



MINIVER UPGRADE FOR THE AVID SYSTEM

VOLUME II: LANMIN INPUT GUIDE

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FOREWORD

This final report presents work which was conducted for Langley 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		LESID2		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		FLOTS		
	DINT	PMEXP	PMEXP		
	DINT1	PMID	PMID		
DOWNID	DOWNID		#PRINTA		
	#DRIVEL	RADEQT*	RADEQT		
DSTM		REGIME			
DWNSTM*	DWNSTM	RHOMUR	RHOMUR		
ECKERT	ECKERT	SLOPE	#SETMUP		
EDPARM	EDPARM	SPCHI*	SPCHI		
ERF		SPFP			
FAYRID*	FAYRID		#STABLE		
FINE		STHEAT			
FINPKH			#STOCK		
FINPKP		SWCYL	SWCYL		
	#FINALT	SWCYL2*	SWCYL2		
FLAPH					
FLOW*	FLOW				
FMHEAT					
FSUBC*	FSUBC				
	#GUASS				
HANSEN*	HANSEN				
	#INOUIR				

*These Subroutines Have Been Modified.

#Conduction Related Subroutines.

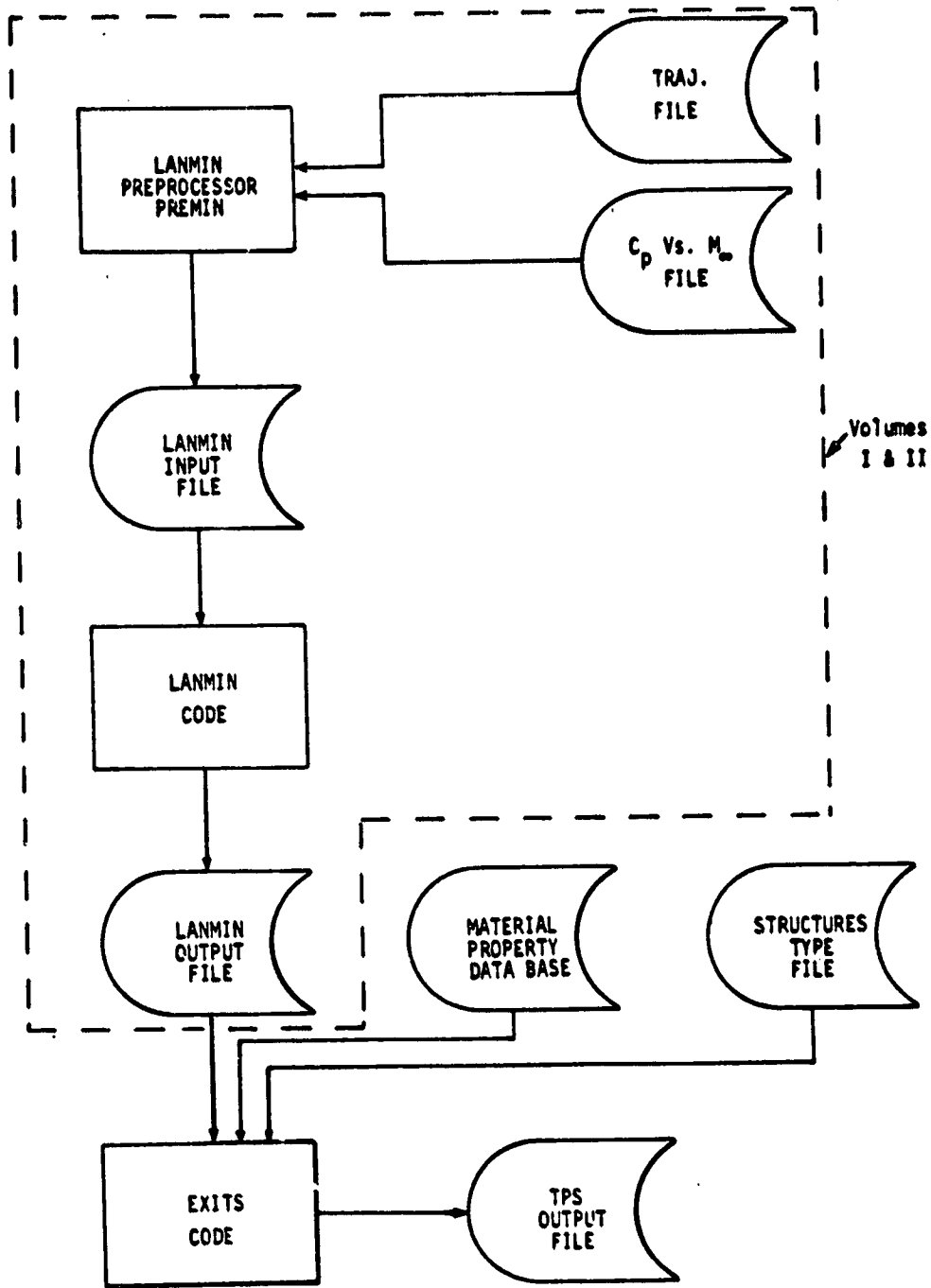


Fig. 1.1 Overall Information Flow

ORIGINAL COPY OF POOR QUALITY

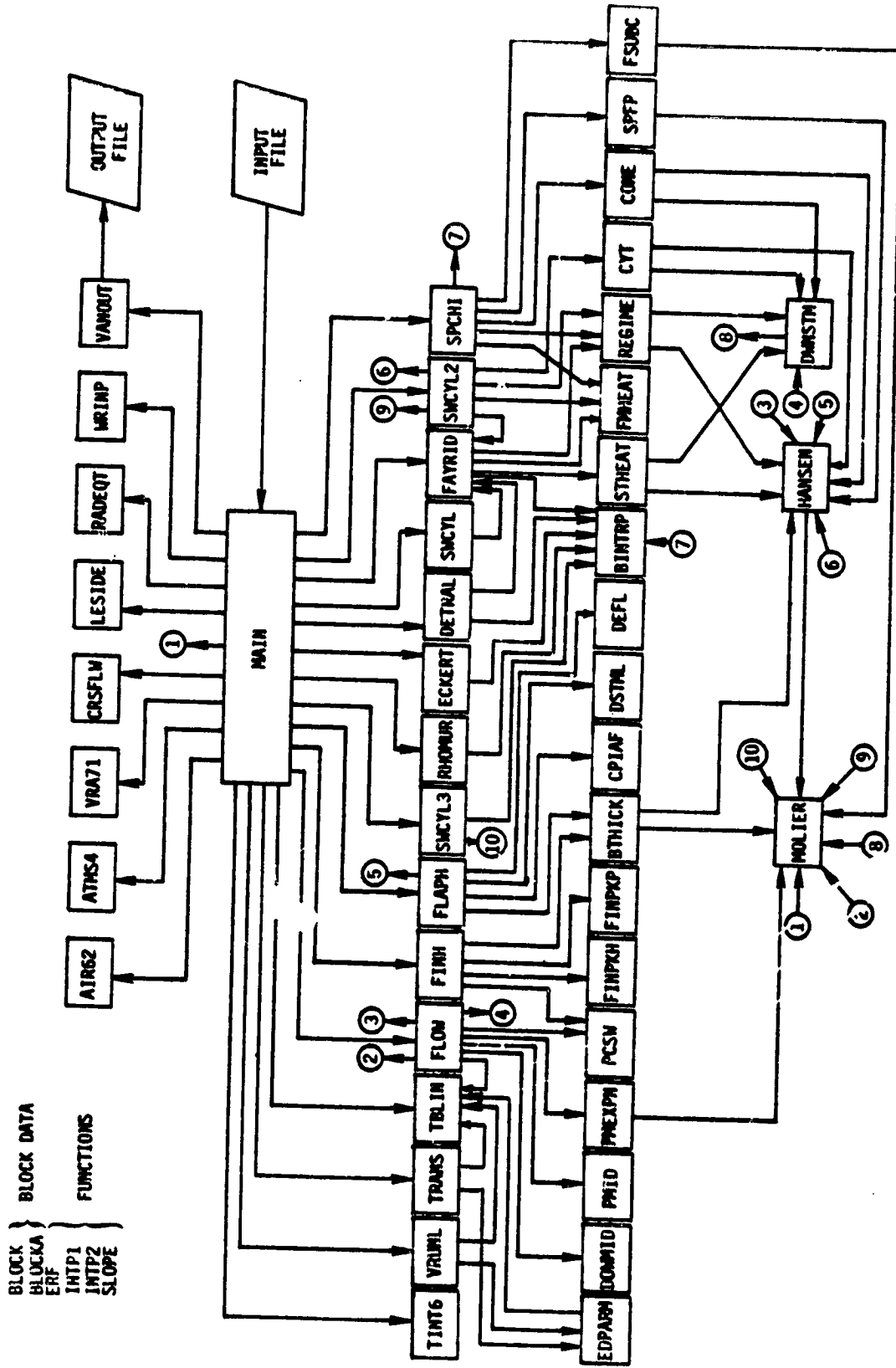


Fig. 1.2 LANMIN Macro Flow Diagram

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 $TCPM() = C_p$, $TMCP() = M_\infty$, $NCPMT =$ 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) CROSSEFLOW DATA

Format 5(I3, A. 5)

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, R_c , 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, D_o , 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 $(90-\lambda)$.

