
 330  WRITE(IOUT,265)I
      READ(IIN,*,ERR=330,END=9999)W(360+I),W(370+I),W(380+I)
C  TEST FOR VALUE LESS THAN OR EQUAL TO 0.0
      IF(W(360+I).LE.0.0)GO TO 333
      IF(W(370+I).LE.0.0)GO TO 333
      IF(W(380+I).LE.0.0)GO TO 333
      GO TO 2000
 333  WRITE(IOUT,335)
 335  FORMAT(1X,'VALUE CANNOT BE LESS THAN OR EQUAL TO 0.0',/)
      WRITE(IOUT,320)
      GO TO 330
 2000 CONTINUE
 340  WRITE(IOUT,150)
      READ(IIN,30,ERR=340,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 300
C  CHECK NUMBER OF TABLE ENTRIES (MIN=2)
      IF(ITT.LT.2.0)GO TO 500
      DO 3000 I=1,ITT
C  CONVERT TO LOG VALUE
      W(360+I)=ALOG10(W(360+I))
      W(370+I)=ALOG10(W(370+I))
      W(380+I)=ALOG10(W(380+I))
 3000 CONTINUE
 400  CONTINUE
      RETURN
 500  WRITE(IOUT,510)
 510  FORMAT(1X,'MINIMUM NUMBER MACH NO. = 2')
      GO TO 310
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE HTRMTD
C
C  ROUTINE FOR SELECTING HEAT TRANSFER METHOD
C
C  XLEWNO - LEWIS NUMBER
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      CHARACTER*50 CHAR(11)
      INTEGER ANS,TFLAG,ANS1
C  TITLES FOR HEAT TRANSFER OPTIONS
      DATA CHAR/'HEMISPHERE STAGNATION POINT',
     $ 'CATO/JOHNSON SWEPT CYLINDER',
     $ 'ECKERT REF. ENTHALPY FLAT PLATE METHOD',
     $ 'ECKERT/SPAULDING-CHI FLAT PLATE METHOD',
     $ 'BOEING RHO-MU FLAT PLATE METHOD',
     $ 'BECKWITH/GALLAGHER SWEPT CYLINDER METHOD',
     $ 'BOEING RHO-MU SWEPT CYLINDER METHOD',
     $ 'LEES/DETRA-HIDALGO HEMISPHERE DISTRIBUTION',
     $ 'LEESIDE ORBITER HEATING',
     $ 'FLAP REATTACHMENT HEATING',
     $ 'FIN-PLATE PEAK INTERFERENCE HEATING'/
C  MAY USE DATA FROM PREVIOUS CASE IF JFKS = 1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
    1 WRITE(IOUT,2)NC,NCM1
    2 FORMAT(1H1,'IS CASE ',I3,' HEAT TRANSFER DATA SAME AS ',
     $ 'FOR CASE ',I3,' ?')
      READ(IIN,70,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
    9 CONTINUE
   10 WRITE(IOUT,20)(I,CHAR(I),I=1,11)
   20 FORMAT(///,'      HEAT TRANSFER METHOD',//,1X,'OPTIONS',
     $ 3X,I2,'.  ',A50,/,10(11X,I2,'.  ',A50,/))
C ---------------------- CHOOSE A HEAT TRANSFER METHOD ---------
   30 WRITE(IOUT,40)
   40 FORMAT(1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=30,END=9999)W(11)
   50 WRITE(IOUT,60)
   60 FORMAT(1X,'SHOULD RAREFIED FLOW HEATING BE INCLUDED ?')
      READ(IIN,70,ERR=50,END=9999)ANS
   70 FORMAT(A1)
      W(646)=0.0
      IF(ANS.EQ.1HY)W(646)=1.0
   80 WRITE(IOUT,90)
   90 FORMAT(1X,'IS THE HEAT TRANSFER OPTION CORRECT ?')
      READ(IIN,70,ERR=80,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 10
      GO TO (100,200,300,400,500,600,700,800,900,1000,1100),W(11)
      GO TO 1200
C ---------------------------- HEAT TRANSFER METHOD 1 -----------
  100 IF(MFLAG.EQ.0)WRITE(IOUT,110)CHAR(1)
      IF(MFLAG.EQ.1)WRITE(IOUT,111)CHAR(1)
  110 FORMAT(1H1,'1.    ',A50,//,1X,'BODY RADIUS (FT) ?')
```

```
111   FORMAT(1H1,'1.    ',A50,//,1X,'BODY RADIUS (M) ?')
      READ(IIN,*,ERR=100,END=9999)W(12)
120   WRITE(IOUT,130)
130   FORMAT(1X,'LEWIS NO. = 1.0 OR 1.4 ?')
      READ(IIN,*,ERR=120,END=9999)XLEWNO
      IF(XLEWNO.EQ.1.0)W(315)=1.0
      IF(XLEWNO.EQ.1.4)W(315)=0.0
      IF(W(646).EQ.1.0)WRITE(IOUT,140)
140   FORMAT(/,1X,'NOTE: RAREFIED FLOW OPTION HAS BEEN SELECTED.')
160   WRITE(IOUT,170)
170   FORMAT(1X,'ANY CHANGES ?')
      READ(IIN,70,ERR=160,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 100
      GO TO 1300
C ----------------------------- HEAT TRANSFER METHOD 2 -----------
200   IF(MFLAG.EQ.0)WRITE(IOUT,210)CHAR(2)
      IF(MFLAG.EQ.1)WRITE(IOUT,211)CHAR(2)
210   FORMAT(1H1,'2.    ',A50,//,1X,'BODY RADIUS (FT) ?')
211   FORMAT(1H1,'2.    ',A50,//,1X,'BODY RADIUS (M) ?')
      READ(IIN,*,ERR=200,END=9999)W(12)
220   WRITE(IOUT,230)
230   FORMAT(1X,'SWEEP ANGLE ?')
      READ(IIN,*,ERR=220,END=9999)W(17)
240   WRITE(IOUT,130)
      READ(IIN,*,ERR=240,END=9999)XLEWNO
      IF(XLEWNO.EQ.1.0)W(315)=1.0
      IF(XLEWNO.EQ.1.4)W(315)=0.0
260   WRITE(IOUT,170)
      READ(IIN,70,ERR=260,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 200
      GO TO 1300
C ----------------------------- HEAT TRANSFER METHOD 3 -----------
300   IF(MFLAG.EQ.0)WRITE(IOUT,310)CHAR(3)
      IF(MFLAG.EQ.1)WRITE(IOUT,311)CHAR(3)
310   FORMAT(1H1,'3.    ',A50,//,1X,'RUNNING LENGTH (FT) ?')
311   FORMAT(1H1,'3.    ',A50,//,1X,'RUNNING LENGTH (M) ?')
      READ(IIN,*,ERR=300,END=9999)W(13)
320   WRITE(IOUT,330)
330   FORMAT(1X,'TURBULENT MANGLER FACTOR ?')
      READ(IIN,*,ERR=320,END=9999)W(16)
340   WRITE(IOUT,350)
350   FORMAT(1X,'LAMINAR MANGLER FACTOR ?')
      READ(IIN,*,ERR=340,END=9999)W(15)
360   WRITE(IOUT,370)
370   FORMAT(1X,'SURFACE DISTANCE TO START OF TURBULENT B.L.',
     $ /,1X,'THIS DISTANCE IS SUBTRACTED FROM THE RUNNING ',
     $ 'LENGTH',/,1X,'FOR TURBULENT HEATING CALCULATIONS.',/,1X,
     $ 'DESIRED LENGTH ?')
      READ(IIN,*,ERR=360,END=9999)W(354)
375   WRITE(IOUT,376)
376   FORMAT(1X,'IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION ',
     $ 'DESIRED ?')
      READ(IIN,70,ERR=375,END=9999)ANS
      IF(ANS.EQ.1HN)W(29)=0.0
      IF(ANS.EQ.1HY)W(29)=1.0
```

```
 380  WRITE(IOUT,170)
      READ(IIN,70,ERR=380,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 300
      GO TO 1300
C ---------------------------- HEAT TRANSFER METHOD 4 -----------
 400  IF(MFLAG.EQ.0)WRITE(IOUT,405)CHAR(4)
      IF(MFLAG.EQ.1)WRITE(IOUT,406)CHAR(4)
 405  FORMAT(1H1,'4.   ',A50,//,1X,'RUNNING LENGTH (FT) ?')
 406  FORMAT(1H1,'4.   ',A50,//,1X,'RUNNING LENGTH (M) ?')
      READ(IIN,*,ERR=400,END=9999)W(13)
 410  WRITE(IOUT,370)
      READ(IIN,*,ERR=410,END=9999)W(354)
 415  WRITE(IOUT,416)
 416  FORMAT(1X,'IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION ',
     $ 'DESIRED ?')
      READ(IIN,70,ERR=415,END=9999)ANS
      IF(ANS.EQ.1HN)W(29)=0.0
      IF(ANS.EQ.1HY)W(29)=1.0
 420  WRITE(IOUT,330)
      READ(IIN,*,ERR=420,END=9999)W(16)
 430  WRITE(IOUT,350)
      READ(IIN,*,ERR=430,END=9999)W(15)
 440  WRITE(IOUT,445)
 445  FORMAT(/,1X,'REYNOLDS-ANALOGY FACTOR',//,11X,
     $ '0.   COLBURN',/,11X,'1.   VON KARMAN',//,1X,
     $ 'DESIRED FACTOR ?')
      READ(IIN,*,ERR=440,END=9999)W(319)
      IF(W(646).NE.1.0)GO TO 470
 450  WRITE(IOUT,455)
 455  FORMAT(/,1X,'RAREFIED FLOW OPTIONS',/,11X,
     $ '0.   CONE',/,11X,'1.   FLAT PLATE',/,1X,
     $ 'DESIRED OPTION ?')
      READ(IIN,*,ERR=450,END=9999)W(314)
      IF(W(314).NE.0.0)GO TO 470
 460  WRITE(IOUT,465)
 465  FORMAT(/,1X,'RAREFIED CONE OPTIONS',/,11X,
     $ '0.   SHARP CONE',/,11X,'1.   BLUNT CONE',/,1X,
     $ 'DESIRED OPTION ?')
      READ(IIN,*,ERR=460,END=9999)W(650)
 470  WRITE(IOUT,170)
      READ(IIN,70,ERR=470,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 400
      GO TO 1300
C ---------------------------- HEAT TRANSFER METHOD 5 -----------
 500  IF(MFLAG.EQ.0)WRITE(IOUT,510)CHAR(5)
      IF(MFLAG.EQ.1)WRITE(IOUT,511)CHAR(5)
 510  FORMAT(1H1,'5.   ',A50,//,1X,'RUNNING LENGTH (FT) ?')
 511  FORMAT(1H1,'5.   ',A50,//,1X,'RUNNING LENGTH (M) ?')
      READ(IIN,*,ERR=500,END=9999)W(13)
 520  WRITE(IOUT,370)
      READ(IIN,*,ERR=520,END=9999)W(354)
 525  WRITE(IOUT,526)
 526  FORMAT(1X,'IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION ',
     $ 'DESIRED ?')
      READ(IIN,70,ERR=525,END=9999)ANS
```

```
      IF(ANS.EQ.1HN)W(29)=0.0
      IF(ANS.EQ.1HY)W(29)=1.0
 530  WRITE(IOUT,170)
      READ(IIN,70,ERR=530,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 500
      GO TO 1300
C ----------------------------- HEAT TRANSFER METHOD 6 -----------
 600  IF(MFLAG.EQ.0)WRITE(IOUT,610)CHAR(6)
      IF(MFLAG.EQ.1)WRITE(IOUT,611)CHAR(6)
 610  FORMAT(1H1,'6.    ',A50,//,1X,'RADIUS (FT) ?')
 611  FORMAT(1H1,'6.    ',A50,//,1X,'RADIUS (M) ?')
      READ(IIN,*,ERR=600,END=9999)W(12)
      WRITE(IOUT,620)
 620  FORMAT(/,1X,'NOTE: THIS OPTION IS USED WITH THE PARALLEL ',
     $ /,7X,'SHOCK FLOW FIELD OPTION 4. THE SWEEP',/,7X,'ANGLE ',
     $ 'IS CALCULATED USING THE ANGLE',/,7X,'OF ATTACK + INPUT ',
     $ 'ANGLE WITH FF OPTION 4.')
      IF(W(646).EQ.1.0)WRITE(IOUT,630)
 630  FORMAT(/,1X,'NOTE: THE RAREFIED CYLINDER OPTION HAS BEEN ',
     $ 'SELECTED ')
 640  WRITE(IOUT,170)
      READ(IIN,70,ERR=640,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 600
      GO TO 1300
C ----------------------------- HEAT TRANSFER METHOD 7 -----------
 700  IF(MFLAG.EQ.0)WRITE(IOUT,710)CHAR(7)
      IF(MFLAG.EQ.1)WRITE(IOUT,711)CHAR(7)
 710  FORMAT(1H1,'7.    ',A50,//,1X,'RADIUS (FT) ?')
 711  FORMAT(1H1,'7.    ',A50,//,1X,'RADIUS (M) ?')
      READ(IIN,*,ERR=700,END=9999)W(12)
 720  WRITE(IOUT,620)
 730  WRITE(IOUT,170)
      READ(IIN,70,ERR=730,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 700
      GO TO 1300
C ----------------------------- HEAT TRANSFER METHOD 8 -----------
 800  IF(MFLAG.EQ.0)WRITE(IOUT,810)CHAR(8)
      IF(MFLAG.EQ.1)WRITE(IOUT,811)CHAR(8)
 810  FORMAT(1H1,'8.    ',A50,//,1X,'RADIUS (FT) ?')
 811  FORMAT(1H1,'8.    ',A50,//,1X,'RADIUS (M) ?')
      READ(IIN,*,ERR=800,END=9999)W(12)
 820  IF(MFLAG.EQ.0)WRITE(IOUT,825)
      IF(MFLAG.EQ.1)WRITE(IOUT,826)
 825  FORMAT(1X,'RUNNING LENGTH (FT) ?')
 826  FORMAT(1X,'RUNNING LENGTH (M) ?')
      READ(IIN,*,ERR=820,END=9999)W(13)
 830  WRITE(IOUT,835)
 835  FORMAT(1X,'LOCAL BODY SLOPE (DEG.) ?')
      READ(IIN,*,ERR=830,END=9999)W(17)
      WRITE(IOUT,840)
 840  FORMAT(/,1X,'NOTE: THIS OPTION IS USED WITH',/,
     $ 7X,'FF OPTION 3. OBLIQUE AND NORMAL SHOCK,SHOCK ',
     $ 'ANGLE = 90.',/,7X,' P OPTION 5. MODIFIED ',
     $ 'NEWTONIAN, ANGLE = BODY SLOPE ')
 850  WRITE(IOUT,170)
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```
      READ(IIN,70,ERR=850,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 800
      GO TO 1300
C ----------------------------- HEAT TRANSFER METHOD 9 -----------
 900  IF(MFLAG.EQ.0)WRITE(IOUT,910)CHAR(9)
      IF(MFLAG.EQ.1)WRITE(IOUT,911)CHAR(9)
 910  FORMAT(1H1,'9.   ',A50,//,1X,'FULL SCALE VEHICLE ',
     $ 'USE RADIUS = 1.0 FT.',/,1X,'RADIUS (FT) ?')
 911  FORMAT(1H1,'9.   ',A50,//,1X,'FULL SCALE VEHICLE ',
     $ 'USE RADIUS = .3048 M.',/,1X,'RADIUS (M) ?')
      READ(IIN,*,ERR=900,END=9999)W(12)
 920  IF(MFLAG.EQ.0)WRITE(IOUT,925)
      IF(MFLAG.EQ.1)WRITE(IOUT,926)
 925  FORMAT(1X,'WINDWARD WALL ENTHALPY',/,1X,
     $ '(480 BTU/LBM = 2000 R ASSUMED IF ZERO IS INPUT) ?')
 926  FORMAT(1X,'WINDWARD WALL ENTHALPY',/,1X,
     $ '(1.12E6 JOULES/KG = 1111 K ASSUMED IF ZERO IS INPUT) ?')
      READ(IIN,*,ERR=920,END=9999)W(21)
      WRITE(IOUT,930)
 930  FORMAT(/,1X,'NOTE: THIS OPTION IS USED WITH',/,
     $ 7X,'FF OPTION 3. OBLIQUE AND NORMAL SHOCK, SHOCK ',
     $ 'ANGLE = 90.',/,7X,' P OPTION 5. MODIFIED NEWTONIAN,',
     $ ' ANGLE = 90.')
 940  WRITE(IOUT,170)
      READ(IIN,70,ERR=940,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 900
      GO TO 1300
C ----------------------------- HEAT TRANSFER METHOD 10 ----------
 1000 IF(MFLAG.EQ.0)WRITE(IOUT,1005)CHAR(10)
      IF(MFLAG.EQ.1)WRITE(IOUT,1006)CHAR(10)
 1005 FORMAT(1H1,'10.  ',A50,//,1X,'RUNNING LENGTH ',
     $ 'TO HINGE LINE (FT) ?')
 1005 FORMAT(1H1,'10.  ',A50,//,1X,'RUNNING LENGTH ',
     $ 'TO HINGE LINE (M) ?')
      READ(IIN,*,ERR=1000,END=9999)W(13)
 1010 WRITE(IOUT,370)
      READ(IIN,*,ERR=1010,END=9999)W(354)
 1015 WRITE(IOUT,1016)
 1016 FORMAT(1X,'IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION ',
     $ 'DESIRED ?')
      READ(IIN,70,ERR=1015,END=9999)ANS
      IF(ANS.EQ.1HN)W(29)=0.0
      IF(ANS.EQ.1HY)W(29)=1.0
 1020 WRITE(IOUT,1025)
 1025 FORMAT(1X,'TURBULENT MANGLER FACTOR ?')
      READ(IIN,*,ERR=1020,END=9999)W(16)
 1030 WRITE(IOUT,1035)
 1035 FORMAT(1X,'LAMINAR MANGLER FACTOR ?')
      READ(IIN,*,ERR=1030,END=9999)W(15)
 1040 IF(MFLAG.EQ.0)WRITE(IOUT,1045)
      IF(MFLAG.EQ.1)WRITE(IOUT,1046)
 1045 FORMAT(1X,'FLAP LENGTH (FT) ?')
 1046 FORMAT(1X,'FLAP LENGTH (M) ?')
      READ(IIN,*,ERR=1040,END=9999)W(22)
 1050 WRITE(IOUT,1055)
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```
 1055 FORMAT(1X,'REYNOLDS ANALOGY FACTOR',/,10X,
     $ '0.   COLBURN',/,10X,'1.   VON KARMAN',/,
     $ 1X,'DESIRED FACTOR ?')
      READ(IIN,*,ERR=1050,END=9999)W(319)
      WRITE(IOUT,1060)
 1060 FORMAT(1X,'NOTE: FLAP ANGLE IS INPUT THROUGH ',
     $ 'LAST PRESS. OPTION ANGLE.')
 1070 WRITE(IOUT,170)
      READ(IIN,70,ERR=1070,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 1000
      GO TO 1300
C ---------------------------- HEAT TRANSFER METHOD 11 -----------
 1100 IF(MFLAG.EQ.0)WRITE(IOUT,1105)CHAR(11)
      IF(MFLAG.EQ.1)WRITE(IOUT,1106)CHAR(11)
 1105 FORMAT(1H1,'11.  ',A50,//,1X,'RUNNING LENGTH ',
     $ 'TO FIN LEADING EDGE (FT) ?')
 1106 FORMAT(1H1,'11.  ',A50,//,1X,'RUNNING LENGTH ',
     $ 'TO FIN LEADING EDGE (M) ?')
      READ(IIN,*,ERR=1100,END=9999)W(13)
 1110 WRITE(IOUT,370)
      READ(IIN,*,ERR=1110,END=9999)W(354)
 1115 WRITE(IOUT,1116)
 1116 FORMAT(1X,'IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION ',
     $ 'DESIRED ?')
      READ(IIN,70,ERR=1115,END=9999)ANS
      IF(ANS.EQ.1HN)W(29)=0.0
      IF(ANS.EQ.1HY)W(29)=1.0
 1120 IF(MFLAG.EQ.0)WRITE(IOUT,1125)
      IF(MFLAG.EQ.1)WRITE(IOUT,1126)
 1125 FORMAT(1X,'DISTANCE ALONG FIN TO POINT OF INTEREST ',
     $ '(FT) ?')
 1126 FORMAT(1X,'DISTANCE ALONG FIN TO POINT OF INTEREST ',
     $ '(M) ?')
      READ(IIN,*,ERR=1120,END=9999)W(25)
 1130 WRITE(IOUT,1135)
 1135 FORMAT(1X,'FIN ANGLE AT ALPHA = BETA = 0 (DEG) ?')
      READ(IIN,*,ERR=1130,END=9999)W(26)
 1140 WRITE(IOUT,1145)
 1145 FORMAT(1X,'FIN ANGLE OPTION',/,10X,
     $ '0.   FIN ANGLE = INPUT FIN ANGLE',/,10X,
     $ '1.   FIN ANGLE = INPUT FIN ANGLE + ALPHA',/,10X,
     $ '2.   FIN ANGLE = INPUT FIN ANGLE + BETA',//,1X,
     $ 'OPTION DESIRED ?')
      READ(IIN,*,ERR=1140,END=9999)W(30)
 1150 WRITE(IOUT,330)
      READ(IIN,*,ERR=1150,END=9999)W(16)
 1160 WRITE(IOUT,350)
      READ(IIN,*,ERR=1160,END=9999)W(15)
 1170 WRITE(IOUT,445)
      READ(IIN,*,ERR=1170,END=9999)W(319)
 1180 WRITE(IOUT,170)
      READ(IIN,70,ERR=1180,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 1100
      GO TO 1300
C ------------------------------------------------ BAD OPTION --
```