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_{θ} . Input requirements are the onset Reynolds number (PARA1, location 014) and the fully turbulent Reynolds number (PARA2, location 020).
4. Transition based on R_{θ}^* . Input requirements are onset Reynolds number (PARA1, 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,

$$\psi = R_{\theta}^* [M_{\infty} (\rho_{\infty} U_{\infty} / \mu_{\infty})^{0.2}]$$

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,

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

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 $\log_{10} R_{\theta}$ versus ratio.

7. Transition based on built in curve data of onset $R_{\theta, \text{TR}}$ versus M_{∞} (Rockwell International criteria). Transition zone length determined in the same manner as option 6.
8. Transition based on $R_{\theta}^* / M_{\infty}$. Input requirements are onset value (PARA1, location 014) and the fully turbulent value (PARA2, location 020). Nominal values are 150. and $\sqrt{2} \times 150$ 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)
	<ol style="list-style-type: none">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 $\rho_x \mu_x$ 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 $\rho_x \mu_x$ 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, Leaside 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 (HIFLAG = 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) ($\log_{10} h_1/h_u$) _{LAN}
381-390	Multiplier Table (Turbulent) ($\log_{10} h_1/h_u$) _{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 $S = (P_r)^{2/3} \quad \text{(Generally used for design)}$
	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_∞ , C_p (2F10.6)
 Card 3 M_∞ , C_p (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
 TTIL1 - 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 Param-

ters 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:

FNAMI - The filename of the trajectory file.
LINE - The number of a line at the trajectory table.
TITLE - Title of the trajectory file.
RFLAG=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 then 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 abbreviations 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. FNAMS 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 angle 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 case, 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 co-

pies 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.

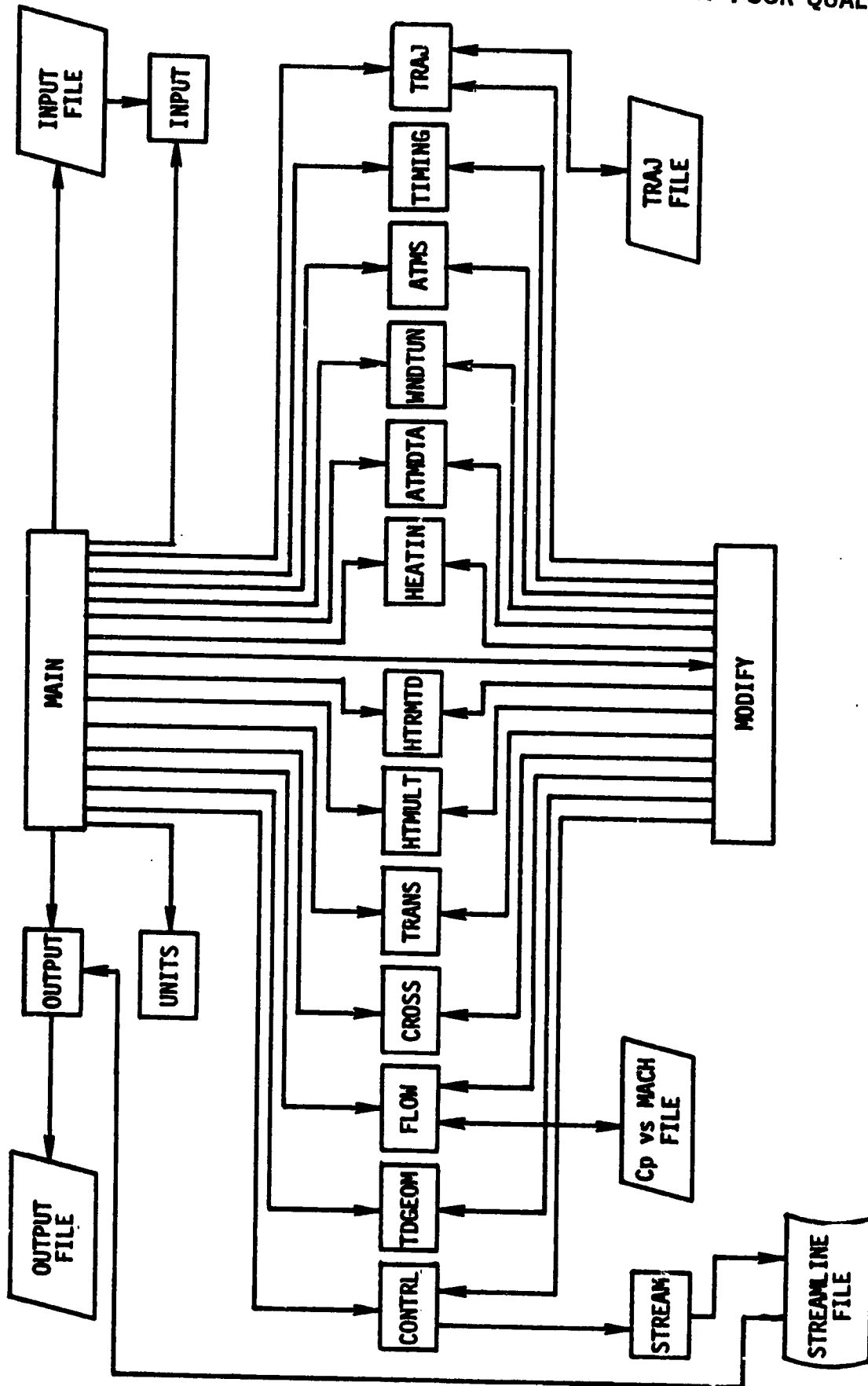


Fig. 3.1 PREMIN Macro Flow Diagram

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 printcut 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 illustrated 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	$\rho\mu$ 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	(LEA/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/SF1-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 MFT	VEL FT/SEC	MACH NO	ANGLE ATTACH	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		
25.0	396.3	28565.1	19.24	41.13	249+001	645-005	.113+005	198.9	.694-001	.208+001	.125+001	RARE		
50.0	388.0	28500.2	20.54	41.20	444+001	877-005	.113+005	251.1	.943-001	.444+001	.204+001	RARE		
75.0	371.5	28595.5	21.85	41.25	628+001	122-004	.112+005	313.5	.131+000	.772+001	.365+001	RARE		
100.0	359.1	28610.3	23.30	41.23	164+002	176-004	.112+005	385.2	.189+000	.124+002	.617+001	RARE		
125.0	346.7	28626.4	24.21	41.05	310+002	250-004	.112+005	462.6	.269+000	.192+002	.109+000	RARE		
150.0	334.5	28637.6	25.23	40.63	614+002	363-004	.112+005	554.2	.390+000	.289+002	.199+000	RARE		
175.0	324.5	28648.1	26.14	40.52	124+003	537-004	.112+005	655.4	.576+000	.433+002	.378+000	RARE		
200.0	315.5	28656.9	26.87	40.63	251+003	801-004	.112+005	771.5	.840+000	.648+002	.731+000	RARE		
225.0	299.3	28658.3	27.62	41.20	508+003	140-003	.112+005	904.5	.129+001	.971+002	.144+001	RARE		
250.0	288.1	28657.6	27.89	41.89	980+003	179-003	.113+005	1045.9	.193+001	.145+003	.280+001	RARE		
275.0	277.3	28635.7	27.86	41.52	174+004	253-003	.112+005	1180.8	.271+001	.213+003	.471+001	RARE		
300.0	260.9	28516.6	27.00	40.26	402+004	301-003	.111+005	1178.0	.269+001	.280+003	.775+001	LAM		
							.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 ATTACH	REYNOLDS NO./M	HEAT COEF KG/50-M-S	REC ENTHALPY JOULES/KGM	RAD EQUIL DEG K	HEAT RATE WATTS/50-M	HEAT LOAD JOULES/50-M	PRESSURE N/50-M	FLOW TYPE		
25.0	120.6	7487.4	19.24	41.13	817+001	315+004	.262+008	365.9	.780+003	.236+005	.599+000	RARE		
50.0	117.0	7492.1	20.54	41.20	146+002	428+004	.262+008	394.9	.107+004	.504+005	.975+000	RARE		
75.0	113.2	7496.7	21.85	41.25	272+002	596+004	.261+008	429.6	.149+004	.676+005	.165+001	RARE		
100.0	109.4	7501.2	23.30	41.23	539+002	857+004	.261+008	469.4	.214+004	.141+006	.295+001	RARE		
125.0	105.7	7505.5	24.21	41.05	102+003	122+003	.261+008	512.4	.305+004	.217+006	.522+001	RARE		
150.0	102.0	7509.5	25.23	40.63	401+003	177+003	.261+008	563.3	.442+004	.328+006	.950+001	RARE		
175.0	98.3	7514.7	26.14	40.52	408+003	262+003	.261+008	619.5	.653+004	.491+006	.181+002	RARE		
200.0	94.7	7515.4	26.87	40.63	824+003	391+003	.261+008	684.0	.975+004	.735+006	.350+002	RARE		
225.0	91.2	7515.9	27.62	41.20	167+004	587+003	.261+008	757.9	.147+005	.116+007	.690+002	RARE		
250.0	87.8	7515.7	27.89	41.89	322+004	876+003	.262+008	836.5	.220+005	.165+007	.134+003	RARE		
275.0	84.7	7507.8	27.86	40.52	570+004	124+002	.260+008	911.4	.307+005	.242+007	.226+003	RARE		
300.0	81.6	7496.7	27.82	39.53	979+004	123+002	.259+008	909.8	.305+005	.318+007	.371+003	LAM		
	79.5	7474.7	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 = Δt_1 (delta time step between time t1 and t2)
- W(3) - T2 = t2 (time 2)
- W(4) - DT2 = Δt_2 (delta time step between t2 and t3)
- W(5) - T3 = t3 (time 3)
- W(6) - DT3 = Δt_3 (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 (NEFLAG = 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) - PF. (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) = F_i Length to Point of interest for Heat Transfer Option 11 (ft)
- W(26) = Fin Angle $\alpha = \beta = 0$ 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) |
- W(34) = GF(4) = FF(4) | -----> Flowfield and local pressure option flags
- 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) _____
 : |
 : | —————> (Trajectory Time, sec)
 W(100) = TZ(50) _____
 W(101) = ZZ(1) _____
 : |
 : | —————> (Trajectory Altitude, feet)
 W(150) = ZZ(50) _____
 W(151) = VZ(1) _____
 : |
 : | —————> (Trajectory Velocity, ft/sec)
 W(200) = VZ(50) _____
 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, U)
 W(205) = CORNR (rectangle corner radius, R_o (ft))
 W(206) = _____
 : |
 : | —————> (Open Locations)
 W(208) = _____
 W(209) = CONFLG (continuity option)
 W(210) = (Open Location)
 W(211) = A1(1) _____
 : |
 : | —————> (Trajectory positive α , degree)
 W(260) = A1(50) _____
 W(261) = 1. _____ Built into α_{eff} added to W(37):
 | If (W(261).LE.0)W(261)=1.0
 —————>
 W(262) = 2. _____ program α_{eff} added to W(38):
 | If (W(262).LE.0)W(262)=2.0