```
 1200 CONTINUE
      WRITE(IOUT,1210)
 1210 FORMAT(//,1X,'BAD OPTION',//)
      GO TO 10
C ------------------------- SET WALL TEMPERATURE ------------
 1300 CONTINUE
 1310 IF(MFLAG.EQ.0)WRITE(IOUT,1320)
      IF(MFLAG.EQ.1)WRITE(IOUT,1321)
 1320 FORMAT(///,1X,'* * * WALL CONDITIONS * * *',//,1X,
     $ 'WALL TEMPERATURE (DEG F) ?')
 1321 FORMAT(///,1X,'* * * WALL CONDITIONS * * *',//,1X,
     $ 'WALL TEMPERATURE (DEG K) ?')
      READ(IIN,*,ERR=1310,END=9999)W(24)
C ------------------------- SET WALL EMISSIVITY ------------
 1330 WRITE(IOUT,1340)
 1340 FORMAT(1X,'WALL EMISSIVITY ?')
      READ(IIN,*,ERR=1330,END=9999)W(23)
C ------------------------- CONTINUATION OPTION ------------
 1400 IF(MFLAG.EQ.0)WRITE(IOUT,1410)
      IF(MFLAG.EQ.1)WRITE(IOUT,1411)
 1410 FORMAT(///,1X,'* * * CONTINUATION OPTION * * *',//,1X,
     $ 'DO YOU WANT TO PROVIDE AN INITIAL HEATING LOAD GT ',
     $ '0.0 (BTU/SQ.FT) ?')
 1411 FORMAT(///,1X,'* * * CONTINUATION OPTION * * *',//,1X,
     $ 'DO YOU WANT TO PROVIDE AN INITIAL HEATING LOAD GT ',
     $ '0.0 (JOULED/SQ.M) ?')
      READ(IIN,70,ERR=1400,END=9999)ANS
      W(209)=0.0
      IF(ANS.EQ.1HY)W(209)=1.0
      IF(ANS.EQ.1HN)GO TO 1500
 1420 IF(MFLAG.EQ.0)WRITE(IOUT,1430)
      IF(MFLAG.EQ.1)WRITE(IOUT,1431)
 1430 FORMAT(1X,'INITIAL LOAD (BTU/SFT) ?')
 1431 FORMAT(1X,'INITIAL LOAD (JOULED/SQ.M) ?')
      READ(IIN,*,ERR=1420,END=9999)W(316)
C ------------------- TEST RAREFIED FLOW FLAG -------------
 1500 CONTINUE
      IF(W(646).NE.1.0)GO TO 1600
      GO TO (1600,1510,1510,1600,1510,1600,1510,1600,1510,1510
     $ ,1510),W(11)
 1510 WRITE(IOUT,1520)
 1520 FORMAT(/,1X,'THE RAREFIED FLOW OPTION CANNOT BE USED WITH ',
     $ 'HEAT TRANSFER',/,1X,'OPTION SELECTED.',//,1X,
     $ ' * RAREFIED FLOW OPTION IS DISENABLED *',//,1X,
     $ 'DO YOU WISH TO CHANGE HEAT TRANSFER OPTIONS ?')
      W(646)=0.0
      READ(IIN,70,ERR=1510,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
 1600 CONTINUE
      RETURN
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE MODIFY
C
C  THIS ROUTINE ENABLES USER TO PICK A SECTION OR ROUTINE
C   TO BE MODIFIED OR REDEFINED
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER ANS,TFLAG,ANS1
C
 17   WRITE(IOUT,18)
 18   FORMAT(///,10X,'MODIFICATION SECTIONS',//,
     $ 1X,' 1.   TIMING PARAMETERS',/,
     $ 1X,' 2.   TRAJECTORY DATA',/,
     $ 1X,' 3.   ATMOSPHERE DATA',/,
     $ 1X,' 4.   FLOWFIELD AND PRESSURE DATA',/,
     $ 1X,' 5.   CROSSFLOW DATA',/,
     $ 1X,' 6.   TRANSITION CRITERIA',/,
     $ 1X,' 7.   HEAT TRANSFER OPTION',/,
     $ 1X,' 8.   HEATING MULTIPLIERS',/,
     $ 1X,' 9.   GEOMETRY DATA',/,
     $ 1X,'10.   CONTROL PARAMETERS',/,
     $ 1X,'11.   HEATING INDICATOR',/,
     $ 1X,'12.   OR CHANGE A SPECIFIC VARIABLE IN W ARRAY',//
     $ 1X,'SECTION TO BE MODIFIED ?')
      READ(IIN,*,ERR=17,END=9999)SECT
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12),SECT
      GO TO 17
  1   CALL TIMING
      GO TO 30
  2   CALL TRAJ
      GO TO 30
  3   CALL ATMS
      IF(W(10).EQ.1.)CALL WNDTUN
      IF(W(10).EQ.2.)CALL ATMDTA
      GO TO 30
  4   CALL FLOW(2)
      GO TO 30
  5   CALL CROSS
      GO TO 30
  6   CALL TRANS
      GO TO 30
  7   CALL HTRMTD
      GO TO 30
  8   CALL HTMULT
      GO TO 30
  9   CALL TDGEOM
      GO TO 30
 10   CALL CONTRL
      GO TO 30
 11   CALL HEATIN
      GO TO 30
 12   GO TO 200
 30   WRITE(IOUT,40)NC
 40   FORMAT(/,1X,'DO YOU WISH TO MODIFY ANY OTHER SECTIONS ',
```