W(263)= 3.-----	Values	α_{off}	added to W(39)
W(264)= 4.-----	must be	α_{off}	added to W(40)
W(265)= 5.-----	input for	α_{off}	added to W(41)
W(266)= 6.-----	to be	α_{off}	added to W(42)
W(267)= 7.-----	added to	α_{off}	added to W(43)
W(268)= 8.-----	body	α_{off}	added to W(44)
W(269)= 9.-----	angle	α_{off}	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)-----
 : |
 : |-----> (Log₁₀) (M_∞)
 W(370)= TMACH(10)-----
 W(371)= AKL3(1)-----
 : |
 : |-----> (Log₁₀ h₁/h_∞) laminar multiplier
 W(380)= AKL3(10)-----
 W(381)= AKT3(1)-----
 : |
 : |-----> (Log₁₀ h₁/h_∞) 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)——
 :
 :
 :
 W(500)= FSTEMP(50)——
 :
 :
 :
 W(501)= FSPRES(1)——
 :
 :
 :
 W(550)= FSPRES(50)——
 :
 :
 :
 W(551)= ————
 :
 :
 :
 W(559)= ————
 :
 :
 :
 W(560)= ENT3 (Number of Table Entries for Geometry as Function of Time)
 W(561)= TMZ(1)——
 :
 :
 :
 W(570)= TMZ(10)——
 :
 :
 :
 W(571)= RNZ(1)——
 :
 :
 :
 W(580)= RNZ(10)——
 :
 :
 :
 W(581)= ELZ(1)——
 :
 :
 :
 W(590)= ELZ(10)——
 :
 :
 :
 W(591)= PHIZ(1)——
 :
 :
 :
 W(600)= PHIZ(10)——
 :
 :
 :
 W(601)= ————
 :
 :
 :
 W(610)= ————
 :
 :
 :
 W(611)= Body Point Number

——> (Table of wind tunnel freestream temperatures, R)

——> (Table of wind tunnel freestream pressure, lb/sq ft)

——> (Open Locations)

——> (Body Geometry is Varying with Time, Sec)

——> (Nose Radius, Ft)

——> (Running Length, Ft)

——> (Local Slope or Sweep Angle, Degree)

——> (Open Locations)

W(612)= _____
 . |
 . |
 . | _____> (Open Locations)
 W(640)= _____
 W(641)= JFK (Input Control Flag)
 W(642)= JFQQ (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.

Heating Indicator Sample Case

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 preceding 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 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)

0.0

PRINTOUT INTERVAL 1 (SEC)

25.0

DELTA TIME

SECOND TIME (SEC)

500.0

PRINTOUT INTERVAL 2 (SEC)

14.0

DELTA TIME

THIRD TIME (SEC)

1200.0

PRINTOUT INTERVAL 3 (SEC)

29.0

DELTA TIME

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

ORIGINAL PAGE IS
 OF POOR QUALITY

	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	0.8910E+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 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 ?

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.

***** 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 ?
OUTPUT.FIL

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

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

TRAJECTORY FILE LISTING
HEATING INDICATOR CASE

ORIGINAL PAGE 19
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	0.5744E+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

ORIGINAL VALUE
OF POOR QUALITY

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			
	30.000				
	300	396300.000	24570.000	41.130	0.000
	40.300	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

ORIGINAL PAGE IS
OF POOR QUALITY

	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 FIG. 3.13
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

CRITICAL POINT
OF POOR QUALITY

135.30	329500.	24640.	40.460
180.30	308000.	24660.	40.650
225.30	288000.	24660.	41.900
270.30	269700.	24610.	39.390
315.30	256300.	24470.	40.710
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.	39.070
569.30	238800.	22680.	39.320
593.30	237700.	22470.	39.020
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
1240.00	150000.	8336.	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	-3.	702.	-1.220

1963 PAFB STD ATMOSPHERE

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

OF POOR QUALITY

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	.688+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	.738-001	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	1453.8	.371+001	.191+003	.229+000	LAM
125.0	334.5	24635.4	25.23	40.63	.586+002	.597-003	.122+005	1609.3	.689+001	.363+003	.429+000	LAM
150.0	322.5	24646.5	26.14	40.92	.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	24660.0	27.62	41.20	.486+003	.199-002	.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	2391.8	.266+002	.211+004	.565+001	LAM
250.0	278.0	24632.6	27.87	40.52	.165+004	.293-002	.122+005	2598.5	.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	.461+002	.414+004	.169+002	LAM
300.0	260.9	24517.6	27.01	40.26	.382+004	.458-002	.121+005	2944.3	.548+002	.551+004	.241+002	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	.198+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	.746-002	.102+005	3208.8	.755+002	.259+005	.636+002	LAM
598.0	237.5	22426.9	23.53	39.07	.955+004	.749-002	.101+005	3202.2	.751+002	.270+005	.643+002	LAM
612.0	236.8	22298.6	23.36	39.20	.974+004	.752-002	.100+005	3194.9	.745+002	.280+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	.650+002	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	.688+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	.686+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	.708+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	.138+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

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 LBH/SFT-S	REC ENTHALPY BTU/LBH	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	.695+004	3110.2	.713+002	.502+005	.141+003	LAN
934.0	205.0	17646.4	17.33	40.40	.258+005	.111-001	.632+004	3077.2	.689+002	.511+005	.142+003	LAN
948.0	203.2	17308.1	16.94	41.56	.270+005	.113-001	.608+004	3051.5	.673+002	.521+005	.147+003	LAN
962.0	200.6	16948.0	16.51	41.60	.289+005	.116-001	.584+004	3033.8	.663+002	.530+005	.155+003	LAN
976.0	197.5	16574.7	16.05	40.96	.315+005	.120-001	.559+004	3021.0	.658+002	.539+005	.168+003	LAN
990.0	194.5	16181.0	15.59	40.82	.341+005	.124-001	.533+004	3000.0	.647+002	.548+005	.179+003	LAN
1004.0	191.6	15777.5	15.12	40.64	.368+005	.127-001	.508+004	2974.1	.632+002	.557+005	.189+003	LAN
1018.0	188.7	15345.8	14.63	40.13	.396+005	.130-001	.481+004	2935.5	.609+002	.566+005	.197+003	LAN
1032.0	185.9	14902.5	14.15	39.74	.423+005	.132-001	.454+004	2895.6	.587+002	.574+005	.206+003	LAN
1046.0	183.2	14447.5	13.66	39.49	.450+005	.134-001	.428+004	2849.0	.560+002	.582+005	.213+003	LAN
1060.0	181.2	13992.5	13.19	39.48	.466+005	.133-001	.401+004	2781.5	.520+002	.589+005	.212+003	LAN
1074.0	179.5	13537.5	12.73	39.54	.478+005	.134-001	.377+004	2723.2	.489+002	.596+005	.214+003	LAN
1088.0	177.7	13082.5	12.27	39.67	.491+005	.132-001	.350+004	2644.3	.447+002	.602+005	.212+003	LAN
1102.0	175.7	12627.5	11.81	39.59	.507+005	.132-001	.330+004	2590.2	.421+002	.608+005	.214+003	LAN
1116.0	173.4	12172.5	11.36	39.12	.530+005	.133-001	.307+004	2527.6	.393+002	.613+005	.216+003	LAN
1130.0	170.6	11713.8	10.89	38.64	.560+005	.134-001	.285+004	2465.6	.367+002	.619+005	.221+003	LAN
1144.0	167.7	11252.9	10.43	38.16	.595+005	.135-001	.264+004	2403.6	.343+002	.623+005	.227+003	LAN
1158.0	164.5	10797.5	9.98	37.50	.639+005	.138-001	.244+004	2344.2	.321+002	.628+005	.235+003	LAN
1172.0	161.4	10351.1	9.55	36.85	.682+005	.139-001	.226+004	2280.5	.299+002	.632+005	.241+003	LAN
1186.0	159.1	9936.2	9.17	36.28	.716+005	.140-001	.209+004	2212.7	.276+002	.636+005	.242+003	LAN
1200.0	156.7	9521.4	8.79	35.70	.753+005	.140-001	.193+004	2142.8	.254+002	.639+005	.243+003	LAN
1229.0	151.8	8662.0	8.03	34.52	.834+005	.140-001	.161+004	1990.5	.210+002	.646+005	.245+003	LAN
1258.0	145.3	7877.6	7.35	32.37	.997+005	.144-001	.135+004	1855.0	.179+002	.651+005	.243+003	LAN
1287.0	137.8	7139.0	6.73	29.62	.126+006	.152-001	.113+004	1726.8	.155+002	.655+005	.249+003	LAN
1316.0	130.2	6437.5	6.14	27.04	.160+006	.159-001	.937+003	1585.0	.132+002	.659+005	.334+003	LAN
1345.0	122.5	5775.6	5.57	24.63	.205+006	.168-001	.773+003	1437.0	.111+002	.662+005	.380+003	LAN
1374.0	115.6	5135.9	5.01	22.60	.253+006	.172-001	.631+003	1268.1	.094+001	.665+005	.410+003	LAN
1403.0	110.4	4538.1	4.46	21.30	.288+006	.168-001	.514+003	1085.0	.677+001	.667+005	.405+003	LAN
1432.0	104.5	3953.0	3.92	19.90	.333+006	.164-001	.413+003	895.3	.497+001	.668+005	.405+003	LAN
1461.0	96.5	3416.5	3.43	18.12	.428+006	.167-001	.332+003	715.5	.371+001	.669+005	.442+003	LAN
1490.0	88.7	2884.7	2.92	16.29	.534+006	.167-001	.263+003	529.9	.255+001	.670+005	.467+003	LAN
1519.0	82.7	2416.0	2.46	13.66	.603+006	.157-001	.212+003	368.9	.159+001	.671+005	.440+003	LAN
1548.0	76.8	1947.3	2.00	11.04	.663+006	.142-001	.170+003	220.9	.042+000	.671+005	.395+003	LAN
1577.0	68.1	1582.3	1.65	9.52	.861+006	.140-001	.141+003	116.0	.433+000	.671+005	.424+003	LAN
1606.0	59.3	1224.9	1.30	8.09	.110+007	.134-001	.118+003	26.7	.107+000	.671+005	.448+003	LAN
1635.0	51.6	1020.8	1.09	7.76	.138+007	.144-001	.108+003	-13.0	-.297-001	.671+005	.511+003	LAN
1664.0	44.2	856.6	.90	7.73	.157+007	.152-001	.105+003	-25.4	-.781-001	.671+005	.583+003	LAN
1693.0	37.4	763.5	.78	7.53	.175+007	.164-001	.108+003	-15.5	-.458-001	.671+005	.716+003	LAN
1722.0	30.8	707.9	.70	7.23	.194+007	.180-001	.112+003	4.1	.357-001	.671+005	.894+003	LAN
1751.0	24.7	660.6	.63	6.89	.212+007	.194-001	.117+003	23.7	.131+000	.671+005	.110+004	LAN
1780.0	19.0	621.0	.58	5.92	.230+007	.208-001	.121+003	40.9	.228+000	.671+005	.132+004	LAN
1809.0	13.3	581.5	.53	5.14	.250+007	.222-001	.125+003	55.5	.323+000	.671+005	.199+004	LAN
1838.0	7.6	542.0	.49	4.37	.271+007	.235-001	.128+003	67.8	.413+000	.671+005	.190+004	LAN
1867.0	3.0	478.6	.43	3.24	.269+007	.237-001	.130+003	75.5	.463+000	.671+005	.217+004	LAN
1896.0	1.5	340.3	.30	1.01	.198+007	.202-001	.129+003	70.1	.371+000	.671+005	.215+004	LAN
1925.0	.0	202.0	.18	-1.22	.122+007	.158-001	.128+003	67.5	.286+000	.672+005	.217+004	LAN
1954.0	.0	202.0	.18	-1.22	.122+007	.158-001	.128+003	67.5	.286+000	.672+005	.217+004	LAN

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 listing 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 SWEEP 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 SWEEP CYLINDER METHOD
 7. BOEING RHO-MU SWEEP 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

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 SWEEP 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 SWEEP CYLINDER METHOD
 7. BOEING RHO-MU SWEEP 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) ?

.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 -----

- 1. FLOWFIELD TYPE NOT NEEDED
- 1. SHARP WEDGE SHOCK ANGLE
- 2. SHARP CONE SHOCK ANGLE
- 3. OBLIQUE AND NORMAL SHOCK (90 DEG)
- 4. PARALLEL SHOCK (PRES NOT NEEDED)

----- PRESSURE -----

- 1. PRESSURE TYPE NOT NEEDED
- 1. INPUT CP VS MACH NO. TABLE
- 2. TANGENT WEDGE PRESSURE
- 3. TANGENT CONE PRESSURE
- 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
?	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), RADIUS (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), RADIUS (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 SWEEP 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 SWEEP CYLINDER METHOD
 7. BOEING RHO-MU SWEEP 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

SET1		TOTAL EFFECTIVE ANGLE	
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), RADIUS (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

LAMIN OUTPUT
WIND TUNNEL CASE

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

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

ORIGINAL PAGE IS
OF POOR QUALITY

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

MATERIAL
EMISSIVITY= .800

FLOWFIELD
FLAG ANGLE
1 36. 2.80
2 15. 2.80

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 H INF= 7.999 P INF = .806+001 T INF = -365.00 H INF = 22.63 RND I = .498-004 MU INF = .713-007
 Z INF = 0. H U = 7.999 P U = .806+001 T U = -365.00 H U = 22.63 RND U = .498-004 MU U = .713-007
 V INF = 3816. H E = 3.771 P E = .146+003 T E = -121.08 H E = 81.27 RND E = .251-003 MU E = .262-006
 A INF = 477. L = .210 P T = .163+005 T T = 843.90 H T = 313.37 RND T = .727-002 MU T = .713-006
 V E = 3410. RN = .000 ALPHA = 22.800 T + = 119.37 H + = 139.20 RND + = .147-003 MU + = .406-006
 REINF =2.654+006 PR = .710 CF/2 = .401-003 TR = -459.70 H R = .00 RND R = .000 MU R = .000
 REL =-6.852+005 ERF6F = .800 TAU M = .133+001 T M = .00 H M = 110.33 RND M = .185-003 MU M = .338-006
 PARAI =.32000+001 PMA2 =.36000+001
 FF FLAG 36. 15. 2 3 4 5 6 7 8 9
 ANGLE 22.80 0. 0. 0. 0. 0. 0. 0. 0. 0.

MC L = .125-001 H RECOV L= 276.55 GC L = .21+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PMA = .00
 MC T = .345-001 H RECOV T= 288.30 GC T = .61+001 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000
 H SUB C= .1254-001 H RECOV= 276.55 GC CONV = .2110+001 GC RAD = .1701-001 GC NET = .2093+001
 H IDEAL= .1108+002 T RECOV= 685.78 GC TOTAL = .0000 GC TOT = .0000 T RAD ED= 352.32

GC CN = .3494+001 GC CNT = .0000

TIME = 2.000 H INF= 7.997 P INF = .821+001 T INF = -364.70 H INF = 22.70 RND I = .503-004 MU INF = .716-007
 Z INF = 0. H U = 7.997 P U = .821+001 T U = -364.70 H U = 22.70 RND U = .503-004 MU U = .716-007
 V INF = 3821. H E = 2.647 P E = .272+003 T E = 85.36 H E = 130.96 RND E = .290-003 MU E = .387-006
 A INF = 478. L = .124 P T = .598+004 T T = 819.97 H T = 314.11 RND T = .272-002 MU T = .795-006
 V E = 3029. RN = .000 ALPHA = 32.660 T + = 184.90 H + = 154.91 RND + = .245-003 MU + = .440-006
 REINF =2.687+006 PR = .710 CF/2 = .643-003 TR = -459.70 H R = .00 RND R = .000 MU R = .000
 REL =-2.813+005 ERF6F = .800 TAU M = .195+001 T M = .00 H M = 110.35 RND M = .344-003 MU M = .338-006
 PARAI =.32000+001 PMA2 =.36000+001
 FF FLAG 36. 15. 2 3 4 5 6 7 8 9
 ANGLE 32.66 0. 0. 0. 0. 0. 0. 0. 0. 0.