```
     $ 'FOR CASE ',I3,' ?')
      READ(IIN,50,ERR=30,END=9999)ANS
 50   FORMAT(A1)
      IF(ANS.EQ.1HY)GO TO 17
      RETURN
C ---------------------------- MODIFY A SPECIFIC W NUMBER ---
 200  CONTINUE
 210  WRITE(IOUT,220)
 220  FORMAT(/,1X,'WHAT IS THE W NUMBER YOU WISH TO CHANGE ?')
      READ(IIN,*,ERR=210,END=9999)J
 230  WRITE(IOUT,240)J
 240  FORMAT(1X,'WHAT IS THE VALUE FOR W(',I3,') ?')
      READ(IIN,*,ERR=230,END=9999)W(J)
 250  WRITE(IOUT,260)
 260  FORMAT(1X,'IS THERE ANOTHER W VARIABLE YOU WISH TO ',
     $ 'CHANGE ?')
      READ(IIN,50,ERR=250,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 200
      GO TO 30
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE STREAM
C
C  ROUTINE FOR CREATING STREAMLINE CASES
C
C  X     - X(FT) OR X(M)
C  SA    - SHOCK ANGLE (DEG)
C  BA    - BODY ANGLE (DEG)
C  BP    - BODY POINT NUMBER
C  CASE  - CASE NUMBER
C  XPRT  - PROGRAM INPUT CONTROL PARAMETER FOR CASE
C  J1    - W INDEX FOR CASE
C  J2    - W INDEX FOR X
C  J3    - W INDEX FOR SA
C  J4    - W INDEX FOR BA
C  J5    - W INDEX FOR BP
C  J6    - W INDEX FOR XPRT
C  JK    - FLAG FOR SPECIAL CASES OF STREAMLINE
C          (PARALLEL SHOCK OR PRANDT-MEYER OPTIONS)
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/STRM/ISTRM,NNC
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER TFLAG,ANS1
C
C  CHECK FOR TIME DEPENDENT GEOMETRY OPTION
      IF(W(560).GT.0.0)GO TO 200
C  CREATE A TEMPORARY FILE FOR STORING STREAMLINE CASE DATA
      OPEN(UNIT=4,FILE='STREAM.TMP',STATUS='UNKNOWN')
      NNC=NC+1
      ISTRM=1
      J1=647
      J2=13
C ------------- DETERMINE SHOCK ANGLE AT PREVIOUS CASE -------
      DO 25 I=48,46,-1
      III=I-3
 25   IF(W(I).GT.34.AND.W(I).LT.40)GO TO 27
      DO 26 I=36,31,-1
      III=I+6
 26   IF(W(I).GT.34.AND.W(I).LT.40)GO TO 27
 27   J3=III
      J3F=I
C ------------- DETERMINE BODY ANGLE AT PREVIOUS CASE --------
      DO 30 I=48,46,-1
      II=I-3
 30   IF(W(I).GT.13.AND.W(I).LT.30)GO TO 50
      DO 40 I=36,31,-1
      II=I+6
 40   IF(W(I).GT.13.AND.W(I).LT.30)GO TO 50
 50   J4=II
      J4F=I
      JK=0
C ------- CHECK FOR PARALLEL SHOCK OR PRANDT-MEYER CASES -----
      IF(W(J4F).EQ.29)JK=1
      IF(J3F.GT.J4F)JK=2
```

```
      IF(JK.EQ.1)J4=0
      IF(JK.EQ.2)J3=0
      J5=611
      J6=641
      XPRT=1.0
      WRITE(IOUT,1)
      IF(MFLAG.EQ.0.AND.JK.EQ.0)WRITE(IOUT,2)
      IF(MFLAG.EQ.0.AND.JK.EQ.1)WRITE(IOUT,3)
      IF(MFLAG.EQ.0.AND.JK.EQ.2)WRITE(IOUT,4)
      IF(MFLAG.EQ.1.AND.JK.EQ.0)WRITE(IOUT,5)
      IF(MFLAG.EQ.1.AND.JK.EQ.1)WRITE(IOUT,6)
      IF(MFLAG.EQ.1.AND.JK.EQ.2)WRITE(IOUT,7)
1     FORMAT(1H1,10X,'STREAMLINE CASES',//,11X,'LIMITATIONS',/,5X,'*'
     $ ,2X,'ALL LOCATIONS ON STREAMLINE HAVE NO INTERVENING SHOCKS OR',
     $ ' EXPANSION FANS',/,5X,'*',2X,'MULTIPLIERS SAME FOR ALL X ',
     $ 'LOCATIONS',/,5X,'*',2X,'FIXED RUNNING LENGTHS WITH ALPHA',/,
     $ 5X,'*',2X,'NOTE: SHOCK ANGLE = SHOCK ANGLE OR SHOCK GENERATOR ',
     $ 'ANGLE',//,1X,'(INPUT DATA FOR EACH CASE - - USE NEG X ',
     $ 'TO INDICATE END OF DATA)')
2     FORMAT(/,1X,'X(FT),SHOCK ANGLE,BODY ANGLE,B.F.NO.')
3     FORMAT(/,1X,'X(FT),SHOCK ANGLE,B.P.NO.')
4     FORMAT(/,1X,'X(FT),BODY ANGLE,B.P.NO.')
5     FORMAT(/,1X,'X(M),SHOCK ANGLE,BODY ANGLE,B.P.NO.')
6     FORMAT(/,1X,'X(M),SHOCK ANGLE,B.P.NO.')
7     FORMAT(/,1X,'X(M),BODY ANGLE,B.P.NO.')
60    WRITE(IOUT,70)NNC
70    FORMAT(1X,I3)
      CASE=FLOAT(NNC)
      IF(MFLAG.EQ.0.AND.JK.EQ.0)READ(IIN,*,ERR=60,END=9999)X,SA,BA,BP
      IF(MFLAG.EQ.0.AND.JK.EQ.1)READ(IIN,*,ERR=60,END=9999)X,SA,BP
      IF(MFLAG.EQ.0.AND.JK.EQ.2)READ(IIN,*,ERR=60,END=9999)X,BA,BP
      IF(MFLAG.EQ.1.AND.JK.EQ.0)READ(IIN,*,ERR=60,END=9999)X,SA,BA,BP
      IF(MFLAG.EQ.1.AND.JK.EQ.1)READ(IIN,*,ERR=60,END=9999)X,SA,BP
      IF(MFLAG.EQ.1.AND.JK.EQ.2)READ(IIN,*,ERR=60,END=9999)X,BA,BP
      IF(MFLAG.EQ.1)X=X*3.28084
C ---------------------------- WRITE TO TEMPORARY FILE ------------
      WRITE(4,80)J1,CASE,J2,X,J3,SA,J4,BA,J5,BP
      WRITE(4,80)J6,XPRT
80    FORMAT(1X,5(I3,F9.4,1X))
      IF(X.LT.0.0)GO TO 100
      NNC=NNC+1
      GO TO 60
100   CONTINUE
      REWIND (UNIT=4)
      RETURN
200   CONTINUE
      WRITE(IOUT,210)
210   FORMAT(/,1X,'CANNOT RUN STREAMLINE CASES AND USE ',
     $ 'TIME DEPENDENT GEOMETRY.')
      RETURN
9999  CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE TDGEOM
C
C  ROUTINE FOR SETTING TIME DEPENDENT GEOMETRY DATA
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER ANS,TFLAG,ANS1
C  MAY USE GEOMETRY DATA FROM PREVIOUS CASE IF JFKS = 1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
  1   WRITE(IOUT,2)NC,NCM1
  2   FORMAT(///,1X,'IS CASE ',I3,' TIME DEPENDENT GEOMETRY ',
     $ 'DATA THE SAME AS FOR CASE ',I3,' ?')
      READ(IIN,30,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
  9   CONTINUE
 10   WRITE(IOUT,20)
 20   FORMAT(///,10X,' TIME DEPENDENT GEOMETRY',//)
 30   FORMAT(A1)
C -------------------CHOOSE NUMBER OF TIME DEPENDENT ENTRIES --
 40   WRITE(IOUT,50)
 50   FORMAT(1X,'NUMBER OF TIME DEPENDENT ENTRIES ? (MAX=10)')
      READ(IIN,*,ERR=40,END=9999)II
      W(560)=FLOAT(II)
 60   IF(MFLAG.EQ.0)WRITE(IOUT,70)
      IF(MFLAG.EQ.1)WRITE(IOUT,71)
 70   FORMAT(1X,'TIME(SEC),RADII(FT),LENGTH(FT),SLOPE OR SWEEP',
     $ '(DEG)')
 71   FORMAT(1X,'TIME(SEC),RADII(M),LENGTH(M),SLOPE OR SWEEP',
     $ '(DEG)')
C -------------- INPUT VALUES FOR EACH TIME ------------------
      DO 1000 I=1,II
      READ(IIN,*,ERR=60,END=9999)W(560+I),W(570+I),W(580+I),
     $ W(590+I)
 1000 CONTINUE
 80   WRITE(IOUT,90)
 90   FORMAT(1X,'ANY CHANGES ?')
      READ(IIN,30,ERR=80,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
 100  CONTINUE
      RETURN
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE TIMING
C
C  ROUTINE THAT SETS TIMING PARAMETERS AND PRINT CONTROL VALUES
C
C  SUM = TOTAL NUMBER OF PRINT TIMES
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
C
      INTEGER ANS
C
      SUM1=0.0
      SUM2=0.0
      SUM3=0.0
 10   WRITE(IOUT,20)
 20   FORMAT(1H1,5X,'SPECIFY PRINTOUT INTERVALS',/)
 30   WRITE(IOUT,40)
 40   FORMAT(1X,'INITIAL TIME (SEC)')
      READ(IIN,*,ERR=30,END=9999)W(1)
 50   WRITE(IOUT,60)
 60   FORMAT(1X,'PRINTOUT INTERVAL 1 (SEC)',10X,'DELTA TIME')
      READ(IIN,*,ERR=50,END=9999)W(2)
 70   WRITE(IOUT,80)
 80   FORMAT(1X,'SECOND TIME (SEC)')
      READ(IIN,*,ERR=70,END=9999)W(3)
      IF(W(2).GT.0.0)SUM1=((W(3)-W(1))/W(2))
 90   WRITE(IOUT,100)
 100  FORMAT(1X,'PRINTOUT INTERVAL 2 (SEC)',10X,'DELTA TIME')
      READ(IIN,*,ERR=90,END=9999)W(4)
 110  WRITE(IOUT,120)
 120  FORMAT(1X,'THIRD TIME (SEC)')
      READ(IIN,*,ERR=110,END=9999)W(5)
      IF(W(4).GT.0.0)SUM2=((W(5)-W(3))/W(4))
 130  WRITE(IOUT,140)
 140  FORMAT(1X,'PRINTOUT INTERVAL 3 (SEC)',10X,'DELTA TIME')
      READ(IIN,*,ERR=130,END=9999)W(6)
 150  WRITE(IOUT,160)
 160  FORMAT(1X,'FOURTH TIME (SEC)')
      READ(IIN,*,ERR=150,END=9999)W(7)
      IF(W(6).GT.0.0)SUM3=((W(7)-W(5))/W(6))
      W(8)=1.0
 170  WRITE(IOUT,180)
 180  FORMAT(/,1X,'ARE THE PRINTOUT TIMES CORRECT ?')
      READ(IIN,190,ERR=170,END=9999)ANS
 190  FORMAT(A1)
      IF(ANS.EQ.1HN)GO TO 10
      SUM=SUM1+SUM2+SUM3
C  TEST FOR GREATER THAN 100 PRINT TIMES
      IF(SUM.LT.100.)GO TO 1000
      WRITE(IOUT,200)
 200  FORMAT(/,1X,'MAXIMUM NUMBER OF TIMES(100) EXCEEDED.',/)
      GO TO 30
 1000 CONTINUE
      RETURN
 9999 CONTINUE
      CALL EXIT
      END
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
      SUBROUTINE TRAJ
C
C  ROUTINE THAT COPIES TRAJ DATA TO W ARRAY
C
C  LINE   -  TRAJ TABLE LINE NUMBER
C  FNAM1  -  NAME OF TRAJ FILE
C  TITLE  -  TITLE OF TRAJ FILE
C  BFLAG  =  0  YAW ANGLE NOT INCLUDED
C  BFLAG  =  1  YAW ANGLE INCLUDED
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      CHARACTER*20 FNAM1
      CHARACTER*80 TITLE
      INTEGER ANS,BFLAG,TFLAG,ANS1
C
 10   WRITE(IOUT,20)
 20   FORMAT(1H1,10X,'TRAJECTORY INPUT',/)
 30   WRITE(IOUT,40)
 40   FORMAT(1X,'DO YOU HAVE A TRAJECTORY INPUT FILE ?')
      READ(IIN,50,ERR=30,END=9999)ANS
 50   FORMAT(A1)
      IF(ANS.EQ.1HN)GO TO 130
C ------------------------------------------------------------
C     INPUT TRAJECTORY VIA FILE
 60   WRITE(IOUT,70)
 70   FORMAT(1X,'WHAT IS THE FILE NAME ?')
      READ(IIN,80,ERR=60,END=9999)FNAM1
 80   FORMAT(A20)
      OPEN(UNIT=7,FILE=FNAM1,STATUS='OLD',ERR=8888)
      READ(7,85)TITLE
 85   FORMAT(A80)
C  BFLAG = 1 IF YAW ANGLE INCLUDED
C  W(50) -   NUMBER OF TIME DEPENDENT TABLE ENTRIES
      READ(7,90)BFLAG,W(50)
 90   FORMAT(I2,F10.5)
      NPTS=IFIX(W(50))
C  READ TIME,ALT,VEL,ANGLE OF ATTACK,AND YAW ANGLE(OPTIONAL)
      IF(BFLAG.EQ.0)READ(7,99,END=98)(W(50+I),W(100+I),W(150+I),
     $ W(210+I),I=1,NPTS)
      IF(BFLAG.EQ.1)READ(7,100,END=98)(W(50+I),W(100+I),W(150+I),
     $ W(210+I),W(650+I),I=1,NPTS)
 98   CONTINUE
 99   FORMAT(4E15.4)
 100  FORMAT(5E15.4)
      IF(MFLAG.EQ.0)GO TO 103
      DO 101 IZ=101,200
 101  W(IZ)=W(IZ)/3.28084
 103  CONTINUE
      CLOSE(UNIT=7,STATUS='KEEP')
C ------------------------------------------------------------
C     DISPLAY TRAJECTORY
 104  CONTINUE
      I=0
```