MC L = .267-001 H RECOV L= 286.63 GC L = .36+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PMA = .00
 MC T = .516-001 H RECOV T= 294.33 GC T = .95+001 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000
 H SUB C= .2048-001 H RECOV= 286.63 GC CONV = .3645+001 GC RAD = .1701-001 GC NET = .3428+001
 H IDEAL= .1829+002 T RECOV= 717.67 GC TOTAL = .2110+001 GC TOT = .1701-001 GC TOT = .2093+001 T RAD ED= 613.39

GC CN = .5927+001 GC CNT = .3494+001

ORIGINAL FILED
OF POOR QUALITY

TIME = 3.000 H INF = 7.997 P INF = .821+001 T INF = -364.70 H INF = 22.70 RHD I = .500-004 MU INF = .716-007
 Z INF = 0. H U = 7.997 P U = .821+001 T U = -364.70 H U = 22.70 RHD U = .500-004 MU U = .716-007
 V INF = 3821. H E = 1.828 P E = .427+003 T E = 324.65 H E = 189.33 RHD E = .317-003 MU E = .508-006
 A INF = 478. L = .086 P T = .255+004 T T = 823.72 H T = 314.11 RHD T = .116-002 MU T = .706-006
 V E = 2500. RN = .000 ALPHA = 42.780 T # = 260.26 H # = 173.18 RHD # = .346-003 MU # = .477-006
 REL INF = 2.687+006 PR = .710 CF/2 = .958-003 TR = -459.70 HR = .00 RHD R = .030 MU R = .000
 REL = 1.341+005 ENS#F = .800 TAU M = .217+006. T M = .00 H M = 110.35 RHD M = .541-003 MU M = .308-006
 FF FLAG 36. 2 3 4 5 6 7 8 9
 ANGLE 42.78 0. 0. 0. 0. 0. 0. 0. 0.
 MC L = .279-001 H RECON L = 295.39 GC L = .52+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PARA = .00
 MC T = .621-001 H RECON T = 300.63 GC T = .12+002 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000
 H SUB C = .2789-001 H RECON = 295.39 GC CON = .5160+001 GC RAD = .1761-001 GC NET = .5143+001
 H IDEAL = .2470+002 T RECON = 752.17 GC TOTAL = .5755+001 GC TOT = .3401-001 GC TOT = .5721+001 T RAD EP = 659.44

TIME = 4.000 H INF = 7.997 P INF = .127+002 T INF = -362.90 H INF = 23.16 RHD I = .762-004 MU INF = .733-007
 Z INF = 0. H U = 7.997 P U = .127+002 T U = -362.80 H U = 23.16 RHD U = .762-004 MU U = .733-007
 V INF = 3859. H E = 1.831 P E = .660+003 T E = 309.18 H E = 192.91 RHD E = .481-003 MU E = .514-006
 A INF = 483. L = .086 P T = .398+004 T T = 845.22 H T = 320.38 RHD T = .177-002 MU T = .713-006
 V E = 2527. RN = .000 ALPHA = 42.780 T # = 274.57 H # = 176.65 RHD # = .523-003 MU # = .484-006
 REL INF = 4.012+006 PR = .710 CF/2 = .199-003 TR = -459.70 HR = .00 RHD R = .000 MU R = .000
 REL = 2.027+005 ENS#F = .800 TAU M = .694+001 T M = .00 H M = 110.35 RHD M = .806-003 MU M = .338-006
 FF FLAG 36. 2 3 4 5 6 7 8 9
 ANGLE 42.78 0. 0. 0. 0. 0. 0. 0. 0.
 MC L = .348-001 H RECON L = 301.26 GC L = .66+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PARA = .00
 MC T = .684-001 H RECON T = 306.62 GC T = .17+002 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000
 H SUB C = .6842-001 H RECON = 306.62 GC CON = .1735+002 GC RAD = .1701-001 GC NET = .1734+002
 H IDEAL = .7845+002 T RECON = 796.36 GC TOTAL = .1072+002 GC TOT = .5102-001 GC TOT = .1086+002 T RAD EP = 750.66

ORIGINAL PAGE IS
OF POOR QUALITY

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

TIME SEC	ALT MFT	VEL FT/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./FT	HEAT COEF LHM/SFT-S	HEAT REC BTU/LHM	EMULPY DEB F	HEAT RATE BTU/SFT-S	HEAT LOAD BTU/SFT	PRESSURE LB/SFT	FLOW TYPE
1.0	.0	3016.0	8.00	20.00	.265+007	.125-001	.279+003	532.3	.211+001	.000	.146+003	LHM
2.0	.0	3021.0	8.00	29.86	.269+007	.207-001	.287+003	613.4	.365+001	.365+001	.272+003	LHM
3.0	.0	3021.0	8.00	39.98	.269+007	.279-001	.295+003	699.4	.516+001	.881+001	.427+003	LHM
4.0	.0	3059.0	8.00	39.98	.401+007	.884-001	.307+003	750.7	.174+002	.262+002	.660+002	TURB

BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT WACH 8-TUNNE. 8

TUNING
 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
 RH = .000 FT.
 L = .353 FT.
 N SUB L = 1.000
 N SUB T = .667
 PHI = .000 DEG.
 VIRT-L OPT = .000

TIME DECREMENT GEOMETRIC PARAMETERS

TIME	SN	L	PHI
1.00	.6300	.35	.00
2.00	.1000	.19	.00
3.00	.0000	.14	.00
4.00	.0000	.14	.00

ORIGINAL PAGE IS
OF POOR QUALITY

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

MATERIAL
EMISSIONITY= .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
	TURBULENT AFTER	3.60 SEC.

FREE STREAM PROPERTIES

TIME	VELOCITY	F.S.TEMP.	F.S.PRESS.
1.00	3816.	94.70	.80649+001
2.00	3821.	95.00	.82089+001
3.00	3821.	95.00	.82089+001
4.00	3859.	96.90	.12672+002

TIME = 1.000	H INF = 7.999	P INF = .806+001	T INF = -365.00	H INF = 22.63	RND I = .496-004	MU INF = .713-007				
Z INF = 0.	H U = 7.999	P U = .806+001	T U = -365.00	H U = 22.63	RND U = .496-004	MU U = .713-007				
V INF = 3816.	H E = 4.115	P E = .123+003	T E = -163.00	H E = 71.21	RND E = .241-003	MU E = .234-006				
A INF = 477.	L = .353	P T = .217+005	T T = 843.90	H T = 313.37	RND T = .969-002	MU T = .713-006				
V E = 3483.	RN = .000	ALPHA = 20.300	T + = 106.27	H + = 136.05	RND + = .126-003	MU + = .399-006				
REINF = 2.654+006	PR = .710	CF/2 = .294-003	TR = -459.70	H R = .00	RND R = .000	MU R = .000				
REL = 1.268+006	ENS#F = .800	TAN U = .971+000	T M = .00	H M = 110.33	RND M = .155-003	MU M = .338-006				
FF FLAG 36.	15.	3	4	5	6	7	8	9	PARA1 = .32000+001	PARA2 = .36000+001
AMBLE 20.30	20.30	0.	0.	0.	0.	0.	0.	0.	PHI = .00	
		.00	.00	.00	.00	.00	.00	.00		

MC L = .897-002 H RECDV L = 277.04 GC L = .15+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PARA = .00
MC T = .284-001 H RECDV T = 287.21 GC T = .50+001 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000

N SUB C = .8772-002 H RECDV = 277.04 GC CONV = .1496+001 GC RAD = .1701-001 GC NET = .1479+001
H IDEAL = .7921+001 T RECDV = 679.82 GC TOTAL = .0000 GC TOT = .0000 GN TOT = .0000 T RAD EB = 518.58

GC CN = .2486+001 GC CUT = .0000

TIME = 2.000	H INF = 7.997	P INF = .821+001	T INF = -364.70	H INF = 22.70	RND I = .503-004	MU INF = .716-007				
Z INF = 0.	H U = 7.997	P U = .821+001	T U = -364.70	H U = 22.70	RND U = .503-004	MU U = .716-007				
V INF = 3821.	H E = 2.912	P E = .235+003	T E = 25.70	H E = 116.56	RND E = .282-003	MU E = .353-006				
A INF = 478.	L = .194	P T = .779+004	T T = 819.90	H T = 314.11	RND T = .355-002	MU T = .704-006				
V E = 3146.	RN = .000	ALPHA = 30.160	T + = 166.30	H + = 150.40	RND + = .219-003	MU + = .431-006				
REINF = 2.687+006	PR = .710	CF/2 = .488-003	TR = -459.70	H R = .00	RND R = .000	MU R = .000				
REL = 1.884+005	ENS#F = .800	TAN U = .154+001	T M = .00	H M = 110.35	RND M = .298-003	MU M = .338-006				
FF FLAG 36.	15.	3	4	5	6	7	8	9	PARA1 = .32000+001	PARA2 = .36000+001
AMBLE 30.16	30.16	0.	0.	0.	0.	0.	0.	0.	PHI = .00	
		.00	.00	.00	.00	.00	.00	.00		

MC L = .157-001 H RECDV L = 284.47 GC L = .27+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PARA = .00
MC T = .449-001 H RECDV T = 292.77 GC T = .52+001 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000

N SUB C = .1572-001 H RECDV = 284.47 GC CONV = .2738+001 GC RAD = .1701-001 GC NET = .2721+001
H IDEAL = .1398+002 T RECDV = 709.15 GC TOTAL = .1496+001 GC TOT = .1701-001 GN TOT = .1479+001 T RAD EB = 586.73

GC CN = .4473+001 GC CUT = .2486+001

ORIGINAL PAGE IS
OF POOR QUALITY

TIME = 3.000 H INF= 7.997 P INF = .821+001 T INF = -364.70 H INF = 22.70 RND I = .503-004 NU INF = .716-007
 Z INF = 0. H U = 7.997 P U = .821+001 T U = -364.70 H U = 22.70 RND U = .503-004 NU U = .716-007
 V INF = 3821. H E = 2.013 P E = .383+003 T E = 263.21 H E = 174.23 RND E = .309-003 NU E = .679-006
 A INF = 478. L = .145 P T = .306+004 T T = 822.23 H T = 314.11 RND T = .139-002 NU T = .705-006
 V E = 2647. RN = .000 ALPHA = 40.280 T # = 240.77 H # = 168.45 RND # = .31E-003 NU # = .448-006
 REINF =2.687+006 PR = .710 CF/2 = .704-003 TR = -459.70 HR = .00 RND R = .000 NU R = .000
 REL =2.471+005 ERS#F = .800 TAU M = .173+061 T M = .00 H M = 110.35 RND M = .465-003 NU M = .338-006
 PPAR2 =.320E+001 PPAR2 =.36000+001

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

MC L = .210-001 H RECDV L= 293.12 GC L = .38+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PAMA = .00
 MC T = .554-001 H RECDV T= 299.00 GC T = .10+002 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T= .000

M SUB C= .2099-001 H RECDV= 293.12 GC CONV = .383+001 GC RAD = .1701-001 GC NET = .3819+001
 H IDEAL= .1858+002 T RECDV= 743.25 GC TOTAL= .4234+001 GR TOT= .3401-001 GR TOT= .4200+001 T RAD EB= 633.12

GC CN = .6152+001 GC CNT= .6759+001

TIME = 4.000 H INF= 7.997 P INF = .127+002 T INF = -362.80 H INF = 23.16 RND I = .762-004 NU INF = .733-007
 Z INF = 0. H U = 7.997 P U = .127+002 T U = -362.80 H U = 23.16 RND U = .762-004 NU U = .733-007
 V INF = 3859. H E = 2.017 P E = .591+003 T E = 276.71 H E = 177.56 RND E = .448-003 NU E = .485-006
 A INF = 483. L = .145 P T = .478+004 T T = 844.66 H T = 320.38 RND T = .214-002 NU T = .713-006
 V E = 2675. RN = .000 ALPHA = 40.280 T # = 255.34 H # = 171.98 RND # = .462-003 NU # = .475-006
 REINF =4.012+006 PR = .710 CF/2 = .174-002 TR = -459.70 HR = .00 RND R = .000 NU R = .000
 REL =3.732+005 ERS#F = .800 TAU M = .657+001 T M = .00 H M = 110.35 RND M = .749-003 NU M = .338-006
 PPAR2 =.320E+001 PPAR2 =.36000+001

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

MC L = .262-001 H RECDV L= 298.96 GC L = .49+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PAMA = .00
 MC T = .791-001 H RECDV T= 304.96 GC T = .15+002 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T= 1.000

M SUB C= .7910-001 H RECDV= 298.96 GC CONV = .1539+002 GC RAD = .1701-001 GC NET = .1338+002
 H IDEAL= .7016+002 T RECDV= 789.83 GC TOTAL= .6070+001 GR TOT= .5102-001 GR TOT= .8019+001 T RAD EB= 741.22

GC CN = .2612+002 GC CNT= .1311+002

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OF POOR QUALITY

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

D.P. NO. 200

TIME SEC	ALT MFT	VEL FT/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./FT	HEAT COEF LBIN/SFT-S	REC ENTHALPY BTU/LIN	RAG EROSION 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	.150+001	.123+003	LAM
2.0	.0	3821.0	8.00	29.86	.269+007	.157-001	.289+003	586.7	.274+001	.423+001	.235+003	LAM
3.0	.0	3821.0	8.00	39.98	.269+007	.210-001	.293+003	633.1	.384+001	.807+001	.383+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

ORIGINAL FROM
OF POOR QUALITY

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

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 K(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

ORIGINAL PAGE 19
OF POOR QUALITY

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

MATERIAL
EMISSIONITY= .800

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

TRANSITION
OPTION

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

FREE STREAM PROPERTIES

T/V	VELOCITY	F.S.TEMP.	F.S.PRESS.
1.06	3816.	94.70	.80640*001
2.00	3821.	95.00	.82080*001
3.00	3821.	95.00	.82080*001
4.00	3859.	96.90	.12872*002

TIME = 1.000 H INF= 7.999 P INF = .806+001 T INF = -365.00 H INF = 22.63 RND I = .494-004 MU INF = .713-007
 Z INF = 0. H U = 7.999 P U = .806+001 T U = -365.00 H U = 22.63 RND U = .494-004 MU U = .713-007
 V INF = 3815. H E = 4.115 P E = .123+003 T E = -163.00 H E = 71.21 RND E = .241-003 MU E = .234-006
 A INF = 477. L = .569 P T = .217+005 T T = 843.90 H T = 313.37 RND T = .949-002 MU T = .713-006
 V E = 3463. RM = .000 ALPHA = 20.300 T + = 106.27 H + = 136.05 RND + = .126-003 MU + = .377-006
 REINF =2.654+006 PR = .710 CF/2 = .233-003 TR = -459.70 H R = .00 RND R = .000 MU R = .000
 REL =2.044+006 ERS# = .800 TAU M = .765+000 T M = .00 H M = 110.33 RND M = .135-003 MU M = .338-006
 PHI = .00 PARAI =.32000+001 PARAI2 =.36000+001
 1 2 3 4 5 6 7 8 9
 FF FLAG 36. 15. 0. 0. 0. 0. 0. 0. 0.
 AMBLE 20.30 20.30 .00 .00 .00 .00 .00 .00 .00

MC L = .707-002 HRECOV L= 277.04 GC L = .12+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PARAI = .00
 MC T = .263-001 HRECOV T= 287.21 GC T = .46+001 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000
 H SUB C= .7067-002 H RECOV= 277.04 GC M = .1178+001 GC RAD = .1701-001 GC NET = .1161+001
 H IDEAL= .6239+001 T RECOV= 287.21 GC TOTAL= .0000 GC TOT= .0000 GC TOT= .0000 T RAD EB= 495.15

GC CU = .1958+001 GC CNT= .0000

TIME = 2.000 H INF= 7.997 P INF = .821+001 T INF = -364.70 H INF = 22.70 RND I = .503-004 MU INF = .716-007
 Z INF = 0. H U = 7.997 P U = .821+001 T U = -364.70 H U = 22.70 RND U = .503-004 MU U = .716-007
 V INF = 3821. H E = 2.912 P E = .235+003 T E = 25.70 H E = 116.56 RND E = .282-003 MU E = .353-006
 A INF = 478. L = .315 P T = .779+004 T T = 819.90 H T = 314.11 RND T = .355-002 MU T = .704-006
 V E = 3146. RM = .000 ALPHA = 30.160 T + = 166.30 H + = 150.40 RND + = .219-002 MU + = .431-006
 REINF =2.687+006 PR = .710 CF/2 = .383-003 TR = -459.70 H R = .00 RND R = .000 MU R = .000
 REL =7.922+005 ERS# = .800 TAU M = .121+001 T M = .00 H M = 110.35 RND M = .278-003 MU M = .338-006
 PHI = .00 PARAI =.32000+001 PARAI2 =.36000+001
 1 2 3 4 5 6 7 8 9
 FF FLAG 36. 15. 0. 0. 0. 0. 0. 0. 0.
 AMBLE 30.16 30.16 .00 .00 .00 .00 .00 .00 .00

MC L = .123-001 HRECOV L= 284.47 GC L = .21+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PARAI = .00
 MC T = .413-001 HRECOV T= 292.77 GC T = .75+001 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000
 H SUB C= .1235-001 H RECOV= 284.47 GC M = .2130+001 GC RAD = .1701-001 GC NET = .2130+001
 H IDEAL= .1091+002 T RECOV= 292.77 GC TOTAL= .1178+001 GC TOT= .1161+001 GC TOT= .1161+001 T RAD EB= 546.42

GC CU = .3512+001 GC CNT= .1958+001

ORIGINAL PAGE 13
OF POOR QUALITY

TIME = 3.000 H INF = 7.977 P INF = .821+001 T INF = -364.70 H INF = 22.70 RND I = .503-004 MU INF = .716-007
 Z INF = 0. H U = 7.977 P U = .821+001 T U = -364.70 H U = 22.70 RND U = .503-004 MU U = .716-007
 V INF = 3821. H E = 2.013 P E = .383+003 T E = 283.21 H E = 174.23 RND E = .309-003 MU E = .479-006
 A INF = 478. L = .228 P T = .306+004 T T = 822.23 H T = 314.11 RND T = .139-002 MU T = .705-006
 V E = 2647. M = .000 ALPHA = 40.280 T # = 240.77 H # = 168.45 RND # = .318-003 MU # = .468-006
 REINF = 2.687+006 PR = .710 CF/2 = .564-003 T R = -659.70 H R = .00 RND R = .000 MU R = .000
 REL = 3.686+005 ERS#F = .800 TAU M = .138+001 T M = .00 H V = 110.35 RND M = .465-003 MU M = .338-002
 PARI = .32000+001 PARI2 = .36000+001
 PHI = .00
 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

MC L = .167-001 HRECIV L = 293.12 GC L = .31+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PAMA = .00
 MC T = .512-001 HRECIV T = 299.00 GC T = .97+001 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = .000