```
 105  CONTINUE
      IF(BFLAG.EQ.0.AND.MFLAG.EQ.0)WRITE(IOUT,110)
      IF(BFLAG.EQ.0.AND.MFLAG.EQ.1)WRITE(IOUT,112)
      IF(BFLAG.EQ.1.AND.MFLAG.EQ.0)WRITE(IOUT,111)
      IF(BFLAG.EQ.1.AND.MFLAG.EQ.1)WRITE(IOUT,113)
 110  FORMAT(/,1X,'        TIME      ALTITUDE    VELOCITY  ANGLE ',
     $ 'ATTACK',/,'        (SEC)       (FT)      (FT/SEC)',
     $ '       (DEG)',/)
 112  FORMAT(/,1X,'        TIME      ALTITUDE    VELOCITY  ANGLE ',
     $ 'ATTACK',/,'        (SEC)       (M)       (M/SEC)',
     $ '       (DEG)',/)
 111  FORMAT(/,1X,'        TIME      ALTITUDE    VELOCITY  ANGLE ',
     $ 'ATTACK    BETA',/,'        (SEC)       (FT)      (FT/SEC)',
     $ '       (DEG)        (DEG)',/)
 113  FORMAT(/,1X,'        TIME      ALTITUDE    VELOCITY  ANGLE ',
     $ 'ATTACK    BETA',/,'        (SEC)       (M)       (M/SEC)',
     $ '       (DEG)        (DEG)',/)
 115  I=I+1
      IF(BFLAG.EQ.0)WRITE(IOUT,120)I,W(50+I),W(100+I),
     $ W(150+I),W(210+I)
      IF(BFLAG.EQ.1)WRITE(IOUT,120)I,W(50+I),W(100+I),
     $ W(150+I),W(210+I),W(650+I)
 120  FORMAT(1X,I2,5E12.4)
      IF(I.EQ.NPTS)GO TO 210
      IF(I.EQ.20.OR.I.EQ.40)READ(IIN,125,ERR=123,END=9999)
 123  IF(I.EQ.20.OR.I.EQ.40)GO TO 105
 125  FORMAT(1X)
      GO TO 115
C -------------------------------------------------------------
C    INPUT TRAJECTORY VIA TERMINAL
 130  CONTINUE
 140  WRITE(IOUT,150)
 150  FORMAT(1X,'WHAT IS THE NUMBER OF TRAJECTORY POINTS ? ',
     $ '(50 TRAJ.PTS. MAXIMUM)')
      READ(IIN,*,ERR=140,END=9999)NPTS
      W(50)=FLOAT(NPTS)
 160  WRITE(IOUT,170)
 170  FORMAT(1X,'WILL BETA VALUES BE INPUT ?')
      READ(IIN,50,ERR=160,END=9999)ANS
      BFLAG=0
      IF(ANS.EQ.1HY)BFLAG=1
      IF(BFLAG.EQ.0.AND.MFLAG.EQ.0)WRITE(IOUT,180)
      IF(BFLAG.EQ.0.AND.MFLAG.EQ.1)WRITE(IOUT,182)
      IF(BFLAG.EQ.1.AND.MFLAG.EQ.0)WRITE(IOUT,181)
      IF(BFLAG.EQ.1.AND.MFLAG.EQ.1)WRITE(IOUT,183)
 180  FORMAT(1X,'TYPE IN THE FOLLOWING TRAJECTORY VARIABLES ',
     $ 'SEPERATED BY COMMAS',/,11(' -'),' 50 TIMES MAXIMUM',
     $ 11(' -'),/,' TIME(SEC),ALTITUDE(FT),VELOCITY(FT/SEC),',
     $ 'ANGLE OF ATTACK(DEG)')
 182  FORMAT(1X,'TYPE IN THE FOLLOWING TRAJECTORY VARIABLES ',
     $ 'SEPERATED BY COMMAS',/,11(' -'),' 50 TIMES MAXIMUM',
     $ 11(' -'),/,' TIME(SEC),ALTITUDE(M),VELOCITY(M/SEC),',
     $ 'ANGLE OF ATTACK(DEG)')
 181  FORMAT(1X,'TYPE IN THE FOLLOWING TRAJECTORY VARIABLES ',
     $ 'SEPERATED BY COMMAS',/,11(' -'),' 50 TIMES MAXIMUM',
```