M SUB C = .1674-001 H RECDA = 293.12 GC M = .3059+001 G RAD = .1701-001 G NET = .3042+001
 H IDEAL = .1482+002 T RECDA = 299.00 GC TOTAL = .3328+001 GR TOT = .3401-001 GR TOT = .3294+001 T RAD EB = 615.40

GC CU = .4906+001 GC CUT = .5470+001

TIME = 4.000 H INF = 7.977 P INF = .127+002 T INF = -362.80 H INF = 23.16 RND I = .762-004 MU INF = .733-007
 Z INF = 0. H U = 7.977 P U = .127+002 T U = -362.80 H U = 23.16 RND U = .762-004 MU U = .733-007
 V INF = 3859. H E = 2.017 P E = .591+003 T E = 276.71 H E = 177.56 RND E = .448-003 MU E = .465-006
 A INF = 483. L = .228 P T = .478+004 T T = 844.66 H T = 320.38 RND T = .214-002 MU T = .713-006
 V E = 2675. M = .000 ALPHA = 40.280 T # = 253.34 H # = 171.98 RND # = .482-003 MU # = .475-006
 REINF = 4.012+006 PR = .710 CF/2 = .162-002 T R = -659.70 H R = .00 RND R = .000 MU R = .000
 REL = 5.873+005 ERS#F = .800 TAU M = .609+001 T M = .00 H V = 110.35 RND M = .749-003 MU M = .338-006
 PARI = .32000+001 PARI2 = .36000+001
 PHI = .00
 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

MC L = .209-001 HRECIV L = 298.96 GC L = .39+001 K SUB L 2 = 1.000 K SUB L 3 = 1.000 K SUB L = 1.000 PAMA = .00
 MC T = .733-001 HRECIV T = 304.96 GC T = .14+002 K SUB T 2 = 1.000 K SUB T 3 = 1.000 K SUB T = 1.000 PCT T = 1.000

M SUB C = .733-001 H RECDA = 298.96 GC M = .1427+002 G RAD = .1701-001 G NET = .1425+002
 H IDEAL = .6305+002 T RECDA = 304.96 GC TOTAL = .6387+001 GR TOT = .5102-001 GR TOT = .6336+001 T RAD EB = 739.54

GC CU = .227+002 GC CUT = .1038+002

ORIGINAL PAGE IS
OF POOR QUALITY

BOTTOM CENTERLINE HEATING TO GENERIC ORBITER AT MACH 8-TUNNEL B I.P. NO. 300

TIME SEC	ALT AFT	VEL FT/SEC	MACH NO	ANGLE ATTACK	REYNOLDS NO./FT	HEAT COEF LBIN/ST-S	REC ENTHALPY BTU/LIN	RAO ESUIL DEG F	HEAT RATE BTU/ST-S	HEAT LOW BTU/ST	PRESSURE LB/ST	FLOW TYPE
1.0	.0	3816.0	8.00	20.00	.265+007	.707-002	.277+003	495.1	.118+001	.118+001	.123+003	LAM
2.0	.0	3821.0	8.00	29.86	.269+007	.123-001	.284+003	566.4	.215+001	.333+001	.255+003	LAM
3.0	.0	3821.0	8.00	39.98	.269+007	.167-001	.273+003	615.4	.306+001	.639+001	.383+003	LAM
4.0	.0	3829.0	8.00	39.98	.401+007	.733-001	.305+003	738.5	.143+002	.287+002	.591+003	TURB

APPENDIX C

PREMIN CODE LISTING

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PREMIN CODE
LANGLEY MINIVER PREPROCESSOR CODE
REMTECH, INC. 1983

BY:
C. ENGEL
C. SCHMITZ

PH. 205-536-8581

PROGRAM MAIN

COMMON/WARRAY/W(700)
COMMON/WWARRAY/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, TMCP(50), TCPMS(50), JFLAG, IADD

C

CHARACTER*20 FNAME
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 FNAME - 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 - MAQH NUMBERS
- C TMCP(50) - 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)=0.3
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=FNAMS,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 ',13)
IF(JFKS.GT.0)GO TO (2,9900,1,1,2,1)JFKS
1  CALL TIMING
IF(JFKS.EQ.3.OR.JFKS.EQ.5)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

```

```

CALL HEATIN
GO TO 9000
50 CALL HTRMTD
64 WRITE(1OUT,55)
72 FORMAT(1H1,'DO YOU WANT TO USE A HEAT TRANSFER ',
$ 'MULTIPLICATION METHOD ?')
READ(1IN,45,ERR=54,END=9999)ANS
IF(ANS.EQ.1HY)CALL HTMULT
CALL TRANS
69 WRITE(1OUT,70)
70 FORMAT(1H1,'DO YOU WANT CROSS FLOW ADJUSTMENT OPTION ?')
READ(1IN,45,ERR=69,END=9999)ANS
IF(ANS.EQ.1HY)CALL CROSS
CALL FLOW(1)
89 WRITE(1OUT,90)
90 FORMAT(1H1,'DO YOU WANT TO USE TIME DEPENDENT GEOMETRY ?')
READ(1IN,45,ERR=89,END=9999)ANS
IF(ANS.EQ.1HY)CALL TDGEOM
9000 CONTINUE
CALL CONTRL
200 CONTINUE
WRITE(1OUT,100)NC
100 FORMAT(/,1X,' ***** INPUT COMPLETE FOR CASE ',13,' *****')
210 WRITE(1OUT,220)NC
220 FORMAT(/,1X,'DO YOU WANT TO MAKE ANY MODIFICATIONS TO ',
$ 'CASE ',13,' ?')
READ(1IN,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(1OUT,110)
110 FORMAT(/,1X,'***** OUTPUT FILE COMPLETE *****')
CALL EXIT
8888 CONTINUE
WRITE(1OUT,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 FUNCTIONS
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), TPCM(50), NCPMT
COMMON/TITLE/TITL1
COMMON/MISC/NC, JFKS, TFLAG, MFLAG, ANS1
COMMON/INP/NI, ND, INSERT, NCPMTS, TMCP(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 ',
$ 13, ' ?')
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(13,F10.6))
IF(W(641))170,170,180
180 CONTINUE
IF(W(641).NE.2.0)GO TO 185
C ----- APPENDING CASES -----
181 WRITE(10UT,182)
182 FORMAT(/,1X,'DO YOU WANT TO ADD ADDITIONAL CASES AFTER THE ',
$ 'CURRENT END CASE ?')
READ(11IN,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(13)
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(10UT,230)NC
230 FORMAT(1X,'DO YOU WISH TO DELETE CASE ',13,' ?')
READ(11IN,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
!F(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 ',13,' ATMS. DATA SAME AS ',
$ 'FOR CASE ',13,' ?')
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,12)
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 ',
$ 11,'. ',A40,/,4(11X,11,'. ',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
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 ',13)
65 FORMAT(A1)
70 WRITE(IOUT,80)NC
80 FORMAT(/,1X,'WHAT IS THE BODY POINT NUMBER FOR CASE ',
$ 13,' ?')
READ(IIN,*,ERR=70,END=9999)W(611)
90 WRITE(IOUT,100)NC
100 FORMAT(1X,'SHOULD LANMIN CREATE AN OUTPUT FILE FOR CASE '
$ ,13,' ?')
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 ',13,' ALONG THE ',
$ 'SAME STREAMLINE',/,1X,'AS CASE ',13,' ?')
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 ',13,' CROSS FLOW DATA THE SAME AS ',
$ 'FOR CASE ',13,' ?')
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 SWEEP 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 FNAMS - 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 FNAMS
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 ',13,' FLOWFIELD DATA THE SAME AS ',
$ 'FOR CASE ',13,' ?')
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.1.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',I)
    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(10UT,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(10UT,1035)I
1035 FORMAT(1X,11)
READ(11IN,*,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 FLOWFIELD/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)JP1=46
IF(JP1.EQ.38)JP1=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 COEFFICIENT 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 ',13,' ?')
      READ(IIN,3140,ERR=3130,END=9999)FNAMS
3140 FORMAT(A20)
      OPEN(UNIT=8,FILE=FNAMS,STATUS='OLD',ERR=8888)
      READ(8,3160)NCPMT
3160 FORMAT(13)
      WRITE(IOUT,3165)NCPMT
3165 FORMAT(//,1X,13,' 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,'
$      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 ',13,' MULTIPLICATION FACTOR DATA ',
$ 'THE SAME AS FOR CASE ',13,' ?')
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(10UT,150)
   READ(11N,30,ERR=270,END=9999)ANS
   IF(ANS.EQ.1HY)GO TO 200
C ----- MULTIPLIER TYPE 3 -----
300 WRITE(10UT,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(11N,30,ERR=300,END=9999)ANS
   IF(ANS.EQ.1HN)GO TO 400
310 WRITE(10UT,315)
315 FORMAT(1X,33HNUMBER OF MACH 'S (10 MAXIMUM) ?)
   READ(11N,*,ERR=310,END=9999)W(360)
   WRITE(10UT,320)
320 FORMAT(1X,'M-INF,LAM MULT,TURB MULT')
   ITT=W(360)+.0001
   DO 2000 I=1,ITT
330 WRITE(10UT,265)I
   READ(11N,*,ERR=330,END=9999)W(360+1),W(370+1),W(380+1)
C TEST FOR VALUE LESS THAN OR EQUAL TO 0.0
   IF(W(360+1).LE.0.0)GO TO 333
   IF(W(370+1).LE.0.0)GO TO 333
   IF(W(380+1).LE.0.0)GO TO 333
   GO TO 2000
333 WRITE(10UT,335)
335 FORMAT(1X,'VALUE CANNOT BE LESS THAN OR EQUAL TO 0.0',/)
   WRITE(10UT,320)
   GO TO 330
2000 CONTINUE
340 WRITE(10UT,150)
   READ(11N,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+1)=ALOG10(W(360+1))
   W(370+1)=ALOG10(W(370+1))
   W(380+1)=ALOG10(W(380+1))
3000 CONTINUE
400 CONTINUE
   RETURN
500 WRITE(10UT,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 SWEEP CYLINDER',
$ 'ECKERT REF. ENTHALPY FLAT PLATE METHOD',
$ 'ECKERT/SPAULDING-CHI FLAT PLATE METHOD',
$ 'BOEING RHO-MU FLAT PLATE METHOD',
$ 'BECKWITH/GALLAGHER SWEEP CYLINDER METHOD',
$ 'BOEING RHO-MU SWEEP 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 ',13,' HEAT TRANSFER DATA SAME AS ',
$ 'FOR CASE ',13,' ?')
READ(IIN,70,ERR=1,END=9999)ANS
IF(ANS.EQ.1HY)RETURN
9 CONTINUE
10 WRITE(IOUT,20)(1,CHAR(1),1=1,11)
20 FORMAT(///,' HEAT TRANSFER METHOD',//,1X,'OPTIONS',
$ 3X,12,'. ',A50,/,10(11X,12,'. ',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(1IN,*,ERR=100,END=9999)W(12)
120 WRITE(1OUT,130)
130 FORMAT(1X,'LEWIS NO. = 1.0 OR 1.4 ?')
    READ(1IN,*,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(1OUT,140)
140 FORMAT(/,1X,'NOTE: RAREFIED FLOW OPTION HAS BEEN SELECTED.')
160 WRITE(1OUT,170)
170 FORMAT(1X,'ANY CHANGES ?')
    READ(1IN,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(1OUT,210)CHAR(2)
    IF(MFLAG.EQ.1)WRITE(1OUT,211)CHAR(2)
210 FORMAT(1H1,'2. ',A50,'//,1X,'BODY RADIUS (FT) ?')
211 FORMAT(1H1,'2. ',A50,'//,1X,'BODY RADIUS (M) ?')
    READ(1IN,*,ERR=200,END=9999)W(12)
220 WRITE(1OUT,230)
230 FORMAT(1X,'SWEEP ANGLE ?')
    READ(1IN,*,ERR=220,END=9999)W(17)
240 WRITE(1OUT,130)
    READ(1IN,*,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(1OUT,170)
    READ(1IN,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(1OUT,310)CHAR(3)
    IF(MFLAG.EQ.1)WRITE(1OUT,311)CHAR(3)
310 FORMAT(1H1,'3. ',A50,'//,1X,'RUNNING LENGTH (FT) ?')
311 FORMAT(1H1,'3. ',A50,'//,1X,'RUNNING LENGTH (M) ?')
    READ(1IN,*,ERR=300,END=9999)W(13)
320 WRITE(1OUT,330)
330 FORMAT(1X,'TURBULENT MANGLER FACTOR ?')
    READ(1IN,*,ERR=320,END=9999)W(16)
340 WRITE(1OUT,350)
350 FORMAT(1X,'LAMINAR MANGLER FACTOR ?')
    READ(1IN,*,ERR=340,END=9999)W(15)
360 WRITE(1OUT,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(1IN,*,ERR=360,END=9999)W(354)
375 WRITE(1OUT,376)
376 FORMAT(1X,'IS AN AUTOMATIC VIRTUAL ORIGIN CORRECTION ',
$ 'DESIRED ?')
    READ(1IN,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)

```