```
     $ 11(' -'),/,' TIME(SEC),ALTITUDE(FT),VELOCITY(FT/SEC),',
     $ 'ANGLE OF ATTACK(DEG),BETA(DEG)')
 183  FORMAT(1X,'TYPE IN THE FOLLOWING TRAJECTORY VARIABLES ',
     $ 'SEPERATED BY COMMAS',/,11(' -'),' 50 TIMES MAXIMUM',
     $ 11(' -'),/,' TIME(SEC),ALTITUDE(M),VELOCITY(M/SEC),',
     $ 'ANGLE OF ATTACK(DEG),BETA(DEG)')
      DO 1000 I=1,NPTS
 190  WRITE(IOUT,200)I
 200  FORMAT(1X,I2)
      IF(BFLAG.EQ.0)READ(IIN,*,ERR=190,END=9999)W(50+I),
     $ W(100+I),W(150+I),W(210+I)
      IF(BFLAG.EQ.1)READ(IIN,*,ERR=190,END=9999)W(50+I),
     $ W(100+I),W(150+I),W(210+I),W(650+I)
 1000 CONTINUE
      GO TO 104
C ------------------------------------------------------------
C     CHANGE TRAJECTORY
 210  WRITE(IOUT,220)
 220  FORMAT(/,1X,'DO YOU WISH TO CHANGE ANY OF THE ',
     $ 'TRAJECTORY INPUT ?')
      READ(IIN,50,ERR=210,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 280
 260  CONTINUE
      WRITE(IOUT,261)
 261  FORMAT(/,1X,'DO YOU WISH TO CHANGE AN EXISTING LINE ?')
      READ(IIN,50,ERR=260,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 400
 262  WRITE(IOUT,263)
 263  FORMAT(1X,'DO YOU WISH TO ADD A NEW LINE TO THE TRAJ. ?')
      READ(IIN,50,ERR=262,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 500
 264  WRITE(IOUT,265)
 265  FORMAT(1X,'DO YOU WISH TO REMOVE A LINE FROM THE TRAJ. ?')
      READ(IIN,50,ERR=264,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 700
 266  WRITE(IOUT,267)
 267  FORMAT(1X,'DO YOU WANT TO CHANGE THE WHOLE TRAJ. ?')
      READ(IIN,50,ERR=266,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 130
C ------------------------------------------------------------------
C     COPY TRAJECTORY TO FILE
 280  CONTINUE
 290  WRITE(IOUT,300)
 300  FORMAT(1X,'DO YOU WISH TO WRITE THIS INPUT TO A FILE ?')
      READ(IIN,50,ERR=290,END=9999)ANS
      IF(ANS.EQ.1HN)GO TO 330
 310  WRITE(IOUT,320)
 320  FORMAT(1X,'WHAT IS THE NEW FILE NAME ?')
      READ(IIN,80,ERR=310,END=9999)FNAM1
      OPEN(UNIT=7,FILE=FNAM1,STATUS='NEW')
 325  WRITE(IOUT,326)
 326  FORMAT(1X,'WHAT IS THE TITLE OF THE TRAJECTORY ?')
      READ(IIN,85,ERR=325,END=9999)TITLE
      WRITE(7,85)TITLE
      WRITE(7,90)BFLAG,W(50)
```

```
      IF(BFLAG.EQ.0)WRITE(7,99)(W(50+I),W(100+I),W(150+I),
     $ W(210+I),I=1,NPTS)
      IF(BFLAG.EQ.1)WRITE(7,100)(W(50+I),W(100+I),W(150+I),
     $ W(210+I),W(650+I),I=1,NPTS)
      CLOSE(UNIT=7,STATUS='KEEP')
 330  WRITE(IOUT,340)
 340  FORMAT(/,1X,'TRAJECTORY INPUT IS COMPLETE')
      RETURN
C ---------------------------------------------------------------
C     CHANGE A LINE OF TRAJECTORY
 400  CONTINUE
      WRITE(IOUT,410)
 410  FORMAT(1X,'WHICH LINE DO YOU WISH TO CHANGE ?')
      READ(IIN,*,ERR=400,END=9999)LINE
 420  IF(BFLAG.EQ.0)WRITE(IOUT,120)LINE,W(50+LINE),W(100+LINE),
     $ W(150+LINE),W(210+LINE)
      IF(BFLAG.EQ.1)WRITE(IOUT,120)LINE,W(50+LINE),W(100+LINE),
     $ W(150+LINE),W(210+LINE),W(650+LINE)
 430  IF(BFLAG.EQ.0.AND.MFLAG.EQ.0)WRITE(IOUT,440)LINE
      IF(BFLAG.EQ.0.AND.MFLAG.EQ.1)WRITE(IOUT,441)LINE
      IF(BFLAG.EQ.1.AND.MFLAG.EQ.0)WRITE(IOUT,442)LINE
      IF(BFLAG.EQ.1.AND.MFLAG.EQ.1)WRITE(IOUT,443)LINE
 440  FORMAT(/,1X,'TIME(SEC),ALTITUDE(FT),VELOCITY(FT/SEC),',
     $ 'ANGLE OF ATTACK(DEG)',/,1X,I2)
 441  FORMAT(/,1X,'TIME(SEC),ALTITUDE(M),VELOCITY(M/SEC),',
     $ 'ANGLE OF ATTACK(DEG)',/,1X,I2)
 442  FORMAT(/,1X,'TIME(SEC),ALTITUDE(FT),VELOCITY(FT/SEC),',
     $ 'ANGLE OF ATTACK(DEG),BETA(DEG)',/,1X,I2)
 443  FORMAT(/,1X,'TIME(SEC),ALTITUDE(M),VELOCITY(M/SEC),',
     $ 'ANGLE OF ATTACK(DEG),BETA(DEG)',/,1X,I2)
      IF(BFLAG.EQ.0)READ(IIN,*,ERR=430,END=9999)W(50+LINE),
     $ W(100+LINE),W(150+LINE),W(210+LINE)
      IF(BFLAG.EQ.1)READ(IIN,*,ERR=430,END=9999)W(50+LINE),
     $ W(100+LINE),W(150+LINE),W(210+LINE),W(650+LINE)
      GO TO 210
C ---------------------------------------------------------------
C     ADD A LINE TO TRAJECTORY
 500  CONTINUE
      WRITE(IOUT,510)
 510  FORMAT(1X,'WHAT IS THE NUMBER OF THE LINE YOU WISH TO ADD ?')
      READ(IIN,*,ERR=500,END=9999)LINE
      DO 600 K=NPTS,LINE,-1
      J=K+1
      W(50+J)=W(50+K)
      W(100+J)=W(100+K)
      W(150+J)=W(150+K)
      W(210+J)=W(210+K)
      W(650+J)=W(650+K)
 600  CONTINUE
 520  IF(BFLAG.EQ.0.AND.MFLAG.EQ.0)WRITE(IOUT,440)LINE
      IF(BFLAG.EQ.0.AND.MFLAG.EQ.1)WRITE(IOUT,441)LINE
      IF(BFLAG.EQ.1.AND.MFLAG.EQ.0)WRITE(IOUT,442)LINE
      IF(BFLAG.EQ.1.AND.MFLAG.EQ.1)WRITE(IOUT,443)LINE
      IF(BFLAG.EQ.0)READ(IIN,*,ERR=520,END=9999)W(50+LINE),
     $ W(100+LINE),W(150+LINE),W(210+LINE)
```

```
      IF(BFLAG.EQ.1)READ(IIN,*,ERR=520,END=9999)W(50+LINE),
     $ W(100+LINE),W(150+LINE),W(210+LINE),W(650+LINE)
      NPTS=NPTS+1
      W(50)=FLOAT(NPTS)
      GO TO 210
C ---------------------------------------------------------------------
C     DELETE A LINE OF TRAJECTORY
 700  CONTINUE
      WRITE(IOUT,710)
 710  FORMAT(1X,'WHAT IS THE NUMBER OF THE LINE YOU WISH TO DELETE ?')
      READ(IIN,*,ERR=700,END=9999)LINE
      DO 800 J=LINE,NPTS-1
      K=J+1
      W(50+J)=W(50+K)
      W(100+J)=W(100+K)
      W(150+J)=W(150+K)
      W(210+J)=W(210+K)
      W(650+J)=W(650+K)
 800  CONTINUE
      NPTS=NPTS-1
      W(50)=FLOAT(NPTS)
      GO TO 210
 8888 CONTINUE
      WRITE(IOUT,350)FNAM1
 350  FORMAT(1X,'CANNOT OPEN ',A20)
      GO TO 60
 9999 CONTINUE
      CALL EXIT
      END
```

ORIGINAL PAGE IS OF POOR QUALITY

```
      SUBROUTINE TRANS
C
C  ROUTINE TO CHOOSE TRANSITION OPTION
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER ANS,TFLAG,ANS1
C  MAY USE TRANSITION DATA FROM PREVIOUS CASE IF JFKS = 1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
  1   WRITE(IOUT,2)NC,NCM1
  2   FORMAT(1H1,'IS CASE ',I3,' TRANSITION DATA THE SAME ',
     $ 'FOR CASE ',I3,' ?')
      READ(IIN,130,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
  9   CONTINUE
 10   WRITE(IOUT,20)
 20   FORMAT(///,10X,' TRANSITION OPTIONS',//,1X,
     $ 'OPTIONS    1.    TIME DEPENDENT: LAM TO TURB',/,
     $ 11X,'2.    TIME DEPENDENT: TURB TO LAM',/,
     $ 11X,'3.    REYNOLDS NO. DEPENDENT',/,
     $ 11X,'4.    RE-THETA',/,
     $ 11X,'5.    MDAC-E TRANSITION',/,
     $ 11X,'6.    MDAC-E TABLE LOOK-UP',/,
     $ 11X,'7.    NAR RE VS ME TABLE LOOK-UP',/,
     $ 11X,'8.    RE-THETA/ME',//,
     $ 1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=10,END=9999)W(27)
      IT=IFIX(W(27))
      GO TO (100,200,300,400,500,600,700,800),IT
      GO TO 900
C ------------------------------ TRANSITION OPTION 1 ------
 100  WRITE(IOUT,105)
 105  FORMAT(//,1X,'1.    TIME DEPENDENT: LAM TO TURB',
     $ //,1X,'TRANSITION BEGINS AT TIME(SEC) ?')
      READ(IIN,*,ERR=100,END=9999)W(14)
 110  WRITE(IOUT,115)
 115  FORMAT(1X,'FULLY TURBULENT AT TIME(SEC) ?')
      READ(IIN,*,ERR=110,END=9999)W(20)
      IF(W(29).EQ.0.0)GO TO 118
 116  WRITE(IOUT,117)
 117  FORMAT(1X,'A VIRTUAL ORIGIN CORRECTION CANNOT BE MADE ',
     $'WITH THIS OPTION.',/,1X,'RESET VIRTUAL ORIGIN OPTION ?')
      READ(IIN,130,ERR=116,END=9999)ANS
      IF(ANS.EQ.1HY)W(29)=0.0
 118  CONTINUE
 120  WRITE(IOUT,125)
 125  FORMAT(1X,'ANY CHANGES ?')
      READ(IIN,130,ERR=120,END=9999)ANS
 130  FORMAT(A1)
      IF(ANS.EQ.1HY)GO TO 10
      GO TO 1000
C ------------------------------ TRANSITION OPTION 2 ------
 200  WRITE(IOUT,205)
```

```
 205  FORMAT(//,1X,'2.   TIME DEPENDENT: TURB TO LAM',//,1X,
     $ 'FULLY TURBULENT AT TIME(SEC) ?')
      READ(IIN,*,ERR=200,END=9999)W(14)
 210  WRITE(IOUT,215)
 215  FORMAT(1X,'LAMINAR FLOW BEGINS AT TIME(SEC) ?')
      READ(IIN,*,ERR=210,END=9999)W(20)
      IF(W(29).EQ.0.0)GO TO 218
 216  WRITE(IOUT,217)
 217  FORMAT(1X,'A VIRTUAL ORIGIN CORRECTION CANNOT BE MADE ',
     $'WITH THIS OPTION.',/,1X,'RESET VIRTUAL ORIGIN OPTION ?')
      READ(IIN,130,ERR=216,END=9999)ANS
      IF(ANS.EQ.1HY)W(29)=0.0
 218  CONTINUE
 220  WRITE(IOUT,125)
      READ(IIN,130,ERR=220,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
      GO TO 1000
C ------------------------------ TRANSITION OPTION 3 ------
 300  WRITE(IOUT,305)
 305  FORMAT(//,1X,'3.   REYNOLDS NO. DEPENDENT',//,10X,
     $ 'RE=LOCAL REYNOLDS NO. FOR FLAT PLATE OPTIONS',/,10X,
     $ 'RE=(RE-INF)D FOR SWEPT CYLINDER OPTIONS',/,1X,
     $ 'HIGHEST LAMINAR RE ?')
      READ(IIN,*,ERR=300,END=9999)W(14)
 310  WRITE(IOUT,315)
 315  FORMAT(1X,'LOWEST TURBULENT RE ?')
      READ(IIN,*,ERR=310,END=9999)W(20)
 320  WRITE(IOUT,125)
      READ(IIN,130,ERR=320,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
      GO TO 1000
C ------------------------------ TRANSITION OPTION 4 ------
 400  WRITE(IOUT,405)
 405  FORMAT(//,1X,'4.   RE-THETA DEPENDENT',//,1X,
     $ 'HIGHEST LAMINAR VALUE ?')
      READ(IIN,*,ERR=400,END=9999)W(14)
 410  WRITE(IOUT,415)
 415  FORMAT(1X,'LOWEST TURBULENT VALUE ?')
      READ(IIN,*,ERR=410,END=9999)W(20)
 420  WRITE(IOUT,125)
      READ(IIN,130,ERR=420,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
      GO TO 1000
C ------------------------------ TRANSITION OPTION 5 ------
 500  WRITE(IOUT,505)
 505  FORMAT(//,1X,'5.   MDAC-E TRANSITION: RE-THETA/',
     $ '(ME*(RHO*V/MU)**.2)',//,1X,
     $ 'HIGHEST LAMINAR VALUE ?')
      READ(IIN,*,ERR=500,END=9999)W(14)
 510  WRITE(IOUT,515)
 515  FORMAT(1X,'LOWEST TURBULENT VALUE ?')
      READ(IIN,*,ERR=510,END=9999)W(20)
 520  WRITE(IOUT,125)
      READ(IIN,130,ERR=520,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
```

```
      GO TO 1000
C ------------------------------ TRANSITION OPTION 6 ------
 600  WRITE(IOUT,605)
 605  FORMAT(//,1X,'6.    MDAC-E TABLE LOOK-UP',//,1X,
     $ 'OPTIONAL INPUT: (L)FULLY TURB/(L)TRAN ONSET',
     $ /,1X,'***** INPUT THE RATIO OR 0.0 *****',/,1X,
     $ 'INPUT DESIRED ?')
      READ(IIN,*,ERR=600,END=9999)W(28)
 610  WRITE(IOUT,125)
      READ(IIN,130,ERR=610,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
      GO TO 1000
C ------------------------------ TRANSITION OPTION 7 ------
 700  WRITE(IOUT,705)
 705  FORMAT(//,1X,'7.    NAR RE VS. ME TABLE LOOK-UP',
     $ //,1X,'NO INPUT REQUIRED')
 710  WRITE(IOUT,125)
      READ(IIN,130,ERR=710,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
      GO TO 1000
C ------------------------------ TRANSITION OPTION 8 ------
 800  WRITE(IOUT,805)
 805  FORMAT(//,1X,'8.    RE-THETA/ME DEPENDENT',//,1X,
     $ 'HIGHEST LAMINAR VALUE ?')
      READ(IIN,*,ERR=800,END=9999)W(14)
 810  WRITE(IOUT,815)
 815  FORMAT(1X,'LOWEST TURBULENT VALUE ?')
      READ(IIN,*,ERR=810,END=9999)W(20)
 820  WRITE(IOUT,125)
      READ(IIN,130,ERR=820,END=9999)ANS
      IF(ANS.EQ.1HY)GO TO 10
      GO TO 1000
C ------------------------------------- BAD OPTION ---------
 900  CONTINUE
      WRITE(IOUT,910)
 910  FORMAT(//,1X,'BAD OPTION NUMBER',//)
      GO TO 10
 1000 CONTINUE
      RETURN
 9999 CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE WNDTUN
C
C  ROUTINE FOR INPUTING ATMOSPHERIC DATA FOR WIND TUNNEL OPTION
      COMMON/WARRAY/W(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER ANS,TFLAG,ANS1
C  NPTS = NUMBER OF TIME DEPENDENT TABLE ENTRIES
C     MAY USE DATA FROM PREVIOUS CASE IF JFKS = 1 OR 3
      IF(JFKS.NE.1.AND.JFKS.NE.3)GO TO 9
      NCM1=NC-1
  1   WRITE(IOUT,2)NC,NCM1
  2   FORMAT(1H1,'IS CASE ',I3,' WIND TUNNEL DATA SAME AS ',
     $ 'FOR CASE ',I3,' ?')
      READ(IIN,80,ERR=1,END=9999)ANS
      IF(ANS.EQ.1HY)RETURN
  9   CONTINUE
      NPTS=W(50)+.0001
 10   WRITE(IOUT,20)NPTS
 20   FORMAT(///,'       WIND TUNNEL OPTION',//,
     $ ' INPUT STATIC TEMPERATURE AND PRESSURE AS A FUNCTION ',
     $ 'OF TIME.',/,' TIME AND FREESTREAM VEL. ARE INPUT ',
     $ 'IN TRAJ. DATA WITH ALT. SET = 0.0',/,1X
     $ 6(' -'),I2,' VALUES REQUIRED',6(' -'),/)
      IF(MFLAG.EQ.0)WRITE(IOUT,30)
      IF(MFLAG.EQ.1)WRITE(IOUT,31)
 30   FORMAT(1X,'T-INF(R),P-INF(LB/SFT)')
 31   FORMAT(1X,'T-INF(K),P-INF(NEWTON/SQ.M)')
      DO 1000 I=1,NPTS
 40   WRITE(IOUT,50)I
 50   FORMAT(1X,I2)
      READ(IIN,*,ERR=40,END=9999)W(450+I),W(500+I)
1000  CONTINUE
 60   WRITE(IOUT,70)
 70   FORMAT(1X,'ARE ALL INPUTS CORRECT ?')
      READ(IIN,80,ERR=60,END=9999)ANS
 80   FORMAT(A1)
      IF(ANS.EQ.1HN)GO TO 10
      RETURN
9999  CONTINUE
      CALL EXIT
      END
```