```
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 !F(MFLAG.EQ.0)WRITE(IOUT,925)
    IF(MFLAG.EQ.1)WRITE(IOUT,926)
925 FORMAT(1X,'WINDWARD WALL ENTHALPY',/,1X,
$ '(480 BTU/LEM = 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) ?')
1006 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)
```



```

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
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 ',13,' ?')
    READ(1IN,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(1OUT,220)
220 FORMAT(/,1X,'WHAT IS THE W NUMBER YOU WISH TO CHANGE ?')
    READ(1IN,*,ERR=210,END=9999)J
230 WRITE(1OUT,240)J
240 FORMAT(1X,'WHAT IS THE VALUE FOR W(',13,') ?')
    READ(1IN,*,ERR=230,END=9999)W(J)
250 WRITE(1OUT,260)
260 FORMAT(1X,'IS THERE ANOTHER W VARIABLE YOU WISH TO ',
    $ 'CHANGE ?')
    READ(1IN,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, JFCS, TFLAG, MFLAG, ANS1
C
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=1
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=1
              JK=0
C ----- CHECK FOR PARALLEL SHOCK OR PRANDT-MEYER CASES -----
      IF(W(J4F).EQ.29)JK=1
      IF(J3F.GT.J4F)JK=2

```

ORIGINAL PAGE IS
OF POOR QUALITY

```
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.P.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,13)
    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(13,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 ',13,' TIME DEPENDENT GEOMETRY ',
  $ 'DATA THE SAME AS FOR CASE ',13,' ?')
  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)I1
  W(560)=FLOAT(I1)
  60 IF(MFLAG.EQ.0)WRITE(IOUT,70)
  IF(MFLAG.EQ.1)WRITE(IOUT,71)
  70 FORMAT(1X,'TIME(SEC),RADI I (FT),LENGTH(FT),SLOPE OR SWEEP',
  $ '(DEG)')
  71 FORMAT(1X,'TIME(SEC),RADI I (M),LENGTH(M),SLOPE OR SWEEP',
  $ '(DEG)')
C ----- INPUT VALUES FOR EACH TIME -----
  DO 1000 I=1,I1
  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
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

```


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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
C CHARACTER*20 FNAM1
C CHARACTER*80 TITLE
C 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(12,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+1),W(100+1),W(150+1),
$ W(210+1),I=1,NPTS)
IF(BFLAG.EQ.1)READ(7,100,END=98)(W(50+1),W(100+1),W(150+1),
$ W(210+1),W(650+1),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+1),W(100+1),
$ W(150+1),W(210+1)
    IF(BFLAG.EQ.1)WRITE(IOUT,120)I,W(50+1),W(100+1),
$ W(150+1),W(210+1),W(650+1)
120 FORMAT(1X,12,5E12.4)
    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',

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$ 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,12)
441 FORMAT(/,1X,'TIME(SEC),ALTITUDE(M),VELOCITY(M/SEC),',
    $ 'ANGLE OF ATTACK(DEG)',/,1X,12)
442 FORMAT(/,1X,'TIME(SEC),ALTITUDE(FT),VELOCITY(FT/SEC),',
    $ 'ANGLE OF ATTACK(DEG),BETA(DEG)',/,1X,12)
443 FORMAT(/,1X,'TIME(SEC),ALTITUDE(M),VELOCITY(M/SEC),',
    $ 'ANGLE OF ATTACK(DEG),BETA(DEG)',/,1X,12)
    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
```

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SUBROUTINE TRANS

ORIGINAL PAGE 19
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```

C
C ROUTINE TO CHOOSE TRANSITION OPTION
COMMON/WARRAY/W(700)
COMMON/UNIT/IIN, IOUT
COMMON/MISC/NC, JFKS, TFLAG, MFLAG, ANS1
C
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 ',13,' TRANSITION DATA THE SAME ',
$ 'FOR CASE ',13,' ?')
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(ICUT,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 SWEEP 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. HY)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, 05)
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
```


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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 ',13,' WIND TUNNEL DATA SAME AS ',
$ 'FOR CASE ',13,' ?')
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(' -'),12,' 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,12)
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
```

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SUBROUTINE UNITS

```
C
C ROUTINE FOR CONVERTING TO METRIC UNITS
C COPIES WORKING ARRAY W INTO OUTPUT ARRAY WW
COMMON/WARRAY/W(700)
COMMON/WWARRAY/WW(700)
COMMON/WWWARY/WWW(700)
COMMON/UNIT/I IN, IOUT
COMMON/MISC/NC, JFCS, TFLAG, MFLAG, ANS1

C
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
  WW(I)=W(I)*3.28084
DO 2 I=101,200
  WW(I)=W(I)*3.28084
DO 3 I=401,450
  WW(I)=W(I)*3.28084
DO 4 I=451,500
  WW(I)=W(I)*1.8
DO 5 I=501,550
  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), TPCM(50), NCPMT
COMMON/TITLE/TITL1
COMMON/MISC/NC, JFKS, TFLAG, MFLAG, ANS1
COMMON/STRM/ISTRM, NNC
C
C INTEGER ANS, TFLAG, ANS1
C CHARACTER*20 FNAM4
C CHARACTER*72 TITL1
C DIMENSION IS(5)
C
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=8.88)
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 ',13)
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 ',13,' ? ',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(1OUT,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(11N,*,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(1OUT,8889)FNAM4
8889 FORMAT(/,1X,'CANNOT OPEN ',A20,/)
GO TO 10
9999 CONTINUE
CALL EXIT
END

```

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