```
      SUBROUTINE UNITS
C
C  ROUTINE FOR CONVERTING TO METRIC UNITS
C  COPIES WORKING ARRAY W INTO OUTPUT ARRAY WW
      COMMON/WARRAY/W(700)
      COMMON/WWARAY/WW(700)
      COMMON/WWWARY/WWW(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
C
      INTEGER TFLAG,ANS1
C
      DO 1000 I=1,700
      WWW(I)=WW(I)
      WW(I)=W(I)
 1000 CONTINUE
C  MFLAG = 0   ENGLISH UNITS
      IF(MFLAG.EQ.0)GO TO 2000
      WW(12)=W(12)*3.28084
      WW(13)=W(13)*3.28084
      WW(22)=W(22)*3.28084
      WW(25)=W(25)*3.28084
      WW(202)=W(202)*3.28084
      WW(205)=W(205)*3.28084
      WW(354)=W(354)*3.28084
      DO 1 I=571,580
 1    WW(I)=W(I)*3.28084
      DO 2 I=101,200
 2    WW(I)=W(I)*3.28084
      DO 3 I=401,450
 3    WW(I)=W(I)*3.28084
      DO 4 I=451,500
 4    WW(I)=W(I)*1.8
      DO 5 I=501,550
 5    WW(I)=W(I)*0.0208855
      WW(316)=W(316)*8.81143E-5
      WW(21)=W(21)*4.30189E-4
      WW(24)=(W(24)*1.8-459.7)
 2000 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE OUTPUT
C
C  ROUTINE TO CREATE INPUT FILE FOR LANMIN
C
C  FNAM4  -  OUTPUT FILENAME (INPUT FILE FOR LANMIN)
      COMMON/WARRAY/W(700)
      COMMON/WWARAY/WW(700)
      COMMON/WWWARY/WWW(700)
      COMMON/UNIT/IIN,IOUT
      COMMON/PCOEFF/TMCP(50),TCPM(50),NCPMT
      COMMON/TITLE/TITL1
      COMMON/MISC/NC,JFKS,TFLAG,MFLAG,ANS1
      COMMON/STRM/ISTRM,NNC
C
      INTEGER ANS,TFLAG,ANS1
      CHARACTER*20 FNAM4
      CHARACTER*72 TITL1
      DIMENSION IS(5)
C
      IF(NC.GT.1.0)GO TO 26
C  OBTAIN OUTPUT FILE NAME AND OPEN
 10   WRITE(IOUT,20)
 20   FORMAT(1H1,10X,'CREATE OUTPUT FILE',//,1X,
     $ 'WHAT IS THE NAME OF THE OUTPUT FILE TO BE CREATED ?')
      READ(IIN,25,ERR=10,END=9999)FNAM4
      OPEN(UNIT=8,FILE=FNAM4,STATUS='NEW',ERR=8888)
 25   FORMAT(A20)
C  WRITE DATA TO OUTPUT FILE ACCORDING TO PROGRAM INPUT CONTROL
C  PARAMETER OF PREVIOUS CASE
 26   CONTINUE
      IF(JFKS.NE.0)GO TO (100,9999,30,30,100,30),JFKS
 30   IF(TFLAG.NE.1)GO TO 33
      WRITE(IOUT,31)NC
 31   FORMAT(1X,'DO YOU WISH TO CHANGE THE TITLE FOR CASE ',I3)
      READ(IIN,32,ERR=30,END=9999)ANS
 32   FORMAT(A1)
      IF(ANS.EQ.1HN)GO TO 52
 33   WRITE(IOUT,40)NC
 40   FORMAT(/,1X,'WHAT IS THE TITLE FOR CASE ',I3,' ? ',5X,
     $ '(NOTE: 72 CHAR. LIMIT)')
      READ(IIN,50,ERR=33,END=9999)TITL1
 50   FORMAT(A72)
C ---------------------------------------------------- TITLE ----
 52   WRITE(8,55)TITL1
 55   FORMAT(A72)
C ------------------ TIMING PARAMETERS AND PRINT CONTROL ----
      WRITE(8,60)(WW(I),I=1,8)
 60   FORMAT(3F20.3)
      IF(JFKS.EQ.3.OR.JFKS.EQ.6)GO TO 100
C ------------ NUMBER OF TIME DEPENDENT TRAJ TABLE ENTRIES --
      WRITE(8,70)WW(50)
 70   FORMAT(3F20.3,2F10.3)
      N=WW(50)+.001
      NT=50+N
C ------------------ ----------------------- TRAJ DATA -------
```

```
      WRITE(8,70)(WW(K),WW(K+50),WW(K+100),WW(K+160),WW(K+600),
     $ K=51,NT)
C ----------------------------------------- CASE DATA -------
C IF IZFLAG = 1 THEN THE ZERO VALUE FOR THE W MUST BE PRINTED
 100  J=9
 110  JS=1
 120  IF(JS.GT.5)GO TO 130
      IZFLAG=0
      IF(J.GT.49.AND.J.LT.201)J=201
      IF(J.GT.210.AND.J.LT.261)J=261
      IF(J.GT.700)GO TO 200
      IF(J.EQ.641)J=J+1
      IF(WW(J).EQ.0.0.AND.WWW(J).NE.0.0)IZFLAG=1
      IF(WW(J).NE.0.0.OR.IZFLAG.EQ.1)IS(JS)=J
      IF(J.EQ.649.AND.WW(J).GT.0.0)GO TO 300
      IF(WW(J).GT.1000.0.OR.WW(J).LT.1.0.AND.WW(J).GT.0.0)GO TO 400
      IF(WW(J).NE.0.0.OR.IZFLAG.EQ.1)JS=JS+1
      J=J+1
      GO TO 120
C --------------- WRITE CASE DATA TO OUTPUT FILE ---------------
 130  WRITE(8,80)(IS(K),WW(IS(K)),K=1,5)
 80   FORMAT(5(I3,F9.4,1X))
 81   FORMAT(5(I3,F9.7,1X))
 82   FORMAT(5(I3,F9.1,1X))
      GO TO 110
C ----------- WRITE PROGRAM INPUT CONTROL PARAMETERS FOR CASE ---
 200  IS(JS)=641
      WRITE(8,80)(IS(K),WW(IS(K)),K=1,JS)
C -------------------------- CHECK FOR STREAMLINE CASES --------
      IF(ISTRM.EQ.1)GO TO 500
 250  CONTINUE
      IF(INSERT.EQ.0)JFKS=WW(641)+.0001
      IF(JFKS.EQ.2)CLOSE(UNIT=8)
      RETURN
C ------------------------- PRESSURE COEFFICIENT INPUT TABLES ---
 300  CONTINUE
      WRITE(8,80)(IS(K),WW(IS(K)),K=1,JS)
      WRITE(8,90)NCPMT
 90   FORMAT(I3)
      WRITE(8,95)(TMCP(K),TCPM(K),K=1,NCPMT)
 95   FORMAT(2F10.6)
      J=J+1
      GO TO 110
C - OPTIONAL FORMAT FOR WRITING CASE DATA TO OUTPUT FILE -------
 400  CONTINUE
      IF(JS-1.GE.1)WRITE(8,80)(IS(K),WW(IS(K)),K=1,JS-1)
      IF(WW(J).LT.1000.)WRITE(8,81)J,WW(J)
      IF(WW(J).GE.1000.)WRITE(8,82)J,WW(J)
      J=J+1
      GO TO 110
C ------ COPY STREAMLINE CASES FROM TEMPORARY STREAMLINE FILE --
 500  CONTINUE
      READ(4,80)J1,W(J1),J2,W(J2),J3,W(J3),J4,W(J4),J5,W(J5)
      READ(4,80)J6,W(J6)
      WRITE(8,80)J1,W(J1),J2,W(J2),J3,W(J3),J4,W(J4),J5,W(J5)
```

```
      IF(W(J1).EQ.NNC-1)GO TO 510
      WRITE(8,80)J6,W(J6)
      GO TO 500
C CHOOSE PROGRAM INPUT CONTROL PARAMETER FOR LAST STREAMLINE CASE
 510  CONTINUE
      WRITE(IOUT,520)
 520  FORMAT(//,10X,'INPUT CONTROL FLAG',//,
     $ 1X,'1.   NEW CASE FOLLOWS USING TITLE,TIMING AND TRAJ. ',
     $ /,6X,'DATA FROM PREVIOUS CASE',/,
     $ 1X,'2.   END OF INPUT (LAST CASE)',/,
     $ 1X,'3.   NEW CASE FOLLOWS USING TRAJ.DATA FROM PREVIOUS ',
     $ 'CASE.',/,6X,'NEW TITLE AND TIMING. INITIAL CASE DATA ',
     $ 'UNCHANGED.',/,
     $ 1X,'4.   NEW CASE FOLLOWS USING NEW TITLE,TIMING,TRAJ. ',
     $ 'AND CASE DATA.',/,6X,'(INITIALLY ZERO W ARRAY)',/,
     $ 1X,'5.   SAME AS (1) EXCEPT ZERO ALL CASE DATA FROM ',
     $ 'PREVIOUS CASE',/,
     $ 1X,'6.   SAME AS (3) EXCEPT INITIALIZE ZERO ALL TIMING ',
     $ 'AND CASE DATA',//,
     $ 1X,'OPTION SELECTED ?')
      READ(IIN,*,ERR=510,END=9999)W(J6)
      WRITE(8,80)J6,W(J6)
      CLOSE(UNIT=4,STATUS='DELETE')
      NC=W(647)+.0001
      GO TO 250
 8888 CONTINUE
      WRITE(IOUT,8889)FNAM4
 8889 FORMAT(/,1X,'CANNOT OPEN ',A20,/)
      GO TO 10
 9999 CONTINUE
      CALL EXIT
      END
```

END

DATE

